
Pu‘u ka Pele Forest Reserve

Management Plan

November 2009

Prepared by:

State of Hawai‘i
Department of Land and Natural Resources
Division of Forestry and Wildlife
Forest Management Section

EXECUTIVE SUMMARY

This management plan for Pu‘u ka Pele Forest Reserve is one in a series of site-specific plans to be prepared by the Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) for individual forest reserves in the State of Hawai‘i. These plans present a brief history of the specific forest reserve, a complete record of land transactions and boundary changes over time, a description of cultural and natural resources, as well as an account of infrastructure and intended use(s) of the area. Plans will serve to: (1) assist in preparation of regulatory compliance documents required to implement management actions outlined in the plan; (2) support DOFAW efforts to secure funding for plan objectives; (3) prioritize implementation of management objectives; and (4) solicit requests for proposals or bids to implement plan objectives.

The Pu‘u ka Pele Forest Reserve was established by Governor’s Proclamation in 1918, for the purpose of retaining the area’s wild scenic beauty for the benefit of the public and to reduce erosion and damage of the steep cliffs by controlling ungulate populations. It is located in northwest Kaua‘i, and is comprised of two non-contiguous areas that total approximately 23,600 acres of public land. In addition to providing some of the best public hunting opportunities on the island of Kaua‘i, Pu‘u ka Pele Forest Reserve offers many other recreational uses, ranging from bird watching to 4-wheel driving. Approximately 1720 acres of the Forest Reserve are planted to native and non-native timber species.

DOFAW’s current principal objectives for the area are to manage the lands for sustainable game hunting opportunities, provide native and non-native timber resources for commercial and non-commercial use, manage existing rare native biological resources, and maintain existing infrastructure. Management priorities were divided into eight categories and ranked on a qualitative basis. Summaries of management priorities and State funds budgeted for planned management projects in Pu‘u ka Pele Forest Reserve are as follows:

1. Watershed Values - management and staff costs only;
2. Resource Protection - \$33,000 annual costs plus management and staff costs;
3. Game Animal Management - \$60,000 annual costs plus management and staff costs;
4. Commercial Activity - \$20,000 annual costs, \$40,000 one-time costs, plus management and staff costs;
5. Additional Public Activity - \$73,000 annual costs, \$299,500 one-time costs, plus management and staff costs;
6. Invasive Species Management - \$25,000 annual costs, approximately \$108,000 one-time costs, plus management and staff costs;
7. Threatened, Endangered, and Rare Species Management - \$10,000 annual costs, \$85,000 one-time costs, plus management and staff costs;
8. Native Ecosystem Management – variable costs depending on planting and restoration acreage plus management and staff costs.

Details of these priorities and costs can be found in Table 6 on page 34 of the plan.

This plan is intended to describe short-term resource management planning and implementation strategies, as well as a basis for future updates to accommodate evolving or additional objectives such as exotic timber harvest and additional fencing projects.

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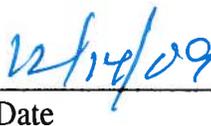
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**PU'U KA PELE FOREST RESERVE
MANAGEMENT PLAN SIGNATURE PAGE**

Kaua'i District certification: This plan was prepared by a team of Division of Forestry and Wildlife (DOFAW) staff to provide a management framework for Pu'u ka Pele Forest Reserve.



Alvin M. Kyono – DOFAW Kaua'i Branch Manager

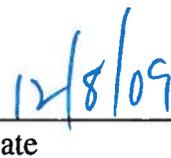


Date

DOFAW Administrator's approval: I have reviewed the enclosed Forest Reserve Management Plan and concur with the recommendations herein. I agree that this Management Plan will serve as a guiding document for the resource management of Pu'u ka Pele Forest Reserve.



Paul J. Conry – DOFAW Administrator



Date

Department of Land and Natural Resources Board approval: This plan meet the criteria established for State Forest Reserve Management Plans as mandated by Chapter 183, Section 16--4, Hawai'i Revised Statues.



Laura H. Thiele – BLNR Chairperson

Approved by the Board
of Land and Natural
Resources at its meeting
held November 19, 2009

DEVELOPMENT PROCESS TIMELINE

Pu‘u ka Pele Forest Reserve, Kaua‘i

Stage of Development	Date Achieved	Comments
Branch review	November 2008	Incorporated
DOFAW review	January 2009	Incorporated
Partner agency consultation	April 2009	<ul style="list-style-type: none"> • One response received from targeted community member • Five responses received from partners and other government agencies
Public consultation	May 2009	<ul style="list-style-type: none"> • Press release May 8, 2009 • Plan posted on DOFAW website from May 1 to May 26, 2009 • No responses received
DOFAW approval	June 2009	None
BLNR approval	November 2009	None

I. INTRODUCTION

The State of Hawai'i Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW) conducts on-going planning efforts to develop and update management plans for all forest reserves across the state. These efforts, to be consistent across the State, serve to organize field management, assist in budgeting and funding concerns, and aim to make the process transparent for partner organizations and the public.

Each Branch office of the Division will have one comprehensive management plan that addresses overall Forest Reserve System issues, goals and objectives for that Branch. In addition, management plans will be developed for individual forest reserves, which will in part reflect the Division's management guidelines specific to that area. This document represents the comprehensive management plan for Pu'u ka Pele Forest Reserve, which fits under the overall forest reserve management plan for Kaua'i. This Management Plan addresses concerns and strategies only on the public lands in Pu'u ka Pele Forest Reserve.

This management plan for the Pu'u ka Pele Forest Reserve was developed using a variety of methods. Initial development consisted of reviewing and analyzing DOFAW historic and current files (both at the Administrative and Kaua'i Branch office) and documents obtained from the Land Division, Survey Division, as well as State Archives. State of Hawai'i Geographic Information Systems (GIS) map layers relating to biological, historical, and environmental resources were referenced to develop this plan. Additional resources utilized included other plans that identified the Forest Reserve or the area. Examples include the Hawai'i Comprehensive Wildlife Conservation Strategy, the Hawai'i Biodiversity and Mapping Program, the Kaua'i Watershed Management Plan, the Kaua'i Invasive Species Council's Action Plan, and others. The plan then evolved into its final iteration through discussions with Division staff from all program areas both at the Branch and Administrative offices, other Divisions and State agencies, DOFAW partners, and the public.

Approval of this Pu'u ka Pele Forest Reserve Management Plan by the Chairperson of the Board of Land and Natural Resources may trigger the following actions:

1. Preparation of regulatory compliance documents as required for implementation of management actions as outlined in the plan.
2. DOFAW efforts to secure operational and planning funding for plan objectives.
3. Prioritized implementation of plan objectives by DOFAW.
4. Periodic solicitation of requests for proposals or bids for implementation of plan objectives, including issuance of permits, licenses, or contracts (Hawai'i Administrative Rules §13-104-22), as necessary.

II. PU'U KA PELE FOREST RESERVE DESCRIPTION

Pu'u ka Pele Forest Reserve is located on the west side of the island of Kaua'i in the District of Waimea. It was an area of interest to the Territorial Government dating back to the early nineteenth century. The primary reasons for adding the area to the Forest Reserve System were

to retain its wild scenic beauty for the benefit of the public and to reduce erosion and damage of the steep cliffs by controlling ungulate populations. Reforestation efforts in the Pu‘u ka Pele area resulted in the establishment of plantations comprised of experimental non-native and native tree species, as well as proven commercial timber species.

DOFAW must manage its lands to accommodate the demands of different users, whose goals sometimes conflict. Pu‘u ka Pele Forest Reserve is a multi-use area which provides some of the best public hunting opportunities on the island of Kaua‘i. DOFAW’s current principal objectives for the area are to manage the lands for sustainable game hunting opportunities, provide native and non-native timber resources for commercial and non-commercial use, manage existing rare native biological resources, and maintain existing infrastructure.

A. Location and Description:

On Kaua‘i, DOFAW has direct management responsibility of approximately 114,200 acres including approximately 76,000 acres within Forest Reserves. The Pu‘u ka Pele Forest Reserve presently consists of approximately 23,600 acres. Table 1 describes the Tax Map Key parcels that comprise Pu‘u ka Pele Forest Reserve (Hawai‘i State GIS data).

Waimea Canyon State Park divides the reserve into two sections: the Canyon Section and the Western Ridge Section (Figure 1). The Canyon Section encompasses the vast majority of Waimea Canyon from Pu‘uhinahina lookout in the north, to the residential development in the Canyon floor in the south, Mokihana trail to the east, and roughly along the canyon road to the west. The Western Ridge Section begins around Kapue Valley to the south, ends at Miloli‘i Valley to the north, and is bounded by the Pacific Ocean on the west and Waimea Canyon State Park on the east. Principal adjacent owners or land uses include the State Department of Hawaiian Homelands (DHHL)/Kekaha Game Management Area, Polihale and Waimea Canyon State Parks, State agricultural lands, private lands owned by the Robinson Family, Nā Pali-Kona Forest Reserve, and Kōke‘e State Park. Most all of Pu‘u ka Pele Forest Reserve is within the State Land Use Conservation (Resource) Subzone designation; only a very small portion at Miloli‘i lies within the Conservation (Protected) Subzone.

Table 1: State of Hawai‘i Tax Map Key (TMK) parcels currently comprising Pu‘u ka Pele Forest Reserve

TMK Number	Tax Acres (entire TMK)	GIS Acres (entire TMK)	GIS Forest Reserve Acres
(4) 1-2-001:001 (portion)	431.0	507.6	480.5
(4) 1-2-001:006	4,891.0	4,389.4	4,389.4
(4) 1-2-001:007	2,480	2,437.7	2,437.7
(4) 1-2-001:010	1.0	1.0	1.0
(4) 1-4-001:003 (Portion)	21,160.8	21,217.0	1,836.0
(4) 1-4-001:007 (Portion)	228.0	178.0	63.0
(4) 1-4-001:014 (Portion)	3,659.0	5,926.1	2,255.0
(4) 1-4-001:016	0.1	0.1	0.1
(4) 1-4-001:017	0.03	0.03	0.03
(4) 1-5-001:001	10,424.2	5,185.3	5,185.3

(4) 1-5-001:002	3,867.6	3,708.4	3,708.4
(4) 1-5-001:017	3,180.0	3,090.0	3,090.0
(4) 1-5-001:018	0.02	0.03	0.03
(4) 1-5-002:019	0.2	0.2	0.2
(4) 1-5-003:001	11.7	12.8	12.8
(4) 1-5-003:007	1.1	1.2	1.2
(4) 1-5-003:008	4.2	5.1	5.1
(4) 1-5-003:009	8.2	8.2	8.2
(4) 1-5-003:010	2.0	2.1	2.1
(4) 1-5-003:013	7.4	7.4	7.4
(4) 1-5-003:015	3.7	3.8	3.8
(4) 1-5-003:016	16.9	16.2	16.2
(4) 1-5-003:017	9.5	9.5	9.5
(4) 1-5-003:019	32.6	34.2	34.2
(4) 1-5-003:020	19.1	20.5	20.5
(4) 1-5-003:021	11.2	11.3	11.3
(4) 1-5-003:022	7.9	8.0	8.0
(4) 1-5-003:024	2.5	4.4	4.4
(4) 1-5-003:027	3.2	3.6	3.6
(4) 1-5-003:030	0.5	0.1	0.1
(4) 1-5-003:040	7.2	6.3	6.3
Total Acres			23,601.36

B. Physical Site Data:

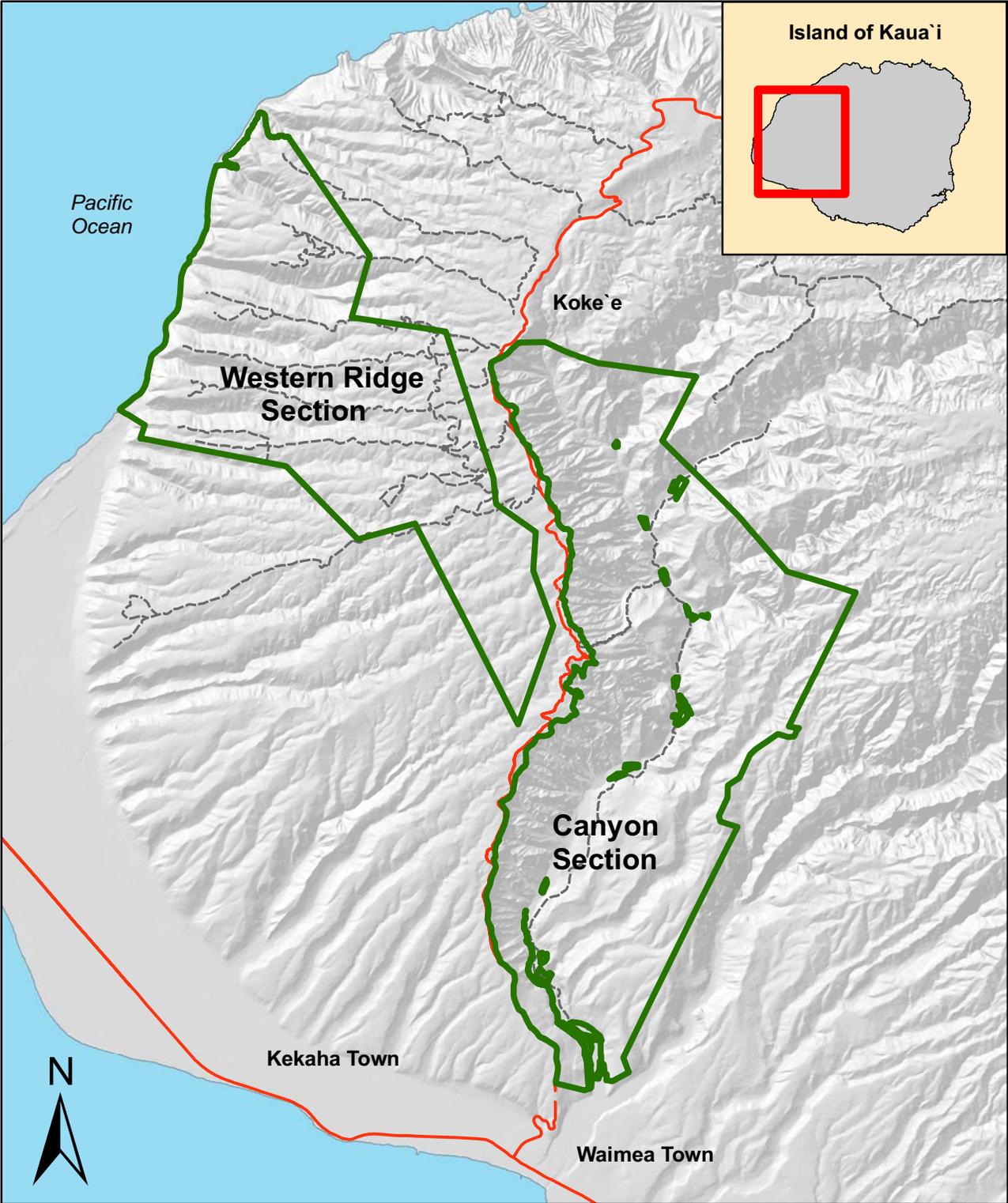
Annual rainfall: Pu‘u ka Pele Forest Reserve receives between approximately 20 to 79 inches of rain per year (Figure 2).

Geographic Features: The Canyon Section contains the following geographic features: Hipalau Valley, Kaluahā‘ula Ridge, Koai‘e Stream, Oneopaewa (Iao) Valley, Po‘okaeha (Chinamans Hat) Summit, Po‘omau Stream, Wahane Valley, Waiahulu Stream, Wai‘alae Stream, and Waipo‘o Falls. The Western Ridge Section contains portions of Kamokala Ridge, Papa‘alai Ridge, Lapa Ridge, Hā‘ele‘ele Ridge, Hikimoe Ridge, Polihale Ridge, Kā‘aweiki Ridge, Kauhao Ridge, and Mākaha Ridge. The elevation in the Forest Reserve ranges from sea level along the makai property boundary to 3,600 feet at Pu‘uhinahina.

Soil Types: Pu‘u ka Pele Forest Reserve contains 35 soil types including rock outcrops, rough mountainous land, rough broken land, oli silt loam with 10 to 70 percent slopes, paaiki loam with 6 to 35 percent slopes, pakala clay loam with 0 to 2 percent slopes, and badland-mahana complex. These soils can be grouped into three classes, highly erodible land, not highly erodible land, and potentially highly erodible land as shown in Figure 3.

Streams and Aquifers: Pu‘u ka Pele Forest Reserve contains six perennial streams or stream courses. Stream courses in the Ridge Section include Hā‘ele‘ele, Ka‘awaloa, Kauhao, Ka‘ula‘ula, and Nahomalū. The Canyon Section contains the Waimea River System. The Forest

Figure 1: Pu`u ka Pele Forest Reserve



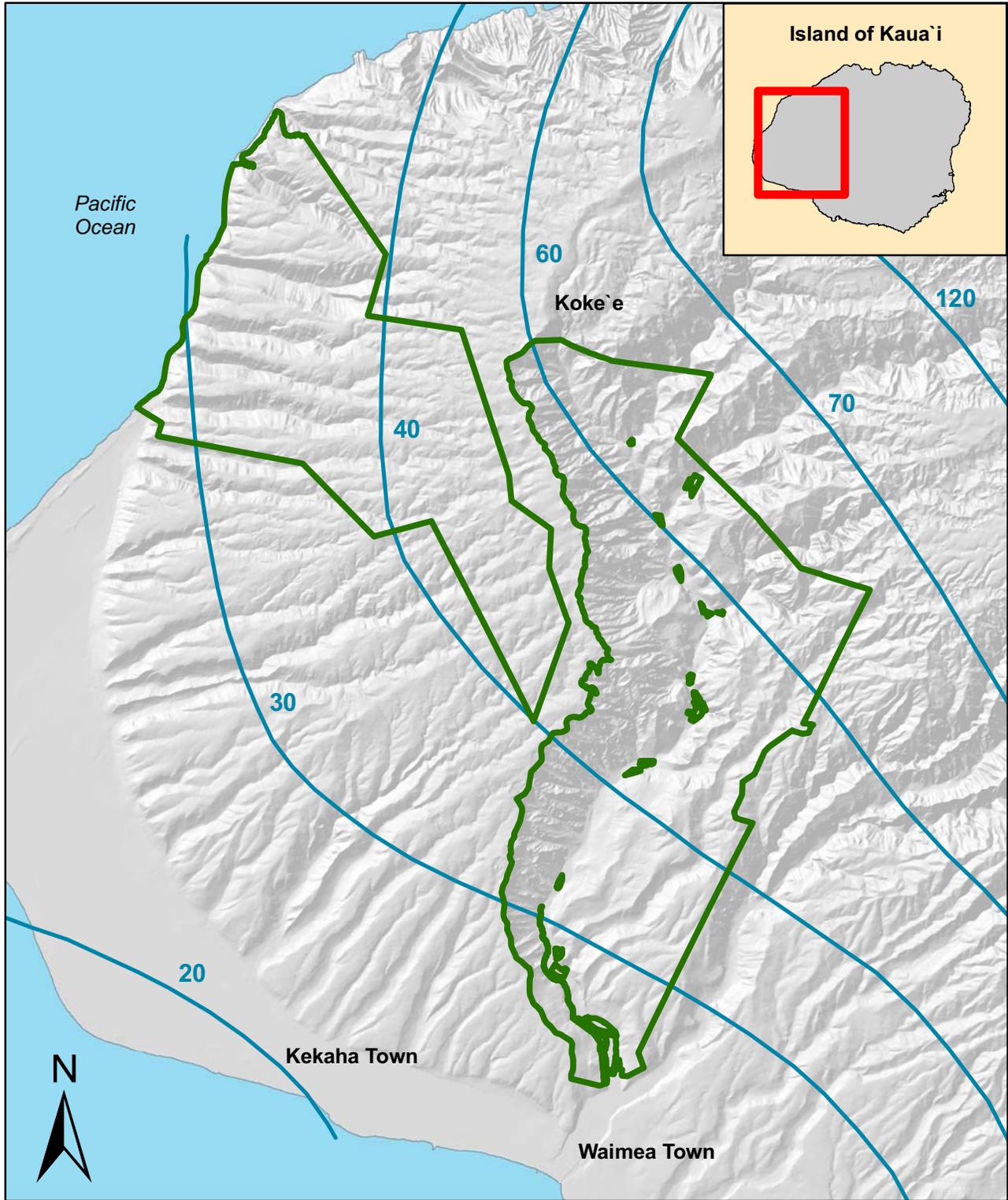
Pu`u ka Pele Forest Reserve
 Major roads
 Secondary roads and trails

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Figure 2: Annual rainfall at Pu`u ka Pele Forest Reserve



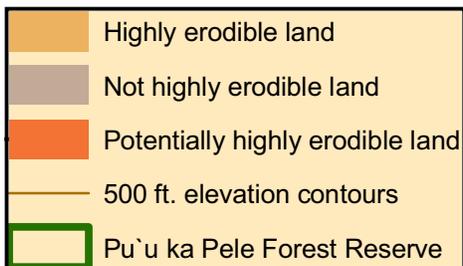
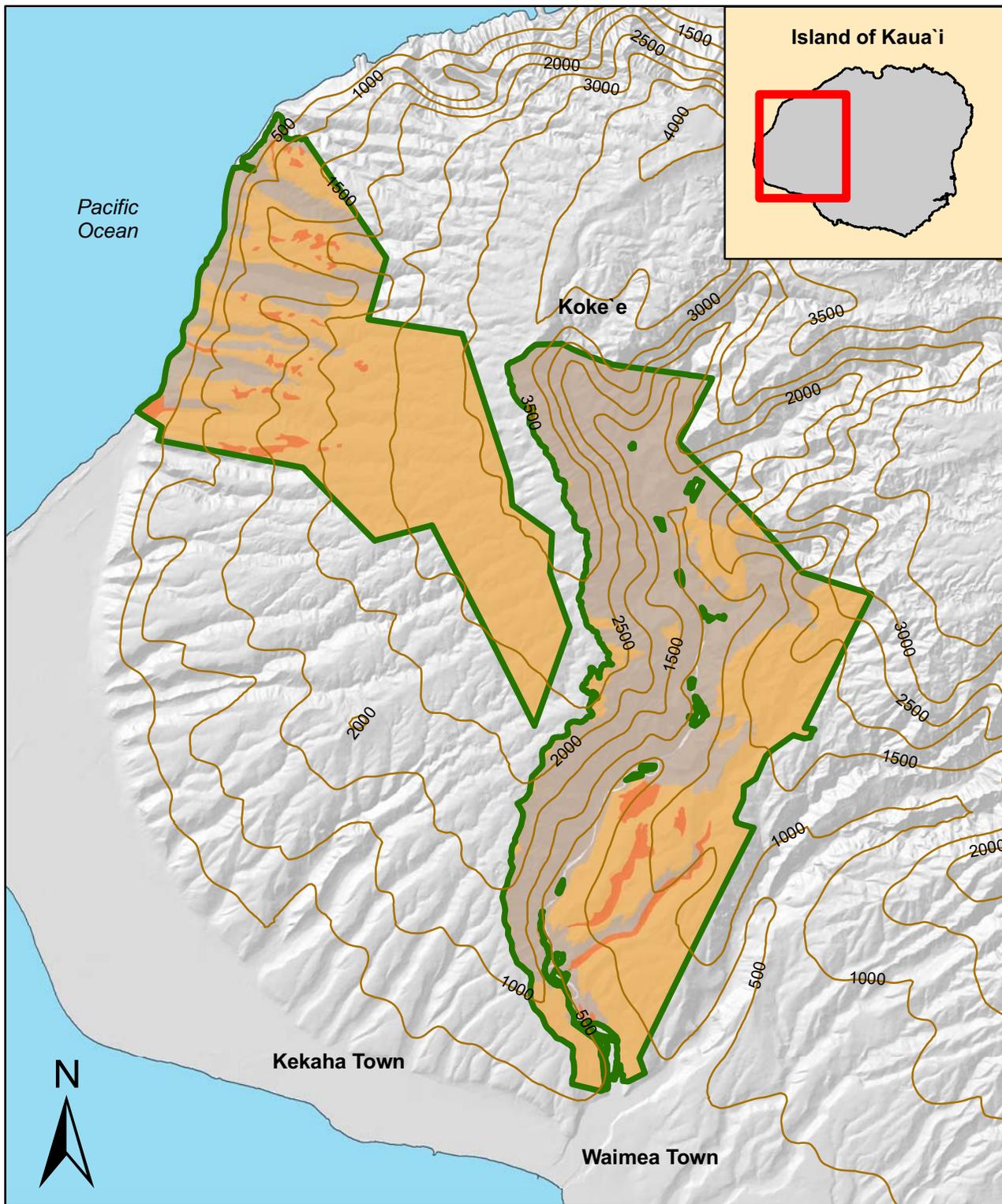
— Annual rainfall (inches)
— Pu`u ka Pele Forest Reserve

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Figure 3: Soils at Pu`u ka Pele Forest Reserve



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Reserve contributes to the Kekaha, Makaweli, Nā Pali, and Waimea aquifers (DLNR aquifer layer) (Figure 4).

C. Pre-Reserve and Subsequent Use History:

Pu‘u ka Pele is the name of a prominent hill located on the rim of Waimea Canyon just past mile marker 11. It appears likely that the upland area of Kōke‘e and the Alaka‘i Swamp were utilized in the pre-contact period as resource gathering zones, rather than areas of permanent habitation or agriculture. Many legends substantiate the use of Pu‘u ka Pele as a resource-gathering site, especially for canoe logs as well as hardwoods, bird feathers, and medicinal plants. In addition, a well-established trail system connected the west side of the island to the north shore.

Even before grazing stopped in the Forest Reserve, tree planting was started in an attempt to curb soil erosion. Trees of many species - both exotic and native - were planted during the 1930s and early 1940s until World War II stopped operations by sugar plantation and government personnel. During the late 1950s and 1960s, tree planting was started again on the lower eroded slopes of the area, primarily with *Eucalyptus saligna*, *Pinus taeda* and *P. elliottii*.

Additions and Withdrawals: Throughout its history, Pu‘u ka Pele Forest Reserve has gone through many additions and withdrawals to reach the land area that comprises the Reserve today (Figures 1, 5 and 6).

Considerable land areas in the western uplands of Kaua‘i were originally placed into Forest Reserves in an attempt to curb erosion and forest degradation by grazing cattle and goats. On December 31, 1918, by Governors Proclamation, Pu‘u ka Pele Forest Reserve was created, consisting of 4,900 acres, for the purposes of preserving scenic vistas, use of the area for the benefit of the public, and to prevent further erosion of the area by feral animals. Land was removed from Pu‘u ka Pele Forest Reserve for addition to the State Park System as part of Na Pali, Kōke‘e, or Waimea Canyon State Parks (Table 2). The most significant additions to the Forest Reserve occurred in 1932, 1938, 1954, and 2007.

Table 2: Summary of public land additions and withdrawals (A/W) for Pu‘u ka Pele Forest Reserve. Data relating to these items are filed at the DOFAW Administrative Office and the State Survey Office.

Action	Date	A/W	Description	Acres	CSF	TMK
Governor’s Proclamation	31-Dec-1918	A	Original Forest Reserve designation	4,900	2,990	(4) 1-4-001:002 (4) 1-4-001:003 (4) 1-4-001:014
Governor’s Proclamation	02-Apr-1919	W	Removed create a public park and summer camp	415	3,147	(4) 1-2-001:002 (and small parcels)
Governor’s Proclamation	03-Jan-1923	W	Removed to be added to Pu‘u ka Pele Park (EO also removes 230 acres from Nā Pali-Kona Forest Reserve)	485	3,705	(4) 1-4-001:002 and many small parcels
Governor’s Proclamation	13-Apr-1932	A	Added area along the canyon to Forest Reserve	760	5,695	(4) 1-2-001:003 (4) 1-4-001:004 (4) 1-4-001:009 (4) 1-4-001:011

Action	Date	A/W	Description	Acres	CSF	TMK
Governor's Proclamation	02-May-1938	A	Added to Pu'u ka Pele Forest Reserve	7,600	8,599	(4) 1-2-001:001 (4) 1-2-001:006 (4) 1-2-001:007
Executive Order 1510	15-May-1952	W	Removed from Pu'u ka Pele Forest Reserve – cancellation of Gov. Proc. 13-Apr-1932	760	11,443 and 11,443-A	(4) 1-2-001:003 (4) 1-2-001:004 (4) 1-2-001:009 (4) 1-2-001: 011
Executive Order 1628	02-Jun-1954	A	Added area in the canyon to Pu'u ka Pele Forest Reserve	3,180	11,849	(4) 1-5-001:017
Executive Order 1682	29-Apr-1955	A	Added to Pu'u ka Pele Park (county) to Pu'u ka Pele Forest Reserve	25.9	12,174	(4) 1-4-001:002 (4) 1-4-002:004 (4) 1-4-002:005 (4) 1-4-002:007 (4) 1-4-002:016 (4) 1-4-002:093
Executive Order 2194	29-Apr-1965	W	Removed Pu'u ka Pele Park from Pu'u ka Pele Forest Reserve – cancellation of EO 1682	25.9	12,174	(4) 1-4-001:002 (4) 1-4-002:004 (4) 1-4-002:005 (4) 1-4-002:007 (4) 1-4-002:016 (4) 1-4-002:093
Executive Order 3241	01-May-1984	W	Removed from Pu'u ka Pele Forest Reserve for addition to Na Pali Coast State Park (Miloli'i)	140	19,798	(4) 1-4-001:007 (4) 1-2-001:001 (4) 1-2-001:006
Executive Order 4202	09-Oct-2007	A	Added area to Pu'u ka Pele Forest Reserve in Waimea Canyon.	9,216	24,483	(4) 1-5-001:001 (4) 1-5-001:002 (4) 1-5-003:007 (4) 1-5-003:008 (4) 1-5-003:009 (4) 1-5-003:010 (4) 1-5-003:013 (4) 1-5-003:015 (4) 1-5-003:016 (4) 1-5-003:017 (4) 1-5-003:019 (4) 1-5-003:020 (4) 1-5-003:021 (4) 1-5-003:022 (4) 1-5-003:024 (4) 1-5-003:027 (4) 1-5-003:040

Kuleana Parcels: Twenty-nine (29) privately owned in-holdings or kuleana with a total of eighty-three (83) acres of land remain within the boundaries of Pu'u ka Pele Forest Reserve.

Documented Activities/Leases/Deeds/Permits: Two general leases (GL) to the Navy and one sublease (New Cingular Wireless) are currently active on Pu'u ka Pele lands. The State receives approximately \$930 in revenue from these leases per year that is dispersed through the general fund. Two revocable permits (RP) were issued for use of Pu'u ka Pele, however they are no longer active (Table 5).

Figure 4: Streams and aquifers at Pu`u ka Pele Forest Reserve

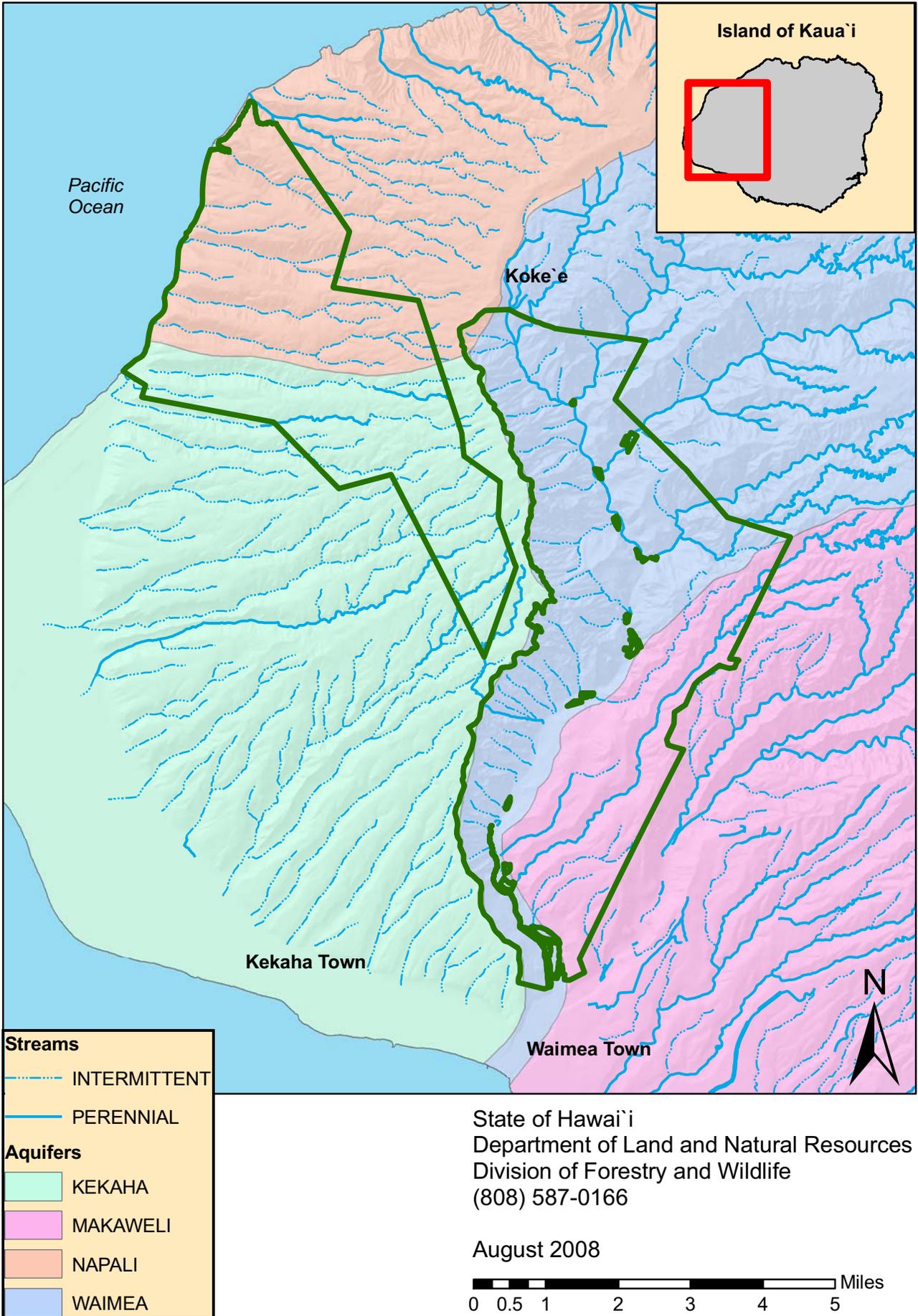
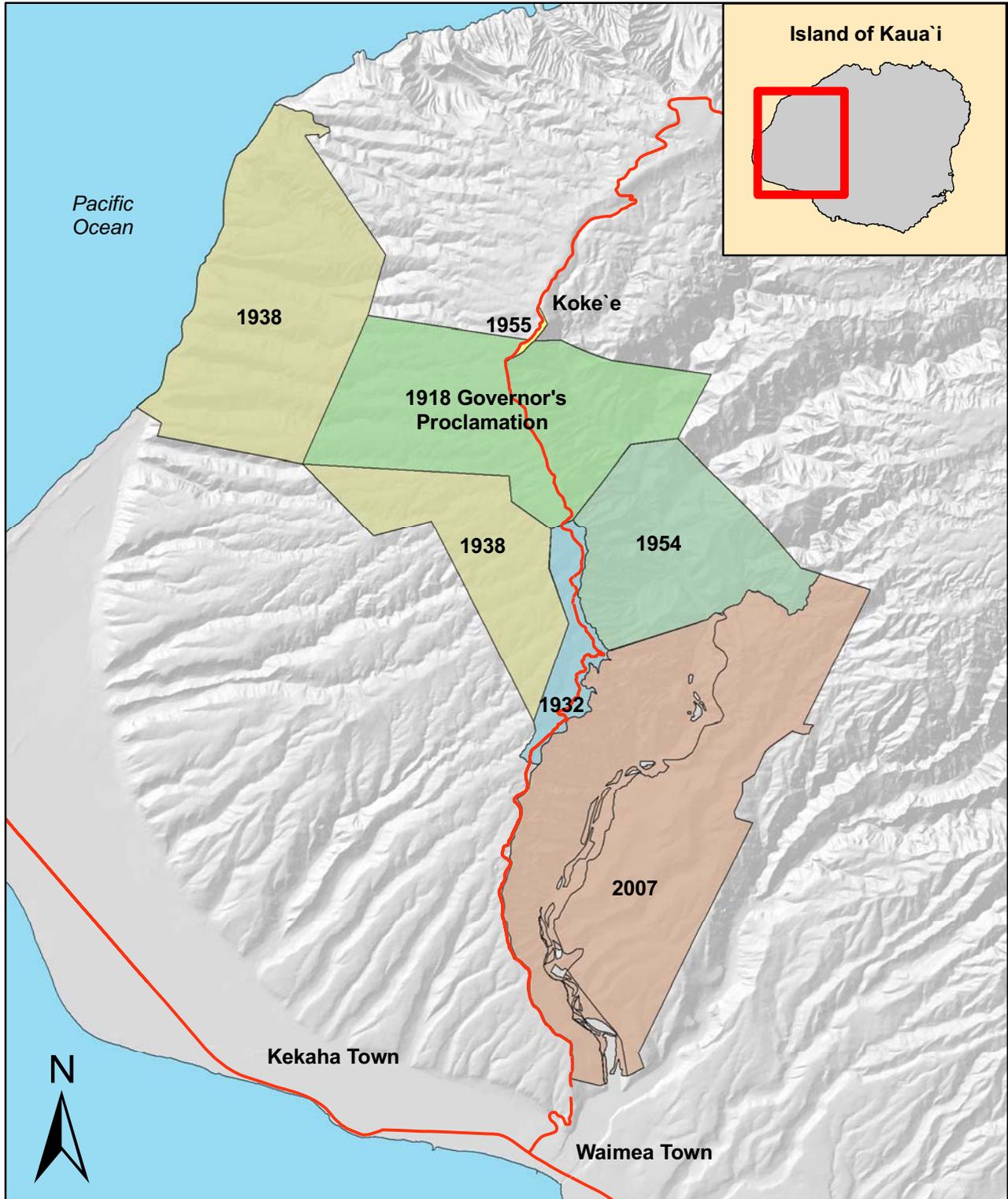


Figure 5: Historic additions to Pu'u ka Pele Forest Reserve (year of addition shown)



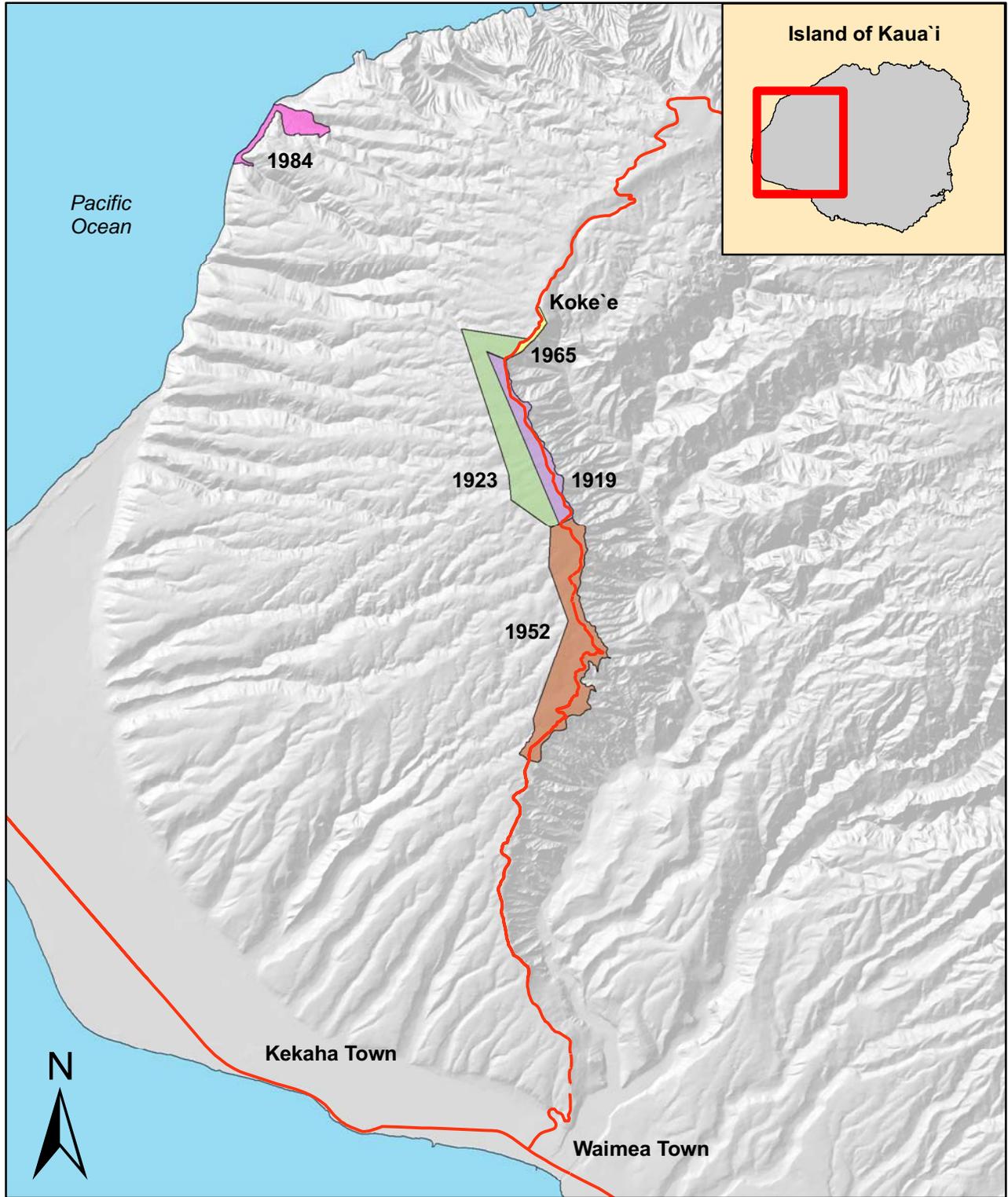
Legend
— Major roads

0 0.5 1 2 3 4 5 Miles

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Figure 6: Historic withdrawals from Pu`u ka Pele Forest Reserve (year of withdrawal shown)



Legend
Major roads

0 0.5 1 2 3 4 5 Miles

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US. Navy: The US. Navy leases, for free, approximately 248.22 acres at Pu‘u ka Pele Forest Reserve for access, utility and aerial line of sight and submerged cable rights of way for communication, research, development, testing, tracking, evaluation, guidance and related government purposes. The term of this lease is 65 years, having commenced on December 17, 1965 and expiring on December 16, 2030. In 1980, the US Navy leased, for free, 600 square feet for a term of 50 years to continue the operation of frequency shift reflector units situated along Miloli‘i Ridge. Most recently, in 2004, the Navy obtained permission from the State to sublease 16 square feet for a term of five years to New Cingular Wireless PCS LLC for a non-exclusive access easement for operation of a wireless telecommunication facility. This agreement brings \$775.00 per year to the State and \$1,000.00 per year to the US Government.

ADC Hydroelectric Plant: The Hawai‘i Department of Agriculture Agribusiness Development Corporation (ADC) currently holds the lease to run and manage a hydroelectric plant in the Waimea River below the Wai‘alae tributary. In addition to the plant itself, ADC also has a lease on the Kekaha ditch including all contributory ditches, dams, intakes, tunnels, black pipe siphon, the power line, Pu‘u ka Pele substation, and an easement for access, maintenance and reconstruction. The cost to maintain the Waimea Valley Road is borne equally by DLNR and ADC. ADC has unrestricted right to utilize heavy equipment, explosives and helicopters (including the right to land) in connection with its maintenance activities.

Table 3: Summary of Active Leases at Pu‘u ka Pele Forest Reserve. Data relating to these items are filed at the State Land Division Office.

Lease Type	Action	Date	Description	Acres	TMK
General Lease	GL 3952	12-17-1965	US NAVY, Pacific Division	248.2	(4) 1-2-001:006
General Lease	GL 5184	6-20-1980	US NAVY, Pacific Division	600 ft ²	(4) 1-2-001:006 (portion)
Sublease on general lease	GL 3952	11-18-2005	Sublease from Navy to New Singular Wireless PCS LLC	16 ft ²	(4) 1-2-001:006 (4) 1-2-001:010
Revocable Permit	ADC RP	Annual renewal - current	Water rights as described above	N/A	(4) 1-5-001:017 (4) 1-5-001:002

D. Vegetation:

A majority of the vegetation communities in Pu‘u ka Pele Forest Reserve represent native or disturbed native ecosystems. Vegetation communities generally belong in the Lowland Mesic Shrubland and Lowland Mesic Forest categories. The majority of planted non-native timber stands are located on the west-facing ridge tops of Pu‘u ka Pele Forest Reserve in the 1,000-3,200 foot elevation range. Understory vegetation in the Forest Reserve is largely dominated by non-native species such as *Schizachyrium condensatum* (beard grass), *Lantana camara* (lantana), *Rubus argutus* (blackberry), *Melinis minutiflora* (molasses grass) and *Pennisetum clandestinum* (kikuyu grass), however native understory species do persist and include *Styphelia tameiameia* (pukiawe), *Dodonaea viscosa* (a‘ali‘i), and *Dianella sandwicensis* (‘uki‘uki). There are also

pockets of native overstory species on ridge tops and in adjacent valley bottoms consisting primarily of *Acacia koa* (koa), *Metrosideros polymorpha* (‘ōhi‘a), *Alphitonia ponderosa* (kauila), *Santalum* spp (‘iliahi), as well as stands of *Myoporum sandwicense* (naio) coastal dry shrubland and *Sapindus oahuensis* (lonomea) lowland dry forest.

Rare Plants: Threatened, endangered, species of concern, and rare taxa currently found within the Forest Reserve are generally restricted to cliff sides and valley bottoms or in small pockets of native vegetation on the ridge tops. Rare species are threatened by habitat loss, predation by vertebrates and invertebrates, competition with non-native plants, loss of pollinators, catastrophic events (such as hurricanes), disease, skewed sex ratios, and reduced reproductive vigor. Fenced plant locations and outplanting sites are detailed in the infrastructure section. There are currently twenty-six (26) rare taxa listed by the United States Endangered Species Act (US-ESA) currently or historically found within the Forest Reserve (Table 4, Figure 7). In 2008, the U. S. Fish and Wildlife Service (USFWS) proposed that 45 more plant species endemic to Kaua‘i be added to this list. The GIS data for these proposed additions, however, show no occurrences of these proposed species within Pu‘u ka Pele Forest Reserve.

Table 4: Rare Plants in Pu‘u ka Pele Forest Reserve

Map Number (Figure 7)	Species	Current/Historic	Listing Status
1	<i>Alectryon macrococcus</i> var. <i>macrococcus</i> (māhoe)	Current	Endangered
2	<i>Bidens sanvicensis</i> ssp. <i>confusa</i> (ko‘oko‘olau)	Current	Species of Concern
3	<i>Canavalia napaliensis</i> (‘awikiwiki)	Historic	Candidate
4	<i>Diellia pallida</i> (no common name (NCN))	Current	Endangered
5	<i>Euphorbia haeleleana</i> (‘akoko)	Current	Endangered
6	<i>Hedyotis st-johnii</i> (NCN)	Current	Endangered
7	<i>Isodendron laurifolium</i> (aupaka)	Current	Endangered
8	<i>Kokia kauaiensis</i> (koki‘o)	Historic	Endangered
9	<i>Lepidium serra</i> (‘ānaunau)	Historic	Rare
10	<i>Lipochaeta fauriei</i> (nehe)	Current	Endangered
11	<i>Lipochaeta waimeaensis</i> (nehe)	Current	Endangered
12	<i>Lobelia niihauensis</i> (‘oha)	Current	Endangered
13	<i>Munroidendron racemosum</i> (NCN)	Current	Endangered
14	<i>Nesoluma polynesianum</i> (keahi)	Current	Species of Concern
15	<i>Nothocestrum peltatum</i> (‘aiea)	Current	Endangered
16	<i>Panicum beecheyi</i> (NCN)	Current	Rare
17	<i>Phyllostegia waimeae</i> (NCN)	Current	Endangered
18	<i>Poa mannii</i> (NCN)	Current	Endangered
19	<i>Poa siphonoglossa</i> (NCN)	Current	Endangered
20	<i>Pteralyxia kauaiensis</i> (kaulu)	Current	Endangered
21	<i>Remya kauaiensis</i> (NCN)	Current	Endangered
22	<i>Schiedea apokremnos</i> (NCN)	Current	Endangered

23	<i>Schiedea spergulina</i> var. <i>spergulina</i> (NCN)	Current	Threatened
24	<i>Spermolepis hawaiiensis</i> (NCN)	Current	Endangered
25	<i>Wilkesia hobdyi</i> (iliau)	Current	Endangered
26	<i>Zanthoxylum hawaiiense</i> (a'e)	Historic	Endangered

Plant Critical Habitat: On February 27, 2003, the U.S. Fish and Wildlife Service designated 52,549 acres of critical habitat for 95 plant species on the islands of Kaua'i and Ni'ihau. Critical habitat is the term used in the Endangered Species Act to define those areas of habitat that are known to be essential for an endangered or threatened species to recover and that require special management or protection. Pu'u ka Pele Forest Reserve contains a total of 973 acres of critical habitat for 17 plant species: 105 acres in the Western Ridge Section for 11 plant species (*Brighamia insignis*, *Centaurium sebaeoides*, *Cyperus trachysanthos*, *Delissea rhytidosperra*, *Hedyotis st. johnii*, *Panicum niihauense*, *Poa manni*, *Pteralyxia kauaiensis*, *Schiedea apokremnos*, *Schiedea membranacea*, and *Wilkesia hobdyi*) and 868 acres in the Canyon Section for seven plant species (*Lipochaeta waimeaensis*, *Nothoctrum peltatum*, *Pteralyxia kauaiensis*, *Schiedea spergulina spergulina*, *Schiedea stellarioides*, *Spermolepis hawaiiensis*, and *Zanthoxylum hawaiiense*). Additional critical habitat was also proposed for Kaua'i by the USFWS in 2008, however none of this new designation is located within Pu'u ka Pele Forest Reserve. In addition to the same factors affecting rare plant species, critical habitat is threatened by soil erosion, changes in rainfall regime, and disease.

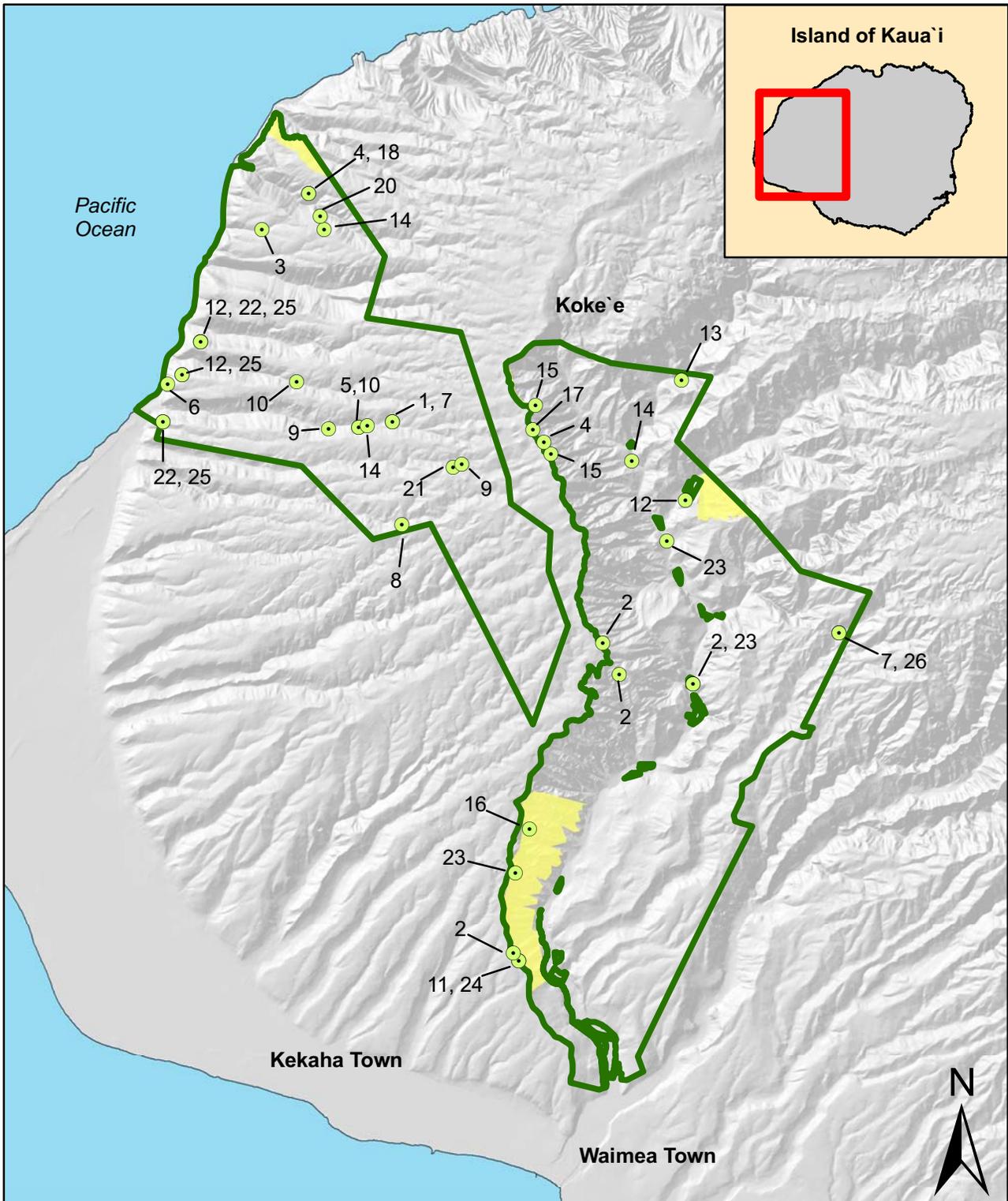
Timber Species: Throughout the 1930s and early 1940s the territory established a variety of timber plantations of both native (koa) and non-native species within the Western Ridge Section of the Forest Reserve, mostly for erosion control, until World War II stopped operations by sugar plantation and government personnel. During the late 1950s and 1960s, tree planting resumed on the lower eroded slopes of the area, primarily with *Eucalyptus saligna* and *E. robusta*, *Pinus taeda* and *P. elliotii*. These timber stands occupy approximately 1,720 acres, or seven percent of the Forest Reserve (Figure 8).

Invasive Plant Species: A wide variety of non-native plants, some of which are considered invasive, are spread throughout both sections of the Forest Reserve. Species of most concern to the Western Ridge Section of the Forest Reserve include: *Olea europaeus* ssp. *cuspidata* (wild olive), *Acacia mearnsii* (black wattle), *Panicum maximum* (guinea grass), *Schizachyrium condensatum* (beard grass), *Setaria palmifolia* (palm grass), *Acacia confusa* (formosa koa), *Sphaeropteris cooperi* (Australian tree fern), *Hedychium flavescens* (yellow ginger), *Lantana camara* (lantana), *Myrica faya* (faya tree), and *Leucaena leucocephala* (haole koa). Species not yet established but of concern include *Hyparrhenia rufa* (thatching grass), *Urena lobata* (aramina). Weeds of concern in the Canyon Section include: *Triumfetta semitriloba* (Sacramento burr), *Furcraea foetida* (Mauritius hemp), *Uncaria tomentosa* (cats claw), *Melia azedarach* (pride of India), *Coffea arabica* (coffee), *Lantana camera* (lantana), *Stachytarpheta mutabilis* (Cheyenne vervain), *Panicum maximum* (guinea grass), *Syzygium cumini* (java plum), and *Leucaena leucocephala*.

E. Wildlife:

Pu'u ka Pele Forest Reserve contains a variety of wildlife resources that provide for both

Figure 7: Pu`u ka Pele Forest Reserve rare plant species and critical habitat



Legend

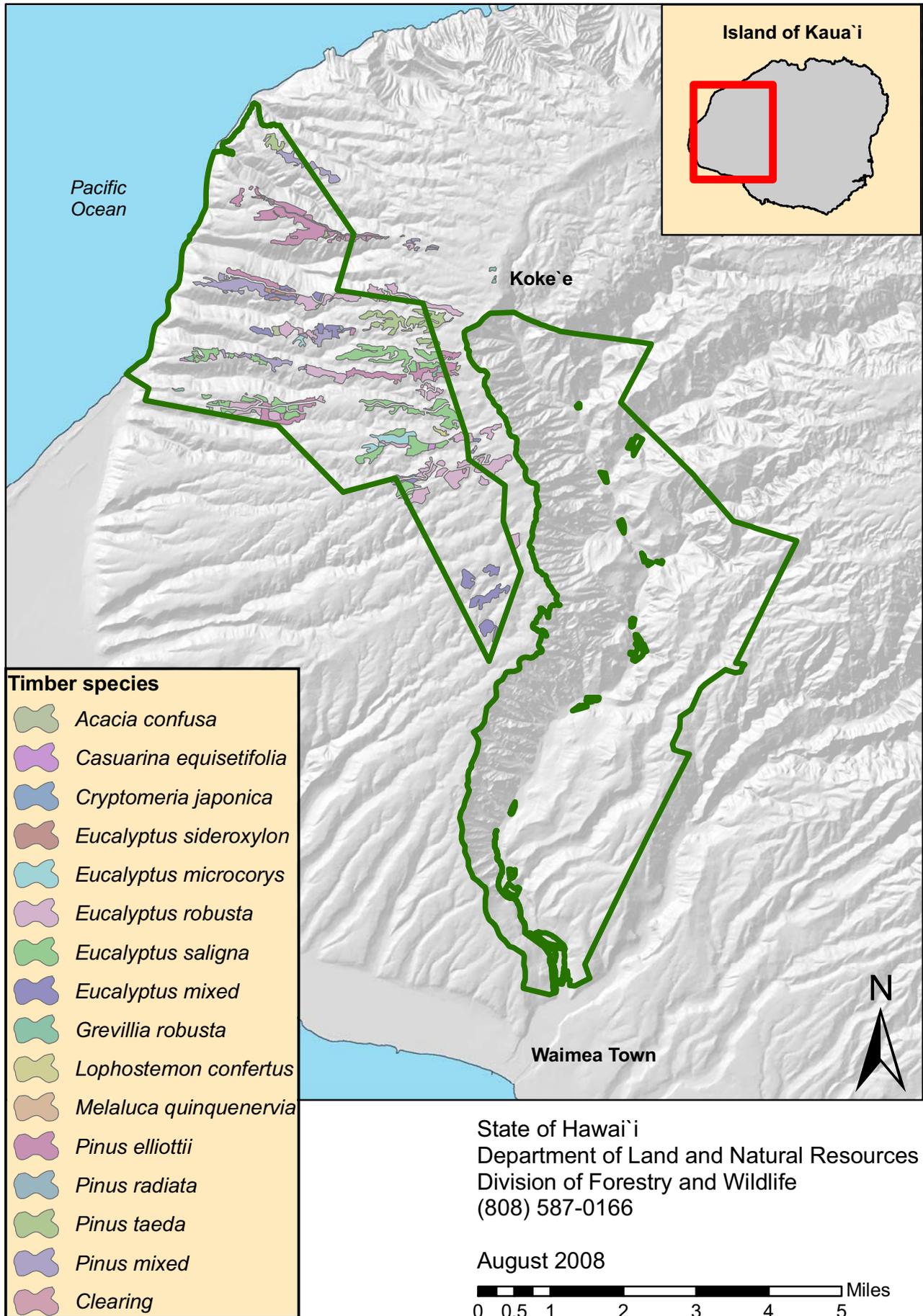
- Rare plant species (see Table 4)
- Plant critical habitat
- Pu`u ka Pele Forest Reserve

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Figure 8: Pu`u Ka Pele Forest Reserve timber stands



consumptive use such as public hunting, and non-consumptive uses such as wildlife viewing and native species preservation and restoration.

Native Wildlife: Only the most common native forest birds remain in those forested areas west of Waimea Canyon rim. Populations of ‘elepaio (*Chasiempis sandwichensis*), apapane (*Himatione sanguinea*), and amakihi, (*Hemignathus kauaiensis*), are still found in the higher elevation valley bottoms that contain remnant native forest. The main reasons for the paucity of native birds in this forest are believed to be avian malaria and avian pox, which are transmitted by mosquitoes which generally range up to 3,500 feet elevation. Some of the more common native forest birds have evidently developed some tolerance to the disease, while the uncommon birds have not. The Canyon Section contains a greater abundance and variety of native forest birds than does the Western Ridge Section. Figure 9 depicts current and historic locations of some of the animals found in the Forest Reserve.

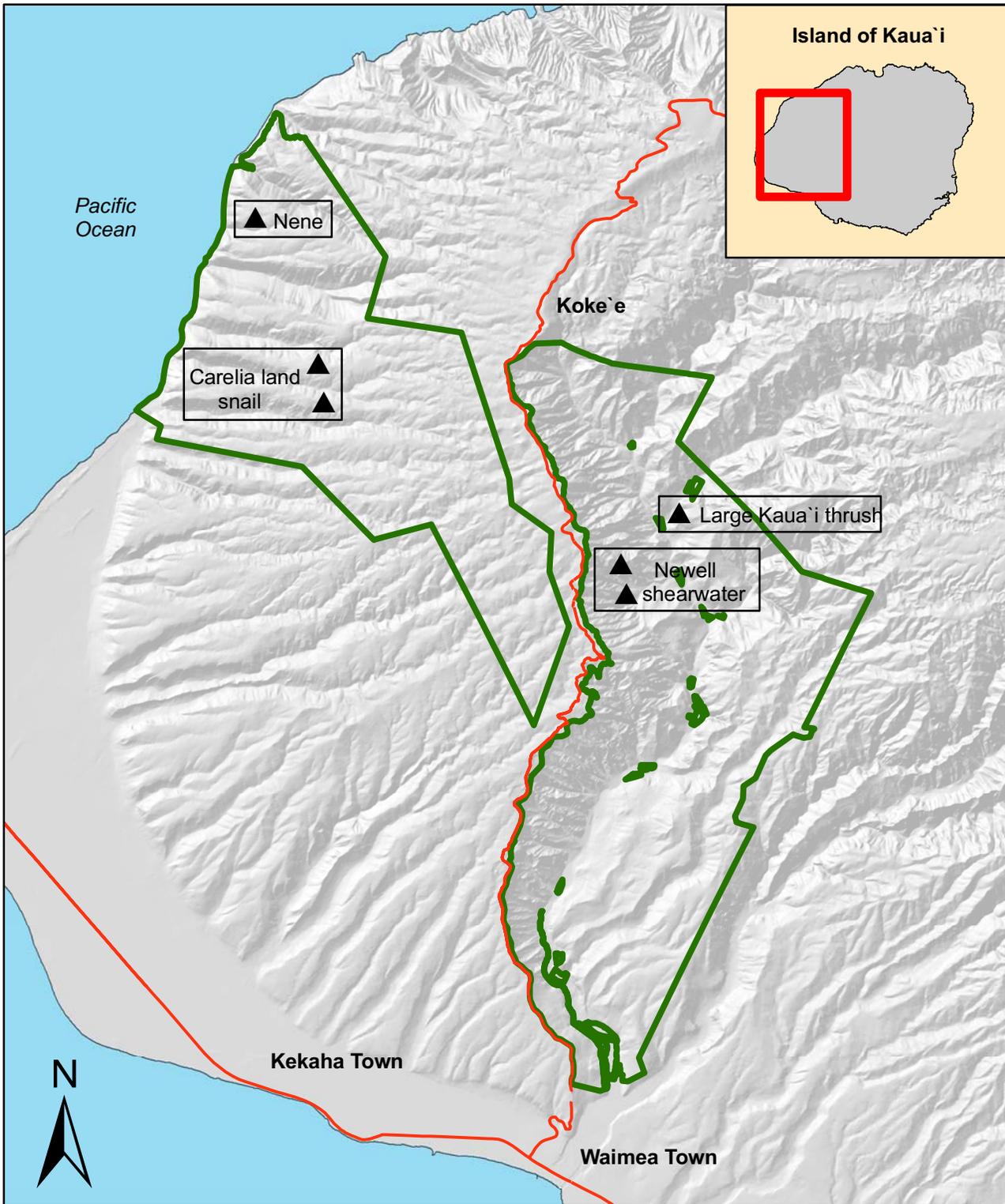
Other birds known from the Western Ridge Section include the endangered nene (*Branta sandwichensis*), white-tailed tropic bird (*Phaethon lepturus*), pueo (*Asio flammeus sandwichensis*), and brown noddy (*Anous stolidus*). The Canyon Section contains white-tailed tropic bird, pueo, koloa (*Anas wyvilliana*), ‘alae ‘ula (*Gallinula chloropus sandvicensis*), and ‘auku‘u (*Nycticorax nycticorax*). The Canyon Section may have historically contained species such as the ‘o‘o‘a‘a (*Moho braccatus*) and kama‘o or large Kaua‘i thrush (*Myadestes myadestinus*), which are possibly extinct.

A recent seabird survey conducted by the Kaua‘i Endangered Seabird Recovery Project at the Pine Forest picnic area on Kauhao Ridge detected Newell’s Shearwaters (*Puffinus auricularis newelli*) and Band-Rumped Storm-Petrels (*Oceanodroma castro*). Less than ten calls during both AM and PM surveys were heard of Newell’s shearwaters suggesting that the birds may be transiting or breeding in small numbers on the sea cliffs at the valley mouth. However, recorded calls of Band-Rumped Storm-Petrel were high (>50 calls). This drier cliff habitat is consistent with where other Band-Rumped Storm-Petrels have been heard in Na Pali valleys and cliffs to the northeast and it is highly likely these birds are breeding in this area. In addition, Band-Rumped Storm Petrels have been heard at Waimea Canoynd lookout, though it is likely that the birds were transiting the area. The Canyon Section of the Forest Reserve contains forest bird habitat while the Western Ridge Section contains nene habitat along the coast.

The Hawaiian hoary bat (*Lasiurus cinereus semotus* or ope‘ape‘a) is Kaua‘i’s only endemic land mammal and exists island wide. The ope‘ape‘a is a subspecies of the mainland hoary bat and is officially listed as endangered. Hawaiian hoary bats roost solitarily in the foliage of trees. They are most active at dusk when they forage on flying insects. Bats appear to be fairly common in the Pu‘u ka Pele Forest area. Individuals are regularly seen in the evenings, and are often seen feeding near stands of mature eucalypts, however, no information on the density and distribution of these animals is available. They are apparently quite versatile and exist from sea level to over 4,000 feet elevation and feed heavily on both native and introduced insects.

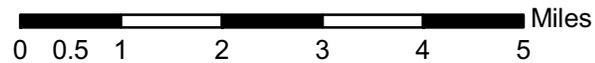
Within the Kōke‘e region (including Pu‘u ka Pele area), there are approximately 1,000 species of insects, making it one of the richest insect habitats in the State. Due to the lack of studies on most of the native Hawaiian insects, there is little biological knowledge of these species.

Figure 9: Pu`u ka Pele Forest Reserve - rare animal species



 Pu`u ka Pele Forest Reserve
 Major roads

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Furthermore, there is strong evidence that there are many more endemic insects in the pockets of native forest that are yet to be discovered. Some of the endemic insects known to exist in the Kōkeʻe forests are the Green Sphinx of Kauaʻi (*Tinostoma smaragdita*), the only known green species of Hawk or Sphinx moths in the world that lives in the tops of ʻōhiʻa trees, the Kauaʻi Antlion, the Flightless Cranefly, and various species of the most ancient Hawaiian fruitfly (*Drosophila* spp.). It is likely that a number of these insect species occur in the native pockets of forest within Puʻu ka Pele Forest Reserve. The Large Kauaʻi land snail, *Carelia evelynae*, may have once existed within the Forest Reserve.

The majority of the streams within the Forest Reserve are considered to be of moderate condition. Amphidromous native fish, ʻoʻopu alamoʻo (*Lentipes concolor*), ʻoʻopu nakea (*Awaous stamineus*), ʻoʻopu nopili (*Sicyopterus stimpsoni*), and the crustacean, ʻoʻpae kalaʻole (*Atyoida bisulcata*), are found within the streams of the Canyon Section of the Forest Reserve. No native aquatic vertebrate species are found within the Western Ridge Section of the Forest Reserve. Invasive aquatic species that impact Forest Reserve resources in Waimea Canyon stream include: Tilapia (family *Cichlidae*), Chinese catfish (*Clarias fuscus*), Tahitian prawn (*Macrobrachium lar*), small Asian clam (*Corbicula fluminea*), guppy (*Poecilia reticulata*), and mosquitofish (*Gambusia affinis*).

Non-Native Wildlife: A large variety of introduced song birds inhabit the western Kauaʻi forests, some of which include: melodious laughing thrush (*Garrulax canorus*), shama (*Copsychus malabaricus*), Japanese bush warbler (*Cettia diphone*), Japanese white-eye (*Zosterops japonicus*), feral fowl (*Gallus gallus*), greater necklaced laughing thrush (*Garrulax pectoralis*), pigeon (*Columba livia domestica*), common mynah (*Acridotheres tristis*), northern mockingbird (*Mimus polyglottus*), northern cardinal (*Cardinalis cardinalis*), red-crested cardinal (*Paroaria coronata*), house sparrow (*Passer domesticus*), house finch (*Carpodacus mexicanus*), chestnut mannikin (*Lonchura malacca*), and nutmeg mannikin (*Lonchura punctulata*). In addition, the introduced barn owl (*Tyto alba*) is also found in the Reserve. Although not of great economic impact, these birds make up of the typical fauna enjoyed by recreationists while using the forest areas for hiking, hunting, camping and fishing.

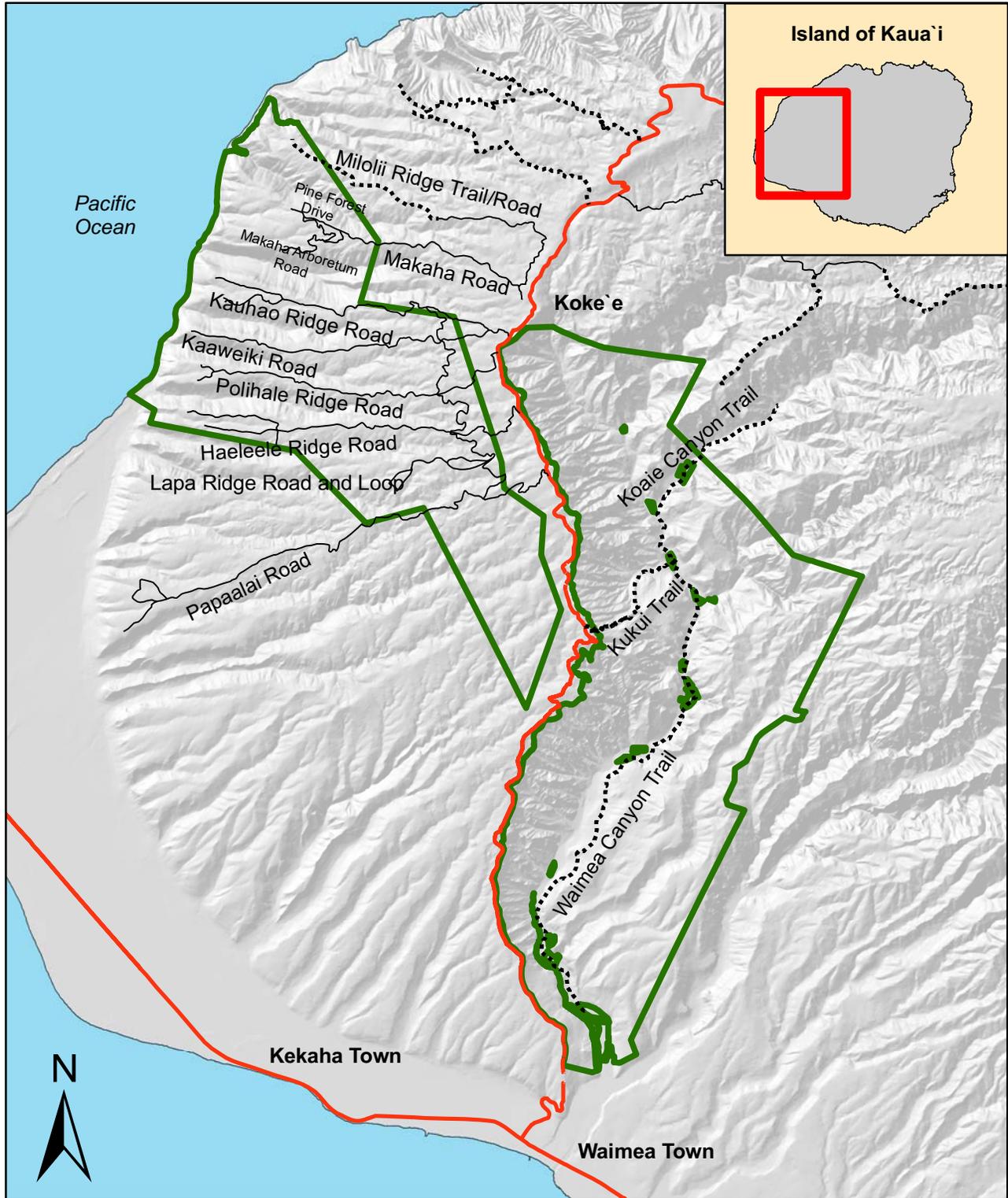
Non-native mammals in the reserve include feral cats (*Felis domesticus*), feral dogs (*Canis domesticus*), rats (*Rattus* spp.) and mice (*Mus* spp.). Fortunately, Kauaʻi has managed to remain free from a resident mongoose (*Herpestes javanicus*) population and has thus been spared this threat to native wildlife.

Introduced game animals, most of which have negative impacts on native ecosystems, are described below in section I: Additional Public Use.

F. Access:

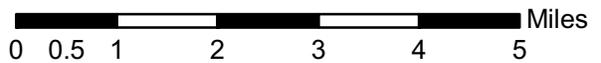
Puʻu ka Pele Forest Reserve is one of the most accessible Forest Reserves on the island. A network of roads, trails, and landing zones has been established and is currently maintained for public use, staff access, firebreaks, and safety (Figure 10).

Figure 10: Pu`u ka Pele Forest Reserve trails and secondary roads/firebreaks



- Secondary roads/firebreaks
- Na Ala Hele trails
- Major roads
- ▭ Pu`u ka Pele Forest Reserve

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Vehicular Access: Vehicular access to the to the Western Ridge Section of Pu‘u ka Pele Forest Reserve is available via paved highways from Waimea Town on Waimea Canyon Drive (Highway 550) or from Kekaha Town via Kōke‘e Road (Highway 552). Approximately six miles from Waimea town, the two roads intersect and Kōke‘e Road continues into Waimea Canyon State Park. Numerous secondary roads along the ridgelines spur from Kōke‘e Road into this section of the forest reserve including: Miloli‘i Ridge Trail, Pine Forest Drive, Mākaha Arboretum Road, Kauhao Ridge Road, Kā‘aweiki Road, Polihale Ridge Road, Hā‘ele‘ele Ridge Road, Lapa Ridge Road and Loop, Papa‘alai Road, 3,000 foot elevation Contour Road, and Mākaha Road. Access to the southwest portion of the Western Ridge Section can be achieved via Polihale Road. Access to the Canyon Section of Pu‘u ka Pele Forest Reserve can be achieved via Menehune Road and a 4-wheel drive road near the 600-foot elevation contour accesses the lower reaches of the Forest Reserve at the canyon bottom.

Trails: Trails within the reserve are primarily located within the Canyon Section of the Reserve. Kukui Trail provides access to the bottom of the canyon near the middle of the Forest Reserve, while Canyon Trail makes a brief foray into the reserve at the northern end. Koai‘e Canyon, Kaluahaulu-Wai‘alae, Wai‘alae Canyon, Pu‘u Ki-Wai‘alae, and Mokihana Trails access the reserve from the east. Waimea Canyon Trail provides access along most of the canyon floor within the Reserve. The Western Ridge Section contains the lower portion of the Miloli‘i trail.

Maintenance and Emergency Helicopter Landing Zones: Helicopter landing zones have been established in the Forest Reserve for use during emergency situations and for general maintenance in both section of the reserve. Landing Zones in the Western ridge section are located on Kā‘aweiki and Polihale ridges at one-mile intervals starting below the Contour Road with a total of 3-4 landing zones on each road. These landing zones have been cleared of woody vegetation and replaced with grass (Bryon Stevens and Kawika Smith, personal communications). Helicopter landing is possible on the other ridge roads in the Western Ridge Section that are wide enough to accommodate at least a Hughes 500 helicopter. In the Canyon Section, landing zones have been established at Hipalau Camp, Poachers Camp, Wiliwili, Waiahulu, Pu‘u Ki, and at the powerhouse.

Boat Landings: Landing is possible for small watercraft at the northern end of Polihale beach where the State Park ends and the Forest Reserve begins. Landing is dependant on calm ocean conditions as there are no facilities (e.g., boat ramp) developed for this purpose.

G. Infrastructure:

Infrastructure to support the various public use and resource management programs have been built and maintained over the years.

Campsites: Campsites are comprised of a toilet and a shelter (no fire pits). A camping permit is required for use of all DOFAW campsites. There are currently four campsites in the Canyon Section of the Forest Reserve located at Hipalau, Kaluahaulu, Wai‘alae Canyon, and Wiliwili. Public camping is not allowed within the Western Ridge Section, therefore, there are no campsites established in this portion of the Reserve.

Fences: Boundary fences were constructed along the southern boundary of the Western Ridge Section and Department of Hawaiian Home Lands and along the Mokihana Game Management Area boundary and Robinson Family lands. These fences were constructed around the 1960's and were made of 4-strand barbwire or smooth wire with wooden posts.

Hydroelectric Plant: Kekaha Sugar Co. built the Waimea Valley Hydroelectric plant in 1954. The Agribusiness Development Corporation (ADC) currently maintains it and sells the power to the Kaua'i Island Utility Cooperative for use in its island wide power grid.

Other Man-Made Hydrologic Facilities: The Western Ridge Section contains, water tanks and game watering units. The Canyon Section contains a ditch system from trail one to Pu'u Opae reservoir.

Public Restrooms: Restroom facilities in the Forest Reserve consist primarily of composting toilets. In the Canyon Section, toilets are located at all campsites (Wiliwili toilet is not operational). The Western Ridge Section has a composting toilet at Lapa and a pit toilet at Pine Forest Drive on Mākaha Ridge.

Shelter/Picnic Areas: Within Pu'u ka Pele Forest Reserve, DOFAW has constructed eight open walled shelters comprised of a roof over one or two picnic tables for public day use. The Western Ridge Section has a total of three shelters: two at Lapa Ridge, and one each at Mākaha Arboretum and Pine Forest Drive. The Canyon Section has a total of four shelters: one at the Kukui Trail Iliau Nature Loop, and three along Mokihana Ridge.

H. Archaeological and Historical Sites:

Historical sites are categorized based on the period of their construction. The first type – archaeological – belongs to the pre-western contact period. Structures include heiau, burials, and house sites. The second type – historic – are associated with the period following the arrival of westerners. Structures are usually of a commercial, religious, or residential nature. Archival research indicates that these ridges were once forest exploitation areas (for feathers, canoe logs, etc.), thus temporary campsites and access trails are expected to be the primary sites found. A survey by Historic Preservation staff in 1993 for the "Roadside Fuel Hazard Reduction" project which included most of the ridge tops of Pu'u ka Pele Forest Reserve, found that extensive alteration of the ridge lines had occurred in this century due to grazing, forest planting and other activities, making it highly unlikely that significant historic sites remain within the non-native timber plantation areas. Five locations within the Forest Reserve that may be possible exceptions include:

1. **Hā'ele'ele Ridge Road:** Located at the top of Kepapa Ridge. Possible historic sites may occur at the bottom of the valley, in the vicinity of Kepapa Springs.
2. **Kauhao Ridge Road:** An area covered with ti plants, which could be a possible site near a fork in the ridge road, approximately 2.5 miles from the Contour Road.
3. **Kā'aweiki Road:** An archaeological survey for roadside clearing was conducted.

4. **Papa‘alai Road:** An area at the road beginning, near the highway, may contain a site.
5. **Polihale Beach:** An area at the end of the beach at the base of the cliffs may contain a heiau.

I. Additional Public Use:

Pu‘u ka Pele Forest Reserve serves as an important area on the island for a variety of public uses. This area is used extensively for hunting, camping, fishing, hiking, horseback and mule riding, motorcycle, 4-wheel driving, and mountain biking, picnicking, as a source for collection of non-commercial forest resources, and eventually, as a source of commercial timber resources.

Public Hunting: DOFAW manages public hunting on all forest reserve lands on Kaua‘i by the regulation of hunting seasons, bag limits, and varied hunting methods. DLNR’s Division of Conservation and Resources Enforcement (DOCARE) carries out enforcement of hunting regulations (Chapter 122 Rules Regulating Game Bird Hunting, and Chapter 123 Rules Regulating Game Mammal Hunting).

Hunting within the Western Ridge Section of Pu‘u ka Pele Forest Reserve is divided among designated Hunting Units “A”, “H” and “J” while the Canyon Section includes hunting units “B”, “E”, “F”, and “K”. Each of these units is managed for specific purposes and goals. Game mammals found within these hunting units consist of feral pigs (*Sus scrofa*), feral goats (*Capra hircus*), and black-tailed deer (*Odocoileus hemionus columbianus*). DOFAW regulates game mammal hunting according to HRS Title 13 Chapter 123; hunting units on Kaua‘i are described in §13-123-15 and mapped in Chapter 123 Exhibit 2. Game birds include: ring-necked pheasant (*Phasianus colchicus*), Erckel’s francolin (*Francolinus erckelii*), black francolin (*Francolinus francolinus*), chukar partridge (*Alectoris graeca*), lace-necked doves (*Streptopelia chinensis*), gray francolin (*Francolinus pondicerianus*), Japanese quail (*Coturnix japonica*), California quail (*Callipepla californica*), and barred doves (*Geopelia striata*) Game bird hunting is regulated according to HRS Title 13 Chapter 122; game bird hunting units are described in §13-122-11.6 and mapped in Chapter 122 Exhibit 12.

Although cattle (*Bos taurus*) are not considered game animals, a remnant, feral population occurs within the Western Ridge Section of the Forest Reserve. In order to protect reserve resources from environmental degradation and the public from cattle hazard, DOFAW intends to eradicate wild cattle via special hunts and/or staff control.

Hunting in all of these forest areas is restricted to weekends and State holidays unless otherwise allowed by special hunts. Illegal hunting activity occurs, but it has been controlled to some degree by a system of locked gates during weekdays.

Camping: Camping is not allowed within the Western Ridge Section because of the fire hazard associated with campsites. Camping is allowed year round in the Canyon Section of the Forest Reserve at the following locations: Kaluahaulu, Hipalau, Wiliwili, and Wai‘alae Canyons. Camping may be restricted for certain periods of time at certain locations as determined by the

Division (*e.g.*, high fire risk, natural disaster, maintenance, etc.). Permits are required for camping and can be obtained free of charge through the Kaua‘i Branch Office located at: 3060 Eiwa Street, Room 306 Līhu‘e, Hawai‘i 96766.

Bird Watching: Pu‘u ka Pele Forest Reserve is a relatively accessible area for native forest bird watching. The Hawaiian birds most likely to be seen include the Kaua‘i ‘amakihi, Kaua‘i ‘elepaio, ‘apapane, pueo, and nene.

Fishing: Fishing is allowed in the Waimea River System year round.

Hiking: Approximately 40 miles of trails and secondary roads, maintained by the Division’s Na Ala Hele trail program, exist within the Forest Reserve. Hiking is open to the public year round.

Horseback Riding: Horseback riding is allowed within both sections of the Forest Reserve year round. Some riders voluntarily restrict their riding to weekdays in order to avoid weekend hunting activity. Hunters access more remote areas of the reserve via horseback on weekends and holidays. Use mostly occurs along secondary roads within the Western Ridge Section or the following trails in the Canyon Section: Koai‘e Canyon, Kaluahaulu-Wai‘alae, Wai‘alae Canyon, Pu‘u Ki, Wai‘alae, Kukui, and Mokihana.

Dirt Bikes, All Terrain Vehicles (ATVs) and Mountain Bikes: Dirt bikes are allowed on secondary roads within the Western Ridge Section of the Forest Reserve if registered by the County Division of Motor Vehicles. Motor cross bikes are not allowed within the Canyon Section of the Forest Reserve. ATV use is prohibited throughout the Forest Reserve. Mountain biking is only allowed in the Western Ridge Section of the Forest Reserve.

Non-Timber Forest Product Collection: Non-timber forest products commonly collected within Pu‘u ka Pele Forest Reserve include:

- a. *Passiflora mollissima* (banana poka) vines
- b. Eucalyptus firewood
- c. Ferns
- d. Flowers
- e. Fruits
- f. *Psidium* spp. (guava) poles
- g. *Alexia oliviformis* (maile)
- h. *Melicope anisata* (mokihana)
- i. *Pinus* spp. (pine) cones & boughs

Gathering of material from plant species that are not on Federal or State threatened and endangered species lists is permitted and regulated by DOFAW through standard Forest Reserve System permit procedures. Gathering of plant materials from threatened or endangered species may be allowed if individuals have obtained a Special Collecting Permit from the DOFAW Administrative office in Honolulu. A permit from the US Fish and Wildlife Service is also required if the plant is listed by the US-ESA. Harvesting permits are required for gathering firewood, maile, and greenery for floral arrangements. Permits for gathering plant material can

be obtained from the DLNR Līhu‘e office at 3060 Eiwa Street, Room 306. Hours are Monday through Friday from 8:00 AM to 4:00 PM excepting State holidays. These permits are free for personal non-commercial use or at a fee for commercial uses. Approximately 250 permits are issued for Pu‘u ka Pele Forest Reserve area annually.

Picnicking: Eight open shelters with picnic tables exist in Pu‘u ka Pele Forest Reserve. They are available for day use without a permit or can be reserved with a permit.

J. Threats:

Threats to Pu‘u ka Pele Forest Reserve resources, DOFAW staff, and public users include diseases and pathogens, environmental hazards, fire, invasive non-native plant and animal species, poaching, and vandalism, and soil erosion. DOCARE is the law enforcement arm of the Department and is responsible for investigating and pressing charges for civil or criminal violations of Hawai‘i Revised Statutes, Chapter 183, or Hawaii Administrative Rules, Chapter 104.

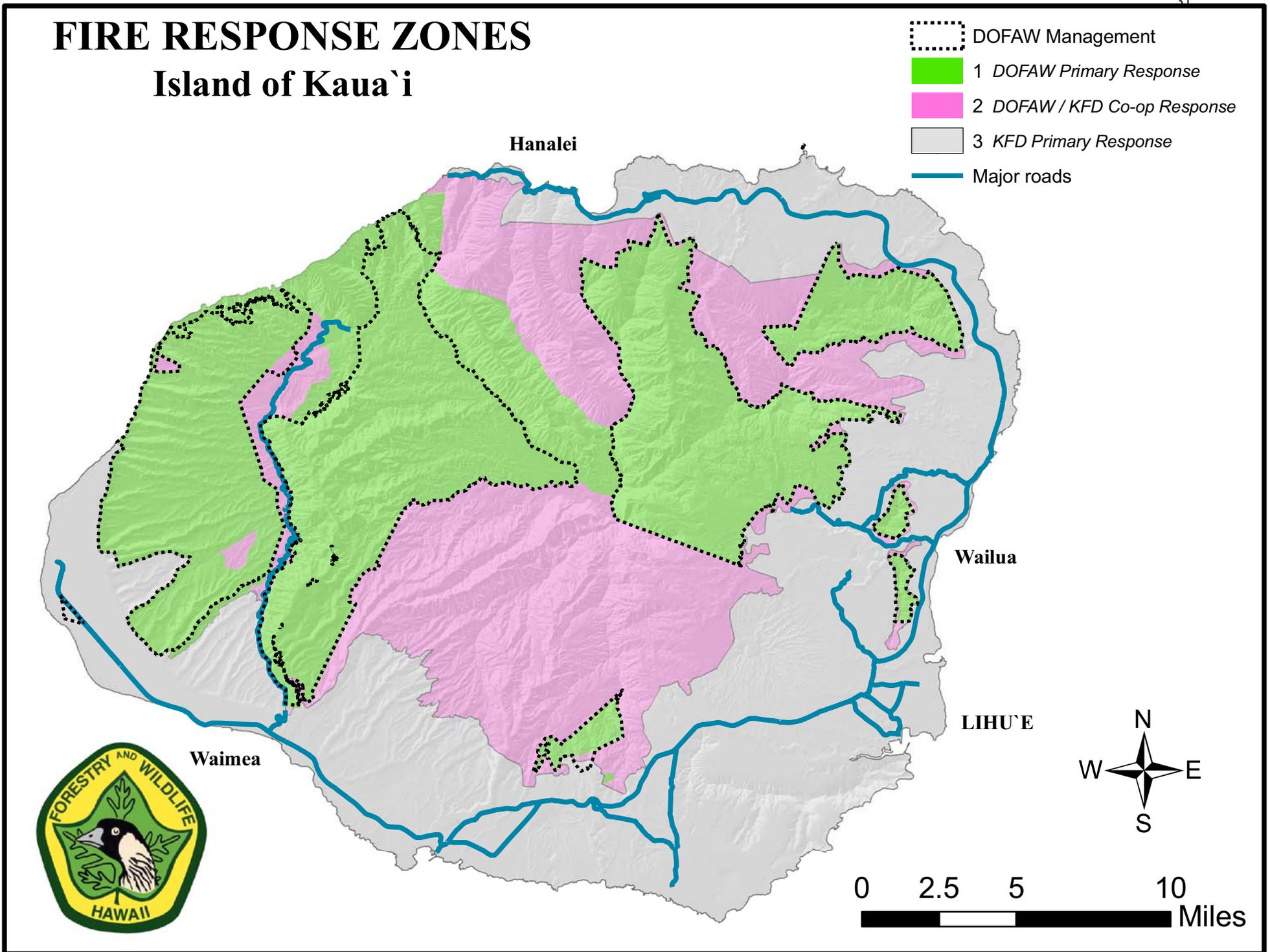
Diseases and Pathogens: Diseases and pathogens pose a threat to reserve resources and sometimes users and management staff. Reserve resources can be negatively impacted by causing death or reduced production of native species, game animals, and timber products. Some of the most damaging non-human diseases and pathogens include: pine dieback (*Botryosphaeria Dothiorella*), ohia rust (*Puccinia psidii*) and koa wilt (*Fusarium oxysporum*). Potential negative impacts to humans are primarily associated with waterborne diseases and pathogens carried by non-native mammals, such as Leptospirosis.

Environmental Hazards: Environmental hazards that threaten public users and DOFAW staff include: natural disasters, road and trail washout, fire, hurricane, flooding (especially at the Waimea Canyon River crossing ½ mile to ¾ mile above Wiliwili Camp) rock and cliff falls in steep areas, tree fall, and feral animals. DOFAW staff monitor environmental conditions and open and close areas available for public use to reflect current conditions.

Fire: Pu‘u ka Pele Forest Reserve is an area of high fire risk due to its high level of human use and relatively low levels of naturally occurring rainfall. Fire risk may also be higher in areas where introduced grasses and trees predominate. Establishment of invasive species is often facilitated by fire, as these plants are often the first to colonize a burned area. The majority of the Forest Reserve is under the primary responsibility of DOFAW (Figure 11). DOFAW shares fire fighting response responsibilities with the Kaua‘i County fire department and the U.S.Navy’s Pacific Missile Range Facility at Mākaha ridge. Secondary roads in the western Western Ridge Section of the reserve function as firebreaks (except Polihale, Mākaha, and Kā‘aweiki). The County, PMRF, and DOFAW currently have MOUs describing fire assistance protocol between the each agency.

Invasive Invertebrate Species: Invasive invertebrate species may impact reserve resources by directly preying on vegetation and desirable invertebrate species or by spreading diseases and pathogens (Table 7). Some of the most deleterious include: black twig borer (*Xylosandrus compactus*), two-spotted leafhopper (*Sophonia rufofascia*), Erythrina gall wasp (*Quadrastichus*

Figure 11: Fire response zones for the island of Kaua'i



erythrinae), koa seed insects, western yellowjacket (*Vespula pensylvanica*), and mosquitoes (*Culex quinquefasciatus*, *Aedes albopictus*, *Aedes aegypti*, and *Aedes vexans nocturnus*).

Table 5: Invasive Invertebrates

Species Name	Impact on Reserve Resources
Black twig borer (<i>Xylosandrus compactus</i>)	Can kill seedlings, saplings and mature trees by direct damage to limbs and twigs and by making the plant susceptible to secondary infections. Especially devastating to rare species.
Two-spotted leafhopper (<i>Sophonia rufofascia</i>)	Can cause dieback of uluhe fern patches, enabling encroachment of invasive species and erosion. Has a wide host range, including several native plants.
<i>Erythrina</i> gall wasp (<i>Quadrastichus erythrinae</i>)	Can kill seedlings, saplings, and mature trees by destroying leaf tissue. Only native tree affected is wiliwili.
Koa seed predators: seed weevils (<i>Araecerus levipennis</i> and <i>Stator</i> spp.) and koa seedworm (<i>Cryptophlebia illepeda</i>)	Consume koa seeds thereby impairing regeneration of trees.
Western yellowjacket (<i>Vespula pensylvanica</i>)	Voracious insect predator and aggressive towards humans – can inflict multiple stings
Mosquitoes (<i>Culex quinquefasciatus</i>)	Spreads avian diseases (malaria and pox), which can kill native, song, and game birds.

Invasive Plant Species: Invasive plant species, including incipient and established populations, are major threats to Reserve resources. DOFAW staff, in conjunction with the Kaua‘i Invasive Species Committee, work to combat the negative effects posed by this threat. Species of most concern include *Olea europaeus* ssp. *cuspidate*, *Acacia mearnsii*, *Panicum maximum*, *Schizachyrium condensatum*, *Setaria palmifolia*, *Acacia confusa*, *Sphaeropteris cooperi*, *Hedychium flavescens*, *Lantana camara*, *Myrica faya*, and *Leucaena leucocephala*. Weeds of concern in the Canyon section include: *Triumfetta semitriloba*, *Furcraea foetida*, *Uncaria tomentosa*, *Melia azedarach*, *Coffea arabica*, *Lantana camera*, *Stachytarpheta mutabilis*, *Panicum maximum*, *Syzygium cumini*, and *Leucaena leucocephala*.

Invasive Vertebrate Species: Feral cats and dogs, rats, mice, non-native birds, and cattle negatively affect reserve resources by preying on native plants (seeds and seedlings) and animals (mostly eggs and immature young), spreading undesirable plant seeds, disrupting natural pollination regimes, spreading disease, and causing erosion. Pigs root and wallow, causing erosion and creating breeding habitat for mosquitoes. Goats, and to a lesser extent deer, reduce vegetation and cause erosion, especially on sloped lands such as those found in Waimea Canyon. The large number of feral chickens on Kaua‘i disturb forest understory and inhibit regeneration of native vegetation.

Poaching and Vandalism: Poaching and vandalism within Pu‘u ka Pele Forest Reserve occurs. However, accurate measures on the impact of this activity on Reserve resources are not specifically recorded. Poaching has been generally focused on game mammals, koa and other high value native woods, and unpermitted gathering. Vandalism is generally focused on

infrastructure such as shelters, locks, and signs. DOCARE is the responsible party for investigating and prosecuting violators.

Soil Erosion: Erosion of topsoil and mineral soils negatively affect the ability of the Reserve to retain water and support vegetation. Much of the soil erosion in Pu‘u ka Pele Forest Reserve can be attributed to vegetation loss caused by feral ungulates. The early foresters recognized the negative effect of erosion and actively took measures (such as planting vegetation and controlling game animals) to reduce this from occurring within the Reserve.

K. Revenue:

Revenue is generated from commercial and non-commercial uses of the Forest Reserve. Primary sources of revenue include permits issued for salvage of timber resources and collection of pine cones and boughs during the Christmas holiday season. DOFAW is interested in expanding revenue generating opportunities with the intent of fulfilling HRS Chapter 183 Section 183-1.5 subsection (5) states that the Department shall: “Devise and carry into operation, ways and means by which forests and forest reserves can, with due regard to the main objectives of title 12, be made self-supporting in whole or in part”.

Timber Use (Commercial): To date, there has been no large-scale commercial timber-harvesting sale from within the Forest Reserve. Some salvaging of logs along roadsides was conducted after Hurricanes Iwa and Iniki. In 2005, DOFAW and State Parks developed the Forest Management Plan for the Kōke‘e Timber Management Area, which details the goals and objectives associated with commercial use of timber in Pu‘u ka Pele Forest Reserve.

DOFAW periodically receives inquiries from the private sector for access to commercial timber resources within Pu‘u ka Pele Forest Reserve. DOFAW can presently issue commercial harvest permits for salvage and other small-scale timber operations. Continued implementation of the issuance of permits for small-scale timber harvest or salvage occurs under the premise that no new roads will be created and that any disturbance of ground area will not exceed 2,000 square feet for a given location. Trees with less than 15% remaining live crown area comprised of healthy leaves are defined as dying. All proposed salvage harvest trees are evaluated and marked by a DOFAW forester prior to any approved and permitted salvage operations.

Large-scale and high value timber sales within Pu‘u ka Pele Forest Reserve are administered through a public procurement process, and may result in issuance of a Timber Land License(s) that requires Board of Land and Natural Resources approval. All large-scale timber-harvesting activities are conducted according to a timber-harvesting plan approved by DOFAW. The timber-harvesting plan must adhere to all of the forest management practices that are specified as best management practices (http://www.state.hi.us/dlnr/dofaw/pubs/BMPs_bestmanagement.pdf) for timber harvesting.

III. MANAGEMENT

The State Department of Land and Resources DOFAW is responsible for management of Forest Reserves in Hawai‘i. Pursuant to Chapter 183, Hawai‘i Revised Statutes (HRS), DOFAW shall

“gather and compile information and statistics concerning the area, location, character, and increase and decrease of the forests in the State” (§183-1.5(1) HRS). Additionally, DOFAW is empowered to “... manage and regulate all lands which may be set apart as forest reserves,” (§183-1.5(3) HRS), “devise ways and means of protecting, extending, increasing, and utilizing the forests and forest reserves...” (§183-1.5(4) HRS).

A. Past Planning:

Three plans have been written that encompass wholly or in part Pu‘u ka Pele Forest Reserve: Pu‘u ka Pele Management Plan (DOFAW, 1973), Kōke‘e Timber Management Plan (DOFAW, 2005), and the Kaua‘i Watershed Management Plan (Kaua‘i Watershed Alliance, 2005).

1973 Pu‘u ka Pele Management Plan: Written in 1970 and revised in 1973 by the DOFAW Kaua‘i Branch District Forester, Ralph E. Daehler. Principal management objectives of the plan were to remedy the results of destructive and undesirable early abuse (including deforestation and soil erosion from cattle grazing) to the area. This was accomplished by the development of valuable renewable natural resources, enhancement of the natural environment for recreational opportunities, and the establishment and maintenance of desirable protective vegetative cover.

2005 Kōke‘e Timber Management Plan (KTMA): DOFAW and State Parks proposed the establishment of the KTMA to add commercial timber management to present management goals and to promote Kaua‘i’s forest industry development. The KTMA encompasses Pu‘u ka Pele Forest Reserve, Waimea Canyon and Kōke‘e State Parks and portions of Nā Pali-Kona Forest Reserve. This plan was written by DOFAW and State Parks to provide a framework for sustainable, responsible and proactive management of forest resources in support of the following goals:

- a) Initiate active long-term commercial forestry operations on Kaua‘i.
- b) Restore native plant communities where partial/remnant native plants exist within areas degraded or dominated by non-native species.
- c) Promote tree removal or harvest methods in support of hazard reduction.
- d) Increase existing limits on salvage operations for dead or dying trees.
- e) Promote use of forests or forest products for cultural or educational purposes.
- f) Stimulate economic activity and growth in the timber processing sectors of both Kaua‘i and the State.
- g) Provide DLNR with an opportunity to supplement annual operations budgets through timber sales revenues, effectively increasing funding available for resource management activities.

2005 Kaua‘i Watershed Management Plan: In 2003, the Kaua‘i Watershed Alliance (KWA) was formed. The members include the major landowners within the conservation district (previously Forest Reserve) boundary on the island of Kaua‘i. These members represent most of the landowners of the watershed of Kaua‘i. The members of the partnership have different interests, priorities, and constituencies, but all share a common commitment – the long-term protection of Kaua‘i’s upper watershed areas. The KWA Management plan was written by the Kaua‘i program of the Nature Conservancy for the Alliance because of their expertise in landscape management in Hawai‘i. This plan stresses the importance of active watershed

management, and outlines the purpose, objectives, and budget of a comprehensive range of site management projects for the summit and upper slopes of Kaua‘i’s watershed. It describes prioritized programs in:

- a. Ungulate management
- b. Weed management
- c. Watershed monitoring
- d. KWA infrastructure and budget.

Although Pu‘u ka Pele Forest Reserve is included in the general KWA boundary, it is not included in either of the areas slated for active management (Core 1 or 2).

B. Summary of Existing Management Activities:

DOFAW’s 2001 Draft Management Guidelines designations for Pu‘u ka Pele Forest Reserve are mapped in Figure 12. Guidelines are defined as follows:

Vegetation Class:	V-1 (Highest Quality Native Ecosystems); V-2 (Predominantly Native Areas); V-3 (Considerably Disturbed Areas); V-4 (Badly Degraded Areas)
Game Animal Management:	A-1 (Game Production); A-2 (Mixed Game and Other Uses); A-3 (Game Control Public); A-4 (Game Control Supervised)
Forest Products:	F-1 (Primary); F-2 (Secondary); F-3 (Personal); F-4 (Restricted)
Recreation Management:	R-1 (Heavy Use Areas); R-2 (Medium Use Areas); R-3 (Light Use Areas); R-4 (Restricted Areas)

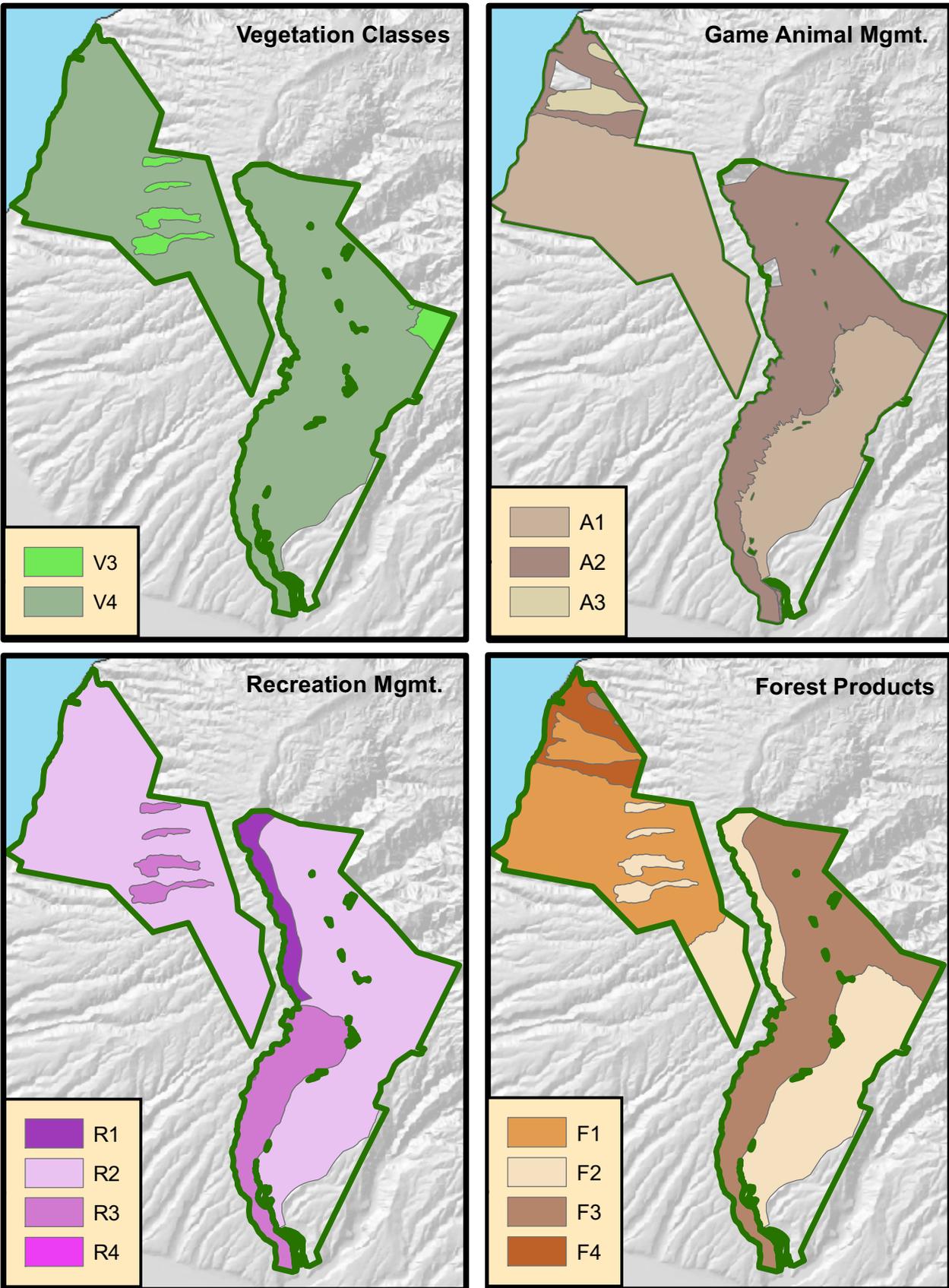
C. Management Objectives and Goals:

Pu‘u ka Pele Forest Reserve is a multi-use area managed for native species conservation, recreational hunting, forestry uses, and other recreational activities. DOFAW’s current principal objectives for Pu‘u ka Pele Forest Reserve are to manage the lands for (listed in order of priority):

1. Watershed Values (aquifer recharge and control of soil erosion);
2. Resource Protection (fire and forest health management);
3. Game Animal Management (hunting);
4. Commercial Activity (including but not limited to timber and tourism);
5. Additional Public Activity (all non-commercial use);
6. Invasive Species Management (control of target non-native species);
7. Threatened, Endangered, and Rare Species Management (plants and animals);
8. Native Ecosystem Management (outplanting common native species).

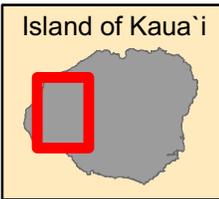
A matrix of management objectives and goals is provided at the end of the section (Table 6). The specific management objectives of DOFAW at Pu‘u ka Pele Forest Reserve are focused on:

Figure 12: DOFAW's 2001 Draft Management Guidelines for Pu`u ka Pele Forest Reserve³⁶



State of Hawai'i
 Department of Land and Natural Resources
 Division of Forestry and Wildlife
 (808) 587-0166

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1. **Watershed Values:** Managing the Forest Reserve to protect and promote watershed values is centered on supporting and promoting aquifer recharge and the reduction of soil erosion.
 - a. Soil erosion control is focused on conducting ground cover tests of select plants in selected areas.
 - b. Maintaining adequate vegetative cover throughout the Forest Reserve optimizes aquifer recharge.
2. **Resource Protection:** Resource protection is centered on controlling and minimizing the effects of fire, insects, disease, and illegal activity on reserve resources.
 - a. Fire suppression is focused on reducing fire ignition by maintaining firebreaks, buffers, and safety zones and by conducting environmental monitoring in order to make informed management decisions.
 - b. Fire suppression is focused on responding to fires quickly and efficiently.
 - c. Post-fire mitigation is focused on salvaging salable timber and implementing KTMA plan and ecosystem restoration goals.
 - d. Disease and pathogen control is largely focused on controlling koa wilt.
 - e. Responding to illegal activity is focused on DOFAW staff providing technical assistance to DOCARE as requested.
3. **Game Animal Management:** Game animal management is centered on providing high quality public hunting opportunities by maintaining watering stations, habitat improvement, and conducting game surveys.
4. **Commercial Activity:** Commercial use of the Forest Reserve is largely driven by market demand and is generally focused on timber products and ecotourism.
 - a. Conducting provenance trials for native and non-native hardwoods (including koa) at low to mid elevation and dry to wet locations (Polihale and Kā'aweiki);
 - b. Retaining area devoted to timber production (native and non-native);
 - c. Selling timber via a Request for Proposals (RFP) process;
 - d. Planting non-native timber species below the 2,400 ft. elevation line for commercial use and planting native timber species above the 2,400 ft. elevation line for commercial use in the Western Ridge section. Such commercial efforts shall be limited to the current extent of non-native timber plantations with the KTMA.
 - e. Assessing and issuing permits for Forest Reserve use and access.
5. **Additional Public Activity:** DOFAW's Forestry Program is mainly concerned with opening and closing areas to public use to reflect current environmental safety concerns, providing access to non-timber resources for non-commercial use, and maintaining and developing infrastructure. DOFAW's primary infrastructure goal is to maintain existing resources. In addition, the Forestry Program supports the Na Ala Hele and Wildlife Programs' maintenance of existing trail and hunting programs. New projects include developing a parking area for the Kukui Trail, building a boundary fence between the Western Ridge Section and DHHL lands, and to build a number of small enclosure fences (less than 10 acres each) to protect rare plant species.
6. **Invasive Species:**
 - a. Invasive plant control is focused on controlling incipient populations of select invasive plant species at specific locations in an attempt to prevent them from becoming established in the reserve and/or from spreading to adjacent reserves

(e.g., *Panicum maximum*). Control efforts may be chemical (e.g. herbicides), mechanical (e.g. pulling weeds), or biological (under appropriate circumstances).

- b. Invasive animal control is focused on eradication of feral cattle populations in the Western Ridge Section. In order to successfully carry out this objective, a boundary fence will need to be rebuilt.
- 7. Threatened, Endangered, and Rare Species Management:**
- a. Rare plant conservation is focused on protecting populations of extant species, collecting genetic material, and outplanting progeny in appropriate, protected (fenced) areas.
 - b. Hawaiian hoary bat conservation consists of working with the Hawai‘i Bat Research Cooperative/Working Group to select a monitoring array site and assist in subsequent data collection (5 year project).
- 8. Native Ecosystem Management:**
- a. Native habitat protection and restoration is focused on areas above 2,400 feet in elevation as well as a few pockets of lowland dry forest areas containing *Erythrina sandwicensis* (wiliwili) trees in the Western Ridge Section.

Table 6: Pu‘u ka Pele Forest Reserve Management Matrix. Management objectives are listed in order of priority (highest first); tactical goals and action items are not prioritized. Estimated cost refers to State funds.

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
Watershed Values	Reduce the threat and impact of erosion on reserve resources	A. Continue ground cover trials with native grasses and shrubs in the plant enclosures.	<ul style="list-style-type: none"> • Continue working with the Natural Resource Conservation Service (NRCS) to acquire seed stock • Monitor and record growth 	Management and staff costs only
Resource Protection	Reduce the threat and impact of fire on reserve resources	A. Maintain existing firebreaks, buffers, and safety zones	<ul style="list-style-type: none"> • Fire break roads: Six roads maintained two times per year • Safety Zones: Kā‘aweiki and Polihale maintained 3 times per year 	<ul style="list-style-type: none"> • \$15,000/yr • \$8,000/yr
		B. Conduct environmental fire hazard monitoring and implement adaptive management based on results	<ul style="list-style-type: none"> • Monitoring at 3 locations, 3 times per year • Open/close public access to areas based on fire hazard. 	Management and staff costs only
		C. Notify public of safety issues and open/close areas to public use in order to reduce risk to public users and staff.	As needed determined by the Hawai‘i fire danger rating system or other catastrophic events.	Management and staff costs only

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
		D. Maintain public awareness with condition notifications, and signs	<ul style="list-style-type: none"> • At trail heads/road entrances (Pu‘u Opae, Papa‘alai, Haele‘ele, Polihale, Kā‘aweiki, Makaha, Kukui Trail, Waimea Valley, Kekaha Game Management Area) and hunter check stations (Kōke‘e, Mānā Tunnels) • Have Smokey Bear conduct school visits 	<ul style="list-style-type: none"> • \$10,000/yr • Management and staff costs only
		E. Maintain fire protection readiness	Conduct annual firefighter refresher training	Management and staff costs only
		A. Work with other agencies and institutions to identify research projects that would address threat management specific to Forest Reserve	<ul style="list-style-type: none"> • UH College of Tropical Agriculture and Human Resources (UH-CTAHR) and State Dept. of Agriculture (HDOA) for biocontrol research • Hawai‘i Agricultural Research Center (HARC) for koa wilt research • Others as appropriate 	Management and staff costs only
Game Animal Management	Provide high quality public hunting opportunities	A. Maintain and improve bird watering units in the Western Ridge Section	Kauhao (2), Papa‘alai (1), Kā‘aweiki (1), and Hā‘ele‘ele (2).	\$10,000/yr
		B. Maintain roadside fuel breaks to improve game habitat	Marine Road, Pu‘u Opae, Papa‘alai	\$30,000/yr
		C. Conduct annual animal surveys	<ul style="list-style-type: none"> • Goat counts • Deer browse transects • Number of animals taken in hunting 	<ul style="list-style-type: none"> • \$20,000/yr • Management and staff costs only
Commercial Activity	Promote the establishment of and provide resources to support a local commercial timber industry	A. Harvest select timber stands	<ul style="list-style-type: none"> • Identify sites and species based on demand • Secure and execute an agreement with a timber contractor via RFP process. • Complete environmental assessment for proposed timber harvest 	<ul style="list-style-type: none"> • Management and staff costs only • \$40,000

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
		B. Plant native timber species above the 2,400-elevation line for commercial use in the Western Ridge section	Only in specific areas should commercial timber harvest occur. Species include: koa, 'ōhi'a, kauila, and other common native species.	\$10,000/yr plus staff and management costs
		C. Plant non-native timber species below the 2,400-elevation line for commercial use	Identify sites and species based on demand and species growth performance	Management and staff costs only
		D. Conduct provenance trials for koa at Polihale and Kā'aweiki	<ul style="list-style-type: none"> • Propagate and outplant seedlings • Collect and analyze data 	\$10,000/yr plus staff and management costs
		E. Support research pertaining to restoration of harvested areas	Work with UH-CTAHR, HARC and USFS to identify timber management research targeted at Forest Reserve needs	Management and staff costs only
	Issue commercial use permits	A. Assess and issue Commercial Harvest Permits as needed.	Most common are salvage sale permits for resources valued up to \$10,000	Management and staff costs only
Additional Public Activity	Provide high quality recreational opportunities	A. Provide access to non-timber resources for non-commercial use.	<ul style="list-style-type: none"> • <i>Passiflora mollissima</i> (banana poka) vines • Eucalyptus firewood * • Ferns • Flowers • Fruits • <i>Psidium</i> spp. (guava) poles * • <i>Alexia oliviformis</i> (maile) • <i>Melicope anisata</i> (mokihana) • <i>Pinus</i> spp. (pine) cones and boughs * • Non-native tree seedlings (i.e., wild olive for bonsai) * Fee may be assessed for permit based on volume collected	Management and staff costs only
	Maintain and develop infrastructure	A. Conduct restroom maintenance	<ul style="list-style-type: none"> • Western Ridge Section: Once per week (Lapa and Pine Forest Drive) • Canyon Section: Once per quarter (Hipalau, Kaluahā'ula, and Wai'alaie Canyon, Waiahulu, Wiliwili) 	<ul style="list-style-type: none"> • Management and staff costs only • \$15,000/yr

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
		B. Conduct campsite and shelter maintenance.	Once quarterly throughout the Forest Reserve.	\$10,000/yr
		C. Conduct fence maintenance	Once quarterly throughout the Forest Reserve.	\$36,000/yr
		D. Conduct Helicopter Landing and Fire Safety Zone Maintenance	<ul style="list-style-type: none"> • Canyon Section: twice yearly at each campsite; • Western Ridge Section: Once quarterly at each of the sites on Kaawiki (3 total) and Polihale (3 total) ridges 	<ul style="list-style-type: none"> • \$12,000/yr • Management and staff costs only
		E. Conduct road maintenance	Two times per year in the Western Ridge Section	Management and staff costs only
		F. Conduct trail maintenance	<ul style="list-style-type: none"> • Implement Hawai'i ESA Community Conservation Initiative trail repair project at Mokihana trail. • Service all trails once per year throughout the Forest Reserve 	<ul style="list-style-type: none"> • \$19,500 • Staff and volunteer time
		G. Create a parking area at the Kukui Trail head.	Coordinate with the Division of State Parks	\$280,000
Invasive Species Management	Reduce degrading impacts of biological agents (native and non-native) on reserve resources	A. Conduct ongoing surveys of entire Forest Reserve for populations of invasive plant species.	<i>Acacia confusa</i> , <i>Acacia mearnsii</i> , <i>Hedychium flavescens</i> , <i>Myrica faya</i> , <i>Panicum maximum</i> , <i>Setaria palmifolia</i> , <i>Sphaeropteris cooperi</i> , <i>Schizachyrium condensatum</i> , <i>Artemisia flavescens</i> , <i>Ligustrum sinense</i> , <i>Rhodomyrtus tomentosa</i> (Isenberg bush), <i>Caesalpinia decapetala</i> , <i>Olea europaeus</i> subsp. <i>cuspidate</i> , and <i>Furcraea foetida</i>	Management and staff costs only

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
		<p>B. Control target populations of invasive plant species in the Western Ridge Section</p>	<ul style="list-style-type: none"> • <i>Acacia confusa</i> (Formosa koa) at Kauhao, Polihale, Kaawaiki, Hā‘ele‘ele, and in the lower elevation ends of the ridges and valleys • <i>Acacia mearnsii</i> (Black wattle) at Haelele, Papaalai, and along the Contour Road. • <i>Hedychium flavescens</i> (Yellow ginger) between Hā‘ele‘ele and Polihale (in the same areas as palm grass). • <i>Myrica faya</i> (Faya tree) on the upper portions of the ridges from Polihale to Makaha Ridge • <i>Panicum maximum</i> (Guinea grass) along the Contour Road and the Ditch Line Road in order to keep the species out of Na Pali Kona Forest Reserve. • <i>Setaria palmifolia</i> (Palm grass) along the Contour Road. • <i>Sphaeropteris cooperi</i> (Australian tree fern) along the Contour Road. • <i>Olea europaeus</i> subsp. <i>cuspidata</i> (olive) at Papa‘alai and Hā‘ele‘ele • <i>Hedychium gardnerianum</i> (Kahili ginger) at upper Kā‘aweiki and Kauhao • <i>Erigeron karvinskianus</i> (Daisy fleabane) at ridge ends • <i>Leptospermum scoparium</i> (New Zealand tea tree) above the Contour Road, between Kauhao and Kā‘aweiki ridges 	\$20,000/yr
		<p>C. Control target populations of invasive plant species in the Canyon Section</p>	<ul style="list-style-type: none"> • <i>Furcraea foetida</i> (Mauritius hemp) • <i>Triumfetta semitriloba</i> (Sacramento burr) 	\$5,000/yr
		<p>D. Monitor invasive plant control areas.</p>	4 times at each location per year	Management and staff costs only

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
		E. Eradicate feral cattle population in Western Ridge Section	<p>Complete environmental assessment for proposed fence project along southern boundary between Forest Reserve and DHHL parcel</p> <p>Secure and execute an agreement with a fence building contractor through RFP process</p> <p>Purchase fence building materials and implement fence construction</p> <ul style="list-style-type: none"> • Conduct special public (with board approval) and staff hunts to eradicate cattle in WRS • Conduct fence monitoring and maintenance 4 times a year • Conduct post eradication cattle monitoring and control 2 times per year. 	<p>\$8,000</p> <p>Management and staff costs only</p> <p>Up to \$100,000 depending on RFP</p> <p>Management and staff costs only</p>
Threatened, Endangered and Rare Species Management	Protect occurrences of listed and rare plants	<p>A. Protect rare plant species by building new fences and maintaining existing fences for existing populations in the Western Ridge section</p> <p>B. Protect rare plant species by building new fences for existing populations in the Canyon section</p>	<p>New fences:</p> <ul style="list-style-type: none"> • Hā'ele'ele Ridge: <i>Wilkesia hobdii</i> (Iliau) • Hā'ele'ele Valley: <i>Lipochaeta faurii</i> (Nehe), <i>Alectrion maccococcus</i> (Mahoe), and <i>Ptelyxia kauaiense</i> (Kaulu), <i>Remya kauaiensis</i> (xx?), <i>Poa siphinoglossa</i>, <p>Existing fences:</p> <ul style="list-style-type: none"> • Papalae Valley: <i>Isodendrian laurifolium</i> (Aupaka) • Kahelu Valley: <i>Bonamia menziesii</i>, <i>Maratia douglassi</i> <ul style="list-style-type: none"> • Poamau: <i>Pteralyxia kauaiensis</i> (Kaulu) • Waimea Canyon Rim 4 mile marker: <i>Lipochaeta waimeaensis</i> plus the other species in critical habitat 	<ul style="list-style-type: none"> • \$10,000 • \$15,000 <p>Management and staff costs only</p> <ul style="list-style-type: none"> • \$20,000 • \$10,000

Management Priority	General Management Action	Tactical Goals	Action Items	Estimated Cost
		C. Collect, store, and propagate genetic material (seeds, cuttings, and air layers) of rare plant species	<i>Wilkesia hobdii</i> , <i>Lipochaeta faurii</i> , <i>Alectrion macrococcus</i> , <i>Pteralyxia kauaiensis</i> , <i>Remya kauaiensis</i> , <i>Poa siphinoglossa</i> , <i>Isodendrion laurifolium</i> , <i>Bonamia menziesii</i> , <i>Maratia douglassi</i> , <i>Lipochaeta waimeaensis</i>	\$10,000/yr
		D. Out plant rare plant progeny in protected areas within their historic ranges outside Pu'u ka Pele Forest Reserve or in protected areas within Pu'u ka Pele FR.	Same species and locations as above	\$30,000
	Protect listed and rare animals	A. Work with Hawai'i Bat Research Cooperative biologists to conserve Hawaiian Hoary Bats	<ul style="list-style-type: none"> Assist in identifying monitoring sites Assist in data collection as needed 	Management and staff costs only
		B. Work with the Navy to improve nene habitat at Makaha Ridge	Control goat population to improve nest sites	Management and staff costs only
Native Ecosystem Management	Protect and expand the extent of native dominated ecosystems	A. Plant native vegetation above the 2,400-elevation line for habitat restoration in the Western Ridge Section.	Plantings would consist of common native understory species in potential commercial koa harvest areas	<ul style="list-style-type: none"> \$10,000/acre for initial planting \$10,000/yr for maintenance – higher cost if timber harvesting occurs
		B. Restore dryland native forest for the benefit of <i>Erythrina sandwicensis</i> (wiliwili) trees in gulch bottoms at lower elevations in the Western Ridge Section.	<ul style="list-style-type: none"> Locations include: Hā'ele'ele, Polihale, Kauhao valleys, and Waimea Canyon. Fencing and possible outplanting of <i>Erythrina sandwicensis</i> trees Work with HDOA to support biological control efforts to combat the <i>Erythrina</i> gall wasp 	<ul style="list-style-type: none"> \$10,000/acre Management and staff costs only

D. Overall Measures of Success

Measures of success for individual forest reserve management plans can be derived from the State of Hawai‘i’s annual variance reports. Initial measures of success that may be applicable to the Pu‘u ka Pele Forest Reserve include:

- Miles of trail maintenance
- Miles of unpaved access road maintenance
- Number of volunteer service projects
- Acres of public hunting grounds managed
- Number of game birds harvested
- Number of game mammals harvested
- Number of hunter trips taken
- Number of licensed hunters
- Number of animal feed and water units maintained
- Number of commercial trail tours
- Number of commercial trail tour patrons
- Number of commercial trail operator permits issued
- Number of camping permits issued
- Number of other permits issued (timber, personal gathering, scientific collection, etc.)
- Acres of noxious plants controlled
- Acres of erosion controlled
- Acres of fire protection area
- Miles of fence constructed
- Miles of fence maintained
- Acres of enclosure developed
- Acres of enclosure maintained
- Number of rare, threatened, or endangered plant/animal species protected
- Number of special use permits issued
- Number of appurtenant features maintained

IV. FUTURE RECOMMENDATIONS

A. Desired Outcome for Pu‘u ka Pele Forest Reserve:

Pu‘u ka Pele Forest Reserve is a multiple resource management area unlike any other on the island of Kaua‘i; important mandates include native ecosystems, hunting, and timber management. Preservation of native plants and ecosystems involves plans to protect important areas from game animals through fencing and controlling game animal populations through hunting. Hunting is and should remain an important component of the area, providing a variety of high quality hunting opportunities for the residents of Kaua‘i. Prospective commercial timber stands, both native and exotic, already exist in Pu‘u ka Pele Forest Reserve; these stands hold the potential to provide revenue for DOFAW and materials for businesses in Hawai‘i, such as carpenters, woodworkers, and bioenergy companies.

B. Future Recommendations:

Pu‘u ka Pele Forest Reserve should be maintained as a multiple mandate area with emphasis on hunting and development of a timber industry. Future proposals include constructing more fences around rare plants and managing goat populations in an effort to increase protection of the pockets of native ecosystem that remain in the Forest Reserve. Hunting should be promoted and sustainably managed; Pu‘u ka Pele Forest Reserve provides the best opportunities for bird and deer hunting on the island. Commercial harvest of existing timber stands should be pursued by seeking parties interested in taking advantage of this valuable resource. If successful, replanting of timber stands with high value hardwoods, both native and exotic, could provide the island with a sustainable industry. Future review and updates to this management plan will occur every five to ten years to keep management goals current. Pu‘u ka Pele Forest Reserve is an area that is heavily used by both by residents of Kaua‘i and by visitors; consideration of the many reasons to enjoy the area should be maintained into the future.