

Draft Environmental Assessment

Kohala Mountain Watershed Management Project

Kohala District
Island of Hawai'i

In accordance with Chapter 343, Hawai'i Revised Statutes

Proposed by:

Kohala Watershed Partnership
c/o 19 E. Kawili Street
Hilo, HI 96720

December 27, 2007

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I. SUMMARY

Project Name:

Kohala Mountain Watershed Management Project

Applicant:

Kohala Watershed Partnership:

Kahua Ranch

Kamehameha Schools

Laupahoehoe Nui, LLC

Parker Ranch

Ponoholo Ranch

Queen Emma Land Company

State of Hawai'i Department of Hawaiian Home Lands

State of Hawai'i Department of Land and Natural Resources

Surety Kohala Corporation

Associate Partners:

Hawai'i County Department of Water Supply

The Nature Conservancy

Contact for the Kohala Watershed Partnership:

Melora Purell, Coordinator

c/o Division of Forestry and Wildlife, Hawai'i Branch

19 E. Kawili Street

Hilo, HI 96720

Tel: 808-333-0976

Approving Agency:

State of Hawai'i Department of Land and Natural Resources

Anticipated Determination:

Finding of No Significant Impact (FONSI)

Project Location:

Land Divisions (ahupua'a and 'ili): 'Āwini, Honokāneiki, Honokānenui, Kahuaiki, Kahuanui, Kawaihae Hikina, Kawaihae Komohana, Laupāhoehoeiki, Laupāhoehoenui, 'Ōuli, Pu'ukapu, Wai'aka 1, Wai'aka 2, Waimanu, Waimea and Waipi'o

North Kohala, South Kohala and Hamakua Districts

Island of Hawai'i

TMK: 347007015, 349001007, 349003006, 349012001, 349012002, 349012003, 349012004, 349012005, 349013001, 349013002, 349014001, 349014003, 349014004, 349014005, 349014008, 349014009, 349014010, 349014011, 349014012, 349014013, 349014014, 349014014, 349014017, 349014020, 3490140,1, 349014022, 349015001, 349015002, 349015003, 349015004, 349015005, 349015009, 349015010, 351001002, 351001003, 351001004, 351001005, 351001006, 351001008, 351001011, 351001016, 351001017, 351001019, 351001021, 351002001, 351002004, 351002012, 351002013, 351002015, 351002017, 351002017, 352001001, 352001002, 352002001, 352002002,

352002003, 352002009, 352003001, 352003002, 352003003, 352004001, 352004002, 352004003, 352004004, 352005008, 352005012, 352005014, 352006003, 353002001, 353003001, 358002001, 358002002, 358002003, 358002005, 35,002007, 358003002, 358003003, 359002001, 359002002, 359002003, 359002004, 359002005, 359002006, 361001001, 361001002, 362001001, 362001002, 362001003, 362001004, 362001005, 362001006, 362001007, 362001008, 362001015, 362001023, 362001025, 362001031, 362001038, 363001001, 363001002, 363001003, 363001004, 363001005, 363001006, 363001007, 364001051, 364001056, 364002061, 364002124, 364002137, 365001003, 365001004, 365001006, 365001008, 365001010, 365001011, 365001013, 365001017, 365001019, 365001020, 365001047

Land Use:

State Agriculture and Conservation Districts (Protective, Limited, Resource, and General subzones)
County zoning (conservation, agriculture)
Special Management Area
Waimea Community Development Plan
State Restricted Watershed
State Natural Area Reserve
State Forest Reserve

Property Owners:

Kahuā Ranch
Kamehameha Schools
Laupāhoehoe Nui, LLC
Parker Ranch
Ponoholo Ranch
Queen Emma Land Company
State of Hawai‘i Department of Hawaiian Home Lands
State of Hawai‘i, Division of Forestry and Wildlife, Department of Land and Natural Resources
Surety Kohala Corporation

Agencies, Organizations, Groups, and Individuals Consulted:

Federal:

U.S. Department of Agriculture
U.S. Fish and Wildlife Service, Department of the Interior

State:

Division of Forestry and Wildlife, Department of Land and Natural Resources
Department of Hawaiian Home Lands

County of Hawai‘i:

Department of Water Supply

Other Organizations, Groups:

Kahuā Ranch
Kamehameha Schools
Kohala Forest Management Group
Laupāhoehoe Nui LLC
Mauna Kea Soil and Water Conservation District
Parker Ranch
Pelekane Bay Watershed Management Project
Ponoholo Ranch
Queen Emma Land Company
Surety Kohala Corporation
The Kohala Center
The Nature Conservancy
Waiulaula Watershed Management Project

Individuals (April 2006 Open Houses):

Leslie Agorastos	
Milton Angelo	
Margaret Becka	June Gomes
Boyd D. Bond	Mark Harris
Lloyd Case	January Herron
Kanaina Case	Pono Hui
Pua Case	Bob Hunter
William Case	M. Kapuniai
Heather Cole	Gay Lambert
Wade Cypriano	Pat Lambert
Jessica Dales	Andi Lingpre
Charles England	Elmo Lincoln
Rose Everly	Dana Moss
Cyrus Field	Estraita Navares
James Frazier	Melora Purell
Everette Franco	Clarence Rengulbai
Troy Franco	Pat Tummons
David Freitas	Kurt Von der Heyden
David Fujishige	Randall Wappler
Anne Gomes	Sam Whitehead
David Gomes	Margaret Wille

II. OVERALL PROJECT DESCRIPTION

Formed in August 2003, The Kohala Watershed Partnership (KWP) is a voluntary alliance of public and private landowners dedicated to protecting watershed values and managing threats that occur across common land ownership boundaries across the Kohala region. The partnership includes: Kahuā Ranch, Kamehameha Schools, Laupāhoehoe Nui, LLC, Parker Ranch, Ponoholo Ranch, Queen Emma Land Company, the State of Hawai‘i Department of Hawaiian Home Lands, and the State of Hawai‘i Department of Land and Natural Resources, and Surety Kohala Corporation. Associate partners include the Hawai‘i County Department of Water Supply and The Nature Conservancy.

The Partnership has developed a 20-year draft management plan, on which this environmental assessment is based, to guide management actions over the roughly 65,000 acre area of the KWP. The overall goal of the plan is to maintain a healthy watershed and all its related ecosystem values and functions (e.g. ecological, economic, sociocultural). As such, management actions are directed at the major threats facing Kohala’s watershed: feral ungulates (hooved animals such as pigs and cattle) and other non-native animals (such as rats and aquatic invasives), invasive plant species (such as banana poka and Kahili ginger), wildfire, and incompatible human activities. Primary management goals are: 1) protection of water resources; 2) prevention of new introductions and control of existing invasive plant species; 3) control of non-native animal populations; 4) native habitat and species protection; 5) wildfire management; and 6) management and promotion of compatible public uses. Major management actions related to these goals are fencing, feral animal removal, invasive species control, outplanting and restoration, monitoring and surveys, research, and infrastructure support and maintenance (including development of new access trails). The entire project area of roughly 65,000 acres is identified as the Kohala Watershed Management Area (WMA) and divided into high yield watershed units and biodiversity units for management purposes (Appendix A). These high yield watershed units and biodiversity units are where a majority of management actions will be focused; however given the changing nature and location of threats, management actions will be occurring over the entire project area as threats are targeted. Management actions will occur over an anticipated 20-year time period and will also depend on funding availability and on-the-ground conditions.

The identified management actions and areas are a result of previous planning initiatives and pre-consultation efforts done in developing the Kohala Watershed Partnership’s draft management plan. They include discussions and meetings of the Natural Area Working Group, Kona/Kohala Natural Resource Area Workshop, Kohala Forest Management Group, Waimea Water Roundtable, 2006 April open houses held in Waimea, North Kohala, and Honoka‘a, and over 90 interviews with community members, businesses, government agencies, recreational users, cultural practitioners, private landowners, researchers, and others (Appendices B and C). Resulting comments stressed the importance of protecting less-accessible areas that have the most precipitation and that are in the best ecological condition from threats such as feral ungulates and invasive plants so that communities can continue to benefit from the watershed’s ecosystem services such as water, clean streams, native habitats and species, culture, recreation,

and economics. Final adoption of the revised draft management plan is pending the completion of this environmental review process.

The boundary of the project area follows State Hwy 250 (Kohala Mountain Road) from ‘Ōuli Gulch at milepost 1.5 as it climbs northwest to mile 11, where it then climbs northward over Kohala Mountain’s northwest shoulder to drop northeastward toward the Pololū Valley estuary. The Watershed Management Area follows the windward coastline, bends up Waipi‘o Valley, and climbs to encompass the Pu‘ukapu section of the Kohala Watershed. The Southern boundary then follows the southern Forest Reserve boundary westward and continues to meet ‘Ōuli Gulch at the Highway 250 crossing.

Kohala mountain provides 154 million gallons of sustainable yield of water per day for the island. In addition to agricultural irrigation, the Kohala Watershed Management Area provides drinking water for North and South Kohala as well as parts of Hāmākua. The Kohala Watershed Management Area is dominated by both wet and mesic lowland and montane forests and shrublands on windward and mauka portions. The leeward slope is characterized by montane wet forest with an abrupt transition to pasture at the mauka fencelines. Within the forest, montane bogs are found on poorly-drained flat areas at high elevation, and the steep cliffs of windward valleys are vegetated with shrubs and trees. There are also streams, cinder cones, lava domes, and native plant and animal species that occur over this 65,000 acre area. The highest point of elevation is 5,480 feet above sea level. There are also man-made dikes, ditches, and other irrigation systems for water harvest.

Historically, the project area was first inhabited and used by Native Hawaiians. In subsequent years, the sandalwood trade flourished with many forests in Kohala harvested for this resource. The trade was then followed by the establishment of ranching in the early 1800s, which was followed by sugar plantations in the mid to late 1800s and other agriculture industries. In addition to these uses, contemporary activities include hunting, hiking, and camping (Appendix A). Traditional cultural usages such as gathering of plants for medicines and hula continue. Currently, there are few residents who live full time in the project area.

State land use designations identify lands in the project area as a mix of Agriculture and Conservation (Protective, Limited, Resource, and General subzones) districts. Much of the windward coastal areas are identified as a Special Management Area, and some management actions identified will be done in these areas. County zoning is conservation and agriculture. Land ownership includes both public (55 %) and private (45%) (Appendix A). Adjacent lands to the Kohala Watershed Management Area include agricultural lands, mostly used for pasture, and the low-density residential areas of Waimea, along Kohala Mountain Road, and in the towns of Hawi, Kapa‘au and Honoka‘a. Current land use for these areas is primarily ranching with some diversified agriculture and eco-tourism.

Purpose and Need

The purpose of the management actions is to insure continued watershed services are provided to the Kohala region and Hawai‘i island by addressing the impacts of current and future threats to the area.

Average annual rainfall on Kohala Mountain ranges from about 30 inches along the leeward section of the Kohala Mountain Road to over 160 inches near the 3,500 foot elevation in the wet forest between Waipi‘o and Honokāne valleys on the windward side. Hawai‘i’s forests play a vital role in watersheds as they provide recharge to underground aquifers and supply surface water. A distinctive feature of Kohala’s hydrology is that a significant portion of its total precipitation comes from water intercepted from the clouds passing through the vegetation high on the mountain (10-20,000 acres of montane cloud forest). Cloud water interception adds significantly to rainfall, with both combining to provide nearly 200 inches per year across Kohala’s broad windward summit region. The geology of Kohala Mountain favors the storage and transport of subsurface water from these forested regions of the mountain to the coastal areas where water is discharged. This water recharges the aquifers or is stored in the soil (soil moisture holding capacity is higher in forested areas). This water also provides Kohala with its numerous perennial streams and rivers that flow from summit regions to the ocean.

The Hawai‘i County Department of Water Supply relies on the streams of Kohala Mountain to fill three reservoirs which serve as the primary water source for the community of Waimea. Residents of Kohala and surrounding areas also depend on groundwater resources accessed by wells for their water supply. These wells tap into aquifers which are filled from recharge zones in upland forests.

In addition to these water resources, the Kohala watershed is also home to unique plants and animals, some of which can be found nowhere else on earth (Appendix D). Native habitat communities include lowland wet forests, montane wet and mesic forests, coastal strand vegetation, montane wet bogs, lowland and montane shrub and grasslands, as well as wet and dry cliffs. The watershed also provides opportunities for cultural practices including the cultivation of kalo (taro), educational activities, and recreation by hikers, hunters, campers, and others. All of these ecosystem values are components of a healthy, holistic, functioning watershed.

However, these watershed areas are faced with several threats that may degrade the ability of the forests to provide clean water and other ecosystem services to the Kohala region. Prevalent invasive alien species found in the Watershed Management Area include strawberry guava (*Psidium cattleianum*), Kahili ginger (*Hedygium gardnerianum*), banana poka (*Passiflora tarminianum*), *Tibouchina herbacea*, palm grass (*Setaria palmifolia*) and Koster’s curse (*Clidemia hurta*). These plant species can alter both the structure and function of the native forest by out-competing native species and decreasing forest diversity, which can reduce the forest’s ability to hold water, and can change the movement of water and nutrients in the ecosystem. Invasive plant species with shallow root structures (like *Tibouchina herbacea*) may cause increased soil erosion by not holding soil effectively (a problem during heavy rains). Fast-growing trees that can create single-species closed canopy forests (like strawberry guava) eliminate all ground-cover vegetation, which reduces moisture in the soil and relative humidity, and may increase run-off and reduce aquifer recharge. Changes in forest structure also reduce available habitat for native wildlife species. In addition, run-off may increase turbidity and nutrient loads in streams to the detriment of native stream life and downstream users like kalo farmers. The streams may also transport sediments and nutrients that degrade near-shore ocean ecosystems by covering coral reefs and polluting fishing areas. Certain plants like fountain grass found on dry leeward slopes may increase fire hazards by providing abundant fire fuels. Invasive

plant species such as strawberry guava form thickets and have strong root systems that can destroy the integrity of archeological sites.

The emergence and establishment of these invasive plant species is also assisted by feral ungulates (wild pigs and cattle), which disturb the soil and destroy low-growing plants like ferns and mosses (understory vegetation critical for the absorption of rainfall and slowing of water and soil run-off). For example, feral pigs can uproot and damage understory vegetation as well as consume native plants and their seeds, leading to pockets of bare soil areas which provide openings for the establishment of invasive plant species, the seeds of which can be carried by feral pigs. Additionally, bare soil areas become a source for soil erosion and affect water quality as sediments are transported via streams or during strong rainfalls and floods into the ocean. This can affect fish populations and other marine life and coral areas. Feral cattle also pose a threat by trampling and damaging forested areas and opening up the vegetation for invasive species introductions. For both ungulate species, opening the understory canopy to light and wind affects the ability of these disturbed areas to hold moisture and to grow epiphytes and mosses that are important for fog capture and rainfall storage. Rats, another non-native animal of concern, can consume the seeds, fruits, and flowers of native plant species as well as strip their bark. This can impact the new growth of Kohala's forests and the diversity of native vegetation that makes its forest an effective watershed. Additionally, both feral ungulates as well as rats can affect water quality and human health by serving as sources for water-borne diseases such as Leptospirosis and Cryptosporidiosis. Feral pigs also create wallows where water collects and produce habitats suitable for mosquito populations. Along with carrying bird pox and bird malaria (which threaten native forest birds), mosquitoes also serve as vectors for West Nile Virus, posing serious human health concerns should the virus ever reach Hawai'i. Feral ungulates have also been known to disturb archaeological sites by knocking over features, turning over soil, and spreading invasive weeds in these areas. Other non-native animals of concern are mongooses, feral cats and dogs, mice, alien birds, alien arthropods, and alien aquatic species.

Another threat posed to Kohala Mountain is human related impacts such as inadvertent trampling of sensitive vegetation, transportation of invasive weeds, trespassing, and wildfires.

The Kohala watershed is an area that is remote, characterized by difficult terrain, restricted access, and mostly uninhabited by people. However, it is also an area rich in biological and socio-economic resources. Consequently, recreational usage of the area, whether it is for hiking, sight-seeing, hunting/fishing, camping, or other activities, has led to issues of safety management for the watershed. People have gotten lost in Kohala and deaths have occurred. People have been linked with accidental introduction of alien species along trails, disturbance of rare habitats and species, disturbance of cultural and archaeological sites, and wildfire as well. The intent of the draft management plan is to support and encourage forms of public use in areas where it is compatible with conservation of water and related watershed values and where negative impacts are minimized.

III. DESCRIPTION OF ACTIONS

Many of the identified management actions (e.g. fencing, feral animal removal, invasive species control, outplanting and restoration, monitoring and surveys, research, and infrastructure support and maintenance) serve more than one of the management goals identified: 1) protection of water

resources; 2) prevention of new introductions and control of existing invasive plant species; 3) control of non-native animal populations; 4) native habitat and species protection; 5) wildfire management; and 6) management and promotion of compatible public uses. The anticipated time frame for all proposed management actions is 20 years, to begin once all regulatory compliance requirements and necessary permits are approved and in-hand. All management actions will be dictated by terrain, consideration of least minimal impact to resources, management access, discovery of any cultural, archaeological, historical or rare biological resources, funding availability, and other management considerations. Description of management actions also includes their technical characteristics. Should any changes in the management plan be required during the period of implementation that substantially differ in scope from the management actions outlined in this environmental assessment, they will undergo subsequent environmental review and a supplemental environmental assessment will be conducted if required.

Feral Ungulate Management

Feral ungulate management consists of fencing (both those that enclose an area and also strategic fencing which uses natural barriers) and ungulate removal through various methods that are chosen based on project objective, terrain, feasibility, and safety of participants. Methods can include, but are not limited to, public hunting, staff controlled hunting, trapping, snaring, and aerial shooting. Feral ungulate management will help to fulfill the management goals of protection of water resources; prevention of new introductions and control of existing invasive plant species; control of non-native animal populations; native habitat and species protection, and management and promotion of compatible public uses. Primary areas where these activities will occur are in both the high- yield watershed management units and biodiversity units (Appendix A). The high-yield watershed management units are units A (~900 acres), B (~1,600 acres), C (~2,100 acres), and D (~2000 acres). These areas comprise a significant portion of the watershed in which groundwater infiltration is occurring and contain the headwaters for streams such as Ohiahuea and Honokāne. Total acreage of management units A-D are approximately 6,600 acres and comprise State lands (Pu‘u O‘Umi Natural Area Reserve, Kohala Forest Reserve – 6,200 acres) and private lands (Laupahoehoe Nui, LLC - 400 acres). State land use zoning is Conservation district. For the biodiversity units, proposed fencing will be considered for portions of or entire biodiversity management units E (640 acres), F (430 acres), G (210 acres), H (160 acres), I (20 acres), J (1,530 acres), K (565 acres), L (290 acres), M and N (65 acres) as well as priority stream corridors in leeward Kohala. These areas have been selected because they host unique, rare, or threatened and endangered species and habitats. These management units are comprised of both public (1,245 acres) and private ownership (2,665 acres) and are a mix of both State Conservation and Agriculture districts.

Proposed fencing initiatives in both the high yield watershed units and the biodiversity units will result in approximately 10,500 total fenced acres of both public and private lands within the Watershed Management Areas (approximately 15% of the total 65,000 project acreage, of which 6,995 acres or 10 % is public and 3,145 acres or 5 % is private). During development of the draft management plan (which included reviewing meetings of the Natural Area Working Group, Kona/Kohala Natural Resource Area Workshop, Kohala Forest Management Group, Waimea Water Roundtable, and over 90 interviews with community members, businesses, government agencies, recreational users, cultural practitioners, private landowners, researchers, and others), these areas were identified as highest conservation values for both watershed and native species

protection and also because they were rarely used (if at all) by hikers, hunters, campers, and others, thereby minimizing impact on use.

Fencing has proven to be an effective tool for other Watershed Partnerships which have engaged in similar management actions to address similar watershed threats. Examples include East Maui, West Maui, East Moloka'i, 'Ōla'a-Kīlauea, and the Ko'olaus on O'ahu. The construction of an ungulate proof fence is the first step in watershed protection and restoration as feral ungulates can degrade native habitat through destruction of forest understory, introduce invasive weed species, and serve as a vector for human diseases; these animals also cause soil erosion, and create wallows where mosquitoes breed and develop. Fencing of such conservation areas followed by animal removal has shown that damage from feral pigs to forest understory and rate of invasive weed disturbance is slowed and even reversed as native vegetation is able to recover.

