
Management Plan for the Ahupua‘a of Pu‘u Wa‘awa‘a and the Makai Lands of Pu‘u Anahulu

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State of Hawaii
Department of Land and Natural Resources
Division of Forestry and Wildlife
Division of State Parks

Acknowledgements

In June 2002, the Pu‘u Wa‘awa‘a Advisory Council (PAC) was formed to function in a consultative capacity with Department of Land and Natural Resources (DLNR) staff involved in planning efforts for Pu‘u Wa‘awa‘a. The PAC is comprised of the following community members, who represent a wide range of expertise and interests in the various components and actions proposed in this plan:

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Through a series of meetings, the PAC has reviewed several drafts of the plan and provided considerable feedback and input to DLNR staff. Many of the PAC’s suggestions have been incorporated or are now represented in this plan. The dedication, candor, and cooperation displayed by the PAC is graciously acknowledged by the DLNR.

Components of this Plan relating to trails, access, ecotourism, cultural considerations, archeological resources and environmental education include modified text originally presented in a proposal by Ka ‘Ahahui o Pu‘u Wa‘awa‘a, or the “Hui”. The DLNR Management Team wishes to acknowledge and thank the Hui for permission to use these materials.

Editorial Note

The management objectives proposed in this management plan are not presented in a prioritized or sequential format. They are grouped by category.

Executive Summary

On January 25, 2002 the Board of Land and Natural Resources transferred responsibility for State managed lands within the ahupua‘a of Pu‘u Wa‘awa‘a and Pu‘u Anahulu from the Land Division to the Divisions of Forestry and Wildlife (DOFAW) and State Parks. Subsequently, DOFAW and State Parks have worked both internally and with the Pu‘u Wa‘awa‘a Advisory Council to develop this management plan for Pu‘u Wa‘awa‘a and the lands of Pu‘u Anahulu makai of Queen Ka‘ahumanu Highway – an area comprising approximately 40,711 acres.

These lands represent a remarkable diversity of historical, natural, cultural and recreational resources: archaeological and cultural sites, a rich history of ancient and contemporary human use, historic coastal trails, an undeveloped coastline environment (approximately 8.5 miles long), good swimming beaches, anchialine ponds, uncommon ecosystems that are highly unique in their species composition, livestock grazing and hunting to name but few of many. The Division of State Parks has always considered the coastal area of these ahupua‘a as a potential State Park, and in past years has undertaken a number of background research studies. In recognition of the decline in suitable habitat for many rare and endangered species, DOFAW initiatives lead to the establishment and official designation of the Pu‘u Wa‘awa‘a Forest Bird Sanctuary. Despite such planning and effort, a tremendous amount of additional research and field management initiatives are required to effectively conserve and manage the unique resources of these ahupua‘a.

Traditional Hawaiian land planning and management was historically conducted at the ahupua‘a scale throughout the islands. The current interest in modifying land use and resource management priorities within Pu‘u Wa‘awa‘a and the makai lands of Pu‘u Anahulu has created a unique and exciting opportunity to emulate the traditional concept of ahupua‘a management in a contemporary context. In this spirit resource management recommendations were developed to promote sustainable resource management and community access to natural resources within the project area.

This plan presents 62 unique objectives that are intended to support the complex array of resource management needs and community interests that apply to Pu‘u Wa‘awa‘a and the makai lands of Pu‘u Anahulu. These objectives are intended to provide a framework for management of this area for a 10-year period beginning in July 2003. The projected budget for this 10-year period is \$26,924,433, of which \$1,806,906 or 6.7% percent can be funded or supported within the current management capacities and operating budgets of the Department of Land and Natural Resources, its cooperators and granting agencies. There is clearly a need to actively seek additional resources through such means as grants, cooperative agreements and partnerships in order to realize the full potential of this plan.

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I. Introduction

Guiding Principles

The following principles represent the spirit and intent of the Department of Land and Natural Resources' (DLNR) and the Pu'u Wa'awa'a Advisory Council's proposals for management of Pu'u Wa'awa'a and Pu'u Anahulu:

- The rich and diverse natural, cultural, and recreational resources of the ahupua'a of Pu'u Wa'awa'a and the makai lands of Pu'u Anahulu shall be protected and enhanced for the enjoyment of current and future generations.
- Principal management efforts will be made in the areas of native ecosystem restoration including endangered species protection and recovery, preservation of cultural and archeological resources, fire prevention and control, reforestation, hunting, recreation, research, livestock grazing, environmental education, trails, public access and eco-tourism.
- The design and implementation of this management plan will emulate the concept and approach of ahupua'a management, which was developed and practiced by ancient Hawaiians. The following Hawaiian phrase will be the foundation of these efforts: *"E malama i ka 'aina, a malama ka aina ia 'oe"* ("Care for the land and the land will care for you")
- Revenue generated from any activity within the ahupua'a should be used to directly support continuing management efforts and programs in the ahupua'a.

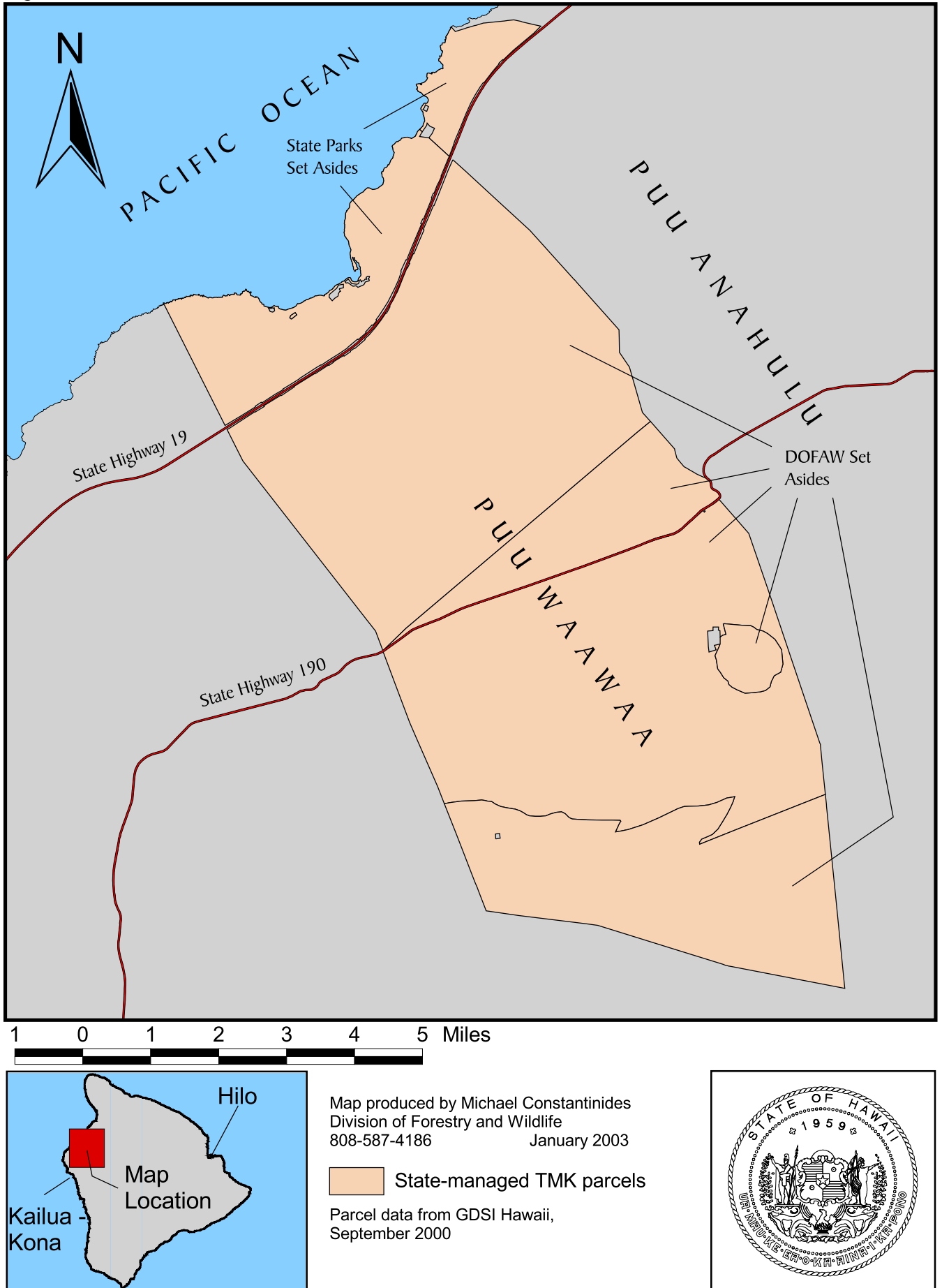
The design and implementation of the collective management objectives proposed in this Plan reflect a balance between these principles.

General Information

The land divisions or ahupua'a of Pu'u Wa'awa'a and Pu'u Anahulu are located on the western or leeward side of the Island of Hawai'i in North Kona District. Pu'u Wa'awa'a lies on the northern flank of Hualalai volcano, extending from sea level to within a mile of the mountain summit. The area is roughly bounded by the 1859 and Ka'upulehu lava flows. Pu'u Anahulu is adjacent to the north boundary of Pu'u Wa'awa'a. State managed lands makai of Queen Ka'ahumanu Highway include tax map parcel 7-1-2-8 and 7-1-2-2 (approximately 3,517 and 3 acres, respectively) in Pu'u Wa'awa'a, and tax map parcel 7-1-3-2 (approximately 825 acres) in Pu'u Anahulu. State managed lands mauka of Queen Ka'ahumanu Highway in Pu'u Wa'awa'a include tax map parcels 7-1-1-1, 7-1-1-4, 7-1-1-6, 7-1-2-1, and 7-1-2-13 totaling approximately 36,366 acres (Figure 1). Approximately 54 acres within Pu'u Wa'awa'a are privately owned, while approximately 271 acres are state highway right-of-ways. In the lands of Pu'u Anahulu makai of Queen Ka'ahumanu Highway, approximately 67 acres are privately owned.

Pu'u Wa'awa'a and Pu'u Anahulu are within Kekaha, which is the region of North Kona from Honokohau through Pu'u Anahulu. Kekaha means "a dry and barren place," a good description of the land below the hills or Napu'u as they were originally called. Pu'u Wa'awa'a ("furrowed hill" in the Hawaiian language) takes its name from a large volcanic cinder cone that is a

Figure 1. Board of Land and Natural Resources Set Asides to State Parks and DOFAW.



prominent landmark in the area. The entire region was forested at one time, but wildfires and more than 100 years of livestock grazing have removed much of the native vegetation.

During the Great Mahele (1848), the ahupuaʻa of Puʻu Waʻawaʻa was chosen by Kauikeaouli King Kamehameha III for his own personal use. These lands were retained by the King and called "Crown lands". The King gave other lands to supporting Aliʻi and Konohiki, which came to be called "Konohiki lands." A third class of lands were given to the Government or Kingdom inventory, and were called "Government lands." These lands were set aside to support government activities, and to provide additional lands for tenancy and lease-hold interests.

From the three classes of lands, native tenants were allowed to file claims for kuleana (approximately 1848-1855); then for grant lands (by Royal Patent); and by the 1880s, lands for homesteading purposes. When the monarchy was overthrown in 1893, both Crown and Government lands were ceded to the United States and later the State of Hawaiʻi. These two land inventories make up the land base of the State at the present time

Land Use Practices

An Anonymous Government document (1903) described the lands of Puʻu Waʻawaʻa: "This is one of the most northern of the Kona lands, running from the sea to within a mile of the summit of Mount Hualalai, a distance of 15 miles. It has about 6 miles of seacoast, the last landing being at Kiholo, where a few hamlets are. The government road from Kailua to Kawaihae passes through the village at Kiholo. There are very few inhabitants on the land. The only real good land for cultivation is near the Puʻu Waʻawaʻa Cone, distant 8 miles from the coast. Here fruits, particularly peaches, grow luxuriantly; also potatoes and taro. The makai portion of the land, say about one-third, is extremely rocky and would offer but scant pasturage to any herd. Above this, in the wood, is found some of the best grazing land in that part of the country. The forest in places is very heavy, the principal wood being koa and ʻohiʻa. Dependent on rain for water supply, which is generally sufficient for all purposes (Area about 40,000 acres)."

In 1865, Francis Spencer obtained a lease of the entire ahupuaʻa of Puʻu Anahulu "excepting the land rights of the native tenants thereon..." (Bureau of Conveyances Liber 19:333). Spencer was a founder of the Waimea Grazing and Agricultural Company, based out of Waimea. By the time he acquired the Puʻu Anahulu lease, he also had bases of operation at Humuʻula in Hilo, and Keʻamoku in Waikoloa. The two primary herds of the company were cattle and sheep. Spencer maintained his lease on Puʻu Anahulu through 1895. It is likely that Spencer's grazing activities overflowed onto lands of Puʻu Waʻawaʻa, and in 1891, he had made application for a lease on land near the actual hill of Puʻu Waʻawaʻa. It appears that no formal agreement between Spencer and the Commissioners of Crown lands for Puʻu Waʻawaʻa was ever made.

Prior to 1873, a native rancher by the name of Kaukuna had received a lease on the Crown Land of Puʻu Waʻawaʻa, primarily for taking goats. The lease was transferred to J.W. Punihaole in 1874. By the late 1880's, the aging Punihaole gave up his residence and lease at Kiholo, and moved to Kohanaiki. It was not until March 1, 1893, that a long-term lease for Puʻu Waʻawaʻa was entered into between the Commissioners of Crown Lands, Robert Hind, Jr., and Eben Low, at terms of 25 years.

On June 1, 1898, Hind and Low acquired Spencer's interest in Pu'u Anahulu, and the lease-hold Government Lands were added to the inventory of the Pu'u Wa'awa'a Ranch holdings. Sheep were raised on the ranch in the early days. About 1922, a weed called Spanish needle (*Bidens pilosa*) became established. Seeds from this plant tangled the sheep's wool, making it impossible to card the fabric. As a result, the sheep operation was abandoned. Dairy heifers were raised at Pu'u Wa'awa'a for use in the Hind family dairy on Oahu. Turkeys were also raised with as many as 700 being shipped to Honolulu during some years (J. Greenwell, personal communication).

Since 1917, the Territory or State of Hawai'i has issued six different leases at Pu'u Wa'awa'a for pasture purposes. Until recently, Pu'u Wa'awa'a Ranch encompassed 105,831 acres of land. All of this except 35 acres (rain shed, 2.75 acres and headquarters area, 32.54 acres) was State managed land. The current lease (General Lease No. S-3589) was let to Dillingham Ranch Inc. for a 40-year period on August 15, 1960. On September 15, 1972 the lease was assigned to Mr. F. Newell Bohnett. Pu'u Wa'awa'a Ranch was greatly reduced in size in 1984 when the State Board of Land and Natural Resources (BLNR) withdrew 84,397 acres from the lease as a result of illegal koa (*Acacia koa*) harvesting activities.

The balance of 21,434 acres remained under pasture lease to Mr. Bohnett until August 14, 2000 when all encumbered lands reverted back to the State. On January 25, 2002, the public lands of Pu'u Wa'awa'a were transferred from the Land Division to DOFAW and the Division of State Parks for resource management purposes including restoration of native plant/animal ecosystems, preservation of cultural resources, reforestation, hunting, public recreation, research, pasture management, nature education, and eco-tourism activities.

Ahupua'a Concept of Land Management

Early native residents of Napu'u and their descendants share a deep cultural attachment with their environment. Their customs, beliefs, practices, and history are place based. This attachment to place is rooted in the native belief that all things within the environment are interrelated. Whether in the uplands, the near shore lowlands, or in the sea, everything was connected. The ahupua'a as the primary native land unit was the thread which bound all things together in Hawaiian life (Maly, 2001). This plan is intended to provide the basis and guidelines for managing Pu'u Wa'awa'a and the makai lands of Pu'u Anahulu in a manner that emulates the concept of ahupua'a management. The following excerpt (Maly, 1999) describes the ahupua'a land division or unit, and provides a purpose and rationale for the use of ahupua'a developed by ancient Hawaiians:

Ahupua'a - A Sustainable Hawaiian Resources Management Unit

The large districts (moku-o-loko) and sub-regions ('okana and kalana) were further divided into manageable units of land, and were tended to by the maka'ainana (people of the land) (Malo, 1951). Of all the land divisions, perhaps the most significant management unit was the ahupua'a. Ahupua'a are subdivisions of land that were usually marked by an altar with an image or representation of a pig placed upon it (thus the name ahu-pua'a or pig altar). Ahupua'a may be compared to pie-shaped wedges of land

that extended from the ocean fisheries fronting the land unit to the mountains or some other feature of geological significances (e.g., a valley or crater). The boundaries of the ahupua‘a were generally defined by the topography and cycles and patterns of natural resources occurring within the lands (Lyons, 1875).

The ahupua‘a were also divided into smaller manageable parcels of land (such as the ‘ili, ko‘ele, mala, and kihapai, etc.) in which cultivated resources could be grown and natural resources harvested. As long as sufficient tribute was offered and kapu (restrictions) were observed, the common people, who lived in a given ahupua‘a had access to most of the resources from mountain slopes to the ocean. These access rights were almost uniformly tied to residency on a particular land, and earned as a result of taking responsibility for stewardship of the natural environment, and supplying the needs of ones’ ali‘i (Malo, 1951; Kamakau, 1961; Boundary Commission testimonies, 1873-1886).

Entire ahupua‘a, or portions of the land were generally under the jurisdiction of appointed konohiki or lesser chief-landlords, who answered to an ali‘i-‘ai-ahupua‘a (chief who controlled the ahupua‘a resources). The ali‘i-‘ai-ahupua‘a in turn answered to an ali‘i ‘ai moku (chief who claimed the abundance of the entire district). Thus, ahupua‘a resources supported not only the maka‘ainana and ‘ohana who lived on the land, but also contributed to the support of the royal community of regional and/or island kingdoms. This form of district subdividing was integral to Hawaiian life and was the product of strictly adhered to resources management planning. In this system, the land provided the fruits and vegetables for the diet, and the ocean provided most of the protein, and in communities with long-term royal residents, divisions of labor came to be strictly adhered to. It is in this setting that we find Napu‘u and the present study area.

Cooperative Approach

A wide range of resource management issues and priorities for Pu‘u Wa‘awa‘a are outlined in this plan through a series of stated objectives and budget estimates for their implementation. Because limited public funding is available to conduct proactive management in these ahupua‘a, DLNR must pursue alternative means for increasing and collecting project funds. The development of partnerships, cooperative agreements and grant proposals will constitute the primary means for obtaining such assistance. DLNR will simultaneously seek independent proposals to meet this great need.

Of particular interest to the implementation of this plan will be the involvement of the Hui ‘Ohana mai Pu‘u Anahulu a me Pu‘u Wa‘awa‘a (Hui ‘Ohana) and other native descendants from the neighboring ahupua‘a. The Hui ‘Ohana is a community-based organization comprised of Hawaiian families, descendants of the native tenants and historic homesteaders who are recorded as having lived in the Pu‘u Anahulu-Pu‘u Wa‘awa‘a (Napu‘u) region prior to the 1840’s. Ancestors of the Hui ‘Ohana are an integral part of the history of the Napu‘u. Their bones are part of the land, and the work of their hands is part of the cultural landscape that makes Napu‘u a unique Hawaiian place. They work under the Hawaiian cultural premise that natural and cultural resources are one in the same (Maly, 2001).

II. Administrative Priorities

A. Context:

State Parks has an established protocol to evaluate areas proposed as new parks, and proceed with their development. Central components are the creation of a master plan and environmental impact statement. Due to potential intensity of use and related impacts, the proposed establishment of a new park in the coastal area of these ahupua‘a must adhere to this process.

Though the BLNR set aside state-managed lands of Pu‘u Wa‘awa‘a and Pu‘u Anahulu to The Division of Forestry and Wildlife (DOFAW) and State Parks, the lands remain in an unencumbered status. Administrative rules for unencumbered lands are sufficient for short-term oversight of these lands from management and enforcement standpoints. However, the unique combination of land zoning and planned management activities for these (and other) State-managed lands suggests that development of a new set of rules would be most appropriate.

Various types of administrative plans and actions are required to lay the foundations for effectively supporting this management plan.

B. Annual Operations:

Not applicable.

C. Management Objectives:

Objective 1. Initiate legislation for establishment of a special fund

Background: Due to long-term State budget reductions, funds to support even basic natural resource management activities (e.g. fire protection) are difficult to obtain. There are many opportunities to develop sustainable income generating activities on public lands within the ahupua‘a of Pu‘u Wa‘awa‘a and Pu‘u Anahulu. Under current law such income would be channeled into the State’s General Fund. If a special fund for the project area were established, such funds could alternatively be used to support the management objectives detailed in this plan.

Proposed Actions: Establish a State special fund for income generated from activities within Pu‘u Wa‘awa‘a and the makai lands of Pu‘u Anahulu.

Objective 2: Develop a Master Plan for the proposed Kiholo State Park

Background: The existing range of noteworthy natural, cultural and recreational resources provide compelling factors for park establishment. These resources include burial caves and historic home sites, extensive coastal wildland environment, good swimming beaches at Kiholo Bay and Keawaiki Bay, the Akahu Kaimu anchialine pools,

Luahinewai Pond, the historic coastal trail and its archaeological features. If established, Kiholo State Park would comprise all public lands makai of the Queen Ka‘ahumanu Highway within the ahupua‘a of Pu‘u Anahulu and Pu‘u Wa‘awa‘a (Figure 1). In addition, a wild coastline park at Kiholo would insure retention of the natural open space and the open coastal views from upland vantage points. This area includes approximately 8.5 miles of undeveloped coastline, 4,357 acres of State-managed coastal lava plain, and 88 acres of private in-holdings.

State park planning is a community-based planning process. It is anticipated that the Pu‘u Wa‘awa‘a Advisory Council or a similar task force will be convened to represent the community for the purpose of developing the park master plan. Community-wide public information meetings will be used to present the task force findings and recommendations, and later the actual draft master plan. Other research needs may be identified as work progresses on development of a park master plan.

Proposed Actions: Fund State Park master plan development including an environmental impact statement, a cultural impact assessment, and facility design.

Objective 3. Develop new DLNR administrative rules for land areas not covered under present DLNR rules

Background: DLNR is currently developing new administrative rules for lands that the Department manages, but are not effectively treated under existing designations (i.e. Forest Reserve, Natural Area Reserve, State Park, etc.). Until the time when the new designation is available, the lands of Pu‘u Wa‘awa‘a and the makai section of Pu‘u Anahulu will be retained in an unencumbered status to allow adequate flexibility for implementing and meeting the management objectives outlined in this Plan. Information detailing regulations for public activities on unencumbered public lands can be found in the Hawai‘i Administrative Rules, Title 13 Sub-title 10, Land Management, Chapter 221, Unencumbered Public Lands.

Proposed Actions: Draft new DLNR administrative rules. Solicit reviews and feedback from other public agencies, the Attorney General’s office, and the public. Seek approval from the BLNR and subsequently the Governor.

Objective 4. Fund and hire a Management Plan Coordinator

Background: Both DLNR staff and the Pu‘u Wa‘awa‘a Advisory Council concur that the broad conceptual intent of this plan coupled with the complex range of proposed objectives implies that a dedicated full-time coordinator is required. As implementation of the Plan is proposed through a cooperative approach, a central logistical requirement will be a mechanism to manage non-State funding inputs.

Proposed Actions: Fund and hire a Management Plan Coordinator. An initial priority of this person will be to identify or establish a mechanism for managing funding inputs, such as a non-profit organization with 501(c)(3) status.

III. Fire Management

A. Context:

Section 185-1, H.R.S. places the responsibility for fire protection within Forest Reserves, Public Hunting Areas, Wildlife and Plant Sanctuaries and Natural Area Reserves on the Department of Land and Natural Resources (DLNR). It further provides that DLNR shall cooperate with established fire control agencies of the County and Federal Government in developing plans, programs and mutual aid agreements for assistance for prevention, control and extinguishment of fires on forest, pasture, and brush lands not within the above mentioned areas. Section 185-3, H.R.S. effectively delegates that responsibility to DOFAW. On the island of Hawaii, DOFAW currently has mutual aid agreements with the Hawai'i County Fire Department (HCFD), National Park Service and the United States Army Support Command, Hawaii. Based upon these guidelines, DOFAW has principal fire control responsibility for lands of Pu'u Wa'awa'a mauka of Queen Ka'ahumanu Highway, and is a cooperative responder for lands of Pu'u Wa'awa'a and Pu'u Anahulu makai of the Highway.

The Pu'u Wa'awa'a area has been significantly modified by human activity. Subsequent invasion by non-native plant species has brought about some of the most notable changes. The profusion of fountain grass (*Pennisetum setaceum*) and Kikuyu grass (*Pennisetum clandestinum*) has caused a major increase in the area's readily ignitable fuel load, making wildland fires the primary threat to the remnant native dryland forests in Pu'u Wa'awa'a. Roadside ignition is responsible for approximately 90% of all wildfires started at Pu'u Wa'awa'a. Such ignitions will continue if invasive vegetation is not controlled.

The fire management approach detailed below incorporates concepts such as weather monitoring, fire potential modeling, fire suppression and pre-suppression strategies, and education. Fire management planning is also integrated directly into other principal programs of this plan, particularly livestock grazing management.

B. Annual Operations:

Current annual operations include the maintenance of fire fighting equipment stationed at the Hilo and Kamuela base yards. The quantity and type of equipment at each location is adjusted as necessary, depending upon the wildfire potential in nearby areas. The Kamuela base yard is approximately 22 miles (a 30 minute drive) from Pu'u Wa'awa'a. During extreme fire danger periods, fire equipment is pre-positioned at Pu'u Wa'awa'a Ranch. DOFAW has a forester on call during weekends and holidays for fire emergencies. HCFD notifies the person on call of all fires within DOFAW's areas, and all fires for which cooperator assistance is needed.

Twelve miles of firebreaks have been constructed on both sides of Highway 190. The firebreaks facilitate control and extinguishment of fires starting along the roadside, with the intent of preventing fires from spreading into adjacent dryland forests. Currently 8.8 miles are being maintained clear of vegetation by DOFAW. Buildup of dangerous fuels such as fountain grass is manually controlled along the breaks by mechanical and chemical means as required. The

DOFAW West Hawai'i Wildlife staff maintains the remaining 2.3 miles along the highway by mowing. Additionally, they are mowing 12.2 miles of interior roads makai of Highway 190.

C. Management Objectives:

Objective 5. Increase public fire hazard awareness through educational programs

Background: The public is generally not aware of the immense fire hazard and related threats to public safety and remaining dryland forests in Pu'u Wa'awa'a. Some fire hazard signs have been posted on highways and hunter access roads in Pu'u Wa'awa'a. The National Fire Danger Rating System (NFDRS) uses fire weather data to estimate fire danger potential on a daily basis.

Proposed Actions: DOFAW will supply educational material to children in grade school classes that tour the DOFAW arboretum and facilities. Fire prevention literature will be made available to the public at the Hilo and Waimea DOFAW offices. Fire prevention public service announcements will be periodically aired through the cooperation of newspapers, television and radio stations. DOFAW will continue to work with the Hawai'i Fire Department and other organizations to promote fire prevention education. Manually operated Smokey Bear fire danger warning signs will be posted on Highway 190 to indicate current fire danger levels based on NFDRS criteria.

Objective 6. Reduce fire hazard at Pu'u Wa'awa'a using prevention measures

Background: Without prevention and pre-suppression measures such as reducing fuel loads, creating firebreaks, and maintaining an appropriate equipment inventory, fires can rapidly spread through Pu'u Wa'awa'a and consume thousands of acres. Though pre-suppression efforts appear costly, they greatly lessen the cost of fire fighting by reducing rates of fire spread and fuel loading. In 1995 a wildfire burned 1,300 acres within Pu'u Wa'awa'a, incurred \$369,000 in suppression costs to DOFAW, and caused an estimated \$1,755,000 of damages to natural resources. In 1999 another wildfire burned 5,000 acres within Pu'u Wa'awa'a, incurred \$109,000 in suppression costs to DOFAW, and caused an estimated \$20,500,000 of damages to natural resources. Fire-fighter safety is also enhanced by prevention measures.

Proposed Actions: Widen firebreaks along Highway 190 to 40 feet and expand the water system along the highway to improve access by fire vehicles and allow fuel load reduction through livestock grazing. Maintain firebreaks and reduce fuel loads immediately outside of and within newly established conservation unit perimeters through grazing, manual, mechanical and chemical means to keep fire potential low. Coordinate with the livestock permittee to maintain grazing corridor along makai boundary of the PWWFBS. Livestock may be returned to conservation units for pulse or short-term grazing to reduce fuel loads. Fabricate and post signage facilitating access to firebreak roads in Pu'u Wa'awa'a. Install parking areas along public access routes in Pu'u Wa'awa'a that are free of fuels to reduce ignition of dry herbaceous vegetation from vehicle catalytic converters. Pursue research for a biological control of fountain grass.

The Branch Protection Forester will monitor fire weather data and may advise the DOFAW Branch Manager to restrict access to selected areas during periods of high fire danger.

Objective 7. Provide fire pre-suppression management for conservation units

Background: Fire represents a major threat to native forests protected within conservation units and the PWWFBS. In 1995 a major fire event burned approximately 1,300 acres, including 1000 acres within the east end of the PWWFBS. Rapid fire response capability is required to minimize resource loss potential in the area.

Proposed actions: New DOFAW employees will be given basic wildland fire training to provide them with the necessary fire fighting skills to combat wildland fires safely and efficiently. Training classes will be conducted annually to provide refresher courses and advanced training for current DOFAW employees. A new mechanic will be hired to assist in the maintenance of an aging fire fighting apparatus fleet. DOFAW will develop a fire control map for the Pu'u Wa'awa'a area similar to those for Pu'u Anahulu and Mauna Kea. Continued mapping of the cultural and rare botanical resources of the area will facilitate prioritization of specific locations for fire protection. Such data will reduce the potential for damage or destruction of these resources due to fire suppression activities.

Objective 8. Effectively suppress fire in the event that a wildland fire does occur at Pu'u Wa'awa'a

Background: DOFAW is not a full time firefighting organization with immediate, initial response capability. Cooperation and communication between agencies, landowners and lessees is critical for successful and efficient fire suppression in the event of a fire incident at Pu'u Wa'awa'a. The Hawai'i County Fire Department (HCFD) provides initial response to all fires on the island of Hawaii. For Pu'u Wa'awa'a, DOFAW authorizes HCFD to hire bulldozers and other equipment services as determined necessary by their assessment of the situation, and accepts liability for payment. DOFAW is currently the primary responder to fires mauka of the Queen Ka'ahumanu Highway in Pu'u Wa'awa'a, and a cooperative responder to fires in the proposed Kiholo State Park.

Proposed Actions: For fires mauka of Queen Ka'ahumanu Highway in Pu'u Wa'awa'a, HCFD will assume initial command of incidents and take appropriate suppression actions until DOFAW personnel arrive at the scene. Other DOFAW Branches and cooperating agencies will be called to assist in the event of a large fire incident. The Pu'u Wa'awa'a livestock permittee and neighboring landowners may also be called to assist.

IV. Natural Resource Management

A. Context:

Pu'u Wa'awa'a's native forest communities have been greatly altered during the past 100 years. Grazing by domestic and feral ungulates has severely impacted native vegetation. An early observer noted that cattle were rapidly changing the forest at Pu'u Wa'awa'a in 1900: "The upper part of the ranch comprises some 12,000 acres of fertile Government land, covered with valuable forest trees, among them the famous koa. It is here where we have seen the sandalwood tree over eighteen inches in diameter. Five years since the present leaseholder had to hew a trail to see the condition of the land; today we find a handsome open park land, so to speak, where one can ride anywhere on horseback. I venture to say that at the expiration of the lease, twenty years hence, we will find an open pasture land, very much in want of moisture" (Koebele, 1900).

Forest destruction proceeded much as Koebele predicted, but at a slightly slower pace. Dry and mesic forests in the area of Pu'u Wa'awa'a were once considered the most diverse forests in all the Hawaiian Islands (Rock, 1913). Their steady degradation due to threats such as land development, fire, ungulate grazing and invasion by non-native flora is contributing to biodiversity loss in both the State of Hawai'i and worldwide. Cabin et al. (2000) estimated that 90% of dryland forests in the Hawaiian Islands have been eliminated due to human presence, and that the remaining 10% are heavily degraded by non-native weeds and ungulate grazing. Pu'u Wa'awa'a represents one of the best places to restore and protect many species that are found only here or in other dry and dry-mesic forest areas of Hawaii.

A unique assemblage of natural communities and species are still found within the ahupua'a of Pu'u Wa'awa'a. Several of these communities and species are rare or restricted in distribution. In addition, a large number of sensitive native species are associated with Pu'u Wa'awa'a's plant communities. The most severe threats within Pu'u Wa'awa'a are currently fire, the non-native weed fountain grass and ungulate grazing. These threats cumulatively exert tremendous pressure on native flora and fauna, many of which are extremely sensitive to changes in their environment. Such pressure may result in the local extinction of rare species. In order to achieve success in native flora and fauna preservation and restoration efforts at Pu'u Wa'awa'a, a delicate balance in the reduction of multiple threats must be attained through intensive management. An additional challenge is the need to manage ecosystems with a focus on biological diversity rather than on single species or populations. The latter approach promotes balanced ecosystems and functioning natural ecological processes over the long term.

Pu'u Wa'awa'a Ranch originally leased 105,796 acres of State land at Pu'u Anahulu and Pu'u Wa'awa'a for pasture purposes on August 15, 1960. On October 12, 1984, the State BLNR withdrew 84,397 acres from the lease in response to certain lease violations. Included in this action was a set aside of 3,806 acres of forested land specifically for the protection of native forest birds and their habitat. This parcel was identified as the Pu'u Wa'awa'a Forest Bird Sanctuary (PWWFBS). On July 22, 2002, Governor Benjamin J. Cayetano issued Executive Order No. 3937 formally setting aside the PWWFBS. This official designation makes the Sanctuary different from all other land areas of Pu'u Wa'awa'a in that it has a legally defined

purpose. Most of the Sanctuary lies within Conservation District (Subzone “R”), but approximately 800 acres on the northern boundary are zoned Agriculture (Figure 2).

Livestock removal and curtailment of illegal logging activities were the primary management actions that occurred in the PWWFBS from its establishment in 1984 until 1989. Prior to 1985, regeneration of endemic shrubs and trees, including koa (*Acacia koa*), was almost totally lacking in the Forest Bird Sanctuary. Very few young trees were present and old ones were dying without replacements. The forest understory was being invaded by exotic grasses and weeds. If grazing had continued, the entire mountainside may have been transformed to an open grassland. Cattle were not the only animals destroying Pu‘u Wa‘awa‘a’s native forests. Feral pigs damaged native tree seedlings, ferns and herbs growing on the forest floor by rooting and wallowing. Beginning in 1990, management actions such as feral ungulate control, fencing of rare plants, removal of non-native trees, and control of banana poka were initiated to safeguard and improve forest cover and wildlife habitats. The forest experienced extensive recovery after livestock removal - koa, ‘ohi‘a (*Metrosideros polymorpha*), and other native plants germinated by the thousands. Most of these species grew rapidly and exhibited excellent survival. Several rare plants, not recorded for several decades, have reappeared and show signs of increasing distribution.

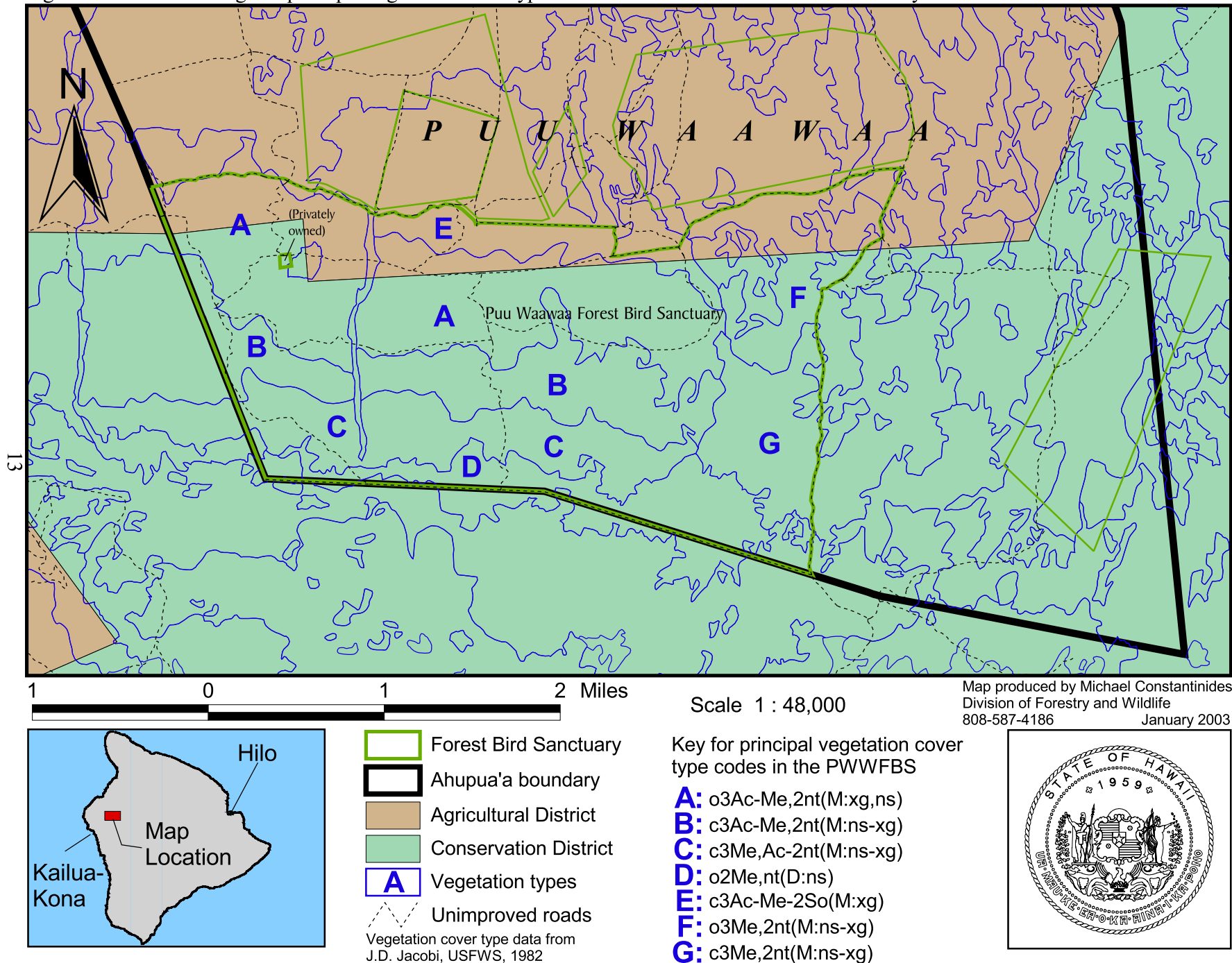
The ahupua‘a of Pu‘u Wa‘awa‘a has no perennial streams, and fresh water sources have always been scarce. People of old who worked, dwelled, or traveled through Pu‘u Wa‘awa‘a knew of certain locations where this precious resource could be accessed even during hot and dry times. Prior to Western influence, there was a vast expanse of dry forest extending from the lowlands of Pu‘u Wa‘awa‘a to the moist forests of Waihou, Kileo and what is now the PWWFBS. The canopy of this forest and the structure of the associated plant communities most likely enhanced the hydrologic cycle collecting fog drip and by protecting the ground from the evaporative effects of wind and sunlight.

Infiltration of rainwater, fog drip and dew are the primary fresh water inputs in Pu‘u Wa‘awa‘a, while subsurface water flow and transmission to fresh water aquifers are the primary means of fresh water movement. Some of the subsurface water captured in mauka areas finds its way down slope feeding springs, anchialine pools like Waielepi, Luahinewai, Keanalele, and seeps in lava tubes.

Groundwater entering the ocean contains dissolved nutrients that directly or indirectly support marine life including basic single celled organisms, limu, fishes and endangered green sea turtles. Fresh water influx is required for the proper function of Lokoi‘a (Hawaiian aquaculture fishponds), which provided high protein food sources and were a vital part of Hawaiian culture. While most fishponds were fed by freshwater streams, the fishpond of Wainanali‘i in Kiholo Bay was fed by groundwater. Without this ground water source, it would not be possible to operate or restore such an aquaculture system along this stretch of arid coastline.

The mauka moist forest areas of Pu‘u Wa‘awa‘a continue to contribute to the hydrological cycle of this dry region. However, it is probable that long-term degradation of the makai dry forest through ungulate grazing and cyclical wild fire has caused a negative impact on the hydrologic cycle of Pu‘u Wa‘awa‘a. The situation is exacerbated by the fact that aquifers are being drawn

Figure 2. Land use zoning and principal vegetation cover types for the Puu Waawaa Forest Bird Sanctuary.



down faster than they can recharge due to wide spread development in the North Kona region. Experiences of the last few decades suggest that pressure for such land development in this area has been nearly continuous, and that this pressure can be expected to last well into the future. Protection and enhancement of remaining dry and moist forest areas in Pu‘u Wa‘awa‘a is important in protecting the hydrologic cycle and water resources of Pu‘u Wa‘awa‘a.

The management objectives detailed below propose the phased establishment of a series of conservation units to support the effort to identify, protect and manage important endemic communities. Incorporated in this rationale are several underlying biological principals:

- Protection and conservation of biological diversity.
- Maintenance of functional ecosystems and watersheds within Pu‘u Wa‘awa‘a.
- Protection and restoration of habitat for native plant and animal species.
- Maintenance of functional wildlife corridors and habitat linkages between conservation units.
- Increase public awareness of the importance of endemic flora and fauna at Pu‘u Wa‘awa‘a.

B. Annual Operations:

Current annual operations within the ranch lease portion of Pu‘u Wa‘awa‘a involve fence maintenance and weed control for 14 conservation units which range from 20' x 20' to eight acres. These conservation units function to protect rare, Threatened and Endangered native flora, and to serve as outplanting sites for these species. Over 1000 seedlings of various endangered species have been planted to date, and these plants are tracked in a database. Such efforts will continue at a greater scale once larger conservation units are established. Close monitoring of outplanted stock helps ensure genetic diversity is maintained in these augmented populations.

C. Management Objectives:

Objective 9. Fence the best remaining sections of native forest and remove ungulates from these conservation units on a priority basis

Background: The ahupua‘a of Pu‘u Wa‘awa‘a contains a compelling list of species that will benefit from restoration management (Appendix A). Grazing and disturbance by cattle, and feral pigs, sheep and goats threatens the existence of native forests within Pu‘u Wa‘awa‘a. These animals browse native vegetation, disturb soils, and create conditions favoring the invasion of non-native weed species. Fenced conservation units must be constructed to effectively protect key areas from ungulate damage. It will be important to incorporate as many community types as possible in this effort to maximize conservation of biodiversity. There are presently 14 small conservation units within Pu‘u Wa‘awa‘a that protect approximately 18 acres of land. Existing large-scale fencing is limited to 9 miles of substandard hogwire on the perimeter of PWWFBS. Ungulates are able to breach this perimeter in many places due to disrepair.

Proposed Actions: The best remaining native forest communities within Pu‘u Wa‘awa‘a have been defined and prioritized for fencing operations (Figure 3; Appendix B). Repairs or upgrades to existing fences in the PWWFBS, and construction of new conservation unit fences will be conducted in a phased approach as funds become available. After each conservation unit is fenced, ungulates will be removed through a variety of methods. A fence maintenance schedule will be initiated.

Objective 10. Protect native flora and fauna by controlling non-native predators

Background: Non-native predators such as rats, mice, mongooses, and cats collectively cause considerable impact on native species by preying upon insects, plant seeds and seedlings, and forest and water birds and their eggs. Live traps are effective predator control tools but represent a costly method due to the need for regular monitoring. Bait stations containing diphacinone (approved for forestry use) are extremely effective in controlling rats and mongooses, but are localized in their impact and high in cost. Native seed predation is greatly reduced when bait stations are deployed in a target area. Aerial application of rodenticide in forested areas may be approved by the EPA in the future. If this method is approved and deemed appropriate it will be employed as a predator control tool within Pu‘u Wa‘awa‘a.

Proposed Actions: Live traps will be deployed at strategic locations within conservation units and the proposed Kiholo State Park to control rats, cats and mongooses. Bait stations employing the rodenticide diphacinone will be deployed to control rats and mongooses.

Objective 11. Control invasive weeds that suppress native plant populations

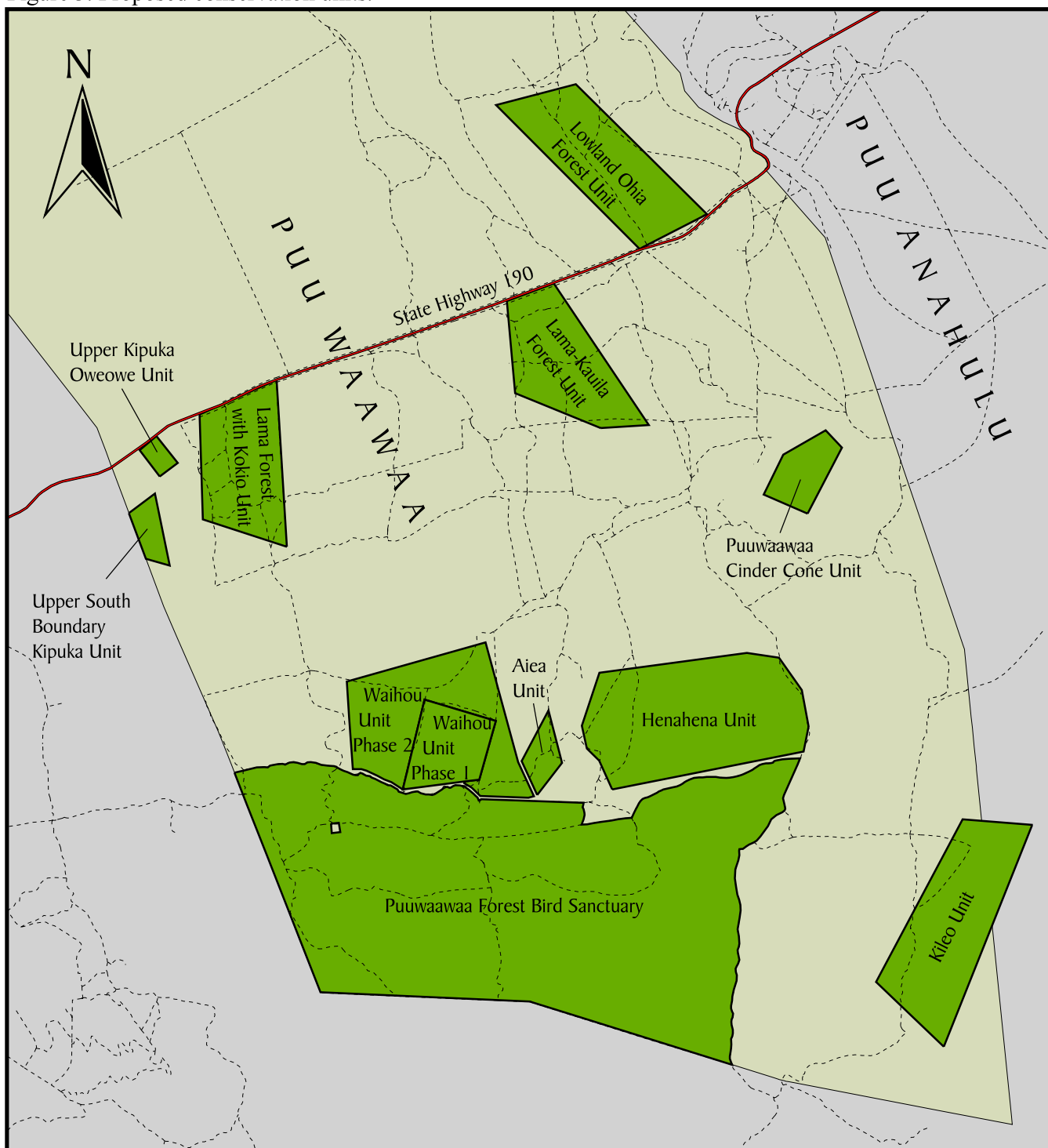
Background: A number of weeds will require control measures within conservation units. Principle examples include fountain grass, lantana (*Lantana camara*), silk oak (*Grevillea robusta*), christmas berry (*Schinus terebinthifolius*), kikuyu grass, koa haole (*Leucaena leucocephala*), banana poka (*Passiflora mollissima*), German ivy (*Delairia odorata*) and milkweed (*Asclepias physocarpa*). These species suppress native flora and contribute to ecosystem fire susceptibility.

Proposed actions: Invasive weed control in conservation units using manual, mechanical, chemical, and approved biological control measures will be conducted through an annual maintenance program. Pulse grazing of domestic livestock may be used to control weeds after consulting with a grazing manager and range specialist regarding timing and intensity. This will also include coordination with the DOFAW Protection staff for reduction of fuels that threaten native plant populations

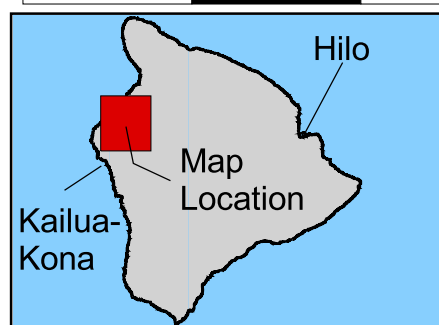
Objective 12. Protect isolated occurrences of rare and endangered species

Background: Many rare and endangered plants occur outside of the proposed conservation units in highly degraded areas that are not appropriate for large-scale fencing. These individuals will need protection from grazing by “spot fencing” to ensure

Figure 3. Proposed conservation units.

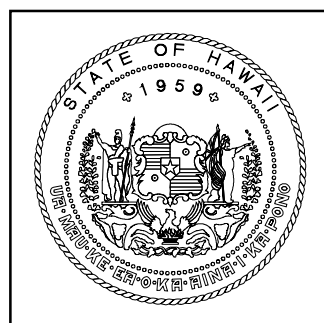


1 0 1 2 3 Miles



Map produced by Michael Constantinides
Division of Forestry and Wildlife
808-587-4186 January 2003

Proposed Conservation Units
 Secondary roads



that overall restoration efforts include the greatest genetic diversity. In this way DOFAW will be able to continue to collect seed from these trees, propagate new seedlings and outplant them into adjacent protected areas. Some plants occur as individuals, while others occur in small concentrations. For example, there are more than 100 ‘aiea (*Nothocestrum breviflorum*) scattered throughout the Pu‘u Wa‘awa‘a Ranch lease with concentrations in the lower Henahena area, around Puu Iki, and below the proposed Waihou Phase I conservation unit.

Proposed Actions: Spot fence eight endangered a‘e (*Zanthoxylum dipetalum* var. *tomentosum*) trees – five in the Puu Iki area, and three adjacent to Waihou. Spot fence five endangered uhiuhi (*Caesalpinia kawaiensis*) in the vicinity of the Old Kiholo Road. Spot fence larger concentrations of ‘aiea as a single unit (see ‘Aiea conservation unit, Appendix B) where possible, and selected individuals of ‘aiea and other rare plants on a priority basis.

Objective 13. Restore native plant populations including rare and endangered species

Background: Restoration of native vegetation will require augmentation of current native plant populations. Once an area is protected from ungulates and invasive weeds are brought into check, natural regeneration may occur except on sites that are very dry. Broadcast seeding has proven effective in some restoration efforts, and this method holds promise for Pu‘u Wa‘awa‘a. Planting shrub and tree seedlings is another tool for increasing native plant populations. An increase in the proportion of native plants in a given area could displace invasive weeds by altering microclimate conditions or through increased shade cast from the native forest canopy. Restoration of native coastal plants will also be implemented by planting seedlings. Rare species such as the species of concern *Capparius sandwichiana* occur at the coast in limited numbers.

Proposed Actions: Native plant restoration will be achieved through a combination of planting seedlings, broadcasting native seeds and encouraging natural regeneration. Seeds of common understory native plants will be collected from areas throughout Pu‘u Wa‘awa‘a and neighboring lands including existing DOFAW conservation units above and below the Mamalahoa Highway. Some seeds will be propagated at the existing Kamuela nursery and the proposed Meeting House greenhouse facility, while others will be broadcast in conservation units at optimal times during the year. This technique will be monitored to evaluate its effectiveness.

Objective 14. Develop a resource management and monitoring program

Background: In order to effectively and responsibly manage native species within the conservation units, base-line data need to be collected on each species. A formal field research protocol designed to collect information on parameters such as population size, distribution, and habitat use is needed. Endangered flora and fauna (e.g. forest birds) would have priority.

Proposed actions: Conduct analyses of species monitoring data that have been collected to date. Based on these initial analyses, either design a monitoring program or secure a cooperative agreement with an agency such as USGS Biological Resources Division, the Hawai'i Heritage Program, or the USDA Forest Service to design and implement the continuing species monitoring program.

Objective 15. Create a native plant seed orchard at the Pu'u Wa'awa'a Meeting House

Background: The Pu'u Wa'awa'a Meeting House and reservoir could serve as an excellent site for the establishment of numerous dryland plant species such as the endangered ma'o hau hele (*Hibiscus brackenridgei* ssp. *brackenridgei*), hala pepe (*Pleomele hawaiiensis*), 'aiea, koki'o (*Kokia drynarioides*), uhiuhi and others. Because of its proximity to a large water source, this area could be used as a stocking site for outplanted endangered species. These plantings would successively become a seed orchard from which seeds are collected for use in other, large-scale outplanting operations.

Proposed Actions: Seeds from the endangered species outlined above will be collected from as many founders as possible. The propagules of these seeds will then be planted out at the Meeting house grounds to establish a seed orchard. Within the first two years approximately 500 seedlings will be planted, with an additional 500 per year in subsequent years. By year seven, seed stock should be available from these orchards. The Waimea Tree Nursery facility will be upgraded to grow the seedlings for this project.

Objective 16: Preserve and protect unique native invertebrate populations at Pu'u Wa'awa'a and the makai lands of Pu'u Anahulu

Background: Pu'u Wa'awa'a supports the last remaining vestige of natural habitat for certain endemic invertebrates. Of critical concern is the survival of unique insects such as the endangered Blackburn Sphinx moth (*Manduca blackburniae*) and the beetle *Plagithmysus simplicicollis* (*Cerambycidae*). Both species are extremely rare and are restricted to the endangered 'aiea tree (*Nothocestrum breviflorum*). *Plagithmysus elegans* is only found on the uncommon papala tree (*Charpentiera obovata*). These insects are doomed to extinction once their host plants are gone. Immediate efforts are needed to protect existing host plants and increase their abundance. The koa bug (*Coleotichus blackburniae*) is threatened with extinction even though its host (koa) is generally common. The host plants for two rare noctuid moths, the black-veined agrotis (*Agrotis melanoneura*) and an endemic underwing (*Hypocala velans*), are unknown.

The big-headed ant (*Pheidole megacephala*) is a serious threat to the survival of endemic forest insects at Pu'u Wa'awa'a. Ants also culture other insects that are detrimental to the host plants of certain rare invertebrate species. Ants are also known to prey on native insects and are suspected of significantly affecting the survival of nestling birds. Yellow-jackets (*Vespula pensylvanica*), predatory wasps, pose a threat to native insects and birds. Control should consist of poisoning colonies of these insects when found.

Proposed actions: Native insects will benefit from the protection and enhancement of native plant communities at Pu‘u Wa‘awa‘a (see Objectives 8 and 12). Non-native insects, that threaten native invertebrates, can be controlled using a variety of methods and pesticides.

Objective 17: Protect and enhance native bird populations and their habitat

Background: Koa is a keystone species for endemic Hawaiian wildlife and should be the focus of habitat restoration activities at the PWWFBS. This fast growing tree in the pea family (*Fabaceae*) is considered one of the most important host plants for endemic Hawaiian invertebrates. These insects and their larvae provide a major food source for native forest birds. Hawaiian birds use koa for nesting, roosting and other needs in their life cycle. Some nectivorous avian species even switch to an insectivorous diet when rearing their young. The success of many native species at Pu‘u Wa‘awa‘a depends on the presence of koa as a forest dominant. The State’s ‘Alala Restoration Plan identifies the PWWFBS as the single most important parcel of State managed land for ‘alala (*Corvus hawaiiensis*) recovery from the perspective of habitat quality and perceived threats to this habitat. The U.S. Fish and Wildlife Service’s (USFWS) ‘Alala and Hawai‘i Forest Bird recovery plans both identify the PWWFBS as essential habitat for the endangered ‘alala, ‘akepa (*Loxops coccineus*) and Hawai‘i creeper (*Oreomystis mana*). The Hawai‘i creeper and ‘akepa are the two species at Pu‘u Wa‘awa‘a that require the greatest management attention. Almost nothing is known about their habitat requirements or factors limiting their survival. A research project is urgently needed to obtain basic life history information for these species. Recommendations are also needed for management actions to prevent the extirpation of these birds on Hualalai. Two suggested management actions are to develop additional nesting sites by providing nest boxes or drilling holes in dead trees. Waterbirds such as the ae‘o (*Himantopus mexicanus knudseni*) occur in Kiholo Bay and have been seen using the reservoir at the ranch. The reservoir is also important habitat for the local nene (*Branta sandvicensis*) population. As ground nesters, these species are very susceptible to predation.

Proposed actions: Certain management actions can be implemented to increase forest bird numbers. These include predator control (see Objective 9), planting of native forage-producing trees, controlling avian disease, reducing interspecific avian competition, and creating additional nesting sites for cavity nesters. ‘Alala and other native forest birds feed extensively on the fruit of ‘olapa (*Cheirodendron* spp.), pilo (*Coprosma* spp.), hoawa (*Pittosporum* spp.), ‘oha wai (*Clermontia* spp.), mamaki (*Pipturus* spp.) and manono (*Hedyotis* spp.). These birds also forage on the trunk of trees (primarily koa and ‘ohi‘a) in search of insects. Any reforestation effort should include the planting of the above forage species (see Objectives 8 and 12). The objective of avian disease control activities at Pu‘u Wa‘awa‘a will be to reduce (with the goal of eliminating) vectors capable of transmitting diseases to birds. Mosquito control activities will focus on eliminating standing water where practical. Permanent water sources can be treated with products that specifically affect mosquito larvae. Habitat enhancement will also be a priority for the nene and waterbirds such as the ae‘o (see Objectives 19 and 57). The abundance and distribution of native birds at Pu‘u Wa‘awa‘a will be monitored annually.

Results of these surveys can be used to demonstrate the effectiveness of ongoing management programs and to alert managers of any major population changes. Native bird research projects that aid in better management of these resources will be encouraged.

Objective 18. Manage Fisheries Resources at Kiholo Bay

Background: Kiholo Bay is presently a Fisheries Management Area. As part of this management designation, gill netting is banned in the area.

Proposed Actions: Future fisheries management in the Kiholo Bay area will be steered by the West Hawai'i Fisheries Council. Recommendations for management will be passed through this council. Current recommendations include the banning of reef spear fishing using scuba tanks. Post educational and regulatory signage for fisheries management.

Objective 19. Continue sea turtle protection and research in the Kiholo Bay Area

Background: Kiholo Bay is commonly used by sea turtles for feeding and basking. Hawai'i Preparatory Academy in partnership with the National Marine Fisheries have been studying turtle populations in the area since the mid 1980's. The most common species at Kiholo is the threatened green sea turtle (*Chelonia mydas*), while the endangered hawksbill turtle (*Eretmochelys imbricata*) is rarely observed.

Proposed Actions: Continue to encourage the present research and protection activities, and post educational signage.

Objective 20. Protect anchialine pool resources in the coastal regions of Pu'u Wa'awa'a and Pu'u Anahulu

Background: Anchialine pools are among the most important biological resources within the proposed Kiholo State Park. Pools are important habitat for several native species. The endangered waterbird ae'o has been seen using the ponds at Kiholo. Presently, several of the pools are infested with non-native species, especially fish such as *Tilapia* and guppies. These non-native fish severely depress populations of native crustaceans such as 'opae'ula (*Halocaridina rubra*, *Metabetaeus lohena*, and others) and change the algal and other biological characteristics of the pools. Other uses of pools, such as swimming and bathing, could also degrade water quality, especially if chemicals from soap and sunscreen are introduced. Anchialine pools also have great cultural significance. Many of the pools were of low enough salinity to serve as waterholes along the dry coastline in ancient as well as historical times. Several were famous for swimming or as bathing pools of ali'i. Settlements were established alongside the larger pools, some were extensively modified as fish ponds. Information on the area's anchialine pools would be part of an educational and interpretive program.

Proposed Actions: Conduct an anchialine pool inventory within the proposed Kiholo State Park to assess the present status of the pools, and initiate a permanent monitoring

protocol. Restore some pools to resemble their pre-contact condition on a prioritized basis, including removal of introduced fish and invasive plant species. Removal of invasive plant species will improve waterbird habitat. Plant native species such as naupaka (*Scaevola sericea*), sedges, milo (*Thespesia populnea*), hala (*Pandanus tectorius*) and hau (*Hibiscus tiliaceus*) and Polynesian introductions such as kou (*Cordia subcordata*) near the heavily modified fish ponds, but not adjacent to anchialine pools that are of high-quality and retain good restoration potential.

Objective 21. Control feral ungulate populations makai of the Queen Ka‘ahumanu Highway

Background: Current public access and use of this area will likely increase over time with the development of Kiholo State Park. This trend coupled with the presence of private residences will restrict managed hunting in the area due to safety concerns. Goats were historically considered pests by the ranchers in the area, and Kiholo Bay was the site of large wild goat drives (7,000 animals in 1922). Browsing ungulates damage both native plants and archaeological sites including caves. The unique cave biota in the Kiholo area are dependant on roots of native plants. Any threats to these plants in turn affect these unique subterranean ecosystems.

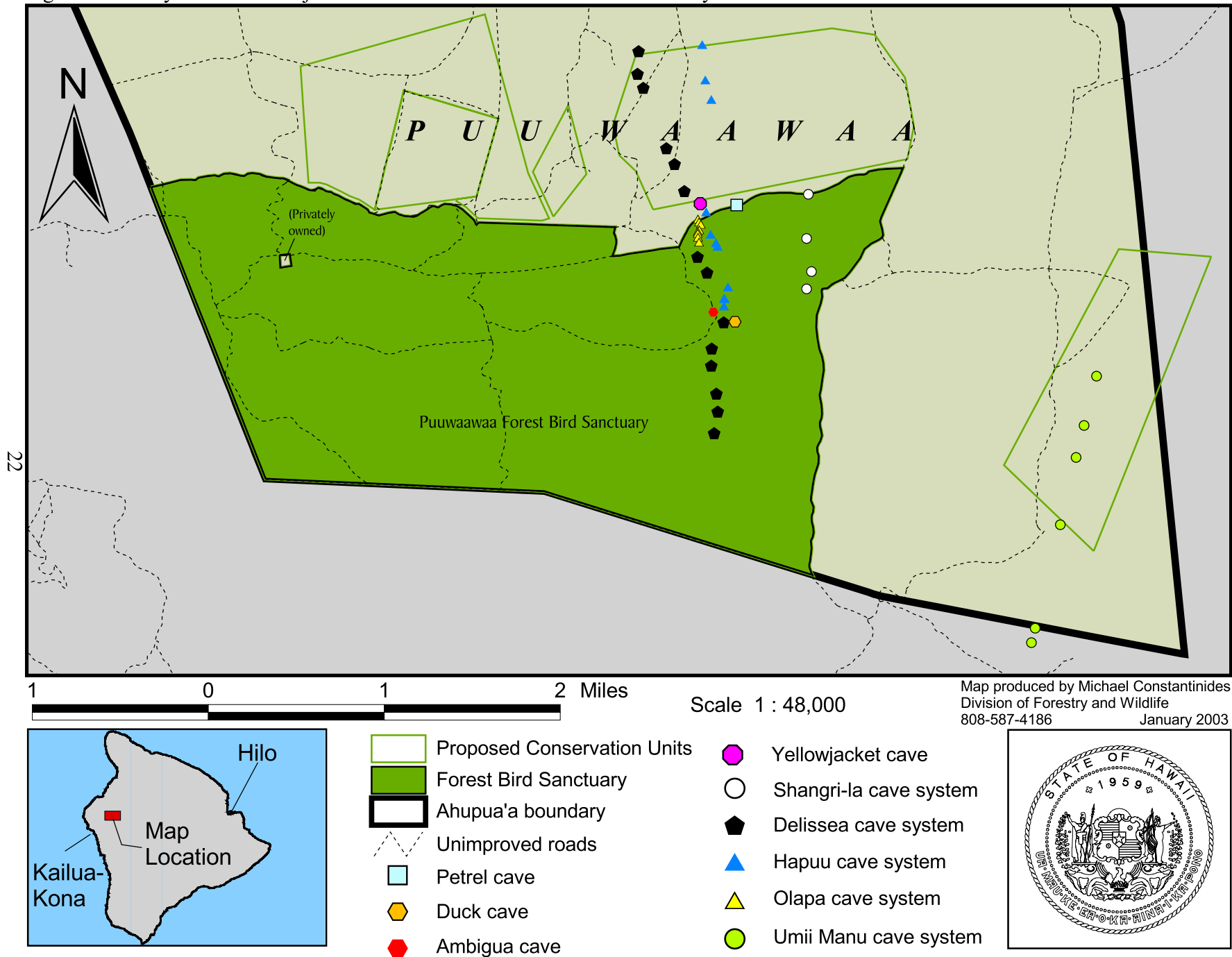
Proposed Actions: Periodically control ungulate populations below the Queen Ka‘ahumanu Highway using a variety of methods including special public hunts and staff control. Fence the perimeter of small sensitive sites (approximately 0.25 acres each) to exclude ungulates.

Objective 22. Protect biological cave resources

Background: Hawaii's lava tubes represent important cultural, biological, geological, aesthetic, recreational and educational resources and values. Important deposits of bird and mammal bones have been accumulating under skylights and in lava tube passages for over 5,000 years. These caves, sinkholes and skylights provide important habitat and natural protection from grazing ungulates for many species, some rare or endangered. Furthermore, endemic forest birds frequently nest on the floor or on ledges in lava tube openings. Protecting vegetation that overlies caves from disturbances is critical to ensure that living biological resources in caves are not subject to harmful alterations in their habitat and associated nutrient cycles. The Henahena lava tubes may be the most biologically significant features on Hualalai volcano. This and several other cave systems exist within and adjacent to the PWWFBS (Figure 4). Unique cave and lava tube resources also exist in the Kiholo Bay area. Caves and lava tubes are threatened by human activity, introduced plants, and grazing ungulates.

Proposed Actions: Portions of the extensive cave systems of Pu‘u Wa‘awa‘a will be protected within the Henahena and Kileo conservation units (Objective 9, Appendix B). Public access to selected caves with biologically and culturally sensitive resources will be controlled to prevent general public access. Cultural and research access to such caves will be permitted through issuance of Special Use Permits.

Figure 4. Cave systems in and adjacent to the Puu Waawaa Forest Bird Sanctuary.



Objective 23. Provide areas for scientific research supporting restoration efforts

Background: While DOFAW currently has the knowledge and capability to implement initial phases of dryland forest restoration, advanced knowledge and methodology are required. Such advances are best supported through research designed to identify practical and effective management techniques while simultaneously supporting scientific inquiry. Research projects incorporating a landscape scale will be encouraged as results from such studies could assist in identifying restoration techniques for imperiled dryland forests and ecosystems worldwide. Research based projects have the additional benefits of providing sound scientific information, increasing public awareness through publications, and bringing in alternate funding to support restoration goals.

Proposed Actions: Solicit requests for research projects relating to specific objectives of this Management Plan including: forest restoration; fuels reduction; weed control; biological control; wildlife ecology; geology; geography; and other areas. The US Forest Service, the US Fish and Wildlife Service, USGS Biological Resources Division, University Researchers and other appropriate organizations will be encouraged to participate in research at Pu‘u Wa‘awa‘a. The Pu‘u Wa‘awa‘a Management Team will approve research proposals and determine acceptable research locations.

Objective 24. Fund and hire permanent field staff to implement natural resource management objectives

Background: The list of objectives proposed in this Plan dictates the need for permanent staff dedicated solely to natural resource management within Pu‘u Wa‘awa‘a and the makai lands of Pu‘u Anahulu.

Proposed Actions: Fund and hire a full-time permanent crew to perform resource management operations to support natural resource management objectives: A Vegetation Specialist, a Wildlife Specialist, and seven crew members. The Specialists will act as crew leaders for the remaining crew, and also supervise DOFAW and volunteer field crews during daily operations.

V. Grazing Management

A. Context:

Continuous grazing operations have existed in Pu‘u Wa‘awa‘a and Pu‘u Anahulu for over 100 years. The communities of Pu‘u Wa‘awa‘a and Pu‘u Anahulu can trace their roots to agriculture and are well known for their ranching background. Many of the older families in the community are direct descendants of former ranchers and ranch workers at Pu‘u Wa‘awa‘a.

Grazing in Pu‘u Wa‘awa‘a and Pu‘u Anahulu has caused considerable damage to native ecosystems and may further degrade remaining native resources. Ironically, grazing has now become a practical tool for protecting existing remnant dryland ecosystems by mitigating the build up of fine fuels. Fountain grass and Kikuyu grass are widespread in this area. Both grasses produce large amounts of highly flammable fuel in this dry leeward side of the Big Island. The presence of these fire-adapted grasses in the Pu‘u Wa‘awa‘a area has established a fire cycle that contributes to the continued demise of native dryland ecosystems. Approximately 90% of all wildfires started in this area can be attributed to roadside ignition, a condition that will continue if left unmitigated.

Grazing will be used both as a tool to mitigate the frequency of wildfires, and to control selected noxious weeds. Such tools will be incorporated either individually or in combination with other techniques for selected objectives of this Management Plan.

B. Annual operations:

Current livestock grazing operations on approximately 18,355 acres continue under a month-to-month revocable permit to the Pu‘u Wa‘awa‘a Ranch Company, operated by Ernest and Marian Deluz, Mikio and Ellen Kato, and Stephen Deluz.

C. Management Objectives:

Objective 25. Continued use of grazing as a means to control fine fuels build up along Highway 190, and at both existing and future conservation units

Background: Unchecked fine fuels build up in the Pu‘u Wa‘awa‘a area is the principal factor contributing to the decline of dryland ecosystems in this area. While fountain grass and Kikuyu grass are highly flammable fuels, their buildup can be effectively controlled by grazing livestock.

Proposed actions: Repair existing or install new fences to facilitate livestock grazing management. Strategically install water troughs near conservation units to focus livestock grazing in a pattern that will create reduced-fuel buffers around the fenced perimeters. Prescribe grazing on a priority basis in and around selected conservation units to minimize fire potential.

Objective 26. Develop and implement a long-term grazing plan supporting the diverse objectives of the Pu‘u Wa‘awa‘a management plan

Background: Livestock grazing in Pu‘u Wa‘awa‘a was traditionally allowed under a general lease. Presently it is conducted under a revocable permit during the development of this management plan. The management plan calls for a wide range of new priorities and objectives in addition to a continued need for livestock grazing. Consequently, livestock grazing activities within Pu‘u Wa‘awa‘a will shift from a sole emphasis on ranching to providing grazing as a management tool to support new priorities such as fire control and natural resource conservation.

Proposed action: DLNR has developed a “Request for Proposals” that will be disseminated to all parties interested in conducting grazing operations at Pu‘u Wa‘awa‘a (Appendix C). DLNR will solicit proposals at an appropriate time.

VI. Public Hunting Program

A. Context:

Public hunting programs in Pu‘u Wa‘awa‘a have existed since 1978. Hunters currently enjoy good feral sheep, goat, pig, and game bird hunting in the mauka and makai hunting areas, and grazing pastures, and the PWWFBS. There are few, if any, places in the world where a bird hunter can go to harvest such a variety of species in one area, including: Erckel francolin; black francolin; gray francolin; Kalij pheasant; wild turkey; peafowl; spotted dove; and barred dove.

Water is probably the most limiting factor to game bird production in the area. Game birds are found throughout Pu‘u Wa‘awa‘a. During years of good rainfall in April through June, game bird production can be excellent.

The lands of Pu‘u Wa‘awa‘a have become a major focal point for the hunting community as other areas on the island (Mauna Kea Game Management Area, Pohakuloa Training Area, and various Natural Area Reserves) have been subjected to large-scale fencing and game mammal removal programs. In 1996, the USFWS set out to help the hunting community establish a list of places to safeguard for the future of hunting. At that time Pu‘u Wa‘awa‘a was identified as one of the top priorities on this list. The USFWS currently perceives a need to reconcile game management interests with endangered species recovery efforts at Pu‘u Wa‘awa‘a. Today the demand for game mammal hunting in Pu‘u Wa‘awa‘a is so great that the Department employs a phone-in reservation system and has instituted trip limits into the area to facilitate a safer hunting environment as well as provide a quality hunting experience. Game mammal hunting in Pu‘u Wa‘awa‘a currently occurs from July to September. Game bird hunting is normally offered in the months of November, January, and March (spring turkey hunt).

Feral game mammals pose a significant challenge to wildlife managers who are tasked with providing public hunting recreation in and around areas where management objectives include both habitat restoration and hunting. Feral game mammal numbers need to be kept at low levels in areas where habitat restoration is a goal and they will be removed from within fenced conservation units.

All hunting is administered via manned hunter check stations at Pu‘u Wa‘awa‘a to provide information to hunters and minimize potential conflicts between grazing and hunting activities. Although this policy protects the Department’s relationship with the livestock permittee, it severely limits hunter access due to limited hunter check station resources. Hunter access is a key issue that limits the ability of DOFAW to manage and manipulate feral game mammal population levels within Pu‘u Wa‘awa‘a.

B. Annual operations:

The public hunting program currently conducts many operations annually. Signage, waterlines, locks, gates, wildlife guzzlers and three structures (Sanctuary cabin, quonset hut & hunter check station) are maintained. Roads and parking areas are graded and mowed to reduce potential

wildfire ignition from vehicle catalytic converters. Selected areas of Pu‘u Wa‘awa‘a are opened for various game mammal and bird hunting seasons. Data and information are disseminated and collected at the hunter check station. Game bird recruitment, pre- and post-game mammal hunting season, and post-season gobbler surveys are conducted. A small-scale mongoose and feral cat predator control program will be employed. Volunteers will be solicited to plant native vegetation to improve game habitat and native ecosystems in Pu‘u Wa‘awa‘a.

C. Management Objectives:

Objective 27. Continue to provide a safe and quality hunting environment

Background: Hunting in Pu‘u Wa‘awa‘a is a popular destination for game mammal hunters. This demand will increase as the island of Hawaii’s human population continues to expand while hunting opportunities in other areas are reduced or eliminated. Increased hunter density compromises safety and any hope for a quality hunting experience. Providing public hunting opportunities under these conditions will require greater controls or restrictions to be placed on the hunting community to ensure a safe and quality hunting environment.

Proposed actions: Utilize a reservation system to regulate entry into Pu‘u Wa‘awa‘a when hunter demand exceeds safe hunter density levels in the various sections of the ahupua‘a.

Objective 28. Provide sustainable public hunting opportunities

Background: Most areas outside of proposed conservation units contain little native vegetation. DOFAW personnel have determined that some of these areas are capable of supporting sufficient animal populations for sustained yield game mammal hunting.

Proposed actions: Areas outside of proposed conservation units will be open for game mammal hunting and managed as a sustained yield resource.

Objective 29. Enhance game habitat in selected areas of the Pu‘u Wa‘awa‘a

Background: For game management, DOFAW has classified the mauka unencumbered State managed lands of Pu‘u Wa‘awa‘a as “Mixed Game and Other Uses.” This designation represents: “Areas where game management is an objective integrated with other uses. Habitat may be manipulated for game enhancement. Game populations are managed to acceptable levels using public hunting.” Excluding lands comprising proposed conservation units and current safety zones, over 25,000 acres of land mauka of Queen Ka‘ahumanu Highway are available for game habitat enhancement efforts.

Natural resource management objectives in this plan mandate that game mammal populations be removed from proposed conservation units. Since game mammals currently prefer much of the same habitat as that proposed for conservation units, it is

likely that alternate habitat will need to be enhanced to ensure a sustainable game mammal hunting program.

In order to minimize adverse or unintended consequences of removing game mammal populations from proposed conservation units, baseline data for population dynamics and habitat requirements are needed. However, there is a lack of such quantitative data for Pu‘u Wa‘awa‘a. Basic information required for each game species includes seasonal distribution and population density, carrying capacity, food and water sources, and preferred habitat. Quantification of such data will facilitate game habitat enhancement efforts in Pu‘u Wa‘awa‘a.

Proposed actions: Contract services to gather baseline data on game mammal species and formulate management actions to enhance game mammal resources in Pu‘u Wa‘awa‘a. Contract habitat enhancement work that includes but is not limited to installation of game water units and planting programs for selected tree and shrub species – particularly in highly degraded areas.

Objective 30. Utilize public hunting to reduce feral ungulate pressure on remaining native plant resources in proposed conservation unit areas

Background: Most of the proposed conservation units are not currently fenced, and fencing will likely occur sequentially over a period of several years. These units represent some of the best remaining native plant resources in the ahupua‘a, but remain susceptible to continued degradation from feral ungulate browsing.

Proposed actions: Utilize public hunting in areas designated as future conservation units to reduce feral ungulate browsing pressure on residual native plants. Experiment with extended hunting seasons, methods to relocate game populations, increased bag limits or pulsed hunting seasons as a game management tools.

Objective 31. Promote youth hunter programs

Background: Youth hunter (below the age of 16 years) programs have been implemented throughout the United States for more than a decade. They were designed to address the decline in hunting participation and the subsequent loss in Pittman-Robertson monies that fund many wildlife management programs. Declining exposure of youths to outdoor activities and an increasing occurrence of ungulate removal programs are believed to be the primary causes for declining hunter participation in Hawaii. The only youth hunter program existing in the State has occurred on the island of Hawai‘i since 1990. Youth hunting programs are intended to encourage youth participation in hunting under a supervised and positive environment. To accomplish this, youths are given hunting opportunities prior to the general public, or in a specific area set aside for their use only. Youths are required to have a licensed, non-hunting adult with them who acts as a mentor. Youth hunts have been met very favorably by the hunting community and should be continued or expanded.

Proposed actions: Continue to offer youth hunts prior to opening areas to the general public or set aside areas for youth hunting only. Youth hunts will be conducted during both game bird and mammal hunting seasons.

Objective 32. Promote disabled hunter access programs

Background: The USFWS has always encouraged the Department to develop access for disabled hunters if possible and appropriate. In 2001, the Department permitted motorized vehicles to be utilized by disabled hunters. During the 2001 fall bird season DOFAW-Hawai'i opened Kaohe State Lease for a limited time to disabled hunter access. Disabled hunters were required to obtain a permit that included a physician's certification of their disability. The area was fairly flat allowing good access by special motorized vehicles outfitted for a paraplegic. A number of disabled hunter permit applications were issued indicating a definite interest and need within the community. The current Pu'u Wa'awa'a ranching lease contains many roads in fairly level terrain and shares much of the same features as Kaohe State Lease. It is an ideal location for disabled hunter access to game bird and mammal hunting.

Proposed actions: Provide disabled hunter access during game bird and game mammal hunting seasons in Pu'u Wa'awa'a.

Objective 33. Determine hunting seasons for feral sheep, goats and pigs based on monitoring their movement, population trends, and habitat conditions

Background: Studies documenting feral ungulate movement in Pu'u Wa'awa'a and Pu'u Anahulu are limited. Additional research is required to effectively manage and minimize what effects the animals are having on ecosystems in these areas. A USFWS Habitat Conservation Plan grant has been awarded to DOFAW, which will support this objective.

Proposed actions: DOFAW will implement research and monitoring programs as outlined in the USFWS grant. Results of the study will be used to guide future hunting program designs and game management efforts in this area of the island.

Objective 34. Expand predator control program

Background: Mongooses and feral cats are probably the greatest predatory threat to game birds in Pu'u Wa'awa'a. Control measures were at one time limited to live traps that were a very costly operation involving baiting, setting and frequent checking. Recently approved waxed chemical bait blocks have aided in reducing labor expenses.

Proposed actions: Place bait stations along the network of roads within the current lease area and the Mauka and Makai hunting areas to facilitate delivery and dispersal of waxed chemical bait blocks. When feral cats are observed in the area, live traps will be utilized and captured cats will be removed from the area.

Objective 35. Develop game bird guzzlers

Background: There is a positive correlation between game bird harvest and rainfall in the months of April through June. Simply providing water alone is not enough to influence game bird production. Rainfall is necessary to stimulate the development of cover and food production that game birds rely upon for survival. However, providing water does increase chances of game bird survival during drought years and help to carry breeding birds over to the next year.

Proposed actions: Develop reliable game bird guzzlers by tapping existing ranch waterlines and installing fences to exclude livestock. In areas without existing waterlines, catchment systems will be built.

Objective 36. Establish dove flights in Pu‘u Wa‘awa‘a by establishing forage plots

Background: An extremely underutilized form of game bird hunting is dove hunting. Dove hunting can be conducted from a blind as the birds fly to and from food and water sources, or roosting areas. The State currently has no public dove hunting areas. Dove hunting is very sporting, does not require a dog, and is conducive to youths, seniors, and disabled hunters who may be mobility impaired. The makai bluff site has water nearby and holds good soil that can be utilized to grow crops to attract doves to the area.

Proposed actions: Cultivate and irrigate an annual grain crop within a five-acre fenced site on Pu‘u Anahulu bluff, makai of Highway 190. Once dove flight is established, construct blinds near the cultivated field and open to dove hunting.

Objective 37. Increase game bird hunting opportunities

Background: Fall bird hunts occur throughout Pu‘u Wa‘awa‘a during eight weekend days in November. On years where rainfall results in larger populations, the season could be extended. Historic difficulty in securing additional hunter check station volunteers for this season is a limiting factor.

Turkey hunts are currently held on unencumbered lands, the mauka hunting areas and the PWWFBS during the last three weekends of January and the last two weekends of March. The January hunt is open to all hunters while the March hunt is for youths only. Turkey hunting seasons are separated from other bird seasons because hunters are completely concealed in camouflage clothing and attempt to call birds to their location. Mixing other types of hunting in the same area would pose a significant safety hazard. There has been an increase in requests to open spring turkey hunting for all hunters in Pu‘u Wa‘awa‘a. Post-season surveys suggest that a large number of gobblers survive current turkey hunting seasons in Pu‘u Wa‘awa‘a, and that there is room to accommodate additional hunting. The turkey seasons have had little impact on DOFAW resources as the volunteers have operated the hunter check station effectively.

Peafowl hunts occur currently on unencumbered lands, the mauka hunting areas and the PWWFBS during November. Prior to that season, bird hunters were not legally allowed to keep young peafowl caught by bird hunting dogs. Today there is a growing desire to harvest mature full plumage peacocks in the spring rather than in the fall when their feathers are still developing. There are very few, if any, places in the United States where bird hunters can come to a place such as Pu‘u Wa‘awa‘a to hunt this exotic species.

Proposed actions: Expand bird hunting opportunities when annual game bird production warrants increased season lengths.

Objective 38. Manage pasture vegetation via grazing to provide game bird habitat

Background: Areas of Pu‘u Wa‘awa‘a with large expanses of rank fountain grass are of little value to game birds. Similarly, game birds will not utilize an area that has been extensively overgrazed due to lack of cover. If effectively managed, livestock grazing can help to break up areas of dense fountain grass cover, creating vegetation edges with scattered openings that is favorable game bird habitat. Game birds are also attracted to cow manure as they scratch and look for dung beetles.

Proposed actions: Utilize grazing as a tool to create game bird habitat within the current lease area. Selected paddocks will be placed under a grazing regime that promotes residual vegetation structure favorable for game bird habitat.

Objective 39. Encourage game species research within Pu‘u Wa‘awa‘a

Background: The State of Hawai‘i is home to 13 different species of game birds and six species of game mammals - all of them introduced from other parts of the world. Information regarding the basic life history characteristics of these animals and birds in the Hawaiian environment is limited.

Proposed actions: Establish agreements with educational and research institutions to conduct game mammal and game bird research programs.

Objective 40. Develop a bird dog training area within Pu‘u Wa‘awa‘a

Background: Trained bird dogs conserve the game resource by maximizing recovery of downed birds. A bird hunting dog must be trained to run a quartering pattern within range of the hunter; to locate and hold game; to remain steady to wing and shot; and to retrieve downed birds. Up to 18 months of weekly training exercises to establish basic performance in a novice dog, coupled with subsequent training over the life of the dog may be required. There are currently no public areas available for conducting dog training on a year-round basis. Bird dog owners need a suitable location to train dogs over live birds during the off-season, and no training can be complete without birds being shot over bird hunting dogs. While the Kaohe Game Management Area and the Pohakuloa Training Area are available to "run" dogs immediately prior to the bird

hunting season, no shooting is permitted. Pu‘u Wa‘awa‘a provides a potential training location in which to conduct this activity.

Proposed Actions: Designate an area acceptable for bird dog training, and issue permits to interested individuals and clubs for periods when bird dog training would not interfere with other planned management activities in the ahupua‘a.

Objective 41. Fund and hire one permanent position to implement management objectives for hunting management within Pu‘u Wa‘awa‘a

Background: The list of objectives in this Plan dictates the need for permanent staff dedicated solely to the management of hunting programs within Pu‘u Wa‘awa‘a.

Proposed actions: Fund and hire one position to implement and oversee hunting programs within Pu‘u Wa‘awa‘a.

VII. Trails, Access and Ecotoursim

A. Context:

Trails and roads are important management tools that provide access for fire suppression, hunting, resource monitoring and research, recreational use, and the potential for commercial ecotourism activities. Current trail management efforts in this ahupua‘a involves the identification of mauka-makai trails that qualify as non-vehicular rights-of-way trails under the 1892 Highways Act, and inventory of other trails. Such identification will help ensure protection of historic trails from development, and documents the existence of these features for cultural value and potential public use. The Na Ala Hele program has identified the following trails and trail segments within and adjacent to the ahupua‘a of Pu‘u Wa‘awa‘a and Pu‘u Anahulu:

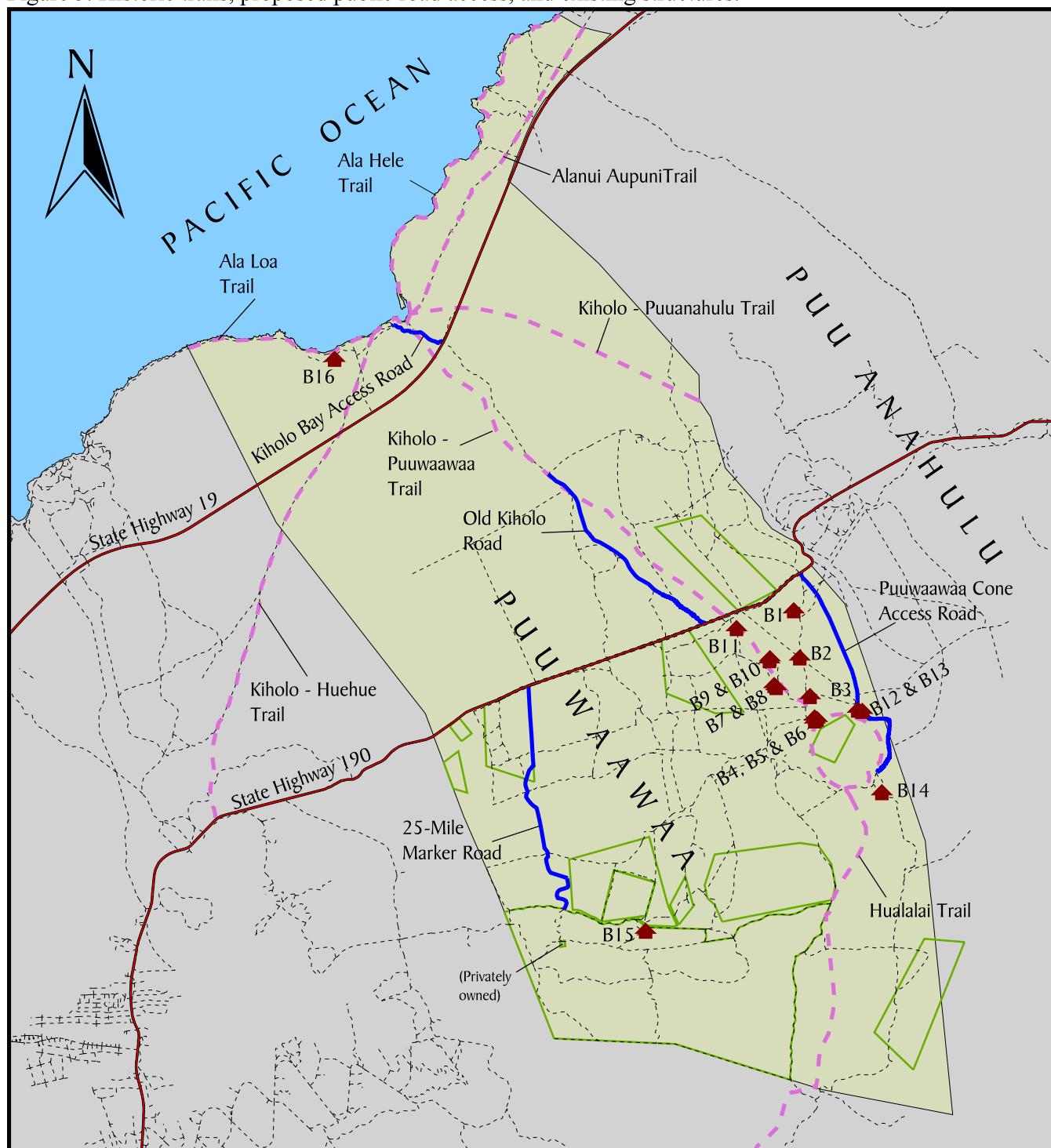
Trail name	Estimated length (miles)
1. Kiholo - Pu‘u Wa‘awa‘a Trail	9.7
2. Kiholo – Pu‘u Anahulu Trail	4.0
3. Kiholo - Huehue Trail	6.9
4. Ala Loa	3.2
5. Ala Hele	5.5
6. Alanui Aupuni Trail	4.5
7. Hualalai Trail	7.5
Total	41.3

These seven trails (Figure 5) are hereafter referred to as “historic trails.” The National Park Service is currently preparing management plans for the Ala Kahakai island-wide, which will include oversight of the Ala Loa and Ala Hele segments passing through Pu‘u Wa‘awa‘a and Pu‘u Anahulu. The Kiholo - Huehue Trail extends beyond Pu‘u Wa‘awa‘a to the south across lands owned by Kamehameha Schools, ending at highway 190. The Hualalai Trail extends beyond Pu‘u Wa‘awa‘a to the south across lands owned by Kamehameha Schools, ending at the summit of Hualalai.

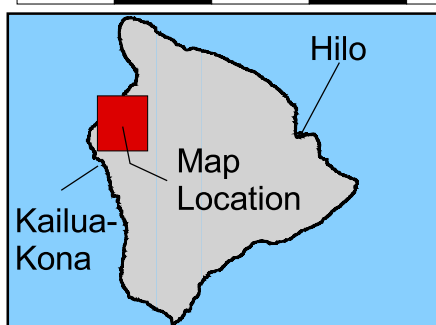
Very few Hawaiian caves or lava tubes are available to the public for recreational purposes. Hawai‘i Volcanoes National Park offers at least two caves for public use. The County of Hawai‘i also recognizes the importance of recreational caving and created Kaumana Cave County Park in the suburbs of Hilo. While State-managed lands on the Island of Hawai‘i contain numerous lava tubes, none are currently managed primarily for recreational caving. If cultural, archaeological, and biological surveys indicate that selected caves or lava tubes do not have sensitive or important resource values, they may be designated for recreational or ecotourism use. Current maps and associated databases of known cave and lava tube resources will be maintained to insure that activities associated with other objectives proposed in this Plan will not adversely impact these important resources.

The lands of Pu‘u Wa‘awa‘a offer a quality setting for a range of activities that would be appropriate for commercial use, particularly when coupled with management strategies and goals presented in this Plan Plan. Any commercial ecotourism on the ahupua‘a must support the goals of the Management Plan. Those submitting proposals for fee-based ecotourism activities will be

Figure 5. Historic trails, proposed public road access, and existing structures.

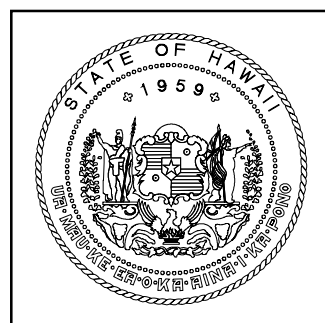


1 0 1 2 3 4 5 Miles



Map produced by Michael Constantinides
Division of Forestry and Wildlife
808-587-4186 January 2003

- Proposed Conservation Units
- Historic trails
- Proposed public road access
- ◆ Existing structures
- Secondary roads



encouraged to include a focus on cultural and environmental interpretation opportunities. The cultural and environmental education component of this Management Plan will provide support for such activities where appropriate. All operators will be required to train and educate their personnel on the various environmental, cultural and social conditions of the ahupua‘a including objectives of the Management Plan.

B. Annual Operations:

DOFAW crews conduct trail restoration and maintenance work in these ahupua‘a for selected historic trails. Examples include: Replacement of a small bridge crossing; reconstructing a section of the Ala Kahakai eroded by high surf and; clearing and restoring a section of the Kiholo-Huehue Trail under the Bakken Land Exchange Agreement.

C. Management Objectives:

Objective 42. Survey and develop historic trails within and adjacent to the ahupua‘a for public use

Background: Some trail segments were used by ancient Hawaiians and have considerable historic significance. Current map data for historic trail locations are incomplete. Some trail map segments are based on alignments designated by the U.S. Geological Survey in 1930. Other trail segments have been moved, lost, or obliterated and their current map locations are either estimated or aligned with newer four-wheel drive roads. A modern, comprehensive survey of the historic trails in and adjacent to Pu‘u Wa‘awa‘a is required to support the additional objectives of the Management Plan. After the completion of survey work restoration of historic trails will enhance the potential for public uses such as, cultural gathering, hiking, hunting, fishing, recreation and ecotourism.

Proposed Actions: Locate, flag and survey historic trails utilizing global positioning technology in coordination with the State Office of Historic Preservation. Determine the necessity for drafting Cultural Mitigation Plans prior to conducting maintenance and improvement operations for all historic trails. Develop and post signage. Develop interpretive trail and access road brochures. The Pu‘u Wa‘awa‘a Advisory Council will develop recommendations for the use of historic trails.

Objective 43. Document Current Public Use of the Kiholo Bay Area

Background: Understanding how the public use the area is an essential task in park management and planning. Current public use includes unregulated camping on unencumbered State land, as well as on the three-acre State Park Reserve. The full extent of current uses and their impacts have not been fully documented. Inappropriate as well as appropriate uses of the area should be addressed. The Division of Conservation and Resources Enforcement monitors public use and enforces applicable State regulations on all State-managed lands within the Kiholo area. In addition to monitoring some public

activity in the area, Dr. Earl Bakken and his associates have also prepared a Public Access Plan. This Plan includes implementing actions designed to comply with public access conditions in Dr. Bakken's land exchange agreement with the Department. New and increased public use of the ahupua'a is expected to arise from this plan. All public uses proposed in this plan must be documented and incorporated into management planning efforts in a way that does not conflict with traditional and customary uses of the ahupua'a.

Proposed Actions: Conduct a study of public use in the Kiholo Bay area and develop compatibility standards to address public use throughout the ahupua'a.

Objective 44. Construct new trail segments as needed

Background: In addition to survey and development historic trails, new trail segments are needed to provide access to scenic areas, vista points, and provide balance for both typical trail use interests as well as ecotourism activities.

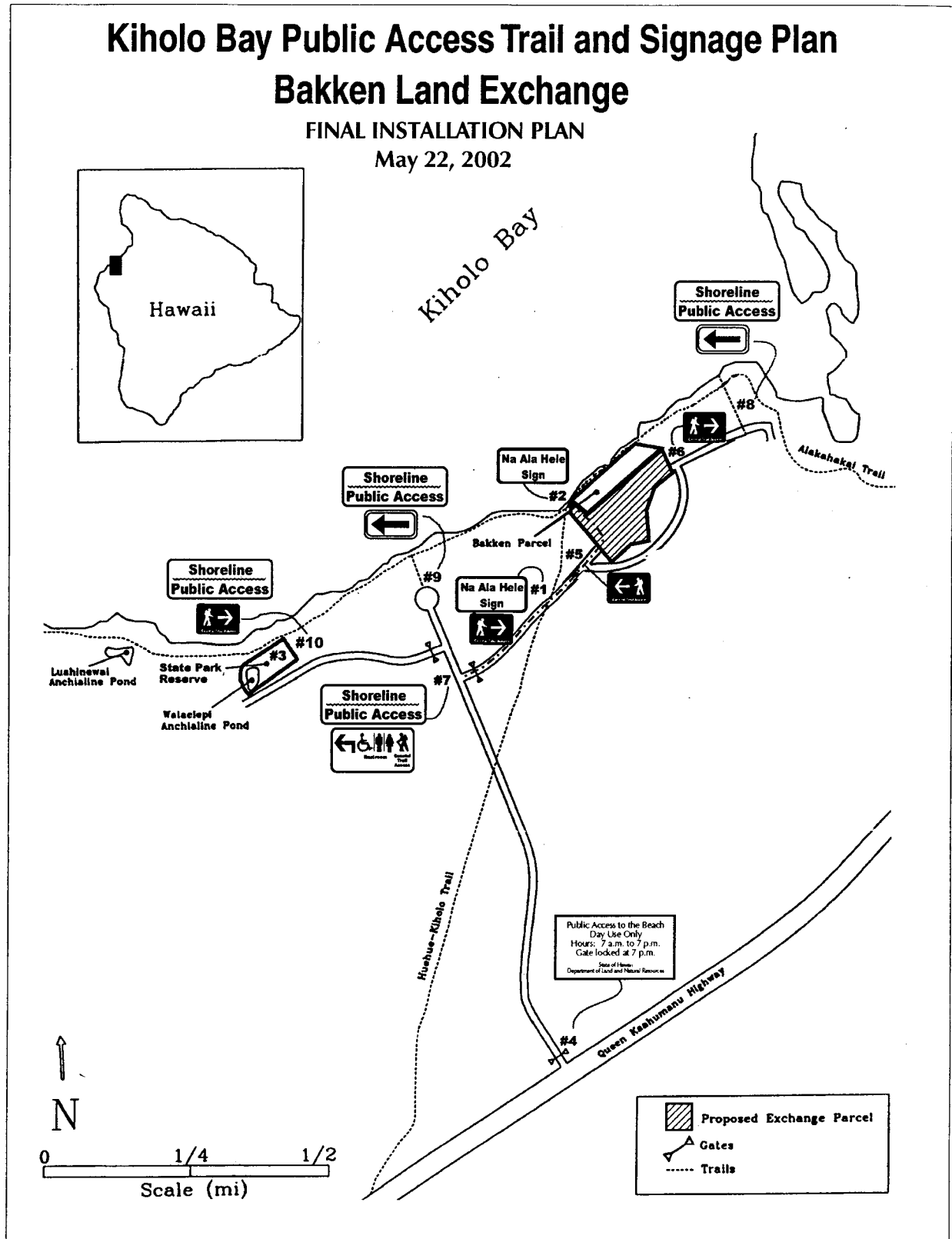
Proposed Actions: Construct new trail segments that provide access to Pu'u Wa'awa'a cone, and can accommodate recreational pursuits such as mountain biking and horseback riding. Draft an Environmental Assessment to determine the feasibility and potential impacts of new trails and access for multiple recreational and commercial uses.

Objective 45. Provide public access to Pu'u Wa'awa'a on selected roads

Background: Selected roads (Figure 5) will be opened for public access when they can be properly developed and managed. During periods of high fire hazard potential or during selected hunting seasons, DOFAW may post and limit such access. In 2001 Dr. Earl Bakken, owner of an in-holding within the proposed park area, gave a three acre parcel at the shoreline (the former Loretta Lynn parcel) to DLNR in exchange for other lands at Kiholo. As a part of the land exchange agreement, Dr. Bakken committed to providing portable toilets and a trash container at the three-acre parcel, and to open and close the main access gate for a period of 5 years. The 5-year period began July 2, 2001 and will end July 2, 2006. Thereafter, the Division of State Parks will manage and maintain the three-acre area, now designated as a State Park Reserve. During 2001-2002, Dr. Bakken and his consultant worked with the State Parks' staff to develop and post appropriate public access signage for the coastal area between Kiholo Bay and Luahinewai to better manage public use. Figure 6 presents the layout of the public access trails, the signs and the wording used on each sign.

Proposed Actions: Proposed public access roads include the Kiholo bay access road, the Old Kiholo road, the 25-Mile Marker road, and the Pu'u Wa'awa'a cone access road. Composting toilets will be sited and maintained on the 25-Mile Marker road at the base of the PWWFBS and at the Pu'u Wa'awa'a cone trail head. Two additional composting toilets will be sited at Kiholo bay after DLNR assumes responsibility for supplying and maintaining the material infrastructure and management support provided by Dr. Bakken at Kiholo bay beginning on July 2, 2006.

Figure 6. Kiholo State Park Reserve, North Kona, Hawaii.



Objective 46. Manage short- and long-term commercial ecotourism activities

Background: All commercial ecotourism activities must be compatible with the overall Management Plan. Some activities have the potential to commence relatively quickly and with little support or infrastructure. Others will require a longer planning process, or will require one or more of the objectives in this Management Plan to be completed. Proposals from potential ecotourism operators will be evaluated using criteria such as compatibility with public use as well as other Management Plan activities, a proven track record, sound fiscal and marketing expertise, and delivery of a quality product. The DOFAW Na Ala Hele Commercial Trail Tour Activity model could be used to administer and manage ecotourism activities at Pu‘u Wa‘awa‘a.

Proposed actions: The Pu‘u Wa‘awa‘a Advisory Council will convene an Ecotourism Subcommittee with the mandate to develop requirements and guidelines for immediate development of activities such as: 1) Guided interpretive hikes with four-wheel drive support, 2) Bird watching, 3) Horseback riding, 4) Caving, 5) Ranch or “dude activities, 6) Multi-day hike, camp, beach excursions, 7) Snorkeling, 8) Kayaking, 9) Multi-day stays with various activities and lodge camping, 10) Integrated trekking tours with other landowners, and 11) Overnight pack trips with horses. The Ecotourism Subcommittee will determine how ecotourism activities will be administered.

Objective 47. Fund and hire permanent field staff to implement management objectives for trails and access projects and the proposed Kiholo State Park, and support enforcement within for both ahupua‘a

Background: The diverse list of objectives proposed in this plan dictates the need for new permanent positions dedicated solely to the management of public activity, services and resources in Pu‘u Wa‘awa‘a and the makai area of Pu‘u Anahulu.

Proposed actions: Fund and hire: one position to implement and oversee trail and access programs and ecotourism activities; two positions to provide enforcement in the entire project area; and three positions to oversee service-related management activities (including gate operation and trash removal) in the proposed Kiholo State Park.

VIII. Cultural and Archeological Resources

A. Context:

Both Pu‘u Wa‘awa‘a and Pu‘u Anahulu have rich cultural and historical traditions. Most prehistoric human activity was centered in coastal areas. However, evidence of past human use is also present at higher elevations. Ancient Hawaiians undoubtedly harvested koa and other forest products from the uplands. Birds were collected for meat and feathers. Flakes of Pu‘u Wa‘awa‘a obsidian or volcanic glass were used by ancient Hawaiians to make small but extremely sharp cutting tools (Handy and Handy, 1972). Under the leadership of “Ehu”, during the 1500’s, the villagers cultivated banana, sugar cane, sweet potatoes, and yams (Kelley, 1996). This history illustrates the hunting, gathering and later agricultural heritage of the area. The many trail systems leading to and from the area suggest that inhabitants of Pu‘u Wa‘awa‘a and Pu‘u Anahulu had extensive interactions with people from surrounding communities.

Volcanic caves are abundant within the ahupua‘a of Pu‘u Wa‘awa‘a, and are important in Hawaiian culture. Several names (ana, lua, pao and a‘a‘a) are associated with these formations, all of which have similar meanings. In the past native Hawaiian people used lava tubes and rock caverns for many purposes including shelter, water catchment, food storage, and personal protection. Ancient Hawaiian burials and charcoal from torches are found in the lava tubes of Pu‘u Wa‘awa‘a. Some passages have man-made structures such as rock platforms, trails paved with smooth stones, fire pits, calabash cradles for catching water and rock walls. Live or freshly killed animals were apparently carried into caves where they were consumed and their remains discarded on the floor. Midden deposits in some shelter caves contain nene and dark-rumped petrel bird bones and marine invertebrate shells.

Handy and Handy (1972) described how Hawaiians living in the Pu‘u Wa‘awa‘a area (Kekaha) obtained their drinking water from caves. According to the account, troughs three to six feet deep and shaped like a canoe hull were made from ‘ohi‘a, koa, and kukui wood. These containers along with gourds and wooden calabashes were used to collect water dripping from the ceiling of caves. Kukui nut torches were said to be used, as a light source while collecting water in dark cave interiors. Ancient Hawaiians often used caves as burial sites for their dead. Skeletal remains were generally wrapped in tapa cloth bundles and placed on ledges or in walled recesses. The disturbance of native Hawaiian remains is prohibited.

Ranching activities in this area started in the 1880’s with goat herding. Subsequently sheep, and finally cattle herding dominated grazing activities. Cattle herding continues to the present day, and has been practiced continuously for over 100 years.

Ancestors of the Hui ‘Ohana and families from neighboring ahupua‘a are an integral part of the history of the Napu‘u. Their bones are part of the land, and the work of their hands is part of the cultural landscape making Napu‘u a unique Hawaiian place. These residents will be encouraged to participate by providing cultural guidance and participating in the implementation of this plan.

B. Annual Operations:

No annual operations relating to cultural and archeological resource management currently exist.

C. Management Objectives:

Objective 48. Conduct a comprehensive cultural and archaeological survey of Pu‘u Wa‘awa‘a and the makai portion of Pu‘u Anahulu

Background: Very few archaeological investigations have been completed in the ahupua‘a of Pu‘u Wa‘awa‘a and Pu‘u Anahulu. Although a limited archaeological reconnaissance has been conducted for the coastal areas, additional work is needed for a comprehensive archaeological inventory survey. Land managers require such knowledge to effectively manage such resources and to mitigate potential impacts to cultural and archaeological resources while implementing other management objectives.

Proposed Actions: Procure the services of a cultural and archaeological specialist to conduct a comprehensive survey of the ahupua‘a to determine the location and condition of historical sites, including cave resources. This survey will also include recommendations for restoring and preserving exemplary sites, and propose rules and regulations needed to protect caves and related resources.

Objective 49. Protect and Restore Cultural Sites

Background: The lack of a comprehensive cultural survey to date has limited preservation and restoration activities for cultural sites.

Proposed Actions: After a comprehensive cultural and archaeological survey has been completed, protect and restore important cultural and archeological sites. Develop access to less sensitive sites for educational purposes as well as for traditional cultural practices.

Objective 50. Establish protocol for sustainable traditional and cultural gathering

Background: DOFAW was a contributor to, and supports the recommendations of the 1994 Hawai‘i Tropical Forest Recovery Action Plan. The Action Plan called for sensitivity to, and accommodation of traditional and cultural rights for both native Hawaiian and local communities. Unfortunately many people take what resources they can find with no regard for the concept of sustainability, and many valuable resources have become gravely degraded. While government-managed natural resources are publicly owned, stewardship responsibilities are commonly disowned or left to under-funded agencies. There is an opportunity to demonstrate new natural resource stewardship models in Pu‘u Wa‘awa‘a and the makai area of Pu‘u Anahulu that respect the rights of native Hawaiians and local communities but re-establish the responsibilities attached to those rights in a culturally appropriate fashion. Themes central to the success of such a new approach for public resource management will be cooperation, and a mutual respect for the rights and interests of others.

Proposed Actions: Convene a workshop to identify native Hawaiian traditional values and cultural concerns including gathering, recreation, and replenishment. Workshop participants will establish a protocol for sustainable traditional and cultural gathering.

IX. Cultural and Environmental Education Program Development

A. Context:

The ahupua‘a of Pu‘u Wa‘awa‘a has the potential to function as a rich backdrop for both cultural and environmental education programs. When managed with a commitment to maintain and restore the ahupua‘a as described in the Management Plan, Pu‘u Wa‘awa‘a promises to provide educational opportunities for a wide range of people including schoolchildren, community groups, university researchers, and international visitors.

The success of the Management Plan depends on the support of the public and community involvement. The community will only support the Plan if it has a good understanding and appreciation of the value of the resource and an understanding of the management challenges, goals, and philosophies inherent in the Plan. In this regard, the importance of cultural and environmental education programs is underscored. Community values and Management Plan objectives must be integrated with educational curricula aimed at increasing knowledge in cultural history, biodiversity, and resource management.

B. Annual operations:

No annual operations relating to cultural and environmental education currently exist.

C. Management Objectives:

Objective 51. Fund and hire an education center staff to initiate education and volunteer programs

Background: An interactive education curriculum will be designed to incorporate several components including native Hawaiian culture, restoration of native plants and animal communities, science and research, livestock grazing practices, and ecotourism activities. In this regard, the education center curriculum will apply Management Plan concepts to inspire participation and involvement from the community, schools, youth organizations, visitors, universities, and corporations.

Aside from hunting and both camping and fishing activity at Kiholo Bay, there is presently little public use of and exposure to the ahupua‘a of Pu‘u Wa‘awa‘a and Pu‘u Anahulu. Raising community interest in these areas will benefit the resources therein. An effective volunteer program would aid in natural resource stewardship and accomplishment of management objectives by providing assistance with labor intensive management efforts while simultaneously providing an environmental educational benefit. Some volunteer groups are already participating in projects within Pu‘u Wa‘awa‘a, but the program needs to be greatly expanded.

Proposed actions: Fund and hire an Education Program Coordinator and a Volunteer Coordinator. The Education Coordinator will oversee the development and implementation of education programs such as youth teaching youth, training employment, cross-training protocol for partners, scout activities, five-day sea and land program, and summer youth employment in cooperation with the Workforce Development Division. Such activity will include leading these groups on field trips. The Education Coordinator will also encourage cooperative agreements with research organizations, develop informational literature describing cultural and biological components of the resources in Pu‘u Wa‘awa‘a and Pu‘u Anahulu, and promote activities and educational programs related to these materials.

The Volunteer Coordinator will develop and oversee a volunteer program to conduct service trips designed to support the objectives of this Management Plan. Such service trips will aid in the dissemination of cultural and environmental information through hands-on work projects and tours within the Sanctuary, the proposed Kiholo State Park and other lands in the ahupua‘a. The Volunteer Coordinator will also support the activities of the Education Coordinator.

X. Facilities and Infrastructure

A. Context:

Most of the facilities and infrastructure (hereafter referred to as improvements) within Pu‘u Wa‘awa‘a were constructed to support grazing operations. Existing improvements in the area include 16 structures (Figure 5), approximately 133 miles of roads, 4 water sources, approximately 30 miles of waterlines, miles of fences and rock walls, and an airplane landing strip. These improvements exist in various states of repair, though most require immediate repairs or upgrades. Most of the existing structures within Pu‘u Wa‘awa‘a do not have valid building permits and require immediate repairs or upgrades. Prior to DOFAW and State Parks assuming control of Pu‘u Wa‘awa‘a and these structures from the Land Division, the three Divisions will discuss what basic repairs and upgrades are required, and develop a plan for cost sharing.

Water is required to support a majority of current and proposed activities in the ahupua‘a including fire suppression, plant propagation, forest restoration, livestock grazing, recreation and wildlife management. Existing water sources and transmission systems within Pu‘u Wa‘awa‘a (Figure 7) have the potential to support all of the proposed activities, but many require development or repair. Two reservoir sites, a water catchment site, and two wells exist within Pu‘u Wa‘awa‘a. The Meeting House and Poohooohoo reservoirs are currently operable at only a fraction of their capacity due to disrepair. The Halepiula catchment site is currently inoperable. Water for the area is presently supplied by a private well from which water must be purchased at high cost. Most existing waterlines are old galvanized pipe in need of replacement. The standpipe at the hunter check station is essential for filling tankers participating in fire suppression activities.

The existing road system within Pu‘u Wa‘awa‘a is sufficient to support all management needs at this time. Approximately 4 miles are paved and 129 miles are unimproved four-wheel drive surfaces. While no additional roads are currently needed, existing roads will require a continual maintenance program. The airplane landing strip is currently operational.

B. Annual operations:

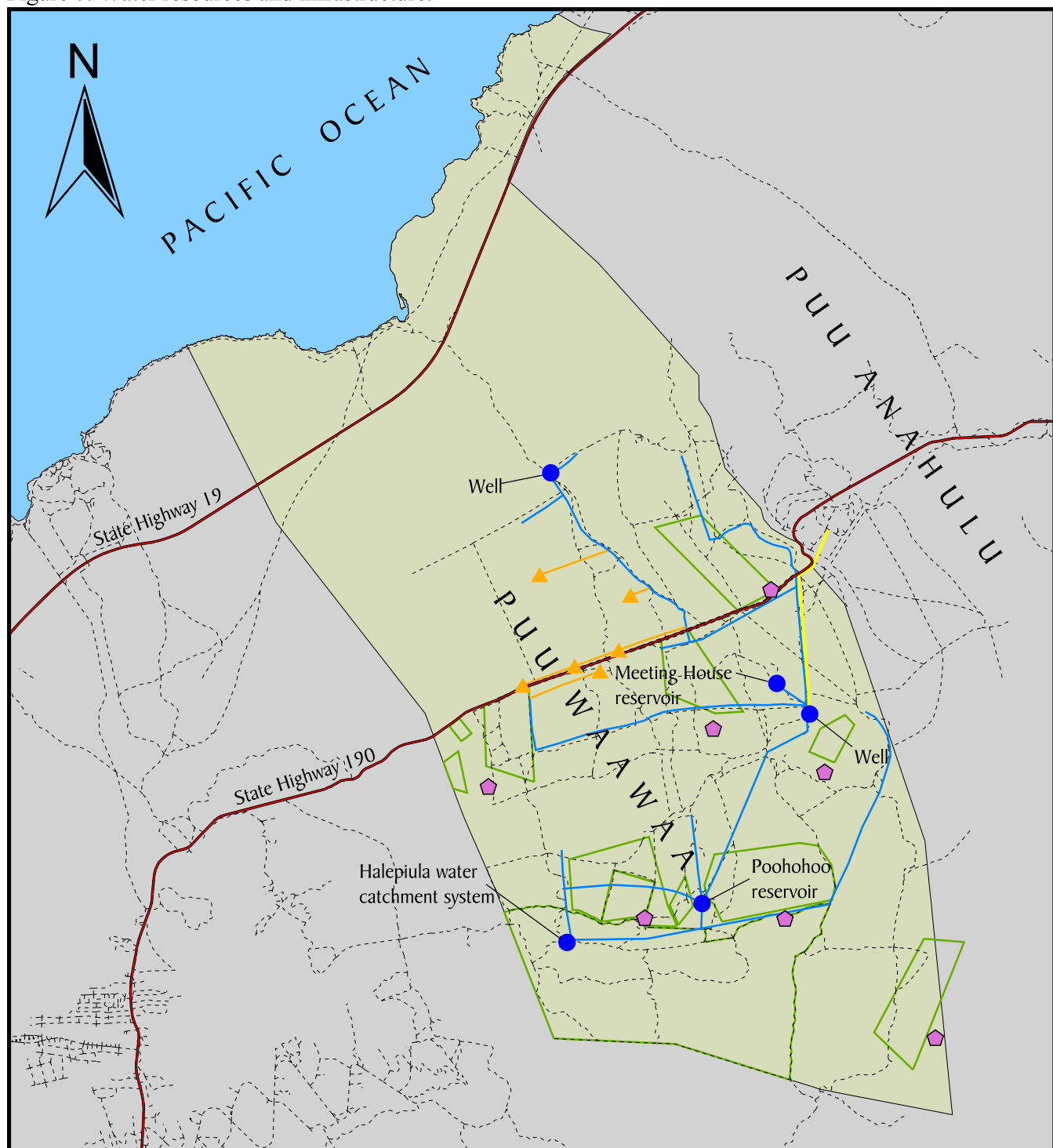
No annual operations relating to improvements currently exist.

C. Management Objectives:

Objective 52. Upgrade and maintain Structures B3, B4, B5, B6, B8, B10, B12, B13, B14 and B15 to support Management Plan operations and objectives

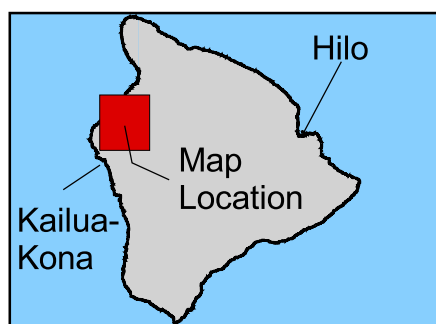
Background: Effective field management, education and research operations at Pu‘u Wa‘awa‘a will require office space and staff housing with supporting infrastructure. Structures B3, B12, and B13 were built in the 1960’s - B12 is a Quonset hut while B13

Figure 7. Water resources and infrastructure.

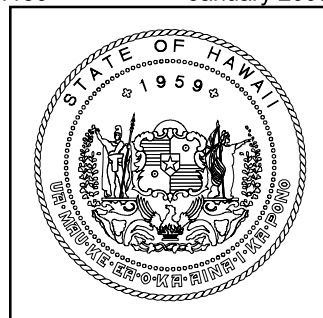


1 0 1 2 3 4 5 Miles

Map produced by Michael Constantinides
Division of Forestry and Wildlife
808-587-4186 January 2003



- 8" water main
- Existing water lines
- Proposed water lines
- Water sources
- ◆ Proposed water tanks
- ▲ Proposed water troughs
- Proposed Conservation Units
- Secondary roads



is of cinder block construction. The flooring of B13 contains asbestos and will require cleanup. B4, B5 and B6 were built in the 1940's. B8, B10 and B14 were built in the 1970's. B15 was built in 1991 and is designated for official DOFAW use only. Structure B3 is currently occupied. B8 and B14 are known as the "Lake House" and the "Protea House," respectively.

Proposed actions: These structures will be upgraded to meet County code and painted. Structure B12 will be upgraded to accommodate up to 20 volunteers. Asbestos cleanup will be conducted for B13.

Objective 53. Upgrade Structures B1, B2 and B9 for use by livestock permittee

Background: Structures B1 and B2 were built in the early 1960's and Structure B9 was built in the late 1970's. B2 is currently occupied. B9 is a hanger that is not walled on one side and is equipped with restrooms. These three Structures will be dedicated to use by the livestock permittee while implementing Management Plan grazing operations.

Proposed actions: Upgrade to meet County code and paint structures.

Objective 54. Establish an education center at Structure B7

Background: Structure B7 was built by ranch lessees for the purpose of entertainment, and is known as "The Pu'u Wa'awa'a Meeting House." Pu'u Wa'awa'a provides a good setting for a hands-on, interactive education center. Here visitors can participate in activities that demonstrate the relationships between the environment and traditional and current human land-use practices. Structure B7 will be used as a public information and education center for interpreting plant and animal resources of the surrounding area.

Proposed actions: Upgrade to meet County code and paint structure. Convert Structure B7 to an education center facility, initially including one classroom. Construct interpretive kiosks and learning stations at the Center and throughout the ahupua'a to support field studies.

Objective 55. Demolish and remove Structure B11

Background: Structure B11 is an iron sheet warehouse. The frame is termite infested and the warehouse is in a degraded condition beyond reasonable repair.

Proposed actions: Demolish and dispose of Structure B11.

Objective 56. Upgrade Cultural and Environmental Education facilities

Background: All DLNR divisions have an interest in the management of coastal resources in the Kiholo Bay area. Structure B16, the former Loretta Lynn residence, is located on the three acre State Park Reserve parcel near the coast. Conversion of this structure into a DLNR interpretive center and DLNR staff office would directly facilitate

implementation of the wide range of objectives proposed in this Plan. The setting and infrastructure at Structure B7, the Pu‘u Wa‘awa‘a Meeting House, also provides great potential for supporting cultural and educational programs.

Proposed actions: The following items and facilities will be developed or constructed at or adjacent to Structure B7: Greenhouse; summer youth camp; children's hands on nature museum; conversion of Structure B7 to an education Center facility, including capability to support conferences, workshops, research and a summer student exchange programs. The following upgrades will be made to Structure B16: upgrade to meet County code and paint structure; convert house to an interpretive center and office facility; bring in utilities and install ADA accessible ramps; install interpretive kiosks and learning stations with a focus on resources of the Kiholo Bay area. Support of programs and activities at both locations will include: website development; interactive education materials integrating Hawaiian language and culture for publishing; establish interpretive trails; and public relation strategies to ensure on-going community involvement.

Objective 57. Repair water reservoirs and tanks at three existing sites

Background: The Meeting House reservoir and Poohoohoo reservoirs are located at 2,300 and 3,800 foot elevations, respectively. The Halepiula site is comprised of two tanks and a water catchment apron, located at 4,600 foot elevation. The Halepiula tanks once served the entire ahupua‘a, but are currently inoperable due to leaks and sediment buildup. Each tank is designed to hold 35,000 gallons, and in years of adequate rainfall these tanks can supplement water supplies at both reservoirs. Collectively these water storage facilities are critical requirements to support all aspects of the Management Plan.

Proposed actions: Clean out reservoirs and tanks, install new liners, install new polyethylene piping. Demolish or refurbish old catchment surface at Halepiula site and construct a replacement. In dry years, water must be purchased to keep the Pu‘u Wa‘awa‘a Meeting House reservoir full.

Objective 58. Install seven new water catchment tanks in Pu‘u Wa‘awa‘a

Background: Most conservation units will require a water source in close proximity (Figure 7) to: support fire suppression; livestock grazing along conservation unit fence lines for fine fuel control; supply water for herbicide use during weed control operations; and provide an irrigation source for newly planted seedlings of rare and endangered plants within conservation units.

Proposed actions: Construct seven 10,000 gallon galvanized metal catchment tanks in close proximity to the proposed conservation units. Place a catchment surface on top of each tank. Water tanks will be pipe fitted to allow connection with fire engines and water tankers.

Objective 59. Upgrade and expand existing waterline system

Background: Additional waterline infrastructure is required to support multiple objectives proposed in this Management Plan. Kileo conservation unit is not on the primary waterline system and will be serviced only by one of the tanks proposed in Objective 59.

Proposed actions: Replace 20 miles of existing galvanized waterline with polyethylene pipe. Install nine additional miles of new polyethylene waterlines, with 12 water troughs to support livestock grazing and wildlife management objectives. Install waterline spurs from main grid to all conservation units (except Kileo) including required valves and fittings. Waterlines will be pipe fitted to allow connection with fire engines and water tankers.

Objective 60. Repair and maintain existing roads within Pu‘u Wa‘awa‘a

Background: Many miles of roads within Pu‘u Wa‘awa‘a require repairs. After repairs are completed, a maintenance program for all roads will be established.

Proposed actions: Maintain two miles of paved roads between Highway 190 and the structures at Pu‘u Wa‘awa‘a Cone annually. Allow two miles of paved road leading to Structure B12 to revert to unimproved status. Initiate a scheduled rotation of grading and associated maintenance for all unimproved roads within Pu‘u Wa‘awa‘a.

Objective 61. Maintain the airplane landing strip

Background: One section of the existing landing strip will be maintained to support helicopter operations during fire suppression activities.

Proposed actions: Airstrip maintenance.

Objective 62. Develop a Public Shooting Range

Background: The Big Island presently has no public shooting range. There is a major need for a dedicated shooting range facility for users including the County Police Department, the State Division of Conservation and Resource Enforcement, National Parks Service Enforcement, other enforcement agencies and the public. Several of these entities will provide support for the development and operation of such a facility.

Proposed actions: Design a construct a shooting range facility at the old quarry or another designated site, including supporting infrastructure and noise mitigation measures.

				XI. Projected ten-year budget										
							Total Cost							
	Item description	Funded 1=yes 2=no	Funding Source	Quan.	Units	Unit Cost	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10-13	Line Item Totals
	Administrative priorities													
	<i>Objective 1. Legislation</i>													
	Staff time for drafts, correspondence and meetings	1	E	50	hour	25	1,250							1,250
	<i>Objective 2. Park master plan</i>													
	Master plan and associated requirements	2	X	1	contract	350,000						350,000		350,000
	<i>Objective 3. Develop new DOFAW administrative rules</i>													
	Staff time for drafts, correspondence and meetings	1	E	400	hour	25	8,000	2,000						10,000
	<i>Objective 4. Fund and hire a Management Plan Coordinator</i>													
	Coordinator (including fringe)	2	EHXZ1	1	staff	75,000	75,000	75,000	75,000	75,000	75,000	75,000	300,000	750,000
	Coordinator vehicle	2	EHXZ1	2	each	40,000	40,000					40,000		80,000
	Annual vehicle maintenance	2	EHXZ1	1	each	5,000	5,000	5,000	5,000	5,000	5,000	5,000	20,000	50,000
	SUBTOTAL						129,250	82,000	80,000	80,000	80,000	470,000	320,000	1,241,250

			XI. Projected ten-year budget											
						Total Cost								
	Item description	Funded 1=yes 2=no	Funding Source	Quan.	Units	Unit Cost	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10-13	Line Item Totals
	Fire Management													
	Objective 5. Fire hazard educational programs													
	Fire prevention educational materials	1	A	1	set	1,500	1,500	1,500	1,500	1,500	1,500	1,500	6,000	15,000
	Fire prevention education	1	AE	20	hour	25	500	500	500	500	500	500	2,000	5,000
	Signage	1	E	1	set	25,000	25,000							25,000
	Signage maintenance	1	E	9	year	500		500	500	500	500	500	2,000	4,500
	National Fire Danger Rating signs	2	AE	2	each	1,500	3,000							3,000
	Objective 6. Fire prevention program													
	Annual fire training courses	1	ACDE	1	year	20,000	20,000	20,000	20,000	20,000	20,000	20,000	80,000	200,000
	Fund and hire mechanic	2	ABCDE	1	each	45,000	45,000	45,000	45,000	45,000	45,000	45,000	180,000	450,000
	Firebreak signage for Puuwaawaa	1	A	1	set	9,000	9,000							9,000
	Fire access road map	1	AEH	80	hour	25	2,000							2,000
	Fire break widening project	2	G	1	each	94,000	94,000							94,000
	Fire break - annual maintenance	2	ABCDE	1	year	30,000	30,000	30,000	30,000	30,000	30,000	30,000	120,000	300,000
	Annual maintenance - signage	1	E	1	year	1,000	1,000	1,000	1,000	1,000	1,000	1,000	4,000	10,000
	Protection vehicle	2	ABCDE	2	each	40,000	40,000					40,000		80,000
	Spray rig vehicle	2	ABCDE	1	each	55,000	55,000							55,000
	Annual vehicle maintenance	2	ABCDE	2	each	5,000	10,000	10,000	10,000	10,000	10,000	10,000	40,000	100,000
	Biological control research	2	ABCDE	1	each	100,000	100,000							100,000
	Annual Maintenance for RAWS weather station	1	A	1	year	1,500	1,500	1,500	1,500	1,500	1,500	1,500	6,000	15,000
	Objective 7. Fire pre-suppression for ungulate exclosures													
	ATV with spray rig	2	BCDFHIJ	8	each	7,500	30,000					30,000		60,000
	Annual ATV maintenance	2	BCDEFHI	4	each	500	2,000	2,000	2,000	2,000	2,000	2,000	8,000	20,000
	Objective 8. Wildland fire suppression													
	Average fire incident occurrence and cost	1	E	2	incident	150,000	150,000					150,000		300,000
	SUBTOTAL						619,500	112,000	112,000	112,000	112,000	332,000	448,000	1,847,500

						XI. Projected ten-year budget											
						Total Cost											
	Item description	Funded 1=yes 2=no	Funding Source	Quan.	Units	Unit Cost	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10-13	Line Item Totals			
Natural Resources Management																	
	Objective 9. Construct and maintain conservation unit fences																
	Fencing material (Contractor Built)																
	Waihou Exclosure Phase I	1	BFHI	2.2	mile	20,454	45,000							45,000			
	PWWFBS Phase I	2	BFHI	3.0	mile	40,000	120,000							120,000			
	Aiea Exclosure	2	BFHI	1.3	mile	40,000		52,000						52,000			
	Waihou Exclosure Phase II	2	BFHI	2.3	mile	40,000			92,000					92,000			
	PWWFBS Phase II+B77	2	BFHI	10.0	mile	40,000			400,000					400,000			
	Lama/Kauila Forest	2	BFHI	3.2	mile	40,000			128,000					128,000			
	Puuwaawaa Cinder Cone	2	BFHI	2.4	mile	40,000				96,000				96,000			
	Henahena	2	BFHI	6.5	mile	40,000				260,000				260,000			
	Lama/Kokio Forest	2	BFHI	3.3	mile	40,000				132,000				132,000			
	Upper Kipuka Oweowe	2	BFHI	1.0	mile	40,000					40,000			40,000			
	Upper South Boundary Kipuka	2	BFHI	1.3	mile	40,000					52,000			52,000			
	Lowland Ohia Forest	2	BFHI	4.0	mile	40,000					160,000			160,000			
	Kileo	2	BFHI	3.8	mile	40,000					152,000			152,000			
	Maintenance for fenced units	2	E	2	enclosure	1,500	3,000							3,000			
	Maintenance for fenced units	2	E	3	enclosure	1,500		4,500						4,500			
	Maintenance for fenced units	2	E	7	enclosure	1,500			10,500					10,500			
	Maintenance for fenced units	2	E	10	enclosure	1,500				15,000				15,000			
	Annual maintenance for fenced units	2	E	14	enclosure	1,500					21,000	21,000	84,000	126,000			
	Labor (contractor coordination)	2	E	10	day	200	2,000							2,000			
	Labor (contractor coordination)	2	E	10	day	200		2,000						2,000			
	Labor (contractor coordination)	2	E	20	day	200			4,000					4,000			
	Labor (contractor coordination)	2	E	30	day	200				6,000				6,000			
	Labor (contractor coordination)	2	E	40	day	200					8,000			8,000			

XI. Projected ten-year budget					Total Cost								
Item description	Funded 1=yes 2=no	Funding Source	Quan.	Units	Unit Cost	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10-13	Line Item Totals
Natural Resources Management Continued													
Objective 10. Predator control													
Bait stations and rodenticide	2	BEFHI	4	enclosure	2,500	10,000							10,000
Bait stations and rodenticide	2	BEFHI	5	enclosure	2,500		12,500						12,500
Bait stations and rodenticide	2	BEFHI	9	enclosure	2,500			22,500					22,500
Bait stations and rodenticide	2	BEFHI	12	enclosure	2,500				30,000				30,000
Annual bait stations and rodenticide	2	BEFHI	16	enclosure	2,500					40,000	40,000	160,000	240,000
Slug and insect control	2	BEFHI	4	enclosure	1,000	4,000							4,000
Slug and insect control	2	BEFHI	5	enclosure	1,000		5,000						5,000
Slug and insect control	2	BEFHI	9	enclosure	1,000			9,000					9,000
Slug and insect control	2	BEFHI	12	enclosure	1,000				12,000				12,000
Annual slug and insect control	2	BEFHI	16	enclosure	1,000					16,000	16,000	64,000	96,000
Objective 11. Noxious weed control													
Herbicide	2	BEFHI	2	enclosure	2,500	5,000							5,000
Herbicide	2	BEFHI	3	enclosure	2,500		7,500						7,500
Herbicide	2	BEFHI	5	enclosure	2,500			12,500					12,500
Herbicide	2	BEFHI	8	enclosure	2,500				20,000				20,000
Annual herbicide	2	BEFHI	12	enclosure	2,500					30,000	30,000	120,000	180,000
Srpay Equipment	2	BEFHI	2	sets	7,000	14,000							14,000
Equipment, Fuel, and Supplies	2	BEFHI	1	each	6,000	6,000	6,000	6,000	6,000	6,000	6,000	24,000	60,000
Objective 12. Protect isolated endangered species													
Annual fence supplies, weed and rodent control	2	BEFHI	1	year	12,500	12,500	12,500	12,500	12,500	12,500	12,500	50,000	125,000
Objective 13. Restore native plant populations													
Nursery supplies for outplanting	2	BEFHI	1	each	5,000	5,000	5,000	5,000	5,000	5,000	5,000	20,000	50,000
Dibble sticks	2	B	4	each	55	220							220
Tree propagation in nursery dibble tubes	2	BE	12,500	seedlings	0.5	6,250	6,250	6,250	6,250	6,250	6,250	25,000	62,500
Tree planting volunteer labor	1	K	50	day	120	6,000	6,000	6,000	6,000	6,000	6,000	24,000	60,000
Objective 14. Monitoring program													
Analyze current data set	2	BDEHLS	460	hour	25	11,500							11,500
Develop monitoring protocol	2	BDEHLS	66	hour	45	990			990			990	2,970
Implement monitoring program	2	BDEHLS	1056	day	100	105,600	105,600	105,600	105,600	105,600	105,600	422,400	1,056,000

			XI. Projected ten-year budget											
						Total Cost								
	Item description	Funded 1=yes 2=no	Funding Source	Quan.	Units	Unit Cost	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10-13	Line Item Totals
	Natural Resources Management Continued													
	<i>Objective 15. Seed orchard</i>													
	Retro-fit Kamuela Nursery	2	BEFHI	1	each	2,000	2,000							2,000
	Annual maintenace	2	BEFHI	1	year	2,000	2,000	2,000	2,000	2,000	2,000	2,000	8,000	20,000
	<i>Objective 16. Preserve and protect native invertebrate populations</i>													
	Bait and pesticide supplies	2	BEFHI	1	year	500	500	500	500	500	500	500	2,000	5,000
	Bait and pesticide labor	2	BEFHI	100	day	200	2,000	2,000	2,000	2,000	2,000	2,000	8,000	20,000
	<i>Objective 17. Protect and enhance native forest birds</i>													
	Annual bird monitoring	2	BEFHI	200	day	200	4,000	4,000	4,000	4,000	4,000	4,000	16,000	40,000
	Mosquito control supplies	2	BEFHI	1	year	500	500	500	500	500	500	500	2,000	5,000
	Mosquito control labor	2	BEFHI	100	day	200	2,000	2,000	2,000	2,000	2,000	2,000	8,000	20,000
	<i>Objective 18. Manage fisheries resources</i>													
	Public meetings	2	1	40	each	300	1,200	1,200	1,200	1,200	1,200	1,200	4,800	12,000
	Signage	2	1	1	set	25,000		25,000						25,000
	Signage maintenance	2	1	8	year	500			500	500	500	500	2,000	4,000
	<i>Objective 19. Sea turtle protection</i>													
	Signage	2	1	1	set	25,000	25,000							25,000
	Signage maintenance	2	1	9	year	500		500	500	500	500	500	2,000	4,500
	<i>Objective 20. Protect anchialine pool resources</i>													
	Anchialine pool survey	2	BEFHX1	1	contract	50,000	50,000							50,000
	Signage	2	BEFHX1	1	set	25,000	25,000							25,000
	Signage maintenance	2	BEFHX1	9	year	500		500	500	500	500	500	2,000	4,500
	Anchialine pool restoration	2	BEFHX1	1	contract	100,000		100,000						100,000
	Anchialine pool maintenance	2	BEFHX1	8	year	10,000			10,000	10,000	10,000	10,000	40,000	80,000
	<i>Objective 21. Control ungulates makai of Queen Kaahumanu highway</i>													
	Staff control	2	BEFHX1	240	days	200	4,800	4,800	4,800	4,800	4,800	4,800	19,200	48,000
	Special hunt public notices	2	BEFHX1	1	year	100	100	100	100	100	100	100	400	1,000
	Special hunt supervision	2	BEFHX1	100	days	200	2,000	2,000	2,000	2,000	2,000	2,000	8,000	20,000
	Protect sensitive sites from ungulates by fencing	2	BEFHX1	20	sites	4,200	8,400	8,400	8,400	8,400	8,400	8,400	33,600	84,000
	Fence maintenance - five sites per year	2	BEFHX1	20	sites	280				560	1,220	1,400	5,600	8,780

XI. Projected ten-year budget														
Total Cost														
Item description	Funded 1=yes 2=no	Funding Source	Quan.	Units	Unit Cost	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10-13	Line Item Totals	
Natural Resources Management Continued														
Objective 22. Protect biological cave resources														
Seal off sensitive caves	2	EFX	20	each	4,000	8,000	8,000	8,000	8,000	8,000	8,000	32,000	80,000	
Enclosure costs covered by Objective 7 fencing														
Objective 23. Provide areas for research														
Management Team planning meetings	2	E	160	hour	25	4,000	4,000	4,000	4,000	4,000	4,000	16,000	40,000	
Funded by cooperating research organizations														
Objective 24. Permanent field crew														
Field Crew (including fringe)	2	BEFHI	7	staff	35,000	245,000	245,000	245,000	245,000	245,000	245,000	980,000	2,450,000	
Natural Resource Specialists (including fringe)	2	BEFHI	2	staff	45,000	90,000	90,000	90,000	90,000	90,000	90,000	360,000	900,000	
Vehicles for resource management crew	2	BEFHI	8	each	40,000	160,000					160,000		320,000	
Annual Vehicle Maintenance	2	BEFHI	4	each	5,000	20,000	20,000	20,000	20,000	20,000	20,000	80,000	200,000	
SUBTOTAL						1,013,560	745,350	1,225,850	1,119,900	1,067,570	815,750	2,623,990	8,611,970	
Grazing Management														
Objective 25. Grazing to control fine fuels														
Kileo Boundary Fence	2	EH	5	mile	17,000	85,000							85,000	
1859 Lava Flow Boundary Fence(A)	2	EH	2	mile	40,000		80,000						80,000	
1859 Lava Flow Boundary Fence(B)	2	EH	2	mile	40,000			80,000					80,000	
BICC Golf Course Boundary Fence(A)	2	EH	5	mile	40,000				200,000				200,000	
BICC Golf Course Boundary Fence(B)	2	EH	2	mile	40,000					80,000			80,000	
Install water troughs	2	EH	3	each	500	1,500							1,500	
Materials	2	EH	3	each	500	1,500							1,500	
Fence and trough Maintenance	2	EH	1	each	3,000	3,000	3,000	3,000	3,000	3,000	3,000	12,000	30,000	
Objective 26. Develop and imlement a long-term grazing plan														
Grazing plan development	2	EQ	40	hour	25	1,000							1,000	
Develop soils, vegetation, and paddock maps	2	EQ	80	hour	25	2,000							2,000	
Layout and implement grazing plan	2	EQ	160	hour	25	4,000							4,000	
Paddock evaluations and compliance monitoring	2	EQ	160	hour	25		4,000	4,000	4,000	4,000	4,000	16,000	36,000	
Management Team meetings	2	E	80	hour	25	2,000							2,000	
SUBTOTAL						100,000	87,000	87,000	207,000	87,000	7,000	28,000	603,000	

XI. Projected ten-year budget														
-----Total Cost-----														
Item description	Funded 1=yes 2=no	Funding Source	Quan.	Units	Unit Cost	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10-13	Line Item Totals	
Public Hunting Program														
Objective 27. Safe & quality hunting environment														
Hunt administration	2	EJK	66	day	176	11,616	11,616	11,616	11,616	11,616	11,616	46,464	116,160	
Applications, tags, miscellaneous information	2	EJ	1	each	500	500	500	500	500	500	500	2,000	5,000	
Objective 28. Provide sustainable public hunting opportunities														
Hunt administration incorporated into Objective 29														
Objective 29. Enhance game habitat in selected areas of Puu Waawaa														
Contract baseline research program	2	EFH	2	year	125,000	125,000	125,000						250,000	
Contract Habitat improvement program	2	EFH	10	year	50,000	50,000	50,000	50,000	50,000	50,000	50,000	200,000	500,000	
Objective 30. Utilize public hunting to reduce feral ungulate grazing pressure in proposed conservation units														
Hunt administration contract	2	EH	10	year	50,000	50,000	50,000	50,000	50,000	50,000	50,000	200,000	500,000	
Objective 31. Promote youth hunts														
Hunt administration	2	EJK	24	day	176	4,224	4,224	4,224	4,224	4,224	4,224	16,896	42,240	
Objective 32. Promote disabled hunter access														
Hunt administration	2	EJK	24	day	176	4,224	4,224	4,224	4,224	4,224	4,224	16,896	42,240	
Objective 33. Game mammal HCP study														
HCP grant - State share	1	E	2	year	108,145	108,145	108,145						216,290	
HCP grant - Federal share	1	F	2	year	324,433	324,433	324,433						648,866	
Helicopter surveys	2	EF	12	hour	650	7,800	7,800	7,800	7,800	7,800	7,800	31,200	78,000	
Objective 34. Expand predator control program														
Bait stations	2	EJ	75	enclosure	20	1,500	1,500	1,500	1,500	1,500	1,500	6,000	15,000	
Bait blocks	2	EJ	30	box	100	3,000	3,000	3,000	3,000	3,000	3,000	12,000	30,000	
Live Traps	2	EJ	20	trap	25	500	500	500	500	500	500	2,000	5,000	
Labor	2	EJ	52	day	190	10,000	10,000	10,000	10,000	10,000	10,000	40,000	100,000	
Objective 35. Develop game bird guzzlers														
Waterline type	2	EJK	12	each	500	6,000							6,000	
Catchment type	2	EJK	8	each	1,750		14,000						14,000	
Objective 36. Establish dove flight														
Cultivate, seed, irrigate, fence	2	EJK	2	acre	4,500	9,000							9,000	

				XI. Projected ten-year budget										
							Total Cost							
	Item description	Funded 1=yes 2=no	Funding Source	Quan.	Units	Unit Cost	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10-13	Line Item Totals
	Public Hunting Program Continued													
	<i>Objective 37. Increase game bird hunting opportunities</i>													
	Additional days (fall, turkey, peacock)	2	EJK	20	day	176	3,520	3,520	3,520	3,520	3,520	3,520	14,080	35,200
	<i>Objective 38. Manage pasture vegetation</i>													
	See Grazing Management Section													
	<i>Objective 39. Game research program</i>													
	Funded by cooperating research organizations													
	<i>Objective 40. Develop bird dog training area</i>													
	Administration	2	EJK	80	hour	25	2,000	2,000	2,000	2,000	2,000	2,000	8,000	20,000
	<i>Objective 41. Fund and hire permanent staff</i>													
	Full time wildlife labor	2	EJK	2	each	35,000	70,000	70,000	70,000	70,000	70,000	70,000	280,000	700,000
	Vehicle	2	EJK	4	each	40,000	40,000					40,000		80,000
	Annual vehicle maintenance	2	EJK	2	each	5,000	10,000	10,000	10,000	10,000	10,000	10,000	40,000	100,000
	SUBTOTAL						841,462	800,462	228,884	228,884	228,884	268,884	915,536	3,512,996

XI. Projected ten-year budget														
Total Cost														
Item description	Funded 1=yes 2=no	Funding Source	Quan.	Units	Unit Cost	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10-13	Line Item Totals	
Trails, Access and Ecotourism														
Objective 42. Survey and develop historic trail inventory														
Locate and survey entire inventory	2	ETUV	10	mile	5,000		50,000						50,000	
Develop Historic Preservation Plan	2	ETUV	1	plan	100,000	100,000							100,000	
Maintenance and improvements	2	ETUV	5	mile	8,000				30,000				30,000	
Post set of 25 signs	2	ETUV	1	set	4,000			4,000					4,000	
Develop trails brochure	2	ETUV	1	layout	2,000	2,000							2,000	
Print trail brochures	2	ETUV	10000	each	0.40	2,000					2,000		4,000	
Objective 43. Document current public use at Kiholo bay														
Public use study	2	X	1	contract	30,000	30,000							30,000	
Objective 44. Construct new trail segments														
Puuwaawaa cone segment	2	ET	1	each	25,000		25,000						25,000	
Segments for ecotourism activities	2	ET	1	each	10,000		10,000						10,000	
Draft EA for new trails and access	2	ET	1	each	50,000	50,000							50,000	
Objective 45. Provide public access on selected roads														
Improve access at 25 mile gate	2	E	1	each	25,000	25,000							25,000	
Composting toilets	2	EX	4	each	40,000		80,000		80,000				160,000	
Objective 46. Manage commercial ecotourism activities														
Ecotourism Subcommittee meetings	2	W	96	hour	25	2,400	2,400	2,400	2,400	2,400	2,400	9,600	24,000	
Objective 47. Fund and hire permanent staff														
Full time trail and access staff	2	E	1	staff	45,000	45,000	45,000	45,000	45,000	45,000	45,000	180,000	450,000	
Full time enforcement staff	2	EX12	2	staff	90,000	90,000	90,000	90,000	90,000	90,000	90,000	360,000	900,000	
Full time maintenance staff for proposed park	2	X	3	staff					90,000	90,000	90,000	360,000	630,000	
Vehicle	2	ETVX12	5	each	40,000	120,000					200,000		320,000	
Annual vehicle maintenance	2	ETVX12	1	each	5,000	15,000	15,000	15,000	15,000	15,000	25,000	100,000	200,000	
SUBTOTAL														

				XI. Projected ten-year budget										
							----- Total Cost -----							
	Item description	Funded 1=yes 2=no	Funding Source	Quan.	Units	Unit Cost	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10-13	Line Item Totals
	Cultural Resources													
	<i>Objective 48. Cultural and archaeological survey</i>													
	Cultural and archeological survey	2	BEFHIX	1	each	450,000	450,000							450,000
	<i>Objective 49. Protect and restore cultural sites</i>													
	Signage	2	X	1	set	25,000		25,000						25,000
	Signage maintenance	2	X	8	year	500			500	500	500	500	2,000	4,000
	Seal off sensitive caves	2	X	30	each	4,000	12,000	12,000	12,000	12,000	12,000	12,000	48,000	120,000
	Fence, protect, restore cutural sites	2	X	1	site	5,000	5,000	5,000	5,000	5,000	5,000	5,000	20,000	50,000
	<i>Objective 50. Establish protocol for sustainable traditional and cultural gathering</i>													
	Planning workshop	2	EISX	1	each	5,000	5,000							5,000
	Signage	2	EISX	1	set	25,000		25,000						25,000
	Signage maintenance	2	EISX	8	year	500			500	500	500	500	2,000	4,000
	Monitoring	2	EISX	1	year	1,000	1,000	1,000	1,000	1,000	1,000	1,000	4,000	10,000
	SUBTOTAL						473,000	68,000	19,000	19,000	19,000	19,000	76,000	693,000

	Cultural and Environmental Education													
	<i>Objective 51. Fund and hire education and volunteer coordination staff</i>													
	Education Coordinator	2	EFHIX	1	each	45,000	45,000	45,000	45,000	45,000	45,000	45,000	180,000	450,000
	Volunteer Coordinator	2	EFHIX	1	each	45,000	45,000	45,000	45,000	45,000	45,000	45,000	180,000	450,000
	Vehicles	2	BEFHIX	4	each	40,000	80,000					80,000		160,000
	Annual vehicle maintenance	2	BEFHIX	2	each	5,000	10,000	10,000	10,000	10,000	10,000	10,000	40,000	100,000
	SUBTOTAL						180,000	100,000	100,000	100,000	100,000	180,000	400,000	1,160,000

XI. Projected ten-year budget														
Total Cost														
Item description	Funded 1=yes 2=no	Funding Source	Quan.	Units	Unit Cost	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10-13	Line Item Totals	
Facilities and Infrastructure														
Objective 52. Upgrade residential structures B3, B4, B5, B6, B8, B10, B12, B13, B14, and B15														
Upgrade to County code and paint	2	EM	9	each	20,375	183,000							183,000	
Annual maintenance program	2	E	1	year	15,000	15,000	15,000	15,000	15,000	15,000	15,000	60,000	150,000	
Upgrade B12 to accommodate 20 volunteers	2	BEFHI	1	each	50,000	50,000							50,000	
Asbestos clean up for B13	2	EM	1	contract	6,000	6,000							6,000	
Computers & furniture for project offices	2	EM	1	contract	15,920	15,920							15,920	
Objective 53. Upgrade residential structure B1, B2, and B9														
Upgrade to County code and paint	2	EM	3	each	16,000	48,000							48,000	
Annual maintenance program	2	E	1	year	3,000	3,000	3,000	3,000	3,000	3,000	3,000	12,000	30,000	
Objective 54. Upgrade and furnish education center structure B7														
Upgrade to County code and paint	2	EM	1	each	25,000	25,000							25,000	
Install power and utilities for B7	2	EF	1	contract	80,000	80,000							80,000	
Furnish education center facility	2	EF	1	contract	12,000	12,000							12,000	
Annual maintenance and supplies	2	EF	1	year	5,000	5,000	5,000	5,000	5,000	5,000	5,000	20,000	50,000	
Objective 55. Demolish and remove structure B11														
Demolition and disposal contract	2	EM	1	contract	10,000			10,000					10,000	
Objective 56. Upgrade cultural and environmental education facilities														
Construct greenhouse facility	2	BEFHIX	1	each	35,000	35,000							35,000	
Greenhouse materials and maintenance	2	BEFHIX	1	year	1,000	1,000	1,000	1,000	1,000	1,000	1,000	4,000	10,000	
Construct camp facilities	2	BEFHI	1	contract	2,150,000			2,150,000					2,150,000	
Camp facility equipment and maintenance	2	BEFHI	1	year	30,000				30,000	30,000	30,000	120,000	210,000	
Establish interpretive trails	2	BEFHIX	6	mile	500	1,000	1,000	500			500		3,000	
Publish program materials	2	BEFHIX	1	set	150,000	150,000							150,000	
Initiate public relations program	2	BEFHIX	1	year	10,000	10,000	10,000	10,000	10,000	10,000	10,000	40,000	100,000	
Upgrade education center facilities - Structure B7	2	BEFHI	1	contract	200,000		200,000						200,000	
Annual maintenance - Structure B7	2	BEFHI	8	year				20,000	20,000	20,000	20,000	80,000	160,000	
Upgrade interpretive center/office - Structure B16	2	BFHIX	1	contract	250,000	250,000							250,000	
Annual maintenance - Structure B16	2	BFHIX	9	year			20,000	20,000	20,000	20,000	20,000	80,000	180,000	
Interpretive kiosks and signage	2	BEFHIX	1	contract	50,000	50,000							50,000	
Kiosk and signage maintenance	2	BEFHIX	1	year	5,000	5,000	5,000	5,000	5,000	5,000	5,000	20,000	50,000	
Construct and furnish children’s museum	2	BEFHI	1	contract	40,000				40,000				40,000	
Annual Puuwaawaa Management team meetings	1	EX	40	hour	25	1,000	1,000	1,000	1,000	1,000	1,000	4,000	10,000	

XI. Projected ten-year budget														
Total Cost														
Item description	Funded 1=yes 2=no	Funding Source	Quan.	Units	Unit Cost	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10-13	Line Item Totals	
Facilities and Infrastructure Continued														
Objective 57. Repair water reservoirs and tanks														
Repair and reline Meeting House reservoir	1	H	1	contract	230,000	230,000							230,000	
Reservoir	2	NOP	1	year	30,000	30,000	30,000	30,000	30,000	30,000	30,000	120,000	300,000	
Repair and reline Poohooohoo reservoir	2	NOP	1	contract	110,000	110,000							110,000	
Repair and reline Piula water tanks	2	BFHMNOP	2	each	20,000	40,000							40,000	
Demolish old Piula site catchment apron	2	BFHMNOP	1	contract	4,000	4,000							4,000	
Construct new Piula site catchment apron	2	BFHMNOP	1	contract	25,000	25,000							25,000	
Annual maintenance three sites	2	BFHNOP	1	year	5,500	5,500	5,500	5,500	5,500	5,500	5,500	22,000	55,000	
Objective 58. Install new water tank infrastructure														
Water tanks	2	BEFHI	7	each	6,500	19,500	26,000						45,500	
Pipe and irrigation supplies	2	BEFHI	1	set	10,000	10,000							10,000	
Pipe and irrigation supplies	2	BEFHI	1	set	12,000		12,000						12,000	
Fit tanks & waterlines for fire engine hookups	2	ABCDEH	7	each	1,000	3,000	4,000						7,000	
Annual maintenance program	2	BEFHI	1	year	1,500	1,500	1,500	1,500	1,500	1,500	1,500	6,000	15,000	
Objective 59. Upgrade and expand existing waterline system														
Replace selected existing waterlines	2	ABCDEFHINOP	20	mile	3,749	74,980							74,980	
Install new waterlines	2	ABCDEFHINOP	9	mile	3,749	33,741							33,741	
Install water troughs	2	ABCDEFHINOP	12	each	500	6,000							6,000	
Waterline spurs, tanks, and associated fittings	2	ABCDEFHINOP	1	set	10,156	10,156							10,156	
Installation (lay/fuse pipe, set tanks, install fittings)	2	ABCDEFHINOP	29	mile	2,480	71,920							71,920	
Objective 60. Repair and maintain existing roads within Puuwaawaa														
Repair existing unimproved roads	2	E	20	mile	3,000	60,000							60,000	
Annual maintenance – paved roads	2	E	2	mile	2,500	5,000	5,000	5,000	5,000	5,000	5,000	20,000	50,000	
Annual maintenance – unimproved roads	2	E	131	mile	250	32,750	32,750	32,750	32,750	32,750	32,750	131,000	327,500	
Objective 61. Maintain airplane landing strip														
Annual maintenance program	2	E	1	year	1,000	1,000	1,000	1,000	1,000	1,000	1,000	4,000	10,000	
Objective 62. Develop a public shooting range														
Design and survey	2	GJYZ	1	contract	100,000	100,000							100,000	
Infrastructure, construction, and noise mitigation	2	GJYZ	1	contract	225,000		225,000						225,000	
Annual maintenance and operations	2	GJYZ	8	year	20,000			20,000	20,000	20,000	20,000	80,000	160,000	
SUBTOTAL														
						1,819,967	603,750	2,336,250	245,750	205,750	206,250	823,000	6,240,717	

[illegible]

XII. Accomplished Objectives

Add the PWWFBS to the State of Hawai'i Register via Executive Order

Background: Currently there is no official "Sanctuary" designation for the PWWFBS until the Governor signs the Executive Order officially declaring its title. This motion and designation has been approved by the Board of the Department of Land and Natural Resources (BLNR). This Sanctuary designation will officially mandate and prioritize the protection of native natural resources over other uses for this area. Simultaneously, access to funding sources available solely for natural resource conservation efforts will be enabled.

Proposed Action: Have the BLNR approved "Sanctuary" designation signed in Executive Order by the Governor to the State register, officially declaring this parcel the PWWFBS.

Outcome: On July 22, 2002, Governor Benjamin J. Cayetano issued Executive Order No. 3937 formally setting aside the parcel as a forest bird sanctuary. During this process approximately \$1,000 in DOFAW staff time was expended for drafting documentation, conducting correspondence and attending meetings.

Use advance weather monitoring capability to monitor and manage fire danger in Pu'u Wa'awa'a

Background: Fire weather data availability for Pu'u Wa'awa'a is limited. Such information is critical to support assessments of fire potential. The U.S. Bureau of Land Management (BLM) in Boise, Idaho currently maintains and monitors five remote area weather stations (RAWS) in Pohakuloa Training Area, adjacent to Pu'u Wa'awa'a. These stations have satellite links allowing data transmission and remote monitoring. The National Fire Danger Rating System (NFDRS) uses such data to estimate fire danger potential on a daily basis. The BLM is willing to monitor an additional RAWS for Pu'u Wa'awa'a. Data output from these six RAWS will provide invaluable fire weather data to assist fire management efforts in Pu'u Wa'awa'a and adjacent areas that have a wildfire history.

Proposed Actions: A DOFAW RAWS will be upgraded for satellite capability and placed in Pu'u Wa'awa'a. The Branch Protection Forester will also monitor such data and may advise the Branch Manager to restrict access to selected areas during periods of high fire danger.

Outcome: In April 2003, an operational RAWS was placed in Pu'u Wa'awa'a. This RAWS provides 24 hour weather data for the area that can be monitored by DOFAW staff via the internet. Approximately \$10,000 in equipment upgrades and DOFAW staff time was expended to make this RAWS unit operational.

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Appendix A. Pu‘u Wa‘awa‘a Threatened and Endangered Species List

A. Species presently occurring within Pu‘u Wa‘awa‘a

1. Plants:	Hawaiian name:	Common name:	Status:
<i>Asplenium fragile</i> var. <i>insulare</i>			Endangered
<i>Caesalpinia kavaensis</i>	uhiuhi		Endangered
<i>Colubrina oppositifolia</i>	kauila		Endangered
<i>Cyanea stictophylla</i>	haha		Endangered
<i>Hibiscus brackenridgei</i> ssp. <i>brackenridgei</i>	ma‘o hau hele		Endangered
<i>Kokia drynarioides</i>	koki‘o		Endangered
<i>Nothocestrum breviflorum</i>	‘aiea		Endangered
<i>Phyllostegia velutina</i>		mint	Endangered
<i>Plantago hawaiiensis</i>	laukahi kuahiwi		Endangered
<i>Pleomele hawaiiensis</i>	halapepe		Endangered
<i>Stenogyne angustifolia</i>		mint	Endangered
<i>Vicia menziesii</i>		Hawaiian vetch	Endangered
<i>Zanthoxylum dipetalum</i> var. <i>tomentosum</i>	a‘e		Endangered
<i>Bidens micrantha</i> subsp. <i>ctenophylla</i>	ko‘oko‘olau		Candidate for endangered listing
<i>Acacia koaia</i>	koai‘a		Species of concern
<i>Alphitonia ponderosa</i>	kauila		Species of concern
<i>Capparis sandwichiana</i>	maiapilo	caper bush	Species of concern
<i>Chamaesyce olowaluana</i>	‘akoko		Species of concern
<i>Cyrtandra menziesii</i>	ha‘iwale		Species of concern
<i>Eragrostis deflexa</i>			Species of concern
<i>Melicope hawaiiensis</i>	manena		Species of concern
<i>Phytolacca sandwicensis</i>	popolo ku mai		Species of concern
<i>Reynoldsia sandwicensis</i>	‘ohe makai		Species of concern
<i>Rubus macraei</i>	‘akala		Species of concern
<i>Sicyos macrophyllus</i>			Species of concern
<i>Sisyrinchium acre</i>	mau‘u la‘ili		Species of concern
<i>Stenogyne macrantha</i>		mint	Species of concern

2. Vertebrates:

	Hawaiian name:	Common name:	Status:
<i>Branta sandvicensis</i>	nene	Hawaiian goose	Endangered
<i>Buteo solitarius</i>	i‘o	Hawaiian hawk	Endangered
<i>Eretmochelys imbricata</i>	‘ea	hawksbill turtle	Endangered
<i>Himantopus mexicanus knudseni</i>	ae‘o	Hawaiian stilt	Endangered
<i>Lasiurus cinereus semotus</i>	‘ope‘ape‘a	Hawaiian hoary bat	Endangered
<i>Loxops coccineus coccineus</i>	‘akepa	Hawai‘i ‘akepa	Endangered
<i>Oreomystis mana</i>		Hawai‘i creeper	Endangered
<i>Chelonia mydas</i>	honu	green sea turtle	Threatened
<i>Asio flammeus sandwichensis</i>	pueo	Hawaiian short-eared owl	Species of concern

3. Insects:

	Hawaiian name:	Common name:	Status:
<i>Manduca blackburni</i>			Endangered
<i>Drosophila heteroneura</i>			Candidate for endangered listing
<i>Agrotis melanonera</i>			Species of concern
<i>Anomis vulpicolor</i>			Species of concern
<i>Caconemobius varius</i>			Species of concern
<i>Coleotichus blackburniae</i>			Species of concern
<i>Ectemnius rubrocaudatus</i>			Species of concern
<i>Hylaeus coniceps</i>			Species of concern
<i>Hylaeus difficilis</i>			Species of concern
<i>Hylaeus filicum</i>			Species of concern
<i>Hylaeus hula</i>			Species of concern
<i>Hylaeus kona</i>			Species of concern
<i>Hylaeus laetus</i>			Species of concern
<i>Hylaeus pubescens</i>			Species of concern
<i>Micromus usingeri</i>			Species of concern
<i>Oliarus lorettae</i>			Species of concern
<i>Omiodes monogona</i>			Species of concern
<i>Plagithmysus mezoneuri</i>			Species of concern

3. Insects (continued):

Plagithmysus elegans
Plagithmysus simplicollis
Rhyncogonus giffardi

Hawaiian name:**Common name:****Status:**

Species of concern
Species of concern
Species of concern

4. Snails:

Leptachatina lepida
Neritilia hawaiiensis
Vitrina tenella

Hawaiian name:**Common name:****Status:**

Species of concern
Species of concern
Species of concern

5. Crustaceans:

Metabetaeus lohena

Hawaiian name:**Common name:****Status:**

Species of concern

B. Species historically known to occur within Pu‘u Wa‘awa‘a

1. Plants:	Hawaiian name:	Common name:	Status:
<i>Bonamia menziesii</i>			Endangered
<i>Delissea undulata</i> ssp. <i>undulata</i>			Endangered
<i>Diellia erecta</i>			Endangered
<i>Gardenia brighamii</i>	nanu		Endangered
<i>Hibiscadelphus hualalaiensis</i>	hau kuahiwi		Endangered
<i>Isodendron pyrifolium</i>	wahine noho kula		Endangered
<i>Neraudia ovata</i>			Endangered
<i>Ochrosia kilaueaensis</i>	holei		Endangered
<i>Phyllostegia racemosa</i>	kiponapona		Endangered
<i>Portulaca sclerocarpa</i>	‘ihi		Endangered
<i>Solanum incompletum</i>	popolo ku mai		Endangered
<i>Zanthoxylum hawaiiense</i>	a‘e		Endangered
<i>Dissochodrus biflorus</i>			Species of concern
<i>Exocarpus gaudichaudii</i>	hulumoa		Species of concern
<i>Nesoluma polynesicum</i>	keahi		Species of concern
<i>Pittosporum hawaiiense</i>	ho‘awa		Species of concern
2. Vertebrates:	Hawaiian name:	Common name:	Status:
<i>Anas wyvilliana</i>	koloa	Hawaiian duck	Endangered
<i>Corvus hawaiiensis</i>	‘alala	Hawaiian crow	Endangered
<i>Hemignathus munroi</i>	‘akiapola ‘au		Endangered
<i>Pterodroma phaeopygia sandwichensis</i>	‘ua‘u	Dark-rumped petrel	Endangered
3. Snails:	Hawaiian name:	Common name:	Status:
<i>Partulina confusa</i>			Species of concern

C. Plants that may be suited to habitat conditions within Pu‘u Wa‘awa‘a

Species:	Hawaiian name:	Common name:	Status:
<i>Abutilon menziesii</i>	ko‘oloa‘ula		Endangered
<i>Achyranthes mutica</i>			Endangered
<i>Cyperus faurei</i>			Endangered
<i>Flueggea neowawraea</i>	mehamehame (macron over first e)		Endangered
<i>Gouania vitifolia</i>			Endangered
<i>Haplostachys haplostachya</i>	honohono		Endangered
<i>Hedyotis coriacea</i>	kio‘ele		Endangered
<i>Isodendrion hosakae</i>			Endangered
<i>Isodendrion pyrifolium</i>	wahine noho kula		Endangered
<i>Lipochaeta venosa</i>			Endangered
<i>Pritchardia affinis</i>	loulu		Endangered
<i>Sesbania tomentosa</i>	‘ohai		Endangered
<i>Silene lanceolata</i>		catchfly	Endangered
<i>Spermolepis hawaiiensis</i>			Endangered
<i>Tetramolopium arenarium</i> var. <i>arenarium</i>			Endangered
<i>Vigna o-wahuensis</i>			Endangered
<i>Silene hawaiiensis</i>		catchfly	Threatened
<i>Ranunculus hawaiiensis</i>			Candidate for endangered listing
<i>Bidens campylotheca</i> ssp. <i>campylotheca</i>			Species of concern
<i>Bobea timonioides</i>	‘ahakea		Species of concern
<i>Dissochondrus biflorus</i>			Species of concern
<i>Festuca hawaiiensis</i>			Species of concern
<i>Phyllostegia stachyoides</i>		mint	Species of concern
<i>Tetramolopium consanguineum</i> var. <i>leptophyllum</i>			Species of concern

D. Key plants for restoration efforts that are depleted or no longer exist in Pu‘u Wa‘awa‘a (These plants have no official Federal status)

Species:	Hawaiian name:	Common name:
<i>Alyxia olivaeformis</i>	maile	
<i>Antidesma pulvinatum</i>	hame	
<i>Diplazium sandwichianum</i>	ho‘i‘o	
<i>Bidens menziesii</i>		
<i>Canavalia hawaiiensis</i>	‘awikiwiki	
<i>Charpentiera obovata</i>	papala	
<i>Cheirodendron trigynum</i>	‘olapa	
<i>Chenopodium oahuense</i>	‘aheahea	
<i>Cibotium</i> spp.	hapu‘u	
<i>Claoxylon sandwicense</i>	po‘ola	
<i>Clermontia clermontioides</i>	‘oha wai	
<i>Cocculus trilobus</i>	huehue	
<i>Coprosma cymosa</i>		
<i>Diospyros sandwicensis</i>	lama	
<i>Dodonaea viscosa</i>	‘a‘ali‘i	
<i>Dryopteris</i> spp.		
<i>Dubautia linearis</i>	na‘ena‘e, kupaoa	
<i>Dubautia plantaginea</i>	na‘ena‘e, kupaoa	
<i>Eragrostis atropioides</i>		lovegrass
<i>Eragrostis leptophylla</i>		
<i>Fragaria chiloensis</i> ssp. <i>sandwicensis</i>	‘ohelo papa	
<i>Hesperocnide sandwicensis</i>		
<i>Lipochaeta subcordata</i>	nehe	
<i>Nephrolepis exaltata</i>		sword fern
<i>Nestegis sandwicensis</i>	olopua	
<i>Nototrichium sandwicense</i>	kulu‘i	
<i>Peperomia cookiana</i>	‘ala ‘ala wai nui	
<i>Peperomia leptostachya</i>	‘ala ‘ala wai nui	
<i>Peperomia macraei</i>	‘ala ‘ala wai nui	

D. Key plants for restoration efforts that are depleted or no longer exist in Pu‘u Wa‘awa‘a (These plants have no official Federal status) **(continued)**

Species:	Hawaiian name:	Common name:
<i>Phyllostegia ambigua</i>		mint
<i>Phytolacca sandwicensis</i>	popolo	pokeberry
<i>Pisonia sandwicensis</i>	papala	
<i>Pittosporum terminalioides</i>	ho‘awa	
<i>Plumbago zeylandica</i>	‘ilie‘e	
<i>Polystichum hillebrandii</i>		
<i>Pouteria sandwicensis</i>	ala‘a	
<i>Psychotria hawaiiensis</i>	kopiko	
<i>Psydrax odoratum</i>	alahe‘e	
<i>Rauvolfia sandwicensis</i>	hao	
<i>Rumex giganteus</i>	pawale	
<i>Sadleria</i> spp.	ama‘u	
<i>Santalum paniculatum</i>	‘iliahi	
<i>Senna gaudichaudii</i>	kolomona	
<i>Sicyos lasiocephalus</i>		
<i>Streblus pendulinus</i>	a‘ia‘i	
<i>Urera glabra</i>	opuhe	
<i>Wikstroemia</i> spp.	‘akia	
<i>Xylosma hawaiiense</i>	maua	

Appendix B. Proposed Conservation Units

It is essential to note that the conservation unit acreages stated in this Appendix are estimates. Management activities will not necessarily be limited to these areas and fences may be built to encompass greater or lesser acreages than are outlined below. As such, the layout of boundary lines for conservation units may be subject to change depending upon the location of significant resources that merit protection.

A. Priority 1 Conservation Units:

1. Pu‘u Wa‘awa‘a Forest Bird Sanctuary – 3,806 acres

Rationale: One of the initial steps in achieving protection of Threatened and Endangered species within the PWWFBS is the removal of ungulates from the Sanctuary. The current boundary fence system of the PWWFBS consists of 12 miles of substandard hogwire, and many sections are in disrepair. As such, ungulates are able to freely traverse the fence line in many places. Repairs or upgrades to existing fences, and construction of new fence segments are required to divide the Sanctuary into compartments.

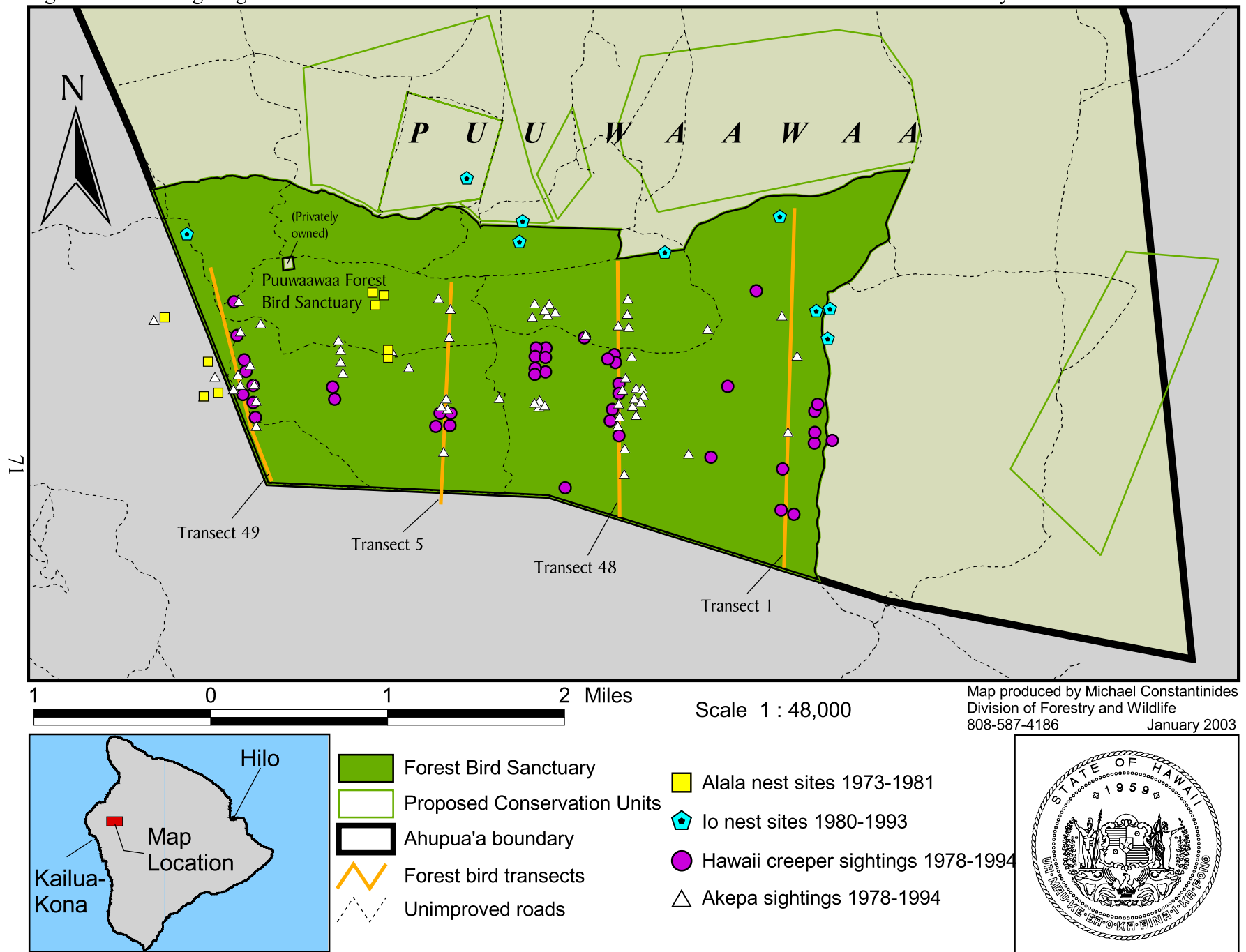
Fence upgrade operations for the Sanctuary will be conducted in two steps. The first will involve replacing, reconstructing, or retrofitting all existing perimeter fences. The second will involve rebuilding or replacing existing paddock fences and rock walls, and installation of a new fence along upper middle road spanning the entire Sanctuary.

Background: The PWWFBS contains an exceptional diversity of native flora and fauna, (many of which are threatened or endangered) as well as some of the best remaining habitat for these species. Indeed, the PWWFBS has been frequently identified as an important area for native bird species management and recovery. Endangered native bird species either currently or formerly found in or adjacent to the Sanctuary include ‘alala, ‘akepa, Hawai‘i creeper and the ‘io (Figure B-1).

Several lave tubes and cave systems exist within and adjacent to the PWWFBS, providing important habitat for many kinds of organisms. These include subterranean bacteria, fungi, mosses and slimes. Other organisms flourish in cave openings where increased shade and moisture create a microhabitat conducive to their survival, such as liverworts, ferns and mints. Volcanic sinkholes and skylights form natural enclosures where rare and endangered vascular plants can persist without being damaged by wild and domestic herbivores. Furthermore, endemic forest birds frequently nest on the floor or on ledges in lava tube openings.

Endangered and rare plant Species: Over 100 species of native plants occur within PWWFBS. The Sanctuary supports several species of rare plants including five that are listed as endangered and eight that are considered rare. Endangered plant species include

Figure B-1. Field sightings and nest observations for selected native birds in the Puu Waawaa Forest Bird Sanctuary.



Hawaiian vetch (*Vicia menziesii*), haha, (*Cyanea stictophylla*), ‘aiea (*Nothocestrum breviflorum*), a mint (*Phyllostegia velutina*), and laukahi kuahiwi (*Plantago hawaiiensis*). Other rare plants that are species of concern include ‘akoko (*Chamaesyce olowaluana*), a fern (*Polystichum hillebrandii*), and a native raspberry or ‘akala (*Rubus macraei*), koko‘olau (*Bidens micrantha* subsp. *ctenophylla*), mau‘u la‘ili (*Sisyrinchium acre*), ‘ohelo papa (*Fragraria chiloensis* var. *sandwicensis*).

Endangered Wildlife: Birds are the dominant form of native wildlife found in the Sanctuary today. The endemic honeycreepers consist of ‘amakihi (*Hemignathus virens*), ‘apapane (*Himatione sanguinea*), ‘i‘iwi (*Vestiaria coccinea*), Hawai‘i ‘akepa (*Loxops coccineus*), and Hawai‘i creeper (*Oreomystis mana*). Other species present are a monarchine flycatcher or ‘elepaio (*Chasiempis sandwichensis*), ‘io or Hawaiian hawk (*Buteo solitarius*), and pueo or Hawaiian owl (*Asio flammeus sandwichensis*). ‘Amakihi, ‘apapane and ‘i‘iwi are the three most abundant species. The distribution and abundance of Sanctuary birds was summarized by Giffin (1990, 1991). ‘Alala or Hawaiian crows (*Corvus hawaiiensis*) were formerly present in the Sanctuary, but are now extirpated. Nene or Hawaiian geese (*Branta sandwicensis*) are restricted to open areas below the Sanctuary. The Hawai‘i ‘akepa, Hawai‘i creeper, ‘io, ‘alala, and nene are all listed as endangered. The Hawaiian hoary bat (*Lasiurus cinereus semotus*) has also been observed flying in the Sanctuary (J. Giffin, personal communication).

Endangered arthropods: The PWWFBS is rich in forest arthropod species. Many of these invertebrates are obligate specialists on their host plants. The rarest arthropod is Blackburn’s sphinx moth (*Manduca blackburni*). This large moth was thought to be extinct on the big island until December 1998, when it was rediscovered in the dry forest at Pu‘u Wa‘awa‘a (1800 feet elevation). Since then, caterpillars and adults have also been observed in the PWWFBS. The moth was officially listed as endangered on February 1, 2000. Many other rare arthropods also occur in the Sanctuary. These include three moths (*Agrotis melanoneura*, *Hypocala velans* and *Progonostola* sp.), a picture-winged pomace fly, (*Drosophila heteroneura*), and a flightless brown lacewing (*Micromus usingeri*). Most of these insects are either candidates for listing or species of concern.

2. Waihou Forest Phase I – 204 acres

Rationale: Fence remaining forested area (approximately 204 acres) to create outplanting sites for rare and threatened plant species, control fine fuels to prevent wildfire spread and encourage native vegetation regeneration, and protect remaining endangered plant species in situ as a seed source for additional population augmentation and allow for endangered species recovery.

Background: Waihou forest is a transitional woodland that once connected the moist montane mesic and lowland dry forests. It is still an important conservation link between the two forest types. At the turn of the last century, this mixed woodland was dominated by ‘ohi‘a (*Metrosideros polymorpha*), koa (*Acacia koa*), mamane (*Sophora chrysophylla*), naio (*Myoporum sandwicense*), and ‘akoko (*Chamaesyce olowaluana*)

trees. Vegetation was said to be so thick in places that it was almost impossible to pass through the forest (Rock, 1913). Even as late as 1959, the mamane tree canopy was still intact according to the former Pu‘u Wa‘awa‘a Ranch manager (B. Paris, personal communication). Vegetation cover maps prepared from aerial photos (Blackmore and Vitousek, 2000) indicate a 51-75 percent decrease in forest cover between 1954 and 1994. Today, Waihou forest consists of remnant patches of native vegetation. While presently degraded, it has good potential for recovery and includes some of the best mixed woodland remaining at Pu‘u Wa‘awa‘a. In this area there is still substantial native tree cover and readily regenerating koa, mamane, and naio, especially after seasonal rains.

Endangered and rare plant Species: Waihou forest supports several species of endangered and rare (species of concern) plants. Endangered species include a‘e (*Zanthoxylum dipetalum* var. *tomentosum*), ‘aiea (*Nothocestrum breviflorum*), and alani (*Melicope hawaiiensis*). Species of concern include ‘akoko (*Chamaesyce olowaluana*), and ‘anunu (*Sicyos macrophyllus*). DOFAW has planted some endangered plants within fenced enclosures in the Waihou forest that were historically known from the area. These include two species that are endangered and extinct from the wild: hau kuahiwi (*Hibiscadelphus hualalaiensis*) and *Delissea undulata*. Other endangered species planted in the fenced enclosures include koki‘o (*Kokia drynarioides*), ma‘o hau hele (*Hibiscus brackenridgei*), kauila (*Colubrina oppositifolia*), hala pepe (*Pleomele hawaiiensis*), and uhiuhi (*Caesalpinia kavaensis*).

Additional endangered and rare species subject to detrimental forces in unprotected areas of Pu‘u Wa‘awa‘a could be planted in the Waihou forest, including *Bidens micrantha* subsp. *ctenophylla* (a candidate for endangered status), the species of concern kauila (*Alphitonia ponderosa*), and ‘ohe makai (*Reynoldsia sandwicensis*).

As part of the mitigative actions required by the US Fish and Wildlife Service for recovery of certain endangered species, the Waihou forest could serve as a refuge for several other endangered species that historically occurred at Pu‘u Wa‘awa‘a including spiny popolo (*Solanum incompletum*), *Neraudia ovata*, and *Bonamia menziesii*. The Waihou forest can provide suitable protected habitat for the recovery of at least 18 different species of rare plants.

Endangered Wildlife: Waihou and adjacent areas support two endangered wildlife species - a bird and an insect. The endangered ‘io or Hawaiian hawk (*Buteo solitarius*) attains extremely high population densities. At least 29 hawks were detected in the vicinity of Waihou between March 1998 and April 1999. Eleven pairs nested here during this same period (Klavitter, 2000). Additionally, the Hawaiian hoary bat (*Lasiurus cinereus semotus*) has been observed flying in the area (J. Giffin, personal communication). Waihou is also rich in forest arthropod species. Many are so highly specialized that they can only exist on a single host plant species. The rarest is Blackburn’s sphinx moth (*Manduca blackburni*). Caterpillars of this species feed primarily on leaves of the endangered ‘aiea (*Nothocestrum breviflorum*) tree. Other rare insects at Waihou include two species of long-horned beetles. One (*Plagithmysus simplicicollis*) is also restricted to

the endangered 'aiea tree. Another closely related beetle (*Plagithmysus elegans*) only inhabits the uncommon (in this area) papala tree (*Charpentiera obovata*). Both are on the verge of extinction because of host tree losses. The koa bug (*Coleotichus blackburniae*) is a species of concern though its host (*Acacia koa*) is generally common.

3. 'Aiea Enclosure – 63 acres

Rationale: Fence large concentration of the endangered 'aiea (*Nothocestrum breviflorum*) that is also important habitat for the endangered Blackburn's sphinx moth (*Manduca blackburni*). This fenced unit will enclose more than 30 'aiea trees and allow for systematic collection of seed from as many individuals as possible for outplanting in the Waihou enclosure. This fence will ensure the long-term survival of these rare trees that are being adversely affected by cattle in this area. The area contains one of the larger concentrations of 'aiea trees in grazed areas of Pu'u Wa'awa'a. The forest here is dominated by 'ohi'a, koa, mamane and naio and contains scattered individuals of the endangered 'aiea, and the species of concern 'akoko (*Chamaesyce olowaluana*).

B. Priority 2 Conservation Units:

1. Waihou Forest Phase II - 519 acres

Rationale: Fence an additional 526 acres of remnant forest and endangered species habitat adjacent to the fenced Waihou forest when funding allows. The expansion of the Waihou forest fence will greatly increase the amount of protected area in which to recover both existing and recently extirpated endangered plant populations. This area is considered a priority because it contains numerous individuals of the endangered 'aiea tree, at least two individuals of the endangered a'e tree (*Zanthoxylum dipetalum* var. *tomentosum*), the species of concern 'akoko (*Chamaesyce olowaluana*), the species of concern *Melicope hawaiiensis*, and has some of the better tree cover in the Pu'u Wa'awa'a ranch lease.

2. Lama/Kauila Forest - 407 acres

Rationale: Fence remaining highest quality lama/kauila dominated forest to exclude goats, pigs, cattle and sheep. Reduce fuel loads around and inside the fenced enclosure using a combination of cattle (outside enclosure), bulldozers, weed eaters and herbicide. Outplant rare and depleted species inside enclosure and encourage native regeneration by controlling non-native grasses, shrubs and tree species.

Background: In Hawaii, the lama (*Diospyros sandwicensis*)/kauila (*Colubrina oppositifolia*) forest type is restricted to the Ka'upulehu /Pu'u Wa'awa'a area and is considered rare and critically imperiled (The Nature Conservancy of Hawaii, 1992).

The substrate is typically thin rocky soil on weathered a'a. While lama is a codominant with kauila at two of three known sites, at one site kauila is the dominant, with lama

subdominant. This kauila-dominated forest is considered a variant of the lama/kauila lowland dry forest. Adjacent to lama/kauila forest, vegetation types include fire-disturbed non-native grasslands with scattered native trees and lama lowland dry forest (TNCH, 1992).

Canopy height of this forest type is usually 5-6 meters (16 to 20 feet). Other native trees and shrubs found in lama/kauila forest include alahe'e (*Psydrax odoratum*), maua (*Xylosma hawaiiense*), wiliwili (*Erythrina sandwicensis*), kulu'i (*Nototrichium sandwicense*), mamane (*Sophora chrysophylla*), 'ala'a (*Pouteria sandwicensis*), and 'iliahi (*Santalum paniculatum*). Rare plants in the lama/kauila forests of Pu'u Wa'awa'a include the endangered hala pepe (*Pleomele hawaiiensis*), the endangered 'aiea (*Nothoctrum breviflorum*) and the species of concern 'ohe makai (*Reynoldsia sandwicensis*). This forest type and the immediately adjacent lama dry forest are the only known habitats of the very rare and endangered koki'o (*Kokia drynarioides*) but no koki'o are currently known in the Pu'u Wa'awa'a examples of the forest type.

Although the tree and shrub layers of lama/kauila forest contain only a few or scattered individuals of non-native plants such as koa haole (*Leucaena leucocephala*) and silk oak (*Grevillea robusta*), the ground layers have been extensively invaded by fountain grass (*Pennisetum setaceum*). The dense cover of fountain grass greatly increases the likelihood of destructive wildfires, and interferes with native tree reproduction. A 1986 fire affected much of the lama/kauila forest stands in the vicinity of Pu'u Wa'awa'a, underscoring the fire risk created by fountain grass.

3. Henahena - 838 acres

Rationale: Protect remaining 'ohi'a forest and the fragile lava tube ecosystems that occur underneath this forest type by building fences to prevent animals from damaging vegetation over the lava tube ecosystem.

Background: Forest dominated by 'ohi'a (*Metrosideros polymorpha*) predominate in this area. The Henahena region contains numerous sandalwood trees ('iliahi - *Santalum paniculatum*) and a few of the endangered 'aiea (*Nothoctrum breviflorum*) trees which are host to the endangered Blackburn's sphinx moth (*Manduca blackburni*). Additionally this area contains lava tube systems that merit protection.

C. Priority 3 Conservation Units:

1. Pu'u Wa'awa'a Cinder Cone - 125 acres

Rationale: Improve existing cattle fence to protect uncommon forest type dominated by olopuu (*Nestegis sandwicensis*) and maneke (*Sapindus saponaria*). Create hiking trail through the forest with interpretive signs so that the general public may learn more about the rare Hawaiian dryland forest.

Background: The Pu‘u Wa‘awa‘a cinder cone contains remnants of an uncommon forest type dominated by olopua and manele. The Hawaiian soapberry tree (manele) is only known on the big island from Kipuka Puaulu and Kipuka Ki in Hawai‘i Volcanoes National Park and from one region at Pu‘u Wa‘awa‘a. Though this species is not considered rare, it is uncommon and deserves protection at this locale.

2. Lama Forest with koki‘o - 400 acres

Rationale: Fence remaining highest quality lama/kauila dominated forest to exclude goats, pigs, cattle and sheep. Reduce fuel loads around and inside the fenced enclosure using a combination of cattle (outside enclosure), bulldozers, weed eaters and herbicide. Outplant rare and depleted species inside enclosure and encourage native regeneration by controlling non-native grasses, shrubs and tree species.

Background: Forest dominated by lama on old substrate containing two of four last remaining wild koki‘o (*Kokia drynarioides*) trees (endangered). This forest type is similar to the lama/kauila forest but does not have kauila as a codominant in the overstory.

D. Priority 4 Conservation Units:

1. Upper Kipuka Oweowe - 27 acres

Rational: Protect this small portion of a kipuka that is dominated by lama and includes rare species such as kauila and ‘aiea.

Background: See above description of the lama/kauila forest type. This forest is dominated by lama, but contains the endangered trees, kauila and ‘aiea. This area contains habitat that is important for the federally listed Blackburn’s sphinx moth (*Manduca blackburni*).

2. Upper South Boundary Kipuka - 57 acres

Rationale: Protect this small portion of a kipuka that is dominated by lama and includes rare species such as kauila and ‘aiea.

Background: See above description of lama/kauila forest. This forest type contains the endangered tree species kauila, ‘aiea, and hala pepe. This area also contains important habitat for the endangered Blackburn’s sphinx moth (*Manduca blackburni*). Hualalai Ranch owns a portion of this kipuka. Its isolation may make it a prime area for restoration as it has the Ka‘upulehu lava flow as a natural firebreak on one side.

3. Lowland ‘ohi‘a Forest -506 acres

Rationale: Protect remaining area dominated by ‘ohi‘a Makai of Highway 190 through the use of ungulate proof fencing. Foster restoration of ecosystem through outplanting and fire pre-suppression efforts.

Background: This area contains dry forests dominated by ‘ohi‘a but containing less common native trees such as ‘ala‘a (*Pouteria sandwicensis*) and maua (*Xylosma hawaiiense*). The endangered hala pepe (*Pleomele hawaiiensis*) and the species of concern ‘ohe makai (*Reynoldsia sandwicensis*) are also observed here.

4. Kileo - 594 acres

Rationale: To protect a section of the oldest geologic kipuka at Pu‘u Wa‘awa‘a and a unique cave system that occurs within the kipuka.

Background: Kileo is the oldest geologic area of Pu‘u Wa‘awa‘a and contains a naio, mamane, and a‘ali‘i woodland (a currently unprotected vegetation type at Pu‘u Wa‘awa‘a). Approximately 96 acres of this unit extends into DOFAW-managed lands of Pu‘u Anahulu. There is a unique cave system that runs from over 6000 foot elevation through the kipuka to 4200 feet. Many sub-fossilized birds have been found in this cave, most have been removed for research. This site has potential for educational and ecotourism purposes (caves).

Appendix C. Preliminary RFP for a Pu‘u Wa‘awa‘a Grazing Plan

Background:

The forests of Pu‘u Wa‘awa‘a were once considered the most diverse in all of the Hawaiian islands (Rock, 1913). A long history of grazing, fire and alien species invasions in the area have degraded the forest. Remnant patches of forest at Pu‘u Wa‘awa‘a are home to a unique suite of endemic Hawaiian species, many of which are endangered. Protection of these remaining stands of forest is one of the goals of the Pu‘u Wa‘awa‘a Management Plan proposed by the Department of Land and Natural Resources (DLNR).

Livestock threaten existing forest by trampling and browsing seedlings and saplings, therefore preventing forest regeneration (Grace, 1995). However, the presence of livestock is now critical for reduction of introduced grass biomass to help prevent the spread of catastrophic fires (Blackmore & Vitousek, 2000). The introduced grasses Kikuyu (*Pennisetum clandestinum*) and fountain grass (*Pennisetum setaceum*) greatly facilitate the spread of wildfire. Ungrazed fountain grass found in the drier areas of Pu‘u Wa‘awa‘a is able to spread fires at a much greater rate than kikuyu (Blackmore & Vitousek, 2000). Reducing the fire fuel load of these grasses will be the main objective of the grazing activities at Pu‘u Wa‘awa‘a. In addition, grazing activities must be carefully implemented to minimize livestock impacts on remaining forest stands.

Biomass measurements and fire behavior modeling will be the main specification for grazing techniques. Following Blackmore and Vitousek (2000) and Mick Castillo (personal communication), grazing in paddocks can reduce the fuel load from 6,868 lbs/acre to 2,042 lbs per acre in the case of kikuyu, and from 11,425 lbs/acre to 2150 lbs/acre in the case of fountain grass. These measures indicate that fire behavior, modeled using the program BEHAVE, will be reduced substantially. This modeling technique, along with new research (Joint Fire Science Project) will serve as a tool to determine if grazing practices are in line with the goals of the Management Plan. Other developing technology and research tools will be applied as they become available.

Additionally, in the transition zone between the moist and dry areas, reduced percent cover of fountain grass will be a measure for suitable grazing practices. In wetter areas (rainfall 950 mm/yr (37 inches)), heavily grazed paddocks are dominated by kikuyu and fountain grass reaches an average of only 23 % cover. As the areas become drier and paddocks are lightly grazed, fountain grass increases in percent cover to 63 % cover (rainfall 750 mm/yr (30 inches)) (Blackmore & Vitousek, 2000) and the likelihood of a catastrophic fire increases. Grazing can be used as a tool in these zones to keep fountain grass cover at bay.

Ranching in Pu‘u Wa‘awa‘a was historically allowed under a general lease. Presently it is conducted under a revocable permit during the development of the DLNR management plan for Pu‘u Wa‘awa‘a. The plan calls for a wide range of new priorities in addition to a continued need for livestock grazing. Consequently, livestock management in Pu‘u Wa‘awa‘a will shift from a sole emphasis on commercial ranching to include of livestock grazing as a management tool in support of new priorities such as fire control and natural resource conservation. A grazing permit for the lands of Pu‘u Wa‘awa‘a will be awarded to aid in these operations.

Goals of the Grazing Program at Pu‘u Wa‘awa‘a:

The awarding of a grazing permit at Pu‘u Wa‘awa‘a is intended to aid the DLNR in achieving its management objectives in the area, and will incorporate specific goals including:

- Reduce grass fine fuel loading to decrease catastrophic fire potential at Pu‘u Wa‘awa‘a.
- Require grazing practices that will reduce the impact of livestock on selected areas containing remnant native vegetation.
- Create a cooperative environment where the grazing permittee works in collaboration with the DLNR and other partners on the project.
- Encourage research in the area of fine fuel reduction, forest protection and restoration using grazing as a tool.

Technical conditions and requirements provided by DLNR and NRCS:

1. A map showing available paddocks, acreages, existing infrastructure, and proposed conservation units.
2. A vegetation type map will be prepared depicting current range ecological conditions, apparent trends in vegetation changes, general forage value rating for each vegetation type, and initial distribution and density of weed species. These data will be summarized by paddock or pasture unit. Historical weather data will be included.
3. NRCS will specify acceptable land cover percentages for weed species. DLNR and NRCS will identify areas that initially have excessive weed cover, and will specify which party is responsible for weed control measures in these areas.
4. Guidelines for quarterly monitoring of pasture conditions by DLNR or NRCS and how compliance to the grazing plan will be enforced. These guidelines will be strictly monitored and evaluated, and lack of compliance may result in the revocation of the permit. Should a given paddock or pasture unit not meet the standard for proper grazing use, the livestock permittee shall be notified in writing. The livestock permittee shall be informed as to the standard for meeting proper grazing use should such circumstances occur. Any action other than the letter of notification will be determined by DLNR. Similarly, if paddocks or pasture units do in fact meet grazing permit standards, the livestock permittee and DLNR shall be notified in writing. The livestock permittee shall be commended in the letter for good stewardship of the range resource. Biomass measures, fire modeling and percent cover of vegetation may be used as indices to evaluate pasture conditions during monitoring efforts.
5. The grazing permit will be awarded for 10-15 years to allow applications for Federal grants.
6. DLNR will provide structures B1, B2 and B9 to support activities of the livestock permittee, including a schedule of their availability.
7. After one year of operation, DLNR and the livestock permittee will meet to discuss the permit/MOA to determine if adjustments are required.
8. The livestock permittee and DLNR should recognize that recommended stocking rates are subject to change. The Natural Resources Conservation Service (NRCS) may recommend changes due to factors such as occurrences of drought, annual

fluctuations in precipitation, and field assessments and evaluations or range conditions. The livestock permittee will be credited for changes that result in losses on capital improvements that were placed previously by the permittee.

9. Present condition of infrastructure supporting ranch operations, including information detailing roads, fences, water supply, and corrals. Methods and responsibility for upgrading and maintaining such infrastructure will also be specified.

Evaluation:

In their proposals, prospective livestock permittees may wish to address or demonstrate skills and abilities such as: knowledge of grazing practices in semi-arid areas; familiarity with the local terrain; the ability to apply sound animal husbandry and; the willingness to remain flexible and possess a cooperative approach while supporting projects planned by DLNR.

Proposals will be evaluated on:

- Technical merit and ability to achieve stated objectives (grazing system, proposed handling of infrastructure, etc.)
- Applicability of the proposal in relation to the Pu‘u Wa‘awa‘a management plan
- Qualification of applicant(s)
- Competitive budget

Proposal Guidelines:

Applicant Information and qualifications:

Please give your name(s), and company name, and a brief summary of the key qualifications for each of the applicants.

Justification:

Please describe why you would like to participate with DLNR as the grazing permittee for the lands of Pu‘u Wa‘awa‘a. Please refer to the Management Plan and how your goals will be integrated with those of the Plan.

Methods:

At a minimum, please address the following concepts and objectives in your proposal to conduct grazing operations at Pu‘u Wa‘awa‘a:

1. For each vegetation/climate zone, propose stocking rates and stocking density for all classes and numbers of livestock that will be grazed in the project area.

2. All paddocks shall have scheduled periods of rest deferment from grazing and scheduled periods of grazing. For each vegetation/climate zone, discuss what system of grazing versus resting will be employed in paddocks.
3. Describe your herd health plan.
4. Periods of drought in Pu'u Wa'awa'a will periodically occur. The grazing plan must be flexible to accommodate both short-lived and extended drought periods. Under such circumstances, paddocks may be grazed for shorter periods of time in order to protect and conserve the range resource. Provide details on how you would determine the need for modifying the basic grazing system due to drought. Detail methods that would be employed, including possible decreases in stocking rates or de-stocking portions of the range within the project area.
5. Selected areas, paddocks or perimeter zones of fenced conservation units may require relatively high livestock grazing pressure due to high fire ignition potential. What methods will be employed to concentrate livestock grazing in these zones once they have been identified.
6. DLNR may periodically request pulse grazing within fenced conservation units to reduce fuel loading. What methods and terms would you propose to meet such requests.
7. All grazing activity must promote control of land disturbances that encourage encroachment of noxious woody species. Examples of such species include tobacco tree, castor bean, lantana, apple-of-sodom, and silk oak. Levels of noxious shrubs and trees will be quantified by percent canopy cover during periodic range monitoring. What weed control measures will be employed in your grazing system.
8. Each applicant will be given the opportunity to inspect current ranch infrastructure. What water and fencing infrastructure will be required, and where. Installation of such infrastructure and subsequent maintenance shall be the responsibility of the livestock permittee.
9. Provide a discussion of how incremental removal of proposed conservation units from active grazing would impact your operation and fee schedule.
10. Discuss how water sources, salt and mineral supplements shall be placed in order to encourage uniform grazing of paddocks.
11. Pu'u Wa'awa'a cone and other old ash deposits have zones are highly susceptible to soil erosion. How will grazing be managed to mitigate this erosion potential.

Budget:

Include an annual per-acre fee schedule for reimbursing the State in your proposal. If your financial analyses indicate that an operation which meets the criteria outlined in this document would be in deficit, indicate what annual per-acre reimbursement from the State you would require to operate.

Proposal length:

5-10 pages.

Submission:

Submit 5 hard copies and one electronic copy (via-email or floppy disk) of the proposal postmarked no later than _____. Selected applicants will be announced by _____.

DLNR reserves the right to reject or request modifications of any or all proposals. Please submit proposals to:

Division of Forestry and Wildlife
Pu'u Wa'awa'a Project Coordinator
P.O. Box 4849
Hilo, Hawai'i 96720

Literature cited:

- Grace, K.T. 1995. Analysis and prediction of growth, grazing effects, and economic production of *Acacia koa*. Ph.D. dissertation. Department of Agronomy and Soil Science. University of Hawaii-Manoa, Honolulu, Hawaii, 176 pp.
- Blackmore, M. and P.M. Vitousek. 2000. Cattle grazing, forest loss, and fuel loading in a dry forest ecosystem at Pu'u Wa'awa'a Ranch, Hawaii. *Biotropica* 32(4a): 625-632.
- Rock, J. 1913. Indigenous Trees of the Hawaiian Islands. Published under patronage, Honolulu, Territory of Hawaii. 517 pp.