Fencing alignments will be dictated by terrain and by any sensitive resources that may be discovered. Prior to fence construction, the fence boundary will be surveyed and marked with plastic flagging. During this survey, any sensitive biological resources such as rare plants, bird nesting sites, or archaeological/historical/cultural resources which may be discovered will be identified and alignments shifted to avoid such sensitive features. Fencing alignments will also avoid trees greater than six inches in diameter. Once the fence alignment has been identified, a cleared corridor to allow for fence construction will be created. The corridor to allow for fence construction will be a maximum of four feet wide, and will not need to accommodate vehicles. Some of the corridors may follow existing pasture fence lines (biodiversity units E, H, L, M, N). Clearing will be done by hand, and materials and crew will be transported to the fencing sites by truck for locations adjacent to pastures, and by helicopter for remote locations.

The fence will be made from steel posts, and will use 47" steel hog wire fencing, with a bottom strand of beznol-coated barbed wire, with anchor pins ("dead men") in-between fence posts to keep the fence tight to the ground. Depending on terrain, height of the fence can range anywhere from four to six feet. Along any steep slopes or uneven surfaces, hog wire skirting will be extended out from the bottom of the fence to eliminate animals digging under the fence and entering the fenced area.

When the fence line crosses a stream, different options (such as breakaway panels or other similar technology to prevent potential flooding build-up) will be considered depending upon the conditions and feasibility, but with foremost consideration focused on limited or no impairment to natural water flow. When the stream has steep, rocky falls or drop-offs, the fence will be tied in to these natural barriers, and will not cross the water flow, but will still restrict animal movements. In the case of more gradual stream beds, culvert pipes, rubber flaps or other animal-restricting devices will be installed along the fence line to allow for variable water flow while reducing damage to the fence from storm events and preventing animal ingress. After any heavy rainstorm, partnership staff will inspect fences along stream crossings to insure that debris has not accumulated.

In addition, where feasible and appropriate, one way gates in the fence will be installed to allow feral pigs to leave fenced areas and move to other areas used for hunting. Similarly, crossovers or self-closing gates will be installed along fencing at trails or other accessible locations to allow

for movement of people into and/or between fenced areas. Proposed fencing is designed to limit animal movement, not block access by people.

Fencing will be conducted in phases due to funding limitations or to reflect on-the-ground situations. After the completion of a fence, the fence will be regularly monitored for integrity and efficacy to ensure that there are no broken fence lines or other problems.

Once the fence is installed, feral ungulate removal will begin using a variety of methods where appropriate (e.g. public hunting, trapping, aerial shooting, professional hunting, staff control hunting, snaring, etc.). As mentioned previously, the main considerations when determining control methods and options are based on project objective, feasibility, and safety of participants. Whenever possible and when not jeopardizing the safety of public hunters and their dogs, the first phase of feral ungulate management for any area will include involvement of public hunters.

Due to the remote locations involved with many of these fenced units, crews may be camping on-site for periods of days to weeks. In wet, remote areas, temporary decking may be erected to reduce impact on vegetation by tents and human activities.

Invasive Species Control

Invasive species control involves both weed management (using either mechanical, biological, or chemical controls) as well as non-native animal control. The management approach selected will consider the invasive species' distribution, mode of spread, and other factors. These actions address the management goals of protection of water resources; prevention of new introductions and control of existing invasive plant species; control of non-native animal populations; native habitat and species protection; and wildfire management. These management actions will be done primarily in high yield watershed area units A-D (6,600 acres) as well as biodiversity units E-N (3,910 acres), which total about 10,500 acres. Land ownership for these units is a mix of both public and private with State land use zoning a mix of Conservation and Agriculture districts.

Alien or non-native plant species already exist within the 65,000 acre Kohala Watershed Management Area. Some alien species found elsewhere on the island have not yet invaded Kohala Mountain, yet pose a potentially serious threat. Some invasive species of concern are miconia (*Miconia calvenscens*), Kahili ginger (*Hedychium gardnerianum*), Australian tree fern (*Sphaeropteris cooperi*), albizia (*Falcataria moluccana*), banana poka (*Passiflora tarminiana*), fountain grass (*Pennisetum setaceum*), Himalayan raspberry (*Rubus ellipticus*), palm grass (*Setaria palmifolia*), fireweed (*Senecio madagascarensis*), *Tibouchina herbacea*, Koster's curse (*Clidemia hirta*), and glorybush (*Tibouchina urvelliana*). These and other invasive species are of concern because they have the ability to change the composition and structure of the forest, impact efficacy of water storage and water quality, as well as pose wildfire risks by increasing fuel loads. Certain species such as *miconia* can cause severe landslides because they have shallow roots that do not have the capacity to hold soils. These invasive weed species also impact native habitats and species by degrading or destroying habitats necessary for species survival. Management actions proposed to combat these existing and potential new threats include monitoring (e.g. surveys and assessments including mapping) and control (e.g. mechanical, biological, grazing, prescribed fires, or chemical).

Mechanical control methods include manual pulling, digging, snipping, cutting, girdling, grinding, and others. Methods such as cut-stump, frill, and notch-cut follow treatment immediately with a spot application of herbicide. Cattle and sheep have been used effectively to reduce wildfire grass fuels in pastures and other grasslands on the island. For example, at Pu‘u Wa‘awa‘a Ranch cattle have been used to reduce wildfire fuels through intensive roadside grazing. Cattle are also currently being utilized at Kohala Ranch, on the lower southwest slopes of Kohala Mountain, to keep wildfire fuels reduced around homes in the subdivision. Sheep have been used to reduce wildfire fuels in a perimeter fuel break for Waiki‘i Ranch. Use of grazing animals may also be an effective method of managing growth of invasive woody plants. Grazing animals would be used only on pastures and other grasslands, not in the forest. Prescribed fire could be used to remove or reduce stands of alien species or to reduce roadside stands of wildfire fuels. It is unlikely that prescribed fire will be used in the watershed for any purpose, but should it need to be used, burn planning will be done cooperatively following established procedures and using best management practices.

Chemical control methods are often an important tool in invasive plant management, especially where mechanical control methods are not feasible, where biological control techniques are not available, and when cost and time constraints dictate. When used responsibly and with caution, herbicides can be an effective tool to quickly kill a plant, keeping it from entering its next reproductive cycle; in many instances, the dead plant tissues form a mulch ground cover. Non-restricted herbicides are carefully used by resource managers throughout the State as part of alien plant management programs with products used in strict adherence to instructions and guidelines. In addition, the herbicides selected will be used in strict accordance with the labeling and selection of herbicides will take into account those approved for use in or near water bodies when applicable.

Biological control is another tool used effectively by managers worldwide in controlling alien species. Biological control uses predators and disease organisms of invasive pests from their native ranges to damage targeted weeds through release of these organisms in infected areas. The process of finding a biological agent can be difficult and expensive, with uncertain results. However, it can provide the only cost-effective method for reducing the negative impacts of priority invasive species that are already well-established in Hawai‘i. The technique has had several successes throughout the world and in Hawai‘i, including effective control of the following species that were once more widespread on Kohala Mountain: panini or prickly pear cactus (*Opuntia* sp.), pamakani (*Ageratina riparia*), and lantana (*Lantana camara*).

The control of non-native animals other than feral ungulates includes small mammals (e.g. rats), alien aquatic species (e.g. exotic fish, mollusks, crustaceans), and incipient species (e.g. coqui frogs and snakes), which are all identified as threats for the Kohala watershed. These non-native species have the ability to change the composition of the watershed by either damaging native habitats, degrading the health and quality of streams, or endangering native species. Management actions proposed to combat these threats include trapping, use of toxicants, baits, netting, and other control methods that may yet be tested for efficacy.

Outplanting and Restoration

The management actions of outplanting of rare, threatened, or endangered native Hawaiian species and restoration of native habitats fulfill the primary management goals of protection of water resources and native habitat, and species protection. Actions will be focused mostly on the biodiversity units, but will focus on those areas that have active management occurring where threats are being removed or minimized so as to provide the best habitat and chances of success for species survival, and growth of native forests.

The overall health of the watershed depends on having the full array of biological components of species and habitat that fulfill specific ecological functions. As such, restoration of native species and native habitats of the Kohala watershed will have already begun by the major actions of fencing, feral ungulate removal, control of invasive weeds, and non-native animal control. However, species and habitat restoration will require additional management actions be taken. Example of such management actions include collection of seeds, outplanting of native plants into managed units, and plant surveys to document location and health of rare plant populations. All collection and propagation of rare plant materials will be done under the guidelines established by the Hawai'i Rare Plant Recovery Group. Additional habitat restoration may be required for translocation of any threatened or endangered species (e.g. more intensive monitoring, increase in predator control, mosquito management, tagging of species, etc.). All necessary State and Federal permits will be acquired and maintained for collection and propagation of these plants as well as any work related to endangered or threatened species (flora and fauna).

Monitoring, Surveys, and Research

All components of management actions and activities will involve monitoring, surveys and research for threat management and to also measure efficacy of actions taken and fulfilling all management objectives and goals for the entire 65,000 acre project area.

For feral ungulates, invasive species, native habitat and species, and compatible human use management, maintenance of existing or establishment of new transects for monitoring and assessments may include flagging routes with colored tape around tree parts, use of metal tags attached to trees, insertion of slim metal rod or PVC piping with transect identification information, geospatial mapping, and other monitoring technologies and methods. Surveys for flora and fauna will be conducted. Research may be required to better understand population dynamics and threat relationship to species survival or habitat and watershed health. Monitoring of water resources will include activities such as, but not limited to, installation of satellite-transmittable telemetric meteorological monitoring stations, stream and/or rain gauges and survey transects.

Infrastructure Support and Maintenance

In order to sustain and fulfill the management goals and objectives of the draft management plan, the project will need to develop and maintain infrastructure support. Examples include possible need of management cabins for staff and volunteers for overnight work trips, creation of helicopter landing zones for transportation of staff and project materials, firebreaks to counter wildfires, establishing new trails and signage, and other infrastructure required to counter threats to the watershed. All potential identified activities will take into consideration as primary factors

absolute need of the infrastructure and minimization of any potential negative impact to resources with regard to how infrastructure is developed and its location. In addition, all infrastructure support activities will obtain the necessary government approvals and permits should they be required. These actions would fulfill all management goals, particularly management and promotion of compatible public uses.

Management actions proposed to minimize human use related impacts to the watershed include development of new access trails for both hunting/hiking/education (which will include flagging a trail, creating a trail corridor by cutting vegetation, and continued maintenance), posting educational/interpretive signage (which can include using ground posts, cutting of vegetation, and soil digging), and continued surveys of documenting and protecting culturally significant areas in the Watershed Management Area. In addition, a boardwalk and interpretive signage for the bog ecosystem near Alakahi stream will be established for educational and outreach purposes as well as to assist with management of the area. Actions related to the boardwalk will entail clearing of vegetation with construction involving use of building supports, trestles, piers, and metal support posts and deck surface. Boardwalk materials may also need to be flown into the area. Similar boardwalks have been constructed on O‘ahu at Ka‘ala Natural Area Reserve as well as other bog ecosystems on Maui, Moloka‘i, and Kaua‘i. The boardwalk will provide an opportunity for students and other members of the community to learn about this unique habitat in Kohala and provide management access to the area with the least impact and disturbance to the bog.

Locations of new trails and signage have yet to be specifically identified in the 65,000 acre project area as they will require more input from the community and further analysis of trail impacts. Trails provide points of ingress to more easily and safely conduct activities such as surveys, ungulate control, search-and-rescue efforts, and fire management, and can represent avenues to experience cultural and historical features, as well as serve as conduits for economic, ecotourism, and recreational opportunities. However, trails can also serve as animal corridors where ungulates will most likely travel and be found, hikers or animals using the trails can contribute to the spread of weeds, and overuse of trails leads to soil compaction and increased water runoff or loss of stabilizing vegetation and soil erosion.

Access to private lands is controlled by the individual landowner (e.g. Parker Ranch offers access to hunters by permit) and access to State lands managed by the Division of Forestry and Wildlife under the rules and regulations of the Division (e.g. permits, access for hunting/hiking/camping, public trail use hours, etc.).

Technical, economic, social, and environmental characteristics, time frame, funding and source

The technical characteristics of the management actions were identified as part of the description of management actions under section III. Given that many of the management actions revolve around protection of water resources, the economic characteristics of the management actions have the potential to affect any commercial activities that rely on the collection and distribution of water to conduct business in the surrounding towns (e.g. Waimea, Kapa‘au, Honoka‘a). Examples include hotels, farms, ranches, restaurants, County Department of Water Supply, and others. As such, the protection of these areas via the proposed management actions will be

critical to ensure these economic activities continue. Tourists enjoy these natural areas, and the continued health of the watershed could have an economic impact on the tourism industry as well as related businesses such as hotels and restaurants. In addition, the materials used to construct the fences/boardwalk, helicopter time contracted, and staff used to implement projects also provides economic benefits resulting from the proposed management actions. Subsistence hunting also occurs as an economic activity and would be supported by the management actions addressing compatible public use and identification and development of new access trails for these activities.

Currently, there are very few residents who live in the project area. However, the project area is used for hiking, hunting, and camping. Traditional cultural usages such as gathering of plants for medicines and hula continue. Management actions aim to maintain, and in some cases either improve or increase, the cultural use of the Watershed Management Area. The addition of environmental education and related activities such as hikes and service volunteer trips will also add to the potential social characteristics. The water resources being protected are also utilized by homes for drinking water. Environmental characteristics will be described in section IV.

The anticipated time frame for all proposed management actions is anticipated to be 20 years, to begin once all regulatory compliance requirements and necessary permits are approved and in-hand.

Funding sources for management actions will consist of government (e.g. federal, state, county) and private funds as well as in-kind donations and contributions such as equipment and labor and volunteer work hours. Funding sources currently in-hand to begin smaller projects include the U.S. Fish and Wildlife Service, U.S. Department of Interior (\$165,000), and the State of Hawai'i Division of Forestry and Wildlife (\$205,700). Existing in-kind contributions have also been provided by members of the partnership.

IV. DESCRIPTION OF AFFECTED ENVIRONMENTS

The following descriptions of affected environments and other resources will address the entire 65,000 acre Watershed Management Area with specific references made to high yield watershed and biodiversity units A-N where applicable.

Hydrological Environment and Water Resources. Kohala Mountain (20°7'N, 156°45'W) is the most northern, smallest, and oldest mountain on Hawai'i island. Kohala is a shield volcano so its slopes are gentle, with intermittent partly-eroded cinder cones across its surface. The windward (east) side is cut with large, deep, well-eroded valleys with near-vertical walls. Kohala Mountain's elongated northwest to southeast shape was formed by thousands of basaltic lava flows that erupted from two main rift zones and possibly a caldera that may have existed but was later buried by younger lava flows. Magma that did not reach the surface may have cooled within the fissures, forming vertical sheets of low-permeability rock. The northeastern slope of the volcano has experienced a major slope failure that resulted in a collapse of the shoreline 12 miles long and extending one mile inland. Pololū and Waipi'o valleys formed along these faults. The exposed volcanics of the Watershed Management Area fall into two main classes: Hawi volcanics and Pololū volcanics. Pololū volcanics occur within the windward valley areas affected

by the slope failure. They are comprised of tholeiitic, transitional, and alkalic basalts. Hawaiian volcanics consist of postshield-stage Hawaiiite, maugerite, benmoreite, and trachyte. Lava flows originated from numerous vents, marked by cinder cones and lava domes, near the rift zones of the volcano. Kohala's summit region is characterized by cinder cones, lava domes, and abrupt slip faults. Topography throughout the rest of the Watershed Management Area is highly varied and ranges from very steep valley walls and sea cliffs, to shallow valleys and narrow drainage gullies and broad rolling pastures. The lower windward slopes are deeply dissected, and major drainage patterns are well established. The mountain is moderately dissected in the upper reaches and along the upper leeward slopes.

Soils of the mountain are primarily inceptisols and are highly-weathered, silty or sandy clay loams. The Amalu soils series dominates and covers nearly all of the slopes along the windward side, except for the Rough Broken Lands, also in the Amalu series, that comprise the valley walls. The upper western windward slopes are Silty Clay Loams in the Kahuā, Palapalai, and Manahaa series, and leeward soils are Silty Loams in the Palapalai and Maile series.

Most notable of the services provided by Kohala Mountain is the abundance of fresh water. Average annual rainfall on Kohala Mountain ranges from about 30 inches along the leeward section of the Kohala Mountain Road to over 160 inches near the 3,500-ft. elevation in the wet forest between Waipi'o and Honokāne valleys on the windward side. As rising moist air cools, it forms clouds that drop moisture in the form of rain. A distinctive feature of Kohala's hydrology is that a significant proportion of its total precipitation comes from water intercepted from the clouds passing through the montane cloud forests high on the mountain. Known as fog drip, water from clouds is intercepted by vegetation. This is a consistent characteristic of the windward Kohala Mountain slopes above 3,000-ft. Fog drip contributes significantly to both stream flow and rainfall. Cloud forests also reduce rates of water loss via evaporation and transpiration and maintain high water storage capacity. A functional, multi-layered forest keeps sunlight from reaching the ground and heating up the surface. Ground cover such as leaf litter, moss, ferns, and other plants, and foliar cover also help to create pockets of moist air that reduce the pull of water from the soil surface by the hot, dry daytime air. In addition, soil moisture-holding capacity, measured in inches of available water capacity per inch of soil, is higher in forested areas such as 'ōhi'a forest. Together, rainfall and fog drip provide close to 200 inches per year across Kohala's broad windward summit region. As such, high yield watershed area units A-D comprise a significant portion of the watershed in which groundwater infiltration is occurring and contain the headwaters for streams such as Ohiahuea and Honokāne. This area of the watershed captures 100-150 inches of rain on average every year, significantly assisted by the existing cloud forest. Portions of units A, B, C and D are part of the Pu'u O 'Umi Natural Area Reserve and contain several rare montane bogs. In biodiversity unit E, the headwaters for five agriculturally important streams, such as Keawewai stream, originate here. This forested area is also the headwaters for Kohakohau stream, which is a main supplier for municipal and agricultural water in the Waimea area. In total, Kohala's cloud forest encompasses approximately 20,000 acres.

The porous and permeable structure of the mountain geology favors the storage and transport of subsurface water from the mountainous interior parts of the Watershed Management Area to the coastal areas where it is discharged. Fresh groundwater that is not withdrawn from wells and

tunnels discharges naturally from the aquifer at subaerial and submarine springs and seeps. Fresh groundwater in Kohala Mountain occurs as either a freshwater-lens system in the dike-free lava flows or as a dike-impounded system. Numerous dikes penetrating through Kohala's basaltic sheets flow form dike complexes that store water at high elevations. The boundary between the dike-impounded system and the freshwater-lens system generally corresponds with the seaward extent of mapped volcanic vents represented by cinder cones and lava domes. Water enters the dike-impounded system mainly by infiltration of some part of rainfall and fog drip. Natural discharges from these stores occur via high-level springs and streams and groundwater flow to the down-gradient freshwater-lens system.

The Watershed Management Area has numerous perennial streams or rivers that flow from summit regions to the ocean. Hawai'i's streams are generally short (less than 10 miles in length), with numerous waterfalls giving the streams steep profiles. Stream flow typically tracks rainfall patterns. Many of the streams flow from non-agricultural forested lands to the ocean; others flow through agricultural lands intermittently and during flood events. Some are perennial in the upper reaches and intermittent at lower elevations. Intermittent streams on the leeward side of Kohala Mountain appear to flow less now than they did in the past. Based on anecdotal information obtained through interviews with residents from the region, stream flow may be reduced today from even half a century ago. Some believe that the flow regime is now flashier in nature.

Biological Environment and Resources. The physical characteristics of Kohala have created a diverse range of habitats that include coastal strand, lowland tropical rain forest, montane rain forest, cloud forest, montane bogs, and mesic (moist) forest – all ecological zones determined primarily by macroclimate. Azonal ecosystems (those dictated by adaptive factors) are represented by windward coastline vegetation, bogs, aquatic ecosystems, and cliff environments. The coastal strand vegetation is characterized by salt-tolerant plants, many of which have indigenous distributions beyond Hawai'i island. Inland from there up to 2,500-feet is the Lowland Wet Forest (biodiversity units I and K). This forest type occurs only on the windward side of the Watershed Management Area. Above 2,500-ft., the Montane Wet Forest (critical in capturing fog drip and converting to water resources) covers the windward slopes and a Diverse Mesic Forest covers the leeward side above pasture lands. Occurring as open patches within the montane cloud forest are wet bogs, a community dominated by grasses or sedges, with few woody plants. Kohala Mountain supports a large bog-cloud forest mosaic across the gently sloping upper windward slopes. Hawai'i island bogs are characterized primarily by sedges, sphagnum moss, and low-stature 'ōhi'a of varying density. Two specific rare bog communities known from Kohala Mountain are the Mixed Grass and Sedge Montane Bog and the 'Ōhi'a Mixed Montane Bog, located adjacent to one another at approximately 3,700-feet in the eastern section of the Pu'u O 'Umi Natural Area Reserve. Other unique plant communities from windward Kohala include the *Carex alligata* Montane Wet Grasslands and the Mixed Fern/Shrub Montane Wet Cliffs, where the steep slopes and cliffs are covered by fern and shrub communities. Three distinct types of 'ōhi'a-dominated forest cover the majority of the Watershed Management Area: 'Ōhi'a-'Olapa Montane Wet Forest comprises the majority of the 'ōhi'a-dominated forests; 'Ōhi'a Mixed Shrub Montane Wet Forest usually occupies the best drained areas on the ridge tops; and a broad expanse of 'Ōhi'a-Uluhe Montane Wet Forest covers the north slopes, ridgetops, and areas recovering from disturbance. A majority of the Watershed Management Area is identified by the State's Division of Forestry and Wildlife as having the

highest quality native vegetation, according to the vegetation classification under its draft management guidelines.

As a result of the range of native habitats found, Kohala Mountain supports over 155 native known species of vertebrates, crustaceans, mollusks, and plants, some of which can be found nowhere else on earth (Appendix D). There is a total of 11 threatened and endangered species, 30 species that are either species of concern or species being considered for listing as either threatened or endangered, and two endemic (found no-where else in the world) species in the Watershed Management Area. Fungi, liverworts, mosses and lichens further contribute to this biological diversity (or biodiversity). The complexity and diversity of Kohala's ecosystems are significant in comparison to other volcanoes on the island.

The Watershed Management Area provides a diversity of bird habitats that support over a dozen species of sea birds, four forest birds, two waterbirds, and a hawk. The Hawaiian Goose or Nēnē (*Branta sandvicensis*) is considered the eighth most endangered waterfowl species in the world and is listed as an endangered species by the U.S. Fish and Wildlife Service (USFWS). Nēnē occasionally use Kohala Mountain. The Koloa maoli (or Hawaiian Duck, *Anas wyvilliana*), also an endangered species, inhabits wetlands, ponds (natural and man-made), and streams in the Watershed Management Area. Kohala ponds and streams are probably the most important habitat for these birds on Hawai'i island and such areas are identified in the USFWS recovery plan for waterbirds as critical core wetlands for species survival. Another endangered species, the Hawaiian Hawk or 'Io (*Buteo solitarius*), is widespread on the island of Hawai'i with its distribution following that of native forest ('Io prefer large 'ōhi'a for nesting). Hawaii's other endemic raptor is the Hawaiian Owl or Pueo (*Asio flammenus sandwichensis*). Pueo inhabit dry forests and rainforests, but are most often seen hunting in leeward pastures and are active during the day and evening hours. Seabirds such as the threatened 'A'o or Newell Shearwater (*Puffinus puffinus newelli*), endangered 'Ua'u or Hawaiian Petrel (*Pterodroma phaeopygia sandwichensis*), and the migratory Kolea or Pacific Golden Plover (*Pluvialis fulva*) also occur within the Watershed Management Area. Records of sightings and calls suggest that 'A'o colonies exist within the Hāmākua and Kohala forests but that these colonies are very dispersed and probably contain very few individuals. 'A'o nest in burrows in steep mountainous terrain between 500 and 2,300-foot elevation, usually in association with uluhe. Because the birds are active at night and nest in dense rain forest on steep slopes, nesting sites are difficult to locate. 'Ua'u nest in burrows 3-6+ feet deep in steep mountainous terrain between 500 and 2,300 feet elevation from March through November each year. As with the 'A'o, their burrows are used repeatedly as they return from year to year. The forest birds 'elepaio (*Chasiempis sandwichensis*), 'amakihi (*Hemignathus virens*), 'apapane (*Himatione sanguinea*), and 'i'iwi (*Vestiaria coccinea*) are most abundant in closed-canopy forests of 'ōhi'a and 'ōlapa. On Kohala Mountain, the majority of these native birds are found above the 4,000-foot elevation, above the range of mosquitoes which can transmit avian diseases. Biodiversity unit L is particularly noted for having all four species of forest birds as well as the 'Io and waterbirds such as Koloa maoli.

The endangered Hawaiian hoary bat or 'Ope'ape'a (*Lasiurus cinereus semotus*) is the only extant land mammal native to the Hawaiian archipelago. Bats are frequently seen along the windward Kohala coast, especially between Waipi'o and Waimanu valleys. Data on the food preferences of the species indicate that 'ope'ape'a consume a broad range of insects, including many beetles.

One of the most highly diversified groups of animals in Hawai‘i are the native land snails. In 1992, researchers found *Partulina physa*, previously not recorded since 1946, on forested leeward slopes on Kohala Mountain (biodiversity units G and H). Other snails observed within the Watershed Management Area include succinids and minute tornatellinids. Hawaii’s native terrestrial arthropods are most noted for their large number of unknown species and extremely high rate of endemism (99%). Generally, Hawaii’s native arthropod fauna includes insects, arachnids, crustaceans, and myriapods. Kohala’s native arthropod fauna is particularly rich and supports many rare species such as the endangered Blackburn’s Sphinx moth (*Manduca Blackburni*) and the endangered *Drosophila ochrobasis*. For the Blackburn’s Sphinx moth, the USFWS has identified areas in Kohala as potential recovery management units for the species.

Kohala streams also support a unique and diverse fauna. Dozens of freshwater streams entering the ocean along the windward coastline support a relatively intact and diverse native stream fauna, including native aquatic insects, fishes, crustaceans, and mollusks. The fishes consist of two closely related families, *Gobiidae* and *Eleotridae*, usually referred to as *o‘opu* or gobies. The native crustaceans include the ‘opae kuahiwi or mountain opae (*Atyoida bisulcata*) and opae ‘oeha‘a (*Macrobrachium grandimanus*). There are three endemic species of river *opihi* (limpets), the most common of which is the hihiwai (*Neritina granosa*).

In addition to native wildlife, the Watershed Management Area is also home to several unique native plant species and over three dozen federally-listed plant species. These rare plants vary in habitat from dry to wet, windward coastal sea cliffs to the montane bogs of the summit region, over to the remnant dry forest still extant in the pastures and gulches of leeward Kohala. One of Kohala’s most conspicuous rare plants (due to its large flowers) is the *Trematolobelia grandiflora*. It occurs in wet, windswept cliffs and in wet forests and low, boggy wet forests on Kohala Mountain. Other notable rare plants from Kohala include the stately loulu fan palm, *Pritchardia lanigera* (biodiversity unit J), and another endangered Lobeliad ōhāwai, *Clermontia drepanomorpha*, both of which occur only on Kohala Mountain. Biodiversity unit F is also the only place on Hawai‘i island that *Trematolobelia macrostachys* (koli‘i) is known to inhabit. This unit also houses one of two native orchids found on the island, *Liparis hawaiiensis*. Biodiversity units G and K include the rare native gardenia, *Gardenia remyi*. All of the five *Clermontia* species can be found in biodiversity unit L.

The native species and habitats described above identify the current known species and distributions. However, new species and new island records for species are always being discovered in Kohala, particularly along the sea cliffs, and will continue to be catalogued and assessed as management actions move forward.

Historical, Archaeological, and Cultural Environments and Resources. The following steps have been taken to determine the cultural, historical, and archaeological significance of the project area: (1) general literature review to determine if there were any reports or studies with relevant information regarding the project area; (2) the preparation of a cultural study for the Kohala-Hāmākua area by Kumu Pono Associates, which included a review of cultural, historical and archaeological activities in the project area; (3) discussions with landowners with longstanding ties to the project area; (4) information gathered during a series of public meetings about the

proposed projects of the Kohala Watershed Partnership (Appendix C). A summary of the information found is presented below.

In Hawaiian culture, natural and cultural resources are one and the same. Native traditions describe the formation (literally the birth) of the Hawaiian Islands and the presence of life on, and around them, in the context of genealogical accounts. All forms of the natural environment, from the skies and mountain peaks, to the watered valleys and lava plains, and to the shore line and ocean depths are believed to be embodiments of Hawaiian gods and deities. The landscape itself is a highly valued cultural property and considered sacred.

In 2004, a cultural study of the Pu‘u O ‘Umi Natural Area Reserve and Kohala-Hāmākua Mountains Lands, Districts of Kohala and Hāmākua was completed by Kumu Pono Associates LLC. This study looked at the cultural, historical, and archaeological resources of the area. The historical-archival research conducted for this study was performed in a manner consistent with Federal and State laws and guidelines for such studies. Among the pertinent laws and guidelines are the National Historic Preservation Act (NHPA) of 1966, as amended in 1992 (36 CFR Part 800); the Advisory Council on Historic Preservation’s “*Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review*” (ACHP 1985); National Register Bulletin 38, “*Guidelines for Evaluating and Documenting Traditional Cultural Properties*” (Parker and King 1990); the Hawai‘i State Historic Preservation Statue (Chapter 6E), which affords protection to historic sites, including traditional cultural properties of on-going cultural significance; the criteria, standards, and guidelines of the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) for the evaluation and documentation of cultural sites and practices, Title 13 Sub-Title 13:275-284 (October 21, 2002); and the November 1997 guidelines for cultural impact assessment studies, adopted by the Office of Environmental Quality Control (which also facilitate the standardized approach to compliance with Act 50 amending HRS Chapter 343; April 26, 2000).

While conducting the research, primary references included, but were not limited to, land use records, including an extensive review of Hawaiian Land Commission Award (L.C.A.) records from the *Māhele ‘Āina* (Land Division) of 1848; Boundary Commission Testimonies and Survey records of the Kingdom and Territory of Hawai‘i; and historical texts authored or compiled by D. Malo (1951); J.P. I‘i (1959); S. M. Kamakau (1961, 1964, 1976, and 1991); Wm. Ellis (1963); Chas. Wilkes (1845); A. Fornander (1916-1919 and 1996); G. Bowser (1880); Handy and Handy with Pukui (1972); M. Kelly (1974); and Clark and Kirch (1983). The study also includes several native accounts from Hawaiian language newspapers (compiled and translated from Hawaiian to English by Kumu Pono Associates LLC), and historical records authored by nineteenth century visitors, and residents of the region. The records also include important oral testimonies of elder *kama‘āina* of the lands which make up and surround the Pu‘u O ‘Umi NAR. Historical and archival resources were located in the collections of the Hawai‘i State Archives, Land Management Division, Survey Division, Natural Area Reserves office, Bureau of Conveyances; the Bishop Museum Archives; Hawaiian Historical Society; University of Hawai‘i-Hilo Mo‘okini Library; private family collections; the Parker Ranch and Paniolo Preservation Society (PPS) collections; and in the collection of Kumu Pono Associates LLC.

The study identified the rich native Hawaiian heritage and culture that can be found in the Kohala area, particularly as it relates to the native habitats and species currently found in the Watershed Management Area and their relationship to native Hawaiian deities and world view. Native Hawaiian peoples were the first to be documented as land stewards and resource users of the Kohala-Hāmākua mountain lands for agriculture and subsistence living and inhabited most of the windward valleys of Kohala Mountain. Many place names from the mountain lands between Kohala and Hāmākua demonstrate knowledge of the landscape and are tied to traditional travel, access, and practices in the uplands, which were primarily used for specialized resource procurement activities as well as certain types of agriculture. As such, the area is the birthplace for many mele and oli. As an example, in association with lands which are now included in the Watershed Management Area, the goddess Hina-ulu-‘ōhi‘a (Hina, goddess whose form is in the groves of ‘ōhi‘a) and Pō-kāhi (the darkened place), a god of the mountain mists (the tradition of Lau-ka-‘ie‘ie) are deified parts of the landscape. Both the ‘apapane and ‘i‘iwi, along with the now extinct ‘ō‘ū and ‘ō‘ō, have been historically documented and linked in Kohala with native Hawaiian use. The o‘opu or goby fish is featured in a native Hawaiian story of the testing of two brothers where in a contest, one of the required items to gather was an ‘o‘opu ‘ai lehua (lehua blossom eating goby fish) known from Hi‘ilawe in Waipi‘o.

The traditional system of land and water tenure and management centered on the *ahupua‘a*, where each chief acted as a steward of the land and granted the *makaainana* (general populace) living in the *ahupua‘a* use of the land’s bounty for their livelihood. Examples of traditional and customary practices include wetland agriculture, particularly kalo(taro), which occurred in the valley streams and terraced agriculture on the lower windward slopes, and leeward Kohala areas which produced dryland foods, such as sweet potatoes and dryland kalo. Food animals, such as pigs, were kept within villages and not allowed to escape into the forest. In the forests, native Hawaiians would gather building materials and fuel, sources of cordage, adornment for display of rank, water, collect birds, herbs and medicines, and craft materials.

As these examples illustrate, in the traditional context, the mountain landscape, its native species, and the intangible components therein, are a part of a sacred Hawaiian landscape. Thus, the landscape itself is a highly valued cultural property. Its protection, and the continued exercise of traditional and customary practices, in a traditional and customary manner, is also mandated by native custom and State and Federal Laws. Today, native Hawaiians continue these traditional and customary practices. *Hula halau* and others may harvest plant materials for the making of lei and adornment for dance and other rituals. Craftspeople gather materials, and Hawaiian healers collect herbs and plants for medicines.

Few archaeological investigations have been conducted in the uplands of Kohala due to its remoteness (and therefore lack of development) and the long-time practice of ranching and grazing, activities that do not usually involve intensive archaeological study. However, there is documented the Kohala Field System, an archaeological site extending approximately 60 sq km along the gently sloping uplands of the Kohala Mountain. This area was converted to fixed field dry land farming by Hawaiians prior to the European discovery of the archipelago and sweet potato was likely the main cultivar. They include extensive stone walls and a few woodland temples. No management actions are planned for these areas. No other archaeological resources are known from the project area.

Historical features include the ditches (e.g. Kohala, Kehena), tunnels, flumes and irrigation systems, some built in the early 1900s, that delivered water to farmers, ranching operations, and sugar plantations in the Kohala region. Due to the earthquake which occurred in October 2006, some of these features have been damaged and assessments are still underway with regard to structural integrity. Storied ranching operations such as Parker Ranch are also historical features of the Watershed Management Area.

Other Environments and Resources. Currently, there are few residents who live full-time within the Watershed Management Area. However, there are communities that surround the remote watershed area. The town of Waimea is the largest neighboring community, with a population of over 7,000 residents. Kapa‘au and Hawi in North Kohala have populations of 1,159 and 938 respectively. To the east, in the district of Hāmākua, Honoka‘a is the largest community with a population of over 2,200 residents. Neighboring Kukuihaele has a population of 317 residents. While located at a greater distance from the watershed area, Paauilo, population 571, is included in this description because of its reliance on water from Kohala Mountain.

The history of cattle ranching on the slopes of Kohala Mountain extends back over 150 years. Today, substantial portions of the Watershed Management Area are actively used as rangeland. Ranching operations such as Parker Ranch, Kahuā Ranch, and Ponoholo Ranch continue Kohala’s modern paniolo culture and add to the history, economy, and lifestyle of the region.

Marked and unmarked trails traverse the Watershed Management Area. Not all trails on Kohala Mountain are open to the public; in fact, many occur on private land or require crossing over private property for access and are accessible only by permission of the landowner. There are two public trails under the State’s Na Ala Hele Program, the Muliwai and Pololū trails along the coast. The Muliwai Trail links the remote Waimanu Valley with Waipi‘o Valley. This nine mile trail on the high plateau between the two valleys crosses numerous gulches and descends steeply into Waimanu Valley. Due to the 2006 October earthquake, some trail sections leading to the back of Waimanu Valley currently remain closed due to persistent danger of landslides and falling rocks from above. Camping is allowed in Waimanu Valley with a permit from the State’s Division of Forestry and Wildlife. The 0.25 mile Pololū Trail descends in switchbacks down into Pololū Valley. In the recent past, a frequently used hiking trail was the trail from the end of White Road in Waimea to overlook the back of Waipi‘o Valley. However, the use of this ditch trail meant hikers had to illegally trespass across leased Department of Hawaiian Homelands property to access the trail, and the Department has now eliminated that public access. Hikers also enter the Kohala Forest Reserve above the reservoirs in Waimea, normally traversing Parker Ranch lands, which requires permission. Many of the trails in the Watershed Management Area were established in order to maintain the ditch systems and other water diversions, and to access stream gauging stations within the watershed. Other trails are used by government personnel and researchers to access transect sites, conduct biological and hydrological surveys, and perform weed control.

Trails within the Watershed Management Area often intersect or lead to hunting areas (state and private lands). The State Division of Forestry and Wildlife records show that there was an average of 114 hunter trips into the Kohala Forest Reserve between 2000 and 2004 (average 29

trips per year). In that time, the average reported harvest of pigs was 53 animals per year for all areas combined. Seasonal game bird hunting is also a popular recreational activity. Both types of hunting (feral ungulates and game birds) occur within State and private and leased ranchlands included in the Watershed Management Area.

There are three public hunting areas on Kohala Mountain managed by DOFAW, Units B (16,460 acres), D (4,770 acres) and K (10,530 acres). All units allow pig hunting with dogs and a variety of weapons, but Unit D is restricted to weekends and holidays only, whereas Units B and K have daily hunting access. The maximum harvest each day is two animals per hunter. Access to these hunting areas is for individuals that hold a current Hawaii Hunting License. According to these and other game management information collected by DOFAW, the proposed fencing areas identified in the Watershed Management Area will reduce available pig hunting areas from approximately 32,000 acres to 26,000 acres. However, these areas proposed for fencing have very low to no use by hunters due to the remoteness of the areas and the extremely rugged terrain.

There are little infrastructure and few facilities within the Kohala Mountain watershed. There are eight camping sites, with composting toilets, in Waimanu Valley. There is vehicular access across some State lands to the edge of the Forest Reserve, from which hunters and hikers must continue on foot. Private ranch roads lead to the Forest Reserve at several locations, and access through these private lands requires landowner permission. Much of the perimeter of the Forest Reserve on the leeward side of the mountain has been fenced to exclude neighboring cattle. The County Department of Water Supply maintains a road above the Waimea reservoirs to its intake on Kohakohau Stream.

Three and three-quarter miles of fences have been built, encompassing approximately 140 acres, to protect sensitive natural bog habitat within the Pu‘u O ‘Umi NAR; these enclosures comprise less than one percent of the total acreage of the Watershed Management Area. Helicopter landing zones have been constructed throughout the watershed to improve access into remote areas for management, personnel safety, and search-and-rescue missions. A management shelter (Mauga Cabin) has been constructed to facilitate DOFAW’s overnight management work trips. Other public and private cabins and landing zones also exist within the Watershed Management Area.

V. SUMMARY OF MAJOR IMPACTS AND MITIGATION MEASURES

The management actions of fencing, feral animal removal, invasive species control, outplanting and restoration, monitoring and surveys, research, and infrastructure support and maintenance are all aimed at conserving and perpetuating Kohala’s watershed and its multiple ecosystem functions of providing surface water and aquifer recharge, native habitats and species, culture, recreation, economics, and climatic benefits. The management actions outlined will have impacts that are both short and long-term for the environment and the surrounding community. Since the goal of management actions is to conserve and enhance the existing watershed and its related services for current and future generations, impacts are beneficial for the long-term.

Environmental Impacts

Native animal species: Noise associated with the construction of fencing may temporarily disrupt the activities of native birds within the project area. However, based on observations during fence construction in other native forests, the impact of construction noise on native birds is expected to be minimal and temporary. The final fence alignment will be selected to avoid large trees; thus, no impact to nesting habitat is anticipated. Long-term benefits of the management actions are anticipated to include the improvement of areas to serve as native forest bird habitat, thereby offsetting any potential temporary disturbance experienced.

The use of barbed wire raises the possibility that the ‘ōpe‘ape‘a (Hawaiian hoary bat) or seabirds could fly into the fencing and become entangled, leading to injury or possibly death. However, in order to prevent bats or seabirds getting caught on the fence, barbs will only be used along the top of the fenceline in areas bordering cattle pasture, and flagging or tape at the top may be used as visual aids for avian and bat fauna. The anticipated benefits of the project should outweigh the small chance of any negative interaction with bats or seabirds. Maintenance of the fence line will include monitoring for the presence of potential bat and seabird interactions. If it appears that bats or seabirds are being injured through contact with the fence, mitigation measures will be developed and implemented.

With regard to actions for invasive weed management, for the use of chemical controls, precautions will be taken to avoid impacts to sensitive species/habitats. Generalist herbicides will be used sparingly in areas with a high occurrence of endangered species or sensitive and rare ecotypes. Use of rodenticides and other toxic baits to control rats and mice could potentially poison non-target animals. However, careful testing of toxic baits will be conducted before and after use, and should any native species be significantly adversely affected, use will be reassessed and likely discontinued. Use of toxic baits will be done in accordance with the toxicant registration. Any release of biocontrol agents will be done in accordance with Federal and State requirements to insure no negative impacts to native species will knowingly occur.

Kohala has the potential to serve as relocation and recovery areas for species that were once found there according to fossil records. An example is the endangered Laysan duck (*Anas laysanensis*), which is now only found in the Northwestern Hawaiian Islands but was once widespread in Kohala. For the Blackburn’s Sphinx moth, the USFWS has identified areas in Kohala as potential recovery management units for the species. By addressing many of the threats such as feral ungulates, rats, and invasive aquatic species, that would make such recovery impossible, proposed management actions would create secure native habitats needed for the survival of rare or threatened and endangered species. As such, overall impacts to native animal species are anticipated to be positive.

For any biological resources (e.g. rare, threatened, endangered species/habitats) that may be discovered during any of the proposed management actions, all work will cease and the appropriate agencies and organizations contacted for appropriate consultation and procedures.

Native vegetation and habitats: Construction of fencing, boardwalk, or new trails should result in minimal disturbance to vegetation within a limited construction corridor as a result of the clearing needed to remove potential hazards to crew and to facilitate construction. Common plant

species would be pruned or removed along the corridor only when necessary. Removal of native plants greater than six inches in diameter will be avoided. If areas of sensitive botanical resources, large trees, or streams are identified, fence alignments would be adjusted to avoid or mitigate impacts to such areas. Based on fencing as well as boardwalk initiatives in similar native forested areas on Maui, O‘ahu, Moloka‘i, and other parts of Hawai‘i island, impact to vegetation would be short-term with regrowth of cleared vegetation for fence construction occurring subsequent to the completion of the fence. However, ongoing inspection and maintenance (particularly of fences) would require that immediate corridors be kept cleared of vegetation to maintain integrity of structure(s). Particularly after storms or heavy rains, feral ungulate barriers that may have been used in stream areas (e.g. breakaway panels, metal grates, durable fabric curtains, etc.) will be checked to insure their integrity, and also cleared of accumulated debris to insure stream flow continues and is not blocked. Where possible, the fence, boardwalk, and trails will be aligned so that it passes through open or sparsely vegetated areas with removal of common native species done only when necessary.

Overall, by addressing threats such as feral ungulates and invasive species, the native habitat and survival of rare or threatened and endangered species will be enhanced by proposed management actions. In particular, bird, snail, aquatic, and plant species will benefit greatly by keeping intact or restoring native habitats for species survival. For sensitive habitats such as those of the Pu‘u O ‘Umi Natural Area Reserve (NAR), impacts of management actions would serve to conserve and enhance these areas. For example, in biodiversity unit I, this 20 acre area will protect one of the last remaining lowland wet forest stands in the NAR. In biodiversity unit L, proposed management actions will provide continued habitat for all of the five *Clermontia* species known from Kohala Mountain. Biodiversity unit F is also the only place on Hawai‘i island that *Trematobelia macrostachys* (koli‘i) is known to inhabit.

Soil and Water: Much of the water of the Kohala watershed is captured and delivered for domestic and agricultural uses in Waimea, Hāmākua, and North Kohala. The forests in the watershed also acts as a filter to clean and to cycle organic matter and nutrients through the vegetation, soils, and streams, and helps deliver a consistent and dependable source of artesian and surface water, as well as mitigating flood damage downstream. In addition to communities and households, Kahuā, PonoHolo, and Parker ranches, as well as many smaller ranchers and farmers, rely heavily on the water resources provided by Kohala for their operations. The farmers of Waipi‘o valley depend upon reliable, clean, abundant water in streams to cultivate their kalo(taro). In addition, there is a growing demand for domestic water within all of the municipalities surrounding Kohala Mountain. Society’s demand for water is expected to grow as the North and South Kohala and Hāmākua districts continue to expand over the coming decades. The impact of proposed management actions would conserve and enhance the water resources available for existing communities and commercial industries as well as help to ensure that future needs could be met as communities grow. Management actions will also allow managers to assess water resources, overall health of the watershed, and effectiveness of management actions.

The conservation and preservation of the forests of Kohala will also help to mitigate soil erosion and sediment run-off into coastal areas. The forest acts as a soil anchor when plants such as ferns and forbs hold surface organic matter that is used as nutrients, and deep-rooted woody plants

hold deeper layers of soil and bedrock. The multi-layered canopy of the Kohala forests also shelter the ground surface from the frequent heavy rains that might otherwise wash away its organic matter and mineral soils, thereby protecting nearshore waters from sediments transported by streams. The existence of the forest may also assist with lessening the impact of flooding. While flooding is a natural process that has occurred throughout time, it has been exacerbated in modern history by human habitation and development. Floods can close roads, damage major water supply lines, destroy property, and disrupt businesses. By providing dense ground cover, forests can serve to slow down water as it flows from the mountains thereby helping to decrease the impact of floods.

In many cases, existing trails are not maintained and have resulted in disturbance to the soil and ground cover. The installation of board walks and better footing will decrease the impact of trail use through sensitive habitats. Fence and boardwalk construction as well as new trail development may contribute in small amounts to erosion in the short-term, however, no changes in normal rainwater runoff or percolation is expected. To minimize the possibility of this occurrence, the Division of Forestry and Wildlife's Best Management Practices (BMPs) for Maintaining Water Quality in Hawai'i (1996) will be incorporated during the project. Specific BMPs to be incorporated include: locating corridors to fit topography and minimize alterations to the natural features; provision of dips and water bars to minimize erosion; avoidance of the diversion of water from natural drainages; keeping grades at less than 10%, except where unavoidable; and other measures as needed. While these practices should mitigate any potential erosion or runoff caused by construction, the long-term benefits of the project, including decreased ungulate-related erosion, should counteract any potential harm. Regarding weed control and management, herbicides approved for use near water bodies will be used and application methods and equipment that minimize impacts will be selected. Pesticide usage will be in full compliance with State and Federal regulations with staff trained on its safe preparation and application thereby minimizing impact of potential soil contamination. For some mechanical techniques, ground disturbance may occur. In order to prevent replacement of one alien species by another after an eradication effort, sequenced replacement with species of choice in the removed gap areas will be done or staggered weed removal will be used. This method requires follow-up maintenance.

Alien species: The disturbance to the ground surface and vegetation involved with building a fence may create conditions suitable for the establishment of alien plants and animals. Construction equipment, materials, and personnel may provide opportunities for the accidental introduction of nonnative plants and animals (either new species or existing species in new areas). The following practices will be implemented to minimize the introduction of alien plants and animals and to reduce the possibility of establishment: First, boots, equipment and materials will be inspected for such items such as seeds, eggs, larvae, etc., prior to delivery and/or entry into the project area, and cleaned as necessary; any vehicles used during construction will be inspected and cleaned as needed, following appropriate alien species prevention protocol; and all workers will be instructed on specific procedures to prevent the spread or introduction of alien plants and animals in the project area. In addition, follow-up monitoring for alien species along the fence and boardwalk post-construction and other projects will also occur.

Air pollution: Use of helicopters for transportation of materials and staff may affect air quality. However, given the short duration of and temporary use of such flights, it is anticipated that this will not contribute significantly to air pollution.

Climate: The forests of the Kohala Mountain watershed support an abundance of dense and multi-storied canopy of woody plants that serve to store carbon. Sphagnum and peat environments that are abundant within forest and bog communities of the watershed represent a relatively high proportion of world carbon stores. Management actions to conserve such areas may provide communities and commercial industries with carbon credits for future consideration, and may mitigate the effects of climate change.

Social Impacts

Periodic noise from helicopter flights, power tools, and other activity associated with fence and boardwalk building as well as flying in staff for maintenance, surveys, and research will be unavoidable during implementation of management actions. However, given the remoteness of this area and the fact that it is not immediately adjacent to any communities, it is anticipated that such noise levels would be negligible. In addition, all activities will be done during daylight hours and for short durations, thereby further mitigating potential noise disturbance.

By keeping forests and species intact and thriving, existing uses of the watershed for recreation (e.g. hiking, hunting, camping) and education will continue if proposed management actions are implemented. Management actions aim to maintain, and in some cases either improve or increase such social uses of the Watershed Management Area. For example, by creating new access trails for hunting and hiking, improved facilities, and signage, potential negative impacts such as people getting lost, accidental introduction of alien species, soil erosion, loss of hunting areas, or disturbance to sensitive areas will be minimized and new opportunities created for more appropriate use areas. Some fences may also have one-way doors to allow feral pigs to move out of management units into other areas for hunting purposes. In addition, pooling or congregating of animals along fences will be minimized because staff will be regularly monitoring fences and implement appropriate measures when needed. In addition, cross-overs or pedestrian gates will also be installed at trails and access points along the fence to allow for people to move across the fence line. This will facilitate access for hikers, hunters, gatherers, researchers, and others who are using the area with approved permits and landowner permission. Finally, development of new access trails will also mitigate for any areas which become unavailable for hunting or hiking by creating new, more appropriate areas for these activities in the watershed.

The addition of environmental education and related activities such as hikes and service volunteer trips will also add to the positive social impacts by providing opportunities to educate adults and children about the unique ecosystems and biodiversity of Hawai‘i. The Watershed Management Area also offers numerous potential sites for scientific research and for field trips to reinforce classroom curricula. The boardwalk, improved trail management, and signage will enhance such experiences. As a result, overall social impacts of this project are expected to be positive.

Economic Impacts

The proposed action involves the expenditures of funds necessary to construct the fencing and boardwalk, including the purchase of materials, the hiring or contracting of crews, and the purchase or rental of equipment including helicopters, removal of animals, and to restore the project area using weed control, outplanting, and fire management. Research related to management actions will also be conducted. Already, estimated total cost for one proposed conservation project related to fencing and feral ungulate removal is close to \$300,000. The Kohala Watershed Partnership is already partnering with local entities such as the Kohala Center to carry out this as well as future management projects.

In addition, the economic characteristics of the management actions have the potential to affect any commercial activities that rely on the collection and distribution of water to conduct business in the surrounding towns (e.g. Waimea, Kapa'au, Honoka'a). Examples include hotels, farmers, ranchers, restaurants, County Department of Water Supply, and others. As such, the protection of these areas via the proposed management actions will be critical to ensure these economic activities continue. Tourists also enjoy these natural areas, and the continued health of the watershed could have a positive economic impact on the tourism industry as well as related businesses such as hotels and restaurants.

As such, economic impacts are positive and will result from the release of project funds into the State economy through the purchase of goods and services from local vendors, as well as employment for fence and boardwalk building as well as conservation workers and researchers and students related to local universities and colleges.

Impacts to Archaeological and Historical Sites or Cultural Resources

In general, the proposed management actions pose no negative impacts to either archaeological or historical resources in the project area as no management actions are being proposed for work at known sites. Eradication or reduction of feral ungulate populations will benefit archaeological sites as these animals have been known to trample or topple artifacts.

Cultural practices in this area (such as gathering), may be impacted by making certain areas inaccessible during periods of fence and boardwalk construction. Efforts will be made to accommodate the continuation of cultural practices during fence and boardwalk construction so as to provide the least disruption.

Overall, the proposed action is expected to have a positive impact on native Hawaiian traditional and cultural practices as protection of the forest and restoration of its native habitats can benefit practices such as traditional gathering by insuring that plants used in such collecting retain robust, abundant populations. In addition, overall conservation of native habitats and species will also aid in preserving the rich native Hawaiian history, as places linked with oli and stories are preserved. Fencing will incorporate pedestrian gates as well as step-overs at appropriate locations so access by people is not blocked (only animal movement), and development of new access trails will be implemented. Therefore, it is anticipated that proposed management actions will have long-term benefits for the perpetuation of native Hawaiian traditions and cultural practices.

While archaeological, historical, or cultural sites are not anticipated to be affected by the proposed actions, should evidence of any such sites be encountered during implementation of management actions (e.g. fence and boardwalk construction, etc.), activities would cease immediately and the appropriate parties would be consulted to determine procedures.

VI. ALTERNATIVES CONSIDERED

Two alternatives have been considered and identified:

Alternative One: Implement identified management actions over the anticipated 20 years for the conservation of the watershed (preferred alternative).

Fencing and animal removal will protect core areas of the forested watershed from feral ungulates; invasive weed control will limit the habitat-modifying affects of these plants to keep forests intact and functioning; establishment of a water resource monitoring system will allow for corrective management to ensure water supply and quality are maintained; trail/recreation use management and signage will mitigate negative impacts to the watershed and sensitive habitats as well as species through education and providing alternative recreation areas; development of a boardwalk will provide scientific and educational opportunities for better natural resource management; and stream management will help to keep these areas healthy and native species thriving. By addressing these identified threats and impacts, the proposed actions aim to ensure that current values and services provided by Kohala's watershed be maintained, enhanced, and conserved for current and future generations without further degradation.

The preferred alternative optimizes protection of the most critically important areas for water recharge and biodiversity through fencing, animal removal, and invasive species management, with the least impact to (and sometimes enhancement of) recreational opportunities such as hiking and hunting as well as cultural practices such as gathering. Under this preferred alternative, all management actions considered have been focused on minimizing potential impact on the environment, cultural practices, biological, historical, and archaeological resources, and recreation while meeting management objectives. Additionally, the management actions were derived from the draft management plan, which was developed using previous planning initiatives and pre-consultation efforts including discussions and meetings of the Natural Area Working Group, Kona/Kohala Natural Resource Area Workshop, Kohala Forest Management Group, Waimea Water Roundtable, and over 90 interviews with community members, businesses, government agencies, recreational users, cultural practitioners, private landowners, researchers, and others.

Alternative Two: No management action taken.

Given the growing domestic demand on water resources with expanding communities, increase in recreational usage of areas in Kohala, and the growing threat of invasive weed species and other non-native animals and plants impacting the forested watershed, not taking any management action to conserve the existing natural resources of the watershed would severely impact future sustainability of the services provided by Kohala's watershed. If no action is taken, degradation of the watershed and its unique habitats and species will continue and steadily worsen to the detriment of native habitat and species as well as communities and commercial operations reliant on the forested watershed.

VII. ANTICIPATED DETERMINATION AND REASONS SUPPORTING THE ANTICIPATED DETERMINATION

The anticipated determination for the Kohala Mountain Watershed Management Project is a Finding of No Significant Impact (FONSI). The intent of proposed management actions is to protect water resources, conserve native habitats and species, and enhance existing cultural, recreational, and economic uses of Kohala's watershed. This determination was based on analysis of the following significance criteria regarding impact on the environment.

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

Proposed management actions will not involve irrevocable commitment to loss or destruction of any natural or cultural resource. Proposed actions will instead conserve and enhance existing natural resources by fencing portions of the core watershed to protect water resources and native habitats from the threat of feral ungulates and other destructive non-native animals. In addition, invasive weed management actions will also address negative impacts to the natural resources by eradicating or controlling these habitat modifying plants from degrading existing native habitats. Proposed management actions will also be restoring certain areas of the watershed by outplanting rare as well as threatened or endangered plant species. By managing negative impacts of incompatible access through improved trails and signage as well as conserving native habitats and species, cultural resources will be protected so they can continue to be sustainably used and enjoyed.

(2) Curtails the range of beneficial uses of the environment.

By addressing multiple threats to the environment (watershed) in a comprehensive manner, management actions aim to conserve and enhance overall current uses of the environment by protecting water resources, native habitats and species for education, culture, recreation, and economic uses, climate change, and soil erosion and flooding mitigation. For feral ungulate management (specifically animal removal which would reduce availability of game for hunting in these areas) and appropriate recreation and trail use, these resources will not be curtailed, but rather enhanced by identifying other more beneficial areas for this use that do not negatively impact the watershed or pose safety concerns (these areas are also remote and very little if any permitted hunting or hiking/camping currently takes place).

In this way, proposed actions do not curtail, but rather keep intact and expand the range of beneficial uses of the environment. In addition, beneficial uses of the environment that have not yet even been identified by science or socio-economic fields will be kept intact and could add to the range of future beneficial uses of the environment.

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

The proposed action is consistent with the environmental policies established in Chapter 344, Hawai'i Revised Statutes (HRS) and contributes to the conservation of threatened and endangered species, as covered by Chapter 195D, HRS. Management actions also support the purpose of the State land use designation of Conservation District under Chapter 13-5 by "conserving, protecting, and preserving the important natural resources of the State through appropriate management and use to promote their long-term sustainability and the public health, safety, and welfare." It is also consistent with Section 4 of the County of Hawai'i General Plan (2005), which sets goals and policies for maintaining environmental quality. The actions are consistent with goals and objectives of the Kohala Watershed Partnership and with the policies outlined in the Memorandum of Understanding of the Hawai'i Association of Watershed Partnerships. Conservation of the Kohala forested watershed also implements the Hawai'i Comprehensive Wildlife Conservation Strategy (2005), the Recovery Plan for the Big Island Plant Cluster (1996), Draft revised recovery plan for Hawaiian waterbirds (1999), and the Draft recovery plan for the Blackburn's Sphinx Moth (*Manduca blackburni*) (2003).

In addition, the proposed management actions support the obligation of the State and its agencies to protect the reasonable exercise of customarily and traditionally exercised rights of Native Hawaiians to the extent feasible, in accordance with *Public Access Shoreline Hawaii versus Hawaii County Planning Commission* and subsequent case law.

(4) Substantially affects the economic or social welfare of the community or state.

There will be no substantial negative affects on the economic or social welfare of the community or State. Management actions will be keeping intact or enhancing current economic and social welfare by conserving the watershed so that it can continue to provide the existing benefits of water, native habitats and species, culture, recreation, economic livelihoods, and education.

(5) Substantially affects public health.

By continuing to provide high quality water and the climate and air filtering benefits of a healthy forest, public health will continue to benefit from Kohala's watershed. Additionally, in managing for feral pigs (which create wallows where water collects and produces habitats for mosquitoes which can carry the West Nile Virus) and small mammalian predators such as rats (which, like pigs, have been identified as carriers of Leptospirosis and other diseases), public health may be improved through decreasing potential vectors and spread of such diseases. As such, no substantial negative affects to public health are anticipated.

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

The proposed management actions are not anticipated to create substantial secondary impacts such as population changes or effects on public facilities given that there are few full-time residents in the proposed Watershed Management Area or existing extensive public facilities.

(7) Involves a substantial degradation of environmental quality.

The goal of the management actions is to keep intact and enhance the existing watershed, its native habitats and species and hydrological elements and features. Therefore, proposed actions will not substantially degrade environmental quality, but rather will conserve and enhance the existing high level of environmental quality found in the area for the long-term.

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

Management actions have been described and identified in a comprehensive manner to reflect all actions identified for the entire 65,000 acre Watershed Management Area during a twenty-year time span. As such, cumulative, rather than individual effects, have been considered throughout this environmental assessment. Since proposed management actions are to conserve and enhance existing conditions and prevent further degradation to Kohala's watershed, negative cumulative effects are not anticipated.

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

Proposed management actions will combat existing threats to rare, threatened, or endangered species and habitats. Fencing, animal removal, surveying and monitoring, better signage and trail management, and invasive weed and non-native animal management are aimed at protecting and propagating these species and habitats. Several of the management actions also support existing plans (e.g. State Comprehensive Wildlife Conservation Strategy, U.S. Fish and Wildlife Service Recovery plans) that are geared for the protection and perpetuation of rare, threatened, or endangered species and their habitats. Therefore, anticipated affects are positive and no substantial negative affects are anticipated.

(10) Detrimentially affects air or water quality or ambient noise levels.

The protection of the native forest and watershed for their air and water quality services are one of the main goals of the proposed management actions. Healthy forests absorb carbon dioxide and provide oxygen as well as filter water and mitigate sedimentation in streams. Therefore, impacts to air and water quality will be positive, not detrimental. Temporary disturbance of ambient noise levels may occur during transportation of materials or staff, however, given that proposed areas for such activity are far from communities, will occur during daylight hours, are for short durations, and few full-time residents reside in these areas, impacts are not anticipated to be detrimental.

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

The purpose of several of the proposed management actions is to protect sensitive areas through fencing, invasive weed control, and recreation management as well as mitigate impacts posed by threats on fresh and coastal waters. As such, management actions are geared toward conserving such sensitive areas and actions are not anticipated to create any damaging affects to areas.

(12) Substantially affects scenic vistas and viewplanes identified in county or state plans or studies.

Management actions are geared toward conserving the socio-economic value of Kohala's watershed by keeping intact scenic vistas and viewplanes. No buildings or large structures are being proposed. The upper most range of proposed fencing height will only be six feet and its location in remote areas means residents should not be able to see it. Similarly, the boardwalk is proposed in an area where scenic vistas or viewplanes is anticipated not to be affected. Fencing, boardwalk, and signs will be well below the forest canopy.

(13) Requires substantial energy consumption.

Energy consumption of the management actions will be derived mainly from vehicle use for management and also the use of helicopters for transporting staff and materials and any hand power tools for fence construction and invasive weed management and other management activities. However, such energy consumption is linked with individual projects that are short-term or temporary in nature. No infrastructure or similar elements that require on-going energy consumption is being proposed. As such, management actions are not anticipated to require substantial energy consumption.

VIII. LIST OF PERMITS REQUIRED FOR PROJECT

Given that a majority of the Watershed Management Area is zoned by the State as Conservation District, a Conservation District Use Permit will be required for these areas and approval secured from the Board of Land and Natural Resources. County permits may also be required as work will entail Special Management Areas. Work related to threatened and/or endangered species will require appropriate permits from the State and Federal agencies.

IX. ENVIRONMENTAL ASSESSMENT PREPARATION INFORMATION

This draft environmental assessment was prepared by:

In cooperation with the staff and partners of the Kohala Watershed Partnership,
Christine Ogura
Watershed Planner, Division of Forestry and Wildlife
Department of Land and Natural Resources

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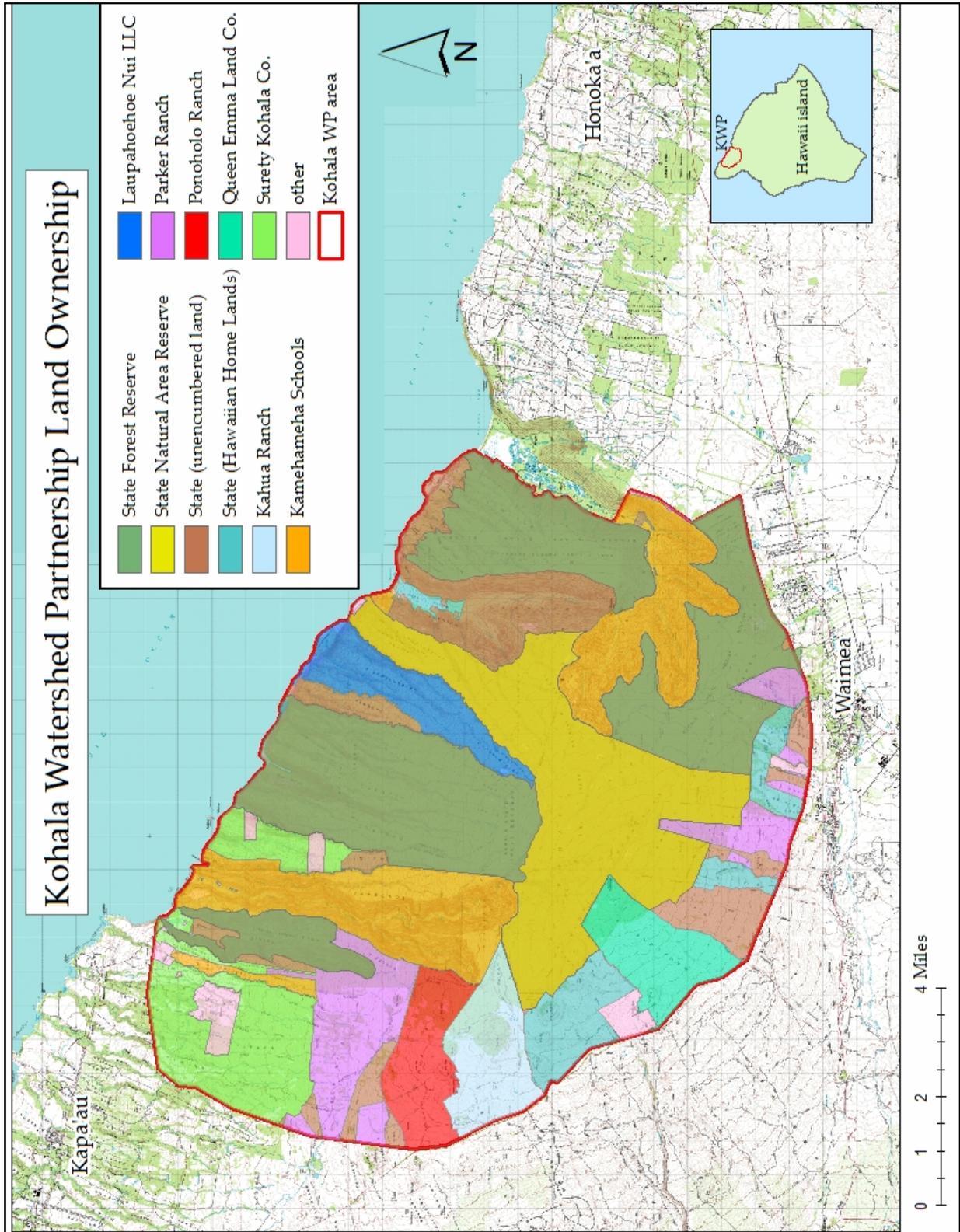
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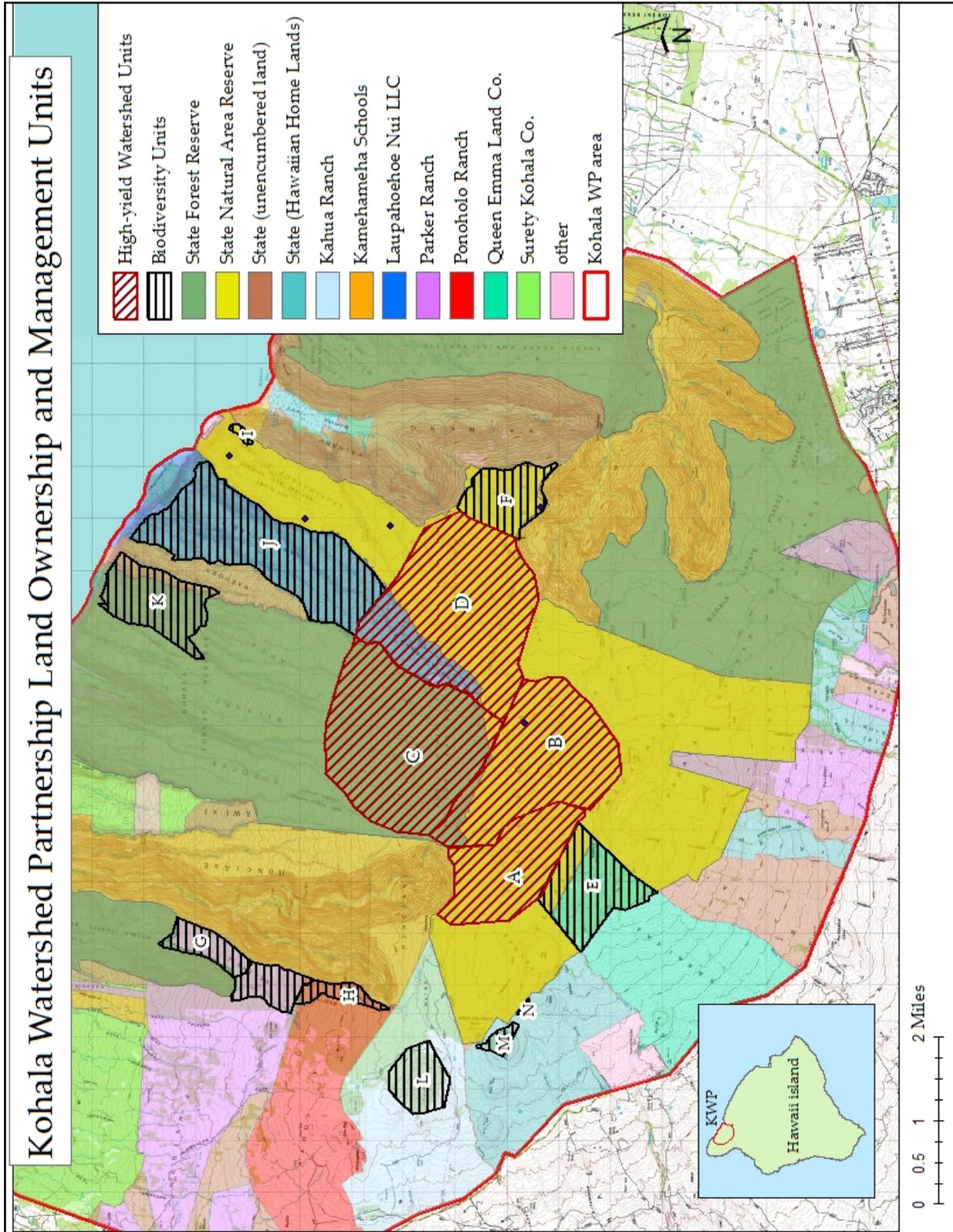
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Appendix A: Maps of the project area.

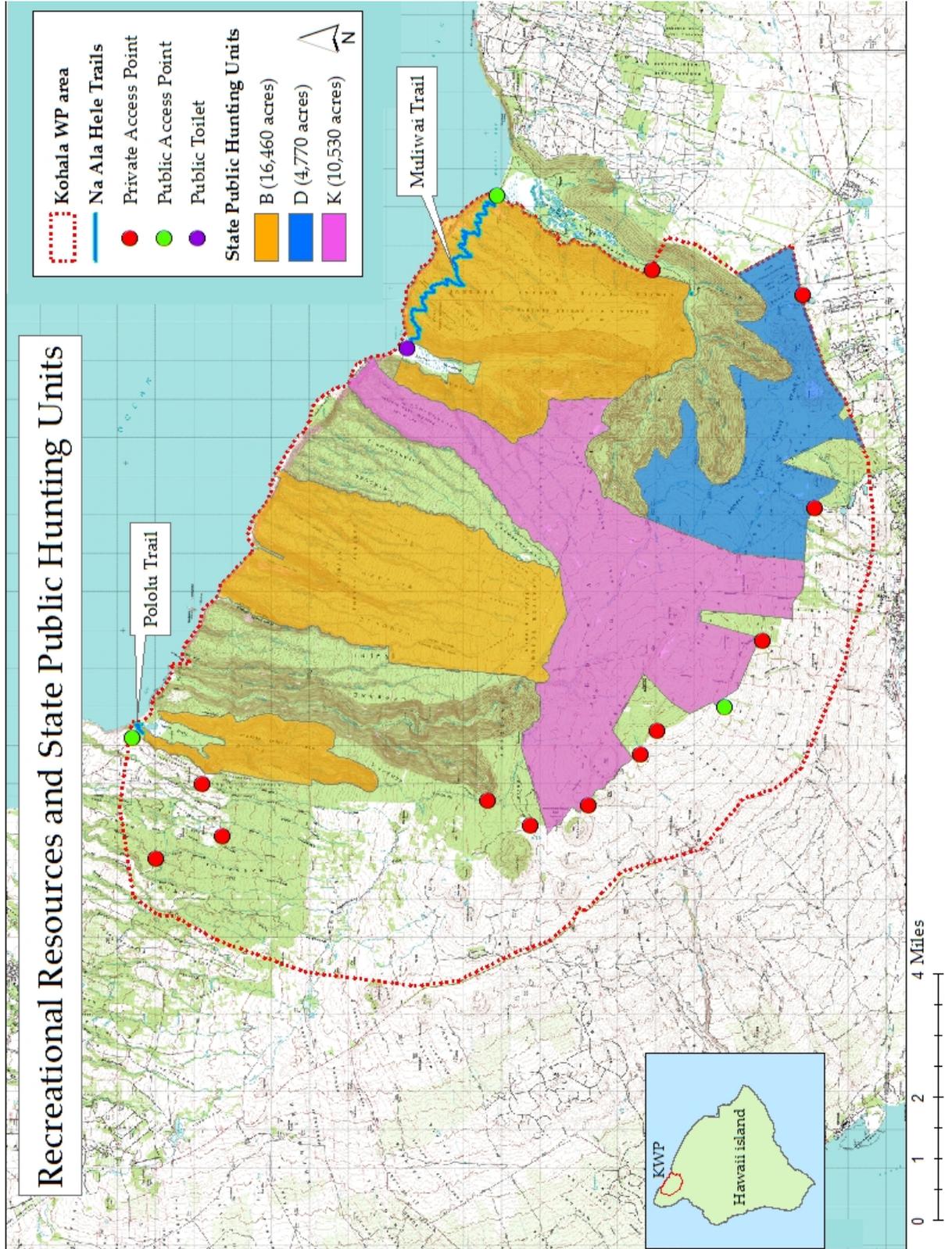
Map 1: Land Ownership and Watershed Management Area.



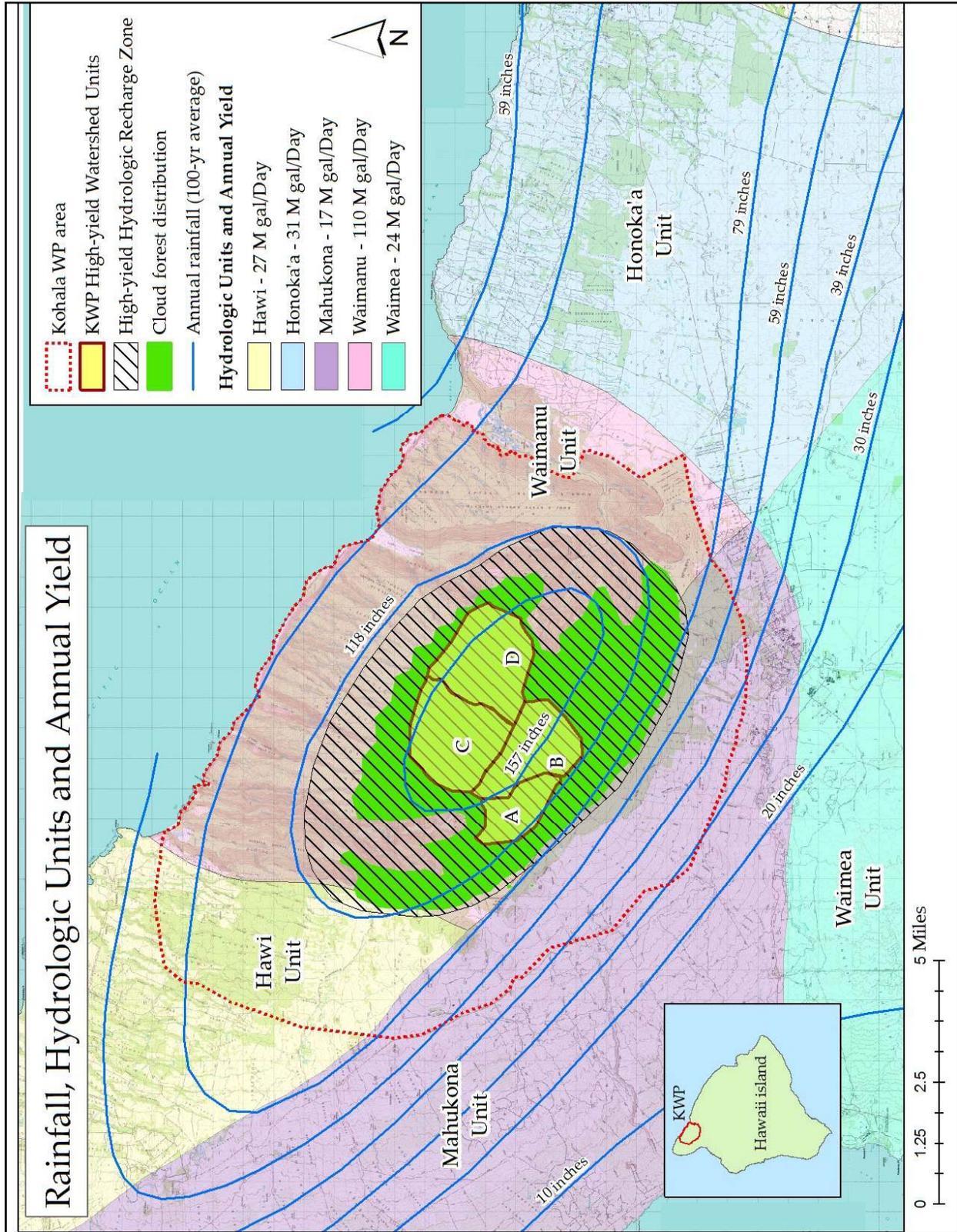
Map 2: KWP Management Units.



Map 3: Recreational Resources and DOFAW Hunting Units.



Map 4: Hydrology of Kohala Mountain.



Appendix B: Pre-Consultation/Development of Draft Management Plan and Ongoing/Future Outreach.

Kohala has had a rich history of discussion and community meetings with respect to the management of the natural resources of the area as well as the watershed. The recommendations that came out of these initiatives were incorporated into the development of the Kohala Watershed Partnership's draft management plan. Additional outreach was also conducted specifically for the purpose of developing the draft management plan. The following is a historical timeline of the pre-consultation initiatives for management in Kohala, the development of KWP's draft management plan, and plans for ongoing/future outreach:

- 1992-1993 Kona/Kohala Watershed Planning Task Force and Workshop**
The task force was convened in 1992 in response to concerns by landowners about the proposed reclassification of agricultural lands in Kona and North Kohala into Conservation District zoning. Its purpose was to plan a series of public informational workshops intended specifically to build the common base of knowledge pertaining to the Kohala and Kona watersheds and natural resources. The task force identified and adopted several statements of agreement.
- 1995-2000 Kohala Forest Management Group**
This community-based planning group was created to address issues specific to Kohala Mountain. The primary goal of the group was to balance the needs of people with the needs of the native ecosystems. Over 40 meetings were held over a five year period to identify issues of concern and develop recommendations.
- 1995-2000 Natural Area Working Group**
The purpose of this group was to look at how to fairly balance and accommodate a range of interests that were involved with the Natural Area Reserve System and maintaining a healthy forest and social community. The group sought to resolve differences concerning fencing, pig hunting, protection of forests and watersheds, and the management of Hawaii's forest lands and rare, threatened, and endangered species. The group reached consensus on 45 recommendations.
- 1996 - Waimea Water Roundtable**
The purpose of this group is to work toward common solutions of water issues as water flows across many terrains and land ownership boundaries. The group shares knowledge and works cooperatively to achieve mutual goals for Waimea's water resources. The group is advisory and has established a communication link among those in private sector, government, the community, and water users.
- 2004 Stakeholder and Community Interviews**
In addition to researching and incorporating the findings of the various working groups and initiatives from 1993-1996 into the draft management plan, specific interviews were held with stakeholders and community members to develop the draft Kohala Mountain Watershed management plan. Interviews were conducted with landowners, cultural and environmental resource experts, and members of

the community. Over 34 participants were asked seven to nine questions pertaining to the history, natural resource values, threats, and management needs of the Kohala Mountain watershed. Themes that emerged from the interviews included identification of areas of the watershed that needed management, priority threats such as feral cattle and invasive alien plants were identified, the need to balance recreation and protection of the watershed and provide for public safety, and the need to increase general awareness of the watershed's resources within the affected communities to build support and appreciation for the watershed's values and its management. These findings were incorporated into developing the management programs in the draft management plan.

2006 **Draft Management Plan and Environmental Assessment Public Open Houses**
In April of 2006, a series of public open houses were conducted by the Kohala Watershed Partnership to share their draft management plan. The purpose of these open houses was to gain additional input from various communities before moving to finalize the plan and also to gain input for the development of the draft environmental assessment. Over 40 people attended.

2006-7 **Ongoing and Future Outreach Initiatives Planned**
The Kohala Watershed Partnership (KWP) believes that support and involvement by the greater Kohala community is important to insure a healthy watershed. KWP has shown their commitment to this belief by developing a draft management plan that was based on previous initiatives that involved different groups and community members. KWP also proved their commitment by hosting open houses to share their draft management plan and to receive input for developing the environmental assessment. KWP incorporated and addressed many of the comments heard at the open houses into the environmental assessment and is waiting to finalize their management plan until this process was done. The Partnership further showed their commitment to listening to different groups within the community when after the April open houses were conducted, hunters who expressed concerns and comments during the open houses were invited on a field trip to look at the areas being proposed for fencing. Seven hunters expressed interest and two field trips were scheduled. The first trip was canceled due to illness of one of the hunters. The second was canceled because the hunter had already been out with staff previously. Though the trips have not yet occurred due to these scheduling issues, staff are open to conducting the field trip if contacted.

In addition, the Partnership has recently hired a coordinator who has a background in outreach and education, thereby further underscoring the Partnership's commitment to involving the Kohala community as the management plan moves forward. The coordinator has already begun connecting with community groups. She has met with or plans to meet with the Waimea Community Association, Tutu's House (or Friends of the Future), both the Kohala and Waimea Outdoor Circles, the Waipi'o Community Circle, and public, private and charter schools such as Kanu O Ka 'Aina and Waimea Middle School. The

focus of her meetings are to introduce people to the Kohala Watershed Partnership and to share experiences and information about Kohala Mountain as well as discuss the draft management plan and proposed actions. The coordinator has also started a volunteer program where people have an opportunity to go out into the field on both learning and work trips. She has also planned nature camps for local children. Outreach materials have been created and distributed to the community, and will continue to be developed. Through these activities, the KWP plans to continue the dialogue started at the April open houses with different groups who use the project area and are interested in its continued management and conservation.

Appendix C: Pre-Consultation for Draft Environmental Assessment and how comments were incorporated.

Specific comments from the April 2006 open houses with regard to what the draft environmental assessment should consider included: fence construction (specifically debris collection after storms, cultural gathering, maintenance, establish need for fences, possible weed vector activity), integration of the plan with other area or island initiatives, clarification on how rare plants will be protected, need for treating the forest with respect, impact of existing trails and continued access (e.g. hunting impacts, cultural gathering), economic impact to community (specifically closing down certain areas to subsistence hunting), preserving the whole system and not keeping out specific components, and valuing multiple ways the watershed is seen by different groups. These comments were addressed in the following manner in the environmental assessment:

Fence construction (specifically debris collection after storms, cultural gathering, maintenance, establish need for fences, possible weed vector activity).

- On pages 11-12 and 26, debris collection after storms has been addressed. Different technologies for barrier construction where streams are present will be considered, including, but not limited to, breakaway panels. In addition, staff will be checking fences near or across streams after major storms to insure barrier integrity, but also for possible debris accumulation and affects to stream flow. Efforts to avoid the need to cross streams for fencing will be the first consideration when determining the fence line.
- On pages 11-12 and 28, the installment of crossovers along the fence to allow for movement of people into and/or between fenced areas is discussed. This addresses cultural gathering as this movement would include activities for cultural gathering. As stated on page 12, the proposed fencing is designed to limit animal movement, not block access to people. Also continued on page 29, use of proposed fencing areas by cultural practitioners is very minimal and all efforts will be made to accommodate the continuation of cultural practices during fence construction so as to provide the least disruption. Over time, fencing and related management is anticipated to benefit cultural practices by protecting areas with native species, enhancing their populations, and contributing to their long-term existence for use by future generations. On page 32, it also states that the proposed management actions in the environmental assessment as well as the draft management plan support the obligation of the State and its agencies to protect the reasonable exercise of customarily and traditionally exercised rights of Native Hawaiians to the extent feasible, in accordance with *Public Access Shoreline Hawaii versus Hawaii County Planning Commission* and subsequent case law.
- On page 12, fencing maintenance is addressed. It states that fences will be monitored regularly to insure fence integrity so that no broken fence lines, if found, are left unattended and will be fixed.
- On pages 9-12, the need for establishing fences has been clearly outlined. To prevent feral ungulates such as cattle and pigs from impacting core watershed areas, fencing to keep these animals out of high-yield infiltration areas as well as sensitive habitats and high-quality native forests is critical in order to manage such threats. Fencing for these purposes has been used effectively in Hawai'i in areas such as the State Forest

Reserves, State Natural Area Reserves, National Wildlife Refuges, the National Parks, and other Watershed Partnerships. Fencing is the first management action necessary in order to mitigate the primary threats of feral ungulates and also invasive weed species. Current fences which already exist within the project area have proven very effective for threat management (see Appendix E for photo examples of fencing efficacy). Historically in Hawai‘i, fencing as a management action to protect forests and watershed areas was used when the territorial government created the Forest Reserve System as a need in response to the degradation of the forest by feral cattle and other hooved animals (which were causing water consumption issues for ranches and plantations). The first action taken was fencing and then removal of these animals from the Forest Reserve. In fact, in 1876 King Kalākaua signed into law an Act for the Protection and Preservation of Woods and Forests, authorizing the Minister of the Interior to set apart and protect from “damage by trespass of animals or otherwise, such woods and forest lands, the property of government . . . best suited for the protection of water resources.” In its 1904 report to the governor, the Division of Forestry noted that “[n]owhere in the Territory is there more pressing need for forest reservation than in this district [Kohala], for on the forest area of the Kohala Mountain depends the chief water supply of the north end of the island. To insure its permanence this forest ought to be reserved at once.” In addition, as mentioned in the environmental assessment on page 11, only 10,500 acres out of the entire 65,000 project area (or 15%) has been identified for proposed fencing.

- On page 27, the issue concerning fence construction and prevention of introduction of alien invasive weed species has been addressed. Alien species inspection protocols will be instituted during any fence construction and when personnel and materials are brought into areas to mitigate for this potential impact. Examples of such protocols are inspection of boots, equipment, and materials prior to entry and departure of the project area, appropriate cleaning procedures and proper instruction of crews working on projects regarding the spread of alien species and follow-up monitoring for weeds along the fence post-construction and other projects.

Integration of the plan with other area or island initiatives.

On pages 6 and 32-33, it outlines how the management actions integrate with other area or island initiatives. Specifically, over ten initiatives are identified. In addition, partnership members have been involved with attending county planning initiatives for the region as well as other public-private initiatives to insure continued integration of management actions with other plans and initiatives occurs.

Clarification on how rare plants will be protected.

Pages 10-15 talk about actions to protect rare plants through threat management (e.g. feral ungulates removal, invasive species control, fencing) and active restoration, collection of seeds, outplanting, and monitoring for these species. There already exists small fenced units within the project area dedicated specifically for protection and management of rare plants.

Need for treating the forest with respect.

The goal of the management actions and the draft management plan of the Kohala

Watershed Partnership is to maintain a healthy watershed and all its related ecosystem values and functions (e.g. ecological, economic, sociocultural). The fact that the Partnership has formed and has taken an active role through its management plan and actions reflects that the Partnership respects the forest. If the Partnership did not respect the forest, it would not care about impacts and degradation to the watershed and allow for these negative impacts to continue into the future. The need for management has clearly been outlined and continues the tradition from the territorial days when public and private landowners worked together to conserve and protect the forest.

Impact of existing trails and continued access (e.g. hunting impacts, cultural gathering).

Pages 10, 12, 15-16, 23-24, 28-30, and 32-33 all discuss trails and access issues (mainly focused on assessing existing trails and their positive and negative impacts, development of new trails, continued access for different activities, trail and access permits, etc.). Management actions support the continued recreational use of the project area and do not try to limit all uses over the entire 65,000 acre project area. In fact, trails and access are vital for management purposes, cultural gathering, recreation, education, and economic reasons. What the management actions propose is insuring that existing trails are lawful (ie. control of illegal trespassing), safe, and are not primary vectors of invasive weed species, feral ungulates, and other threats. As already stated previously, cultural gathering is supported and access provided. With regard to hunting impacts, most areas of public land proposed for fencing are rarely used by hunters, and 26,000 acres of accessible public hunting areas will still be open for hunting. On page 12, feral ungulate control measures state that where feasible (e.g. terrain and safety conditions), involving public hunters will be the first phase for control work. In addition on page 12 with regard to fence construction, one-way gates will be incorporated to allow for animal movement from fenced areas to outside fenced areas and hunting units. In addition, private landowners like Parker Ranch have hunting programs which they will continue. Finally, development of new trails for recreation are also part of the draft management plan in order to facilitate access to other areas in the watershed where impacts are less detrimental to the watershed and safer for people.

Economic impact to community (specifically closing down certain areas to subsistence hunting).

Pages 15-16 and 29-30 address economic impact. By preserving the watershed which provides water to the Kohala area and enhancing recreation areas for residents and tourists, the economic impact to the community is positive. In addition, materials bought and personnel hired for projects will also benefit the community as they will be local. With regard to closing down certain areas to subsistence hunting, again looking at the previous paragraph, the management actions are not deterring hunting since most areas are not heavily utilized by hunters and hunters will be invited to be part of the animal control initiatives. As mentioned in the environmental assessment on page 10, only 10,500 acres out of the entire 65,000 project area (or 15%) has been identified for proposed fencing. As such, 85% or 54,500 is open for other compatible use consideration and with landowner permission. Over 26,000 acres will remain in accessible public hunting areas. In addition, new trails and access are being identified in order to enhance hunting as well as other recreational uses of the watershed. These proposed actions will

increase both access and experiences for hikers, hunters, and other users of the watershed via identification and development of potential new routes to lands not previously accessible.

Preserving the whole system and not keeping out specific components.

The entire draft management plan and the proposed management actions are addressing the entire 65,000 acre area, in other words, the whole system. All components are being addressed and looked at including water, native habitats and species, recreation, culture, education, and economics. As such, specific components are not being left out.

Value multiple ways the watershed is seen by different groups.

The draft management plan and proposed management actions identify and address the multiple resources offered by the watershed and the many different uses and groups that benefit from a healthy Kohala watershed and mountain. The environmental assessment reflects this by identifying on pages 16-24, the many ways the watershed is seen by different groups and therefore its uses. In addition the draft management plan was developed using prior initiatives as outlined in Appendices B and C, which included a broad range of people with different interests who came together and found common ground and agreement for the management needs for Kohala. Management actions are geared toward enhancing these values and insuring that the resources continue to remain in the future for the continued enjoyment and use by the different groups.

Appendix D: Partial list of animals and vascular plants of the Kohala Mountain Watershed (both native and non-native).

Status: USFWS

- END Endangered
- T Threatened
- C Candidate species
- SOC Species of Concern (unofficial designation)

WORLD CONSERVATION UNION (IUCN)

- CR Critically endangered
- EN Endangered
- VU Vulnerable
- NT Near threatened
- LC Least concern

- X Presumed extinct

Affinity:

- N Non-native
- P Polynesian introduction
- I Indigenous
- E Endemic

Family	Taxon	Common/Hawaiian name	Affinity	Status
I. Flora				
Pteridophyta (ferns and fern allies)				
Grammitidaceae	<i>Adenophorus hymenophylloides</i>	pai	E	
Grammitidaceae	<i>Adenophorus pinnatifidus</i>		E	
Grammitidaceae	<i>Adenophorus tamariscinus</i>	wahine noho mauna	E	
Grammitidaceae	<i>Adenophorus tripinnatifidus</i>		E	
Marattiaceae	<i>Angiopteris evecta</i>	mule's-foot fern	N	
Aspleniaceae	<i>Asplenium acuminatum</i>	lola	E	
Aspleniaceae	<i>Asplenium adiantum-nigrum</i>	'iwa'iwa	I	
Aspleniaceae	<i>Asplenium contiguum</i>		E	
Aspleniaceae	<i>Asplenium haleakalense</i>		E	
Aspleniaceae	<i>Asplenium horridum</i>	'iwa	I	
Aspleniaceae	<i>Asplenium kaulfussii</i>	kūau	E	
Aspleniaceae	<i>Asplenium lobulatum</i>	pi'ipi'i lau manamana	I	
Aspleniaceae	<i>Asplenium polyodon</i>	pūnana manu	I	
Aspleniaceae	<i>Asplenium trichomanes</i> subsp. <i>densum</i>	'oāli'i	E	
Aspleniaceae	<i>Asplenium unilaterale</i>	pāmoho	I	
Athyriaceae	<i>Athyrium microphyllum</i>	'ākōlea	E	
Blechnaceae	<i>Blechnum appendiculatum</i>		N	
Thelypteridaceae	<i>Christella dentata</i>	pai'i'ihā	N	
Dicksoniaceae	<i>Cibotium chamissoi</i>	hāpu'u	E	
Dicksoniaceae	<i>Cibotium glaucum</i>	hāpu'u pulu	E	
Dicksoniaceae	<i>Cibotium menziesii</i>	hāpu'u 'i'i	E	
Pteridaceae	<i>Coniogramme pilosa</i>	lo'ulu	E	
Athyriaceae	<i>Deparia petersenii</i>		N	
Gleicheniaceae	<i>Dicranopteris linearis</i>	uluhe	I	

Athyriaceae	<i>Diplazium molokaiense</i>		E	END
Athyriaceae	<i>Diplazium sandwichianum</i>	hō'i'o	E	
Gleicheniaceae	<i>Diplopterygium pinnatum</i>	uluhe lau nui	E	
Blechnaceae	<i>Doodia lyonii</i>		E	SOC
Dryopteridaceae	<i>Dryopteris fusco-atra</i>	'i'i	E	
Dryopteridaceae	<i>Dryopteris glabra</i>	kīlau	E	
Dryopteridaceae	<i>Dryopteris hawaiiensis</i>		E	
Dryopteridaceae	<i>Dryopteris sandwicensis</i>		E	
Dryopteridaceae	<i>Dryopteris unidentata</i>	'akole	E	
Dryopteridaceae	<i>Dryopteris wallichiana</i>	'i'o nui	I	
Dryopteridaceae	<i>Dryopteris</i> sp.		E	
Lomariopsidaceae	<i>Elaphoglossum alatum</i>	hoe a Māui	E	
Lomariopsidaceae	<i>Elaphoglossum paleaceum</i>	māku'e	I	
Lomariopsidaceae	<i>Elaphoglossum wawrae</i>	laukahi	E	
Grammitidaceae	<i>Grammitis hookeri</i>	māku'e lau li'i	I	
Grammitidaceae	<i>Grammitis tenella</i>	kolokolo	E	
Lycopodiaceae	<i>Huperzia phyllantha</i>	wāwae'iole	I	
Grammitidaceae	<i>Lellingeria saffordii</i>	kihe	E	
Polypodiaceae	<i>Lepisorus thunbergianus</i>	pākahakaha	I	
Lycopodiaceae	<i>Lycopodiella cernua</i>	wāwae'iole	I	
Lycopodiaceae	<i>Lycopodium venustulum</i>		I	
Thelypteridaceae	<i>Macrothelypteris torresiana</i>		N	
Hymenophyllaceae	<i>Mecodium recurvum</i>	'ōhi'a kū	E	
Dennstaedtiaceae	<i>Microlepia strigosa</i>	palapalai	I	
Nephrolepidaceae	<i>Nephrolepis cordifolia</i>		I	
Nephrolepidaceae	<i>Nephrolepis multiflora</i>		N	
Dryopteridaceae	<i>Nothoperanema rubiginosa</i>		E	
Ophioglossaceae	<i>Ophioderma pendulum</i>	puapua moa	I	
Pteridaceae	<i>Pityrogramma calomelanos</i>	silver fern	N	
Polypodiaceae	<i>Polypodium pellucidum</i>	'ae	E	
Psilotaceae	<i>Psilotum complanatum</i>	moa	I	
Psilotaceae	<i>Psilotum nudum</i>	moa	I	
Dennstaedtiaceae	<i>Pteridium aquilinum</i> var. <i>decompositum</i>	kīlau	E	
Pteridaceae	<i>Pteris cretica</i>	'ōali	I	
Pteridaceae	<i>Pteris excelsa</i>	waimakanui	I	
Blechnaceae	<i>Sadleria cyatheoides</i>	'ama'u	E	
Blechnaceae	<i>Sadleria pallida</i>	'ama'u	E	
Blechnaceae	<i>Sadleria squarrosa</i>	'apu'u	E	
Blechnaceae	<i>Sadleria souleyetiana</i>	'ama'u	E	
Hymenophyllaceae	<i>Sphaerocionium lanceolatum</i>	palai hinahina	E	
Hymenophyllaceae	<i>Sphaerocionium obtusum</i>	palai lau li'i	E	
Lindsaeaceae	<i>Sphenomeris chinensis</i>	pala'ā	I	
Gleicheniaceae	<i>Sticherus owbyhensis</i>	uluhe	E	
Hymenophyllaceae	<i>Vandenboschia davallioides</i>	palai hihī	E	
Magnoliophyta (angiosperms)				
Liliopsida (monocots)				
Poaceae	<i>Agrostis avenacea</i>	he'upueo	I	
Poaceae	<i>Andropogon virginicus</i>	broomsedge	N	

Orchidaceae	<i>Anoectochilus sandwicensis</i>	jewel orchid	E	SOC, VU
Poaceae	<i>Anthoxanthum odoratum</i>	sweet vernalgrass	N	
Liliaceae	<i>Astelia menziesiana</i>	pa'iniu, kaluaha	E	
Poaceae	<i>Axonopus fissifolius</i>	narrow-leaved carpetgrass	N	
Poaceae	<i>Bambusa</i> sp.	bamboo	N	
Poaceae	<i>Briza minor</i>	little quaking grass	N	
Poaceae	<i>Calamagrostis expansa</i>	Maui reedgrass	E	C, VU
Cyperaceae	<i>Carex alligata</i>		E	
Arecaceae	<i>Cocos nucifera</i>	niu, coconut	P	
Araceae	<i>Colocasia esculenta</i>	kalo, taro	P	
Commelinaceae	<i>Commelina diffusa</i>	honohono	N	
Agavaceae	<i>Cordyline fruticosa</i>	kī, ti	P	
Poaceae	<i>Cynodon dactylon</i>	bermuda grass	N	
Cyperaceae	<i>Cyperus halpan</i>	umbrella sedge	N	
Cyperaceae	<i>Cyperus pilosus</i>	umbrella sedge	N	
Poaceae	<i>Deschampsia nubigena</i>	hairgrass	E	
Poaceae	<i>Dichanthelium cynodon</i>		E	
Poaceae	<i>Dichanthelium hillebrandianum</i>		E	
Poaceae	<i>Digitaria ciliaris</i>	Henry's crabgrass	N	
Poaceae	<i>Digitaria</i> sp.	crabgrass	N	
Poaceae	<i>Ehrharta stipoides</i>	meadow ricegrass	N	
Cyperaceae	<i>Eleocharis</i> sp.	spikerush, kohekohe	N	
Poaceae	<i>Eragrostis grandis</i>	lovegrass	E	
Poaceae	<i>Eragrostis variabilis</i>	kāwelu	E	
Poaceae	<i>Festuca</i> sp.	fescue	N	
Pandanaceae	<i>Freycinetia arborea</i>	'ie'ie	I	
Zingiberaceae	<i>Hedychium coronarium</i>	white ginger	N	
Zingiberaceae	<i>Hedychium flavescens</i>	yellow ginger	N	
Zingiberaceae	<i>Hedychium gardnerianum</i>	kāhili ginger	N	
Poaceae	<i>Holcus lanatus</i>	common velvet grass	N	
Poaceae	<i>Isachne distichophylla</i>	'ohe	E	
Joinvilleaceae	<i>Joinvillea ascendens</i> subsp. <i>ascendens</i>	'ohe	E	C
Juncaceae	<i>Juncus effusus</i>	Japanese mat rush	N	
Juncaceae	<i>Juncus ensifolius</i>	rush	N	
Juncaceae	<i>Juncus planifolius</i>	rush	N	
Juncaceae	<i>Juncus tenuis</i>	rush	N	
Cyperaceae	<i>Kyllinga brevifolia</i>	kili'o'opu	N	
Orchidaceae	<i>Liparis hawaiiensis</i>	'awapuhiakanaloa	E	SOC
Juncaceae	<i>Luzula hawaiiensis</i> var. <i>hawaiiensis</i>	wood rush	E	
Cyperaceae	<i>Machaerina angustifolia</i>	'uki	I	
Cyperaceae	<i>Machaerina mariscoides</i> subsp. <i>meyenii</i>	'ahaniu	E	
Cyperaceae	<i>Oreobolus furcatus</i>		E	
Poaceae	<i>Panicum repens</i>	torpedo grass	N	
Poaceae	<i>Paspalum conjugatum</i>	Hilo grass	N	
Poaceae	<i>Paspalum dilatatum</i>	Dallis grass	N	

Poaceae	<i>Paspalum fimbriatum</i>	Panama paspalum	N	
Poaceae	<i>Paspalum scrobiculatum</i>	ricegrass, mau‘u laiki	I?	
Poaceae	<i>Paspalum urvillei</i>	Vasey grass	N	
Poaceae	<i>Pennisetum clandestinum</i>	kikuyu grass	N	
Agavaceae	<i>Pleomele hawaiiensis</i>	hala pepe	E	END, EN
Poaceae	<i>Poa annua</i>	annual bluegrass	N	
Arecaceae	<i>Pritchardia lanigera</i>	loulu	E	SOC, EN
Cyperaceae	<i>Pycreus polystachyos</i>		I	
Cyperaceae	<i>Rhynchospora chinensis</i>	kuolohia, beak-rush	I	
Poaceae	<i>Sacciolepis indica</i>	Glenwood grass	N	
Poaceae	<i>Setaria gracilis</i>	yellow foxtail	N	
Poaceae	<i>Setaria palmifolia</i>	palmgrass	N	
Poaceae	<i>Setaria verticillata</i>	bristly foxtail	N	
Poaceae	<i>Sporobolus africanus</i>	smutgrass	N	
Poaceae	<i>Sporobolus indicus</i>	West Indian dropseed	N	
Cyperaceae	<i>Uncinia uncinata</i>		I	
Magnoliopsida (dicots)				
Fabaceae	<i>Acacia koaia</i>	koai‘a	E	SOC, VU
Amaranthaceae	<i>Achyranthes mutica</i>		E	END, CR
Asteraceae	<i>Ageratina adenophora</i>	Maui pāmakani	N	
Asteraceae	<i>Ageratina riparia</i>	Hāmākua pāmakani	N	
Asteraceae	<i>Ageratum conyzoides</i>	maile hohono	N	
Euphorbiaceae	<i>Aleurites moluccana</i>	kukui	P	
Betulaceae	<i>Alnus nepalensis</i>	Nepal alder	N	
Apocynaceae	<i>Alyxia oliviformis</i>	maile	E	
Primulaceae	<i>Anagallis arvensis</i>	scarlet pimpernel	N	
Euphorbiaceae	<i>Antidesma platyphyllum</i>	hame	E	
Asteraceae	<i>Artemisia australis</i>	‘āhinahina	E	
Asteraceae	<i>Bidens hawaiiensis</i>	ko‘oko‘olau	E	
Asteraceae	<i>Bidens hillebrandiana</i> subsp. <i>hillebrandiana</i>	ko‘oko‘olau	E	SOC
Rubiaceae	<i>Bobea elatior</i>	‘ahakea lau nui	E	
Rubiaceae	<i>Bobea timonioides</i>	‘ahakea	E	SOC, EN
Urticaceae	<i>Boehmeria grandis</i>	‘ākōlea	E	
Hydrangeaceae	<i>Broussaisia arguta</i>	kanawao	E	
Cannabaceae	<i>Cannabis sativa</i>	marijuana, paka lōlō	N	
Fabaceae	<i>Canavalia hawaiiensis</i>	‘āwikiwiki	E	
Brassicaceae	<i>Cardamine flexuosa</i>	bittercress	N	
Casuarinaceae	<i>Casuarina equisetifolia</i>	common ironwood	N	
Apiaceae	<i>Centella asiatica</i>	Asiatic pennywort	N	
Caryophyllaceae	<i>Cerastium fontanum</i>	common mouse-ear chickweed	N	
Euphorbiaceae	<i>Chamaesyce multiformis</i>	‘akoko	E	
Amaranthaceae	<i>Charpentiera obovata</i>	pāpala	E	
Araliaceae	<i>Cheirodendron trigynum</i>	‘ōlapa	E	

Asteraceae	<i>Cirsium vulgare</i>	bull thistle	N	
Campanulaceae	<i>Clermontia calophylla</i>	‘ōhā wai	E	SOC, EN
Campanulaceae	<i>Clermontia drepanomorpha</i>	‘ōhā wai	E	END, EN
Campanulaceae	<i>Clermontia kohalae</i>	‘ōhā wai	E	
Campanulaceae	<i>Clermontia parviflora</i>	‘ōhā wai	E	
Campanulaceae	<i>Clermontia waimeae</i>	‘ōhā wai	E	SOC, EN
Campanulaceae	<i>Clermontia</i> sp.	‘ōhā wai	E	
Melastomataceae	<i>Clidemia hirta</i>	Koster’s curse	N	
Menispermaceae	<i>Cocculus trilobus</i>	huehue	I	
Asteraceae	<i>Conyza bonariensis</i>	hairy horseweed	N	
Rubiaceae	<i>Coprosma ochracea</i>	pilo	E	
Rubiaceae	<i>Coprosma pubens</i>	pilo	E	
Asteraceae	<i>Crassocephalum crepidioides</i>		N	
Cupressaceae	<i>Cryptomeria japonica</i>	Tsugi pine	N	
Apiaceae	<i>Cryptotaenia Canadensis</i>	honewort	N	
Lythraceae	<i>Cuphea carthagenensis</i>	tarweed	N	
Campanulaceae	<i>Cyanea pilosa</i>	hāhā	E	
Campanulaceae	<i>Cyanea pilosa</i> subsp. <i>pilosa</i>	hāhā	E	
Campanulaceae	<i>Cyanea pycnocarpa</i>	hāhā	E	SOC, X
Campanulaceae	<i>Cyanea tritomantha</i>	‘akū	E	C, VU
Gesneriaceae	<i>Cyrtandra kohalae</i>	ha‘iwale	E	SOC, X
Gesneriaceae	<i>Cyrtandra paludosa</i>	moa	E	
Gesneriaceae	<i>Cyrtandra platyphylla</i>	‘ilihia	E	
Gesneriaceae	<i>Cyrtandra</i> sp.	ha‘iwale	E	
Campanulaceae	<i>Delissea parviflora</i>		E	SOC, X
Ebenaceae	<i>Diospyros sandwicensis</i>	lama	E	
Sapindaceae	<i>Dodonaea viscosa</i>	‘a‘ali‘i	I	
Caryophyllaceae	<i>Drymaria cordata</i>	pipili	N	
Asteraceae	<i>Dubautia plantaginea</i>	na‘ena‘e	E	
Onagraceae	<i>Epilobium billardierianum</i>	willow herb	N	
Asteraceae	<i>Erechtites valerianifolia</i>	fireweed	N	
Myrtaceae	<i>Eucalyptus robusta</i>	swamp mahogany	N	
Theaceae	<i>Eurya sandwicensis</i>	ānini	E	SOC, VU
Moraceae	<i>Ficus macrophylla</i>	banyan	N	
Moraceae	<i>Ficus rubiginosa</i>	banyan	N	
Rosaceae	<i>Fragaria vesca</i>	strawberry	N	
Oleaceae	<i>Fraxinus uhdei</i>	tropical ash	N	
Rubiaceae	<i>Gardenia remyi</i>	nānū	E	C, VU
Geraniaceae	<i>Geranium homeanum</i>	cranesbill	N	
Proteaceae	<i>Grevillea robusta</i>	silk oak, ‘oka kilika	N	
Gunneraceae	<i>Gunnera petaloidea</i>	‘ape‘ape	E	
Rubiaceae	<i>Hedyotis acuminata</i>	au	E	
Rubiaceae	<i>Hedyotis hillebrandii</i>	manono	E	
Rubiaceae	<i>Hedyotis littoralis</i>		E	SOC
Rubiaceae	<i>Hedyotis terminalis</i>	manono	E	

Malvaceae	<i>Hibiscadelphus hualaiensis</i>	hau kuahiwai	E	END, CR, X
Malvaceae	<i>Hibiscus kokio</i>	koki'o	E	SOC, VU
Malvaceae	<i>Hibiscus tiliaceus</i>	hau	I	
Apiaceae	<i>Hydrocotyle sibthorpioides</i>	marsh pennywort	N	
Apiaceae	<i>Hydrocotyle verticillata</i>	pohe	N	
Clusiaceae	<i>Hypericum mutilum</i>	St. John's wort	N	
Asteraceae	<i>Hypochoeris radicata</i>	hairy cat's ear	N	
Aquifoliaceae	<i>Ilex anomala</i>	kāwa'u	I	
Convolvulaceae	<i>Ipomoea indica</i>	koali 'awa	I	
Convolvulaceae	<i>Ipomoea littoralis</i>	morning glory	I	
Viscaceae	<i>Korthalsella complanata</i>	hulumoa	I	
Viscaceae	<i>Korthalsella cylindrica</i>	hulumoa	E	
Loganiaceae	<i>Labordia hedyosmifolia</i>	kāmakahala	E	
Loganiaceae	<i>Labordia helleri</i>	kāmakahala	E	
Loganiaceae	<i>Labordia hirtella</i>	kāmakahala	E	
Verbenaceae	<i>Lantana camara</i>	lākana	N	
Epacridaceae	<i>Leptecophylla tameiameia</i>	pūkiawe	I	
Campanulaceae	<i>Lobelia hypoleuca</i>	kuhi 'aikamo 'owahie, 'ōpelu	E	SOC
Onagraceae	<i>Ludwigia palustris</i>	marsh purslane	N	
Primulaceae	<i>Lysimachia mauritiana</i>		I	
Myrtaceae	<i>Melaleuca quinquenervia</i>	paperbark	N	
Melastomataceae	<i>Melastoma candidum</i>		N	
Rutaceae	<i>Melicope clusiifolia</i>	alani, kolokolo mokihana	E	
Rutaceae	<i>Melicope hawaiiensis</i>	mokihana kūkae moa	E	SOC, VU
Rutaceae	<i>Melicope pseudoanisata</i>	alani	E	
Myrtaceae	<i>Metrosideros polymorpha</i>	'ōhi'a	E	
Malvaceae	<i>Modiola caroliniana</i>		N	
Myoporaceae	<i>Myoporum sandwicense</i>	naio	I	
Myrsinaceae	<i>Myrsine lanaiensis</i>	kōlea	E	
Myrsinaceae	<i>Myrsine lessertiana</i>	kōlea lau nui	E	
Myrsinaceae	<i>Myrsine sandwicensis</i>	kōlea lau li'i	E	
Rubiaceae	<i>Nertera granadensis</i>	mākole	I	
Oleaceae	<i>Nestegis sandwicensis</i>	olopua	E	
Solanaceae	<i>Nothoecstrum breviflorum</i>	'aiea	E	END, CR
Apocynaceae	<i>Ochrosia haleakalae</i>	hōlei	E	C, EN
Rosaceae	<i>Osteomeles anthyllidifolia</i>	'ūlei	I	
Oxalidaceae	<i>Oxalis corniculata</i>	'ihi 'ai, yellow wood sorrel	P ?	
Passifloraceae	<i>Passiflora tarminiana</i>	banana poka	N	
Piperaceae	<i>Peperomia cookiana</i>	'ala'ala wai nui	E	
Piperaceae	<i>Peperomia hypoleuca</i>	'ala'ala wai nui	E	
Piperaceae	<i>Peperomia macraeana</i>	'ala'ala wai nui	E	
Piperaceae	<i>Peperomia membranacea</i>	'ala'ala wai nui	E	
Piperaceae	<i>Peperomia tetraphylla</i>	'ala'ala wai nui	I	
Piperaceae	<i>Peperomia</i> sp.	'ala'ala wai nui	E	
Celastraceae	<i>Perrottetia sandwicensis</i>	olomea	E	

Apiaceae	<i>Peucedanum sandwicense</i>	makou	E	T
Lamiaceae	<i>Phyllostegia ambigua</i>		E	
Lamiaceae	<i>Phyllostegia floribunda</i>		E	C
Lamiaceae	<i>Phyllostegia vestita</i>		E	
Lamiaceae	<i>Phyllostegia warshaueri</i>		E	END
Phytolaccaceae	<i>Phytolacca sandwicensis</i>	pōpolo kū mai	E	
Urticaceae	<i>Pilea peploides</i>		I	
Urticaceae	<i>Pipturus albidus</i>	māmaki	I	
Nyctaginaceae	<i>Pisonia brunoniana</i>	pāpala kēpau	I	
Nyctaginaceae	<i>Pisonia umbellifera</i>	pāpala kēpau	I	
Pittosporaceae	<i>Pittosporum hawaiiense</i>	hō'awa	E	SOC
Pittosporaceae	<i>Pittosporum undulatum</i>	Victorian box	N	
Pittosporaceae	<i>Pittosporum viridiflorum</i>	Cape pittosporum	N	
Pittosporaceae	<i>Pittosporum</i> sp.	hō'awa	E	
Plantaginaceae	<i>Plantago lanceolata</i>	narrow-leaved plantain	N	
Plantaginaceae	<i>Plantago major</i>	broad-leaved plantain	N	
Rutaceae	<i>Platydesma remyi</i>		E	C, EN
Rutaceae	<i>Platydesma spathulata</i>	pilo kea	E	
Asteraceae	<i>Pluchea symphytifolia</i>	sourbush	N	
Polygonaceae	<i>Polygonum capitatum</i>	knotweed	N	
Polygonaceae	<i>Polygonum punctatum</i>	water smartweed	N	
Sapotaceae	<i>Pouteria sandwicensis</i>	'āla'a	E	
Lamiaceae	<i>Prunella vulgaris</i>	selfheal	N	
Rosaceae	<i>Prunus cerasifera</i>	Methley plum	N	
Myrtaceae	<i>Psidium cattleianum</i>	strawberry guava	N	
Myrtaceae	<i>Psidium guajava</i>	common guava	N	
Rubiaceae	<i>Psychotria hawaiiensis</i>	kōpiko 'ula	E	
Rubiaceae	<i>Psychotria hawaiiensis</i> var. <i>hillebrandii</i>	kōpiko 'ula	E	
Rubiaceae	<i>Psydrax odoratum</i>	alahe'e	I	
Ranunculaceae	<i>Ranunculus repens</i>	creeping buttercup	N	
Apocynaceae	<i>Rauvolfia sandwicensis</i>	hao	E	
Rosaceae	<i>Rubus argutus</i>	blackberry	N	
Rosaceae	<i>Rubus hawaiiensis</i>	'ākala	E	
Rosaceae	<i>Rubus rosifolius</i>	thimbleberry	N	
Polygonaceae	<i>Rumex acetosella</i>	sheep sorrel	N	
Polygonaceae	<i>Rumex crispus</i>	curly dock	N	
Polygonaceae	<i>Rumex giganteus</i>	pāwale	E	
Polygonaceae	<i>Rumex</i> sp.	dock	N	
Santalaceae	<i>Santalum paniculatum</i>	'iliahi, sandalwood	E	
Caprifoliaceae	<i>Sambucus mexicana</i>	Mexican elder	N	
Goodeniaceae	<i>Scaevola chamissoniana</i>	naupaka kuahiwi	E	
Goodeniaceae	<i>Scaevola sericea</i>	naupaka kahakai	I	
Caryophyllaceae	<i>Schiedea diffusa</i>		E	SOC
Caryophyllaceae	<i>Schiedea globosa</i>		E	SOC
Anacardiaceae	<i>Schinus terebinthifolius</i>	Christmas berry	N	
Asteraceae	<i>Senecio madagascariensis</i>	fireweed	N	
Taxodiaceae	<i>Sequoia sempervirens</i>	redwood	N	
Cucurbitaceae	<i>Sicyos cucumerinus</i>	panunukuahiwi	E	

Malvaceae	<i>Sida acuta</i>		N	
Malvaceae	<i>Sida fallax</i>	‘ilima	I	
Smilacaceae	<i>Smilax melastomifolia</i>	hoi kuahiwi	E	
Asteraceae	<i>Sonchus oleraceus</i>	pualele, sow thistle	N	
Fabaceae	<i>Sophora chrysophylla</i>	māmane	E	
Lamiaceae	<i>Stenogyne calaminthoides</i>		E	
Lamiaceae	<i>Stenogyne cranwelliae</i>		E	C
Lamiaceae	<i>Stenogyne oxygona</i>		E	SOC, X
Asteraceae	<i>Taraxacum officinale</i>	common dandelion	N	
Combretaceae	<i>Terminalia catappa</i>	tropical almond	N	
Araliaceae	<i>Tetraplasandra hawaiiensis</i>	‘ohe	E	
Araliaceae	<i>Tetraplasandra oahuensis</i>	‘ohe mauka	E	
Melastomataceae	<i>Tibouchina herbacea</i>	glorybush	N	
Melastomataceae	<i>Tibouchina urvilleana</i>	lasiandra	N	
Urticaceae	<i>Touchardia latifolia</i>	olonā	E	
Campanulaceae	<i>Trematolobelia grandifolia</i>		E	SOC
Campanulaceae	<i>Trematolobelia macrostachys</i>	koli‘i	E	
Fabaceae	<i>Trifolium repens</i>	white clover	N	
Urticaceae	<i>Urera glabra</i>	ōpuhe	E	
Ericaceae	<i>Vaccinium calycinum</i>	‘ōhelo, ‘ōhelo kau lā‘au	E	
Ericaceae	<i>Vaccinium dentatum</i>	‘ōhelo	E	
Ericaceae	<i>Vaccinium reticulatum</i>	‘ōhelo	E	
Verbenaceae	<i>Verbena litoralis</i>	ōwī	N	
Scrophulariaceae	<i>Veronica plebeia</i>	trailing speedwell	N	
Scrophulariaceae	<i>Veronica serpyllifolia</i>	thyme-leaved speedwell	N	
Fabaceae	<i>Vigna marina</i>	mohihihi, nanea	I	
Violaceae	<i>Viola maviensis</i>		E	SOC
Thymelaeaceae	<i>Wikstroemia monticola</i>	‘ākia	E	
Thymelaeaceae	<i>Wikstroemia pulcherrima</i>	‘ākia	E	
Thymelaeaceae	<i>Wikstroemia sandwicensis</i>	‘ākia	E	
Flacourtiaceae	<i>Xylosma hawaiiense</i>	maua	E	
Asteraceae	<i>Youngia japonica</i>	oriental hawksbeard	N	
II. Fauna				
Chordata				
Amphibia				
Anura				
Bufonidae	<i>Bufo marinus</i>	cane toad	N	
Leptodactylidae	<i>Eleutherodactylus coqui</i>	coquí frog	N	
Ranidae	<i>Lithobates catesbeianus</i>	bullfrog	N	
Aves				
Anseriformes				
Anatidae	<i>Anas wyvilliana</i>	koloa maoli, Hawaiian duck	E	END, EN
Charadriiformes				
Charadriidae	<i>Phuvialis fulva</i>	kōlea, Pacific golden-plover	I	LC
Ciconiiformes				
Ardeidae	<i>Nycticorax nycticorax hoactli</i>	‘auku‘u, black-crowned night heron	I	LC
Columbiformes				

Columbidae	<i>Streptopelia chinensis</i>	spotted dove	N	
Falconiformes				
Accipitridae	<i>Buteo solitarius</i>	‘io, Hawaiian hawk	E	END, NT
Galliformes				
Phasianidae	<i>Phasianus colchicus</i>	ring-necked pheasant	N	
Passeriformes				
Cardinalidae	<i>Cardinalis cardinalis</i>	northern cardinal	N	
Fringillidae	<i>Carpodacus mexicanus</i>	house finch	N	
Dicruridae	<i>Chasiempis sandwichensis sandwichensis</i>	Hawai‘i ‘elepaio	E	
Timaliidae	<i>Garrulax canorus</i>	hwamei, melodious laughing-thrush	N	
Drepanididae	<i>Hemignathus virens virens</i>	Hawai‘i ‘amakahi	E	LC
Drepanididae	<i>Himatione sanguinea sanguinea</i>	‘apapane	E	LC
Timaliidae	<i>Leiothrix lutea</i>	red-billed leiothrix	N	
Estrildidae	<i>Lonchura punctulata</i>	nutmeg mannikin	N	
Drepanididae	<i>Vestiaria coccinea</i>	‘i‘iwi	E	NT
Zosteropidae	<i>Zosterops japonicus</i>	Japanese white-eye	N	
Procellariiformes				
Procellariidae	<i>Pterodroma sandwichensis</i>	‘ua‘u, Hawaiian petrel	E	END, VU
Procellariidae	<i>Puffinus newelli</i>	‘a‘o, Hawaiian shearwater	E	T, EN
Strigiformes				
Strigidae	<i>Asio flammeus sandwichensis</i>	pueo, Hawaiian short-eared owl	E	
Actinopterygii (ray-finned fishes)				
Cypriniformes				
Cyprininae	<i>Carassius auratus</i>	goldfish	N	
Cyprininae	<i>Cyprinus carpio</i>	common carp	N	
Cyprinodontiformes				
Poeciliidae	<i>Gambusia affinis</i>	mosquitofish	N	
Poeciliidae	<i>Poecilia mexicana</i>	shortfin molly	N	
Poeciliidae	<i>Poecilia reticulata</i>	guppy	N	
Poeciliidae	<i>Xiphophorus hellerii</i>	green swordtail	N	
Perciformes				
Gobiidae	<i>Awaous guamensis</i>	‘o‘opu nākea, giant stream goby	I	
Gobiidae	<i>Bathygobius cotticeps</i>	cheek-scaled frill goby	N	
Gobiidae	<i>Bathygobius fuscus</i>	common frillfin goby	N	
Eleotridae	<i>Eleotris sandwichensis</i>	‘o‘opu ‘akupa, Hawaiian sleeper goby	E	
Gobiidae	<i>Eviota epiphanes</i>	pygmy goby	N	
Gobiidae	<i>Lentipes concolor</i>	‘o‘opu ‘alamo‘o, red-tailed stream goby	E	
Centrarchidae	<i>Lepomis macrochirus</i>	bluegill sunfish	N	
Menidae	<i>Mene maculata</i>	moonfish	N	
Centrarchidae	<i>Micropterus dolomieu</i>	smallmouth bass	N	
Centrarchidae	<i>Micropterus salmoides</i>	largemouth bass	N	
Cichlidae	<i>Oreochromis aureus</i>	blue tilapia	N	

Cichlidae	<i>Oreochromis macrochir</i>	longfin tilapia	N	
Cichlidae	<i>Oreochromis mossambicus</i>	Mozambique tilapia	N	
Cichlidae	<i>Oreochromis niloticus</i>	tilapia	N	
Gobiidae	<i>Oxyurichthys lochotus</i>	point-tailed 'o'opu	N	
Gobiidae	<i>Sicyopterus stimpsoni</i>	'o'opu nōpili, clinging stream goby	E	
Gobiidae	<i>Stenogobius hawaiiensis</i>	'o'opu naniha, black-headed stream goby	E	
Salmoniformes				
Salmonidae	<i>Oncorhynchus mykiss</i>	rainbow trout	N	
Siluriformes				
Clariidae	<i>Clarias fuscus</i>	Chinese catfish	N	
Ictaluridae	<i>Ictalurus punctatus</i>	channel catfish	N	
Mammalia				
Artiodactyla				
Bovidae	<i>Bos taurus</i>	cattle	N	
Bovidae	<i>Capra hircus</i>	goat	N	
Suidae	<i>Sus scrofa</i>	pig, pua'a	P	
Carnivora				
Canidae	<i>Canis lupus familiaris</i>	domestic dog, 'ilio	P	
Felidae	<i>Felis silvestris catus</i>	domestic cat	N	
Herpestidae	<i>Herpestes javanicus</i>	Indian mongoose	N	
Chiroptera				
Vespertilionidae	<i>Lasiurus cinereus semotus</i>	'ōpe'ape'a, Hawaiian hoary bat	E	END
Rodentia				
Muridae	<i>Mus musculus</i>	house mouse	N	
Muridae	<i>Rattus exulans</i>	Polynesian rat, 'iole	P	
Muridae	<i>Rattus rattus</i>	black rat	N	
Arthropoda				
Arachnida				
Araneae (spiders)				
Philodromidae	Unid. genus	crab spiders	E	
Theridiidae	<i>Argyrodes</i> sp.	comb-footed spiders	E	
Theridiidae	<i>Theridion grillator</i>	happyface spider	E	
Thomisidae	<i>Misumenops anguliventris</i> ?	crab spider	E	
Thomisidae	<i>Misumenops facundus</i>	crab spider	E	
Thomisidae	<i>Misumenops</i> sp.	crab spider	E	
Tetragnathidae	<i>Tetragnatha</i> sp.	long-jawed spiders	E	
Pseudoscorpionida (false scorpions)				
Chernetidae	<i>Eumecochernes</i> sp. ?	false scorpion	E	
Entognatha				
Collembola (springtails)				
Unid. family		springtail	?	
Insecta				
Odonata (damselflies and dragonflies)				
Aeshnidae	<i>Anax strenuus</i>	dragonfly	E	
Coenagrionidae	<i>Megalagrion blackburni</i>	large red damselfly	E	
Coenagrionidae	<i>Megalagrion calliphya</i>	damselfly	E	
Coenagrionidae	<i>Megalagrion hawaiiense</i>	Hawaiian damselfly	E	

Orthoptera (grasshoppers, katydids, and crickets)				
Tettigoniidae	<i>Banza</i> sp.	cone-headed katydid	E	
Gryllidae	<i>Laupala</i> sp.	sword-tail cricket	E	
Gryllidae	<i>Leptogryllus</i> sp.	tree cricket	E	
Gryllidae	<i>Prognathogryllus</i> sp.	tree cricket		
Hemiptera (true bugs)				
Delphacidae	Unid. genus	planthopper	E	
Psyllidae	Unid. genus	jumping plant lice	E	
Cixiidae	<i>Iolania perkinsi</i>	planthopper	E	
Miridae	<i>Koanoa</i> sp.	leaf bug	E	
Anthocoridae	<i>Lasiochilus</i> sp.	pirate bug	E	
Veliidae	<i>Microvelia vagans</i>	ripple bug	E	
Nabidae	<i>Nabis blackburni</i>	damsel bug	E	
Nabidae	<i>Nabis curtipennis</i>	damsel bug	E	
Nabidae	<i>Nabis oscillans</i>	damsel bug	E	
Nabidae	<i>Nabis</i> n. sp.	damsel bug	E	
Lygaeidae	<i>Neseis whitei brachypterus</i>	seed bug	E	X
Reduviidae	<i>Nesidolestes selium</i>	thread-legged bug	E	X
Miridae	<i>Nesidiorchestes</i> sp.	leaf bug	E	
Miridae	<i>Nesiomiris</i> sp.	leaf bug	E	
Cicadellidae	<i>Nesophrosyne</i> sp.	leafhopper	E	
Pentatomidae	<i>Oechalia acuta</i>	stink bug	E	X
Cixiidae	<i>Oliarus</i> sp.	planthopper	E	
Miridae	<i>Orthotylus hedyotica</i>	leaf bug	E	
Miridae	<i>Orthotylus kassandra</i>	leaf bug	E	
Miridae	<i>Orthotylus metrosideri</i>	leaf bug	E	
Miridae	<i>Orthotylus</i> sp.	leaf bug	E	
Miridae	<i>Pseudoclerada</i> sp.	leaf bug	E	
Saldidae	<i>Saldula exulans</i>	shore bug	E	
Saldidae	<i>Saldula oahuensis</i>	shore bug	E	
Miridae	<i>Sarona adonias</i>	leaf bug	E	
Miridae	<i>Sarona hamakua</i>	leaf bug	E	
Miridae	<i>Sarona mamaki</i>	leaf bug	E	
Miridae	<i>Sarona</i> sp.	leaf bug	E	
Neuroptera (lacewings and antlions)				
Chrysopidae	<i>Anomalochrysa fulvescens</i>	green lacewing	E	
Chrysopidae	<i>Anomalochrysa fulvescens rhododora</i>	green lacewing	E	
Chrysopidae	<i>Anomalochrysa maclachlani</i>	green lacewing	E	
Hemerobiidae	<i>Micromus longispinosus</i>	brown lacewing	E	
Hemerobiidae	<i>Micromus paradoxus</i>	brown lacewing	E	
Hemerobiidae	<i>Micromus rubrinervis</i>	brown lacewing	E	
Hemerobiidae	<i>Micromus subochraceus</i>	brown lacewing	E	
Hemerobiidae	<i>Micromus vagus</i>	brown lacewing	E	
Coleoptera (beetles)				
Curculionidae	<i>Achalles</i> sp.	true weevil	E	
Scarabaeidae	<i>Adoretus sinicus</i>	Chinese rose beetle	N	
Carabidae	<i>Blackburnia ewingi</i>	ground beetle	E	
Carabidae	<i>Blackburnia hawaiiensis</i>	ground beetle	E	

Carabidae	<i>Blackburnia kilauea</i>	ground beetle	E	
Carabidae	<i>Blackburnia molokaiensis</i>	ground beetle	E	
Eucnemidae	<i>Dromaeolus</i> sp.	false click beetle	E	
Curculionidae	<i>Dryophthorus squalidus</i>	true weevil	E	
Nitidulidae	<i>Eupetinus</i> sp. (2)	souring beetle	E	
Nitidulidae	<i>Gonioryctus</i> sp.	souring beetle	E	
Hydrophilidae	<i>Limnoxenus semicylindricus</i>	water scavenger beetle	E	
Carabidae	<i>Mecyclothorax</i> sp. (5)	ground beetle	E	
Nitidulidae	<i>Nesopetinus</i> sp. (2)	souring beetle	E	
Curculionidae	<i>Nesotocus munroi</i>	true weevil	E	X
Curculionidae	<i>Oodemus</i> sp.	true weevil	E	X
Cerambycidae	<i>Parandra puncticeps</i>	long-horned wood borer	E	
Aglycyderidae	<i>Proterhinus</i> sp.	primitive weevil	E	
Dytiscidae	<i>Rhantus pacificus</i>	diving beetle	E	
Curculionidae	<i>Syagrius fulvitaris</i>	Australian fern weevil	N	
Scolytidae	<i>Xyleborus</i> sp. nr. <i>hawaiiensis</i>	bark beetle	E	
Anobiidae	<i>Xyletobius</i> sp.	death-watch beetles	E	
Diptera (true flies)				
Dolichopodidae	<i>Campsicnemus</i> sp.	long-legged fly	E	
Drosophilidae	<i>Drosophila murphyi</i>	Hawaiian picture wing fly	E	
Drosophilidae	<i>Drosophila ochrobasis</i>	Hawaiian picture wing fly	E	END
Drosophilidae	<i>Drosophila pisonia</i>	Hawaiian picture wing fly	E	
Drosophilidae	<i>Drosophila pullipes</i>	Hawaiian picture wing fly	E	
Drosophilidae	<i>Drosophila setosifrons</i>	Hawaiian picture wing fly	E	
Drosophilidae	<i>Drosophila setosimentum</i>	Hawaiian picture wing fly	E	
Drosophilidae	<i>Drosophila silvestris</i>	Hawaiian picture wing fly	E	
Drosophilidae	<i>Drosophila sobrina</i>	Hawaiian picture wing fly	E	
Drosophilidae	<i>Drosophila sproati</i>	Hawaiian picture wing fly	E	
Dolichopodidae	<i>Eurynogaster</i> sp.	long-legged fly	E	
Tipulidae	<i>Limonia stygipennis</i>	crane fly	E	
Muscidae	<i>Lispocephala</i> sp.	house fly	E	
Ephydriidae	<i>Neoscatella</i> sp.	shore fly	?	
Tephritidae	<i>Trupanea apicalis</i>	fruit fly	E	
Tephritidae	<i>Trupanea crassipes</i>	fruit fly	E	
Tephritidae	<i>Trupanea</i> nr. <i>pantosticta</i>	fruit fly	E	
Tephritidae	<i>Trupanea</i> sp.	fruit fly	E	
Hymenoptera (bees, wasps, and ants)				
Sphecidae	<i>Ectemnius atripennis</i>	square-headed wasp	E	
Sphecidae	<i>Ectemnius polynesialis</i>	square-headed wasp	E	
Sphecidae	<i>Ectemnius rubrocaudatus</i>	square-headed wasp	E	
Sphecidae	<i>Ectemnius tumidoventris</i>	square-headed wasp	E	
Ichneumonidae	<i>Enicospilus</i> sp. ?	wasp	E	
Colletidae	<i>Hylaeus difficilis</i>	yellow-faced bee	E	
Colletidae	<i>Hylaeus dumetorum</i>	yellow-faced bee	E	
Colletidae	<i>Hylaeus laeta</i>	yellow-faced bee	E	
Colletidae	<i>Hylaeus pubescens</i>	yellow-faced bee	E	
Vespidae	<i>Odynerus</i> sp. (2)	potter wasp	E	
Diapriidae	<i>Platymischoides</i> sp.	wasp	E	

Lepidoptera (moths and butterflies)				
Pterophoridae	Unid. genus	plume moth	N	
Sphingidae	<i>Agrius cingulata</i>	sweet potato hornworm	N	
Noctuidae	<i>Agrotis ceramophaea</i>	moth	E	
Noctuidae	<i>Agrotis charmocrita</i>	moth	E	
Noctuidae	<i>Agrotis dislocata</i>	moth	E	
Noctuidae	<i>Agrotis ipsilon</i>	black cutworm moth	N	
Noctuidae	<i>Agrotis psammophaea</i>	moth	E	
Alucitidae	<i>Alucita objurgatella</i>		N	
Tortricidae	<i>Amorbia emigratella</i>	Mexican leaf-roller moth	N	
Noctuidae	<i>Ascalapha odorata</i>	black witch moth	N	
Noctuidae	<i>Athetis thoracica</i>	moth	N	
Tortricidae	<i>Bactra straminea</i>	leaf roller	N	
Carposinidae	<i>Carposina dispar</i>	fruit moth	E	
Carposinidae	<i>Carposina gracillima</i>	fruit moth	E	
Carposinidae	<i>Carposina herbarum ?</i>	fruit moth	E	
Carposinidae	<i>Carposina inscripta</i>	fruit moth	E	
Carposinidae	<i>Carposina nigronotata</i>	fruit moth	E	
Carposinidae	<i>Carposina olivaceonitens</i>	fruit moth	E	
Noctuidae	<i>Chrysodeixis eriosoma</i>	moth	N	
Crambidae	<i>Eudonia</i> sp. (10)	moth	E	
Geometridae	<i>Eupithecia craterias</i>	inchworm	E	
Geometridae	<i>Eupithecia monticolens</i>	inchworm	E	
Geometridae	<i>Eupithecia orichloris</i>	inchworm	E	
Geometridae	<i>Eupithecia staurophragma</i>	inchworm	E	
Geometridae	<i>Fletcherana roseata</i>	inchworm	E	
Noctuidae	<i>Haliophyle compsi</i>	moth	E	
Noctuidae	<i>Haliophyle euclidias</i>	moth	E	
Noctuidae	<i>Haliophyle ignita</i>	moth	E	
Sphingidae	<i>Hyles wilsoni</i>	hawk moth	E	
Noctuidae	<i>Hypocala deflorata</i>	moth	N	
Cosmopterigidae	<i>Hyposmocoma</i> sp.	moth	E	
Geometridae	<i>Macaria infusata</i>	inchworm	N	
Noctuidae	<i>Melipotis indomita</i>	moth	N	
Sphingidae	<i>Manduca blackburni</i>	Blackburn's sphinx moth	E	END
Pyralidae	<i>Maruca testulalis</i>	moth	N	
Crambidae	<i>Mestolobes minuscula</i>	moth	E	
Crambidae	<i>Mestolobes</i> sp.	moth	E	
Crambidae	<i>Omiodes accepta</i>	moth	E	
Crambidae	<i>Omiodes anastreptoides</i>	moth	E	
Crambidae	<i>Omiodes continuatalis</i>	moth	E	
Crambidae	<i>Omiodes monogona</i>	moth	E	
Noctuidae	<i>Ophiusa disjungens</i>	moth	N	
Crambidae	<i>Orthomecyna exigua</i> subsp. <i>exigua</i>	moth	E	
Tortricidae	<i>Panaphelix marmorata</i>	leaf roller	E	
Tortricidae	<i>Pararrhaptica sublichenoides</i>	leaf roller	E	
Tortricidae	<i>Pararrhaptica subsenescens</i>	leaf roller	E	
Tortricidae	<i>Pararrhaptica</i> sp. (2)	leaf roller	E	

Noctuidae	<i>Peridroma selenias</i>	moth	E	
Noctuidae	<i>Pseudaletia unipuncta</i>	army worm moth	N	
Noctuidae	<i>Pseudaletia</i> n. sp.	moth	E	
Noctuidae	<i>Schrankia altivolans</i>	moth	E	
Geometridae	<i>Scotorythra arboricolans</i>	inchworm	E	
Geometridae	<i>Scotorythra artemidora</i>	inchworm	E	
Geometridae	<i>Scotorythra gomphias</i>	inchworm	E	
Geometridae	<i>Scotorythra hyparcha</i>	inchworm	E	
Geometridae	<i>Scotorythra goniastis</i>	inchworm	E	
Geometridae	<i>Scotorythra</i> n. sp. nr. <i>kuschei</i>	inchworm	E	
Geometridae	<i>Scotorythra rara</i>	inchworm	E	
Geometridae	<i>Scotorythra</i> sp.	inchworm	E	
Tortricidae	<i>Spheterista pleonectes</i>	leaf roller	E	
Sphingidae	<i>Theretra nessus</i>	yam hawkmoth	N	
Oecophoridae	<i>Thyrocopa fraudulentella</i>	moth	E	
Oecophoridae	<i>Thyrocopa</i> sp.	moth	E	
Crambidae	<i>Udea endopyra</i>	moth	E	
Crambidae	<i>Udea liopis</i>	moth	E	
Crambidae	<i>Udea pyranthes</i>	moth	E	
Crambidae	<i>Uresiphita polygonalis</i> subsp. <i>virescens</i>	moth	E	
Nymphalidae	<i>Vanessa tameamea</i>	Kamehameha butterfly	E	
Malacostraca (crustaceans)				
Decapoda				
Atyidae	<i>Atyoida bisulcata</i>	‘ōpae kala‘ole, mountain shrimp	E	
Atyidae	<i>Halocaridina rubra</i>	‘ōpae ‘ula, red shrimp	E	
Palaemonidae	<i>Macrobrachium grandimanus</i>	‘ōpae ‘oeha‘a, Hawaiian prawn	E	
Palaemonidae	<i>Macrobrachium lar</i>	Tahitian prawn	N	
Cambaridae	<i>Procambarus clarkii</i>	Louisiana crayfish	N	
Mollusca				
Gastropoda (snails, slugs, etc.)				
Pulmonata				
Achatinellidae	<i>Partulina physa</i>		E	SOC
Achatinellidae subf. Tornatellidinae	?		E	
Succineidae	?		E	
Neritoida				
Neritidae	<i>Neritina granosa</i>	hīhīwai, stream limpet	E	

Appendix E: Photos from other similar projects illustrating pre and post habitat change after fencing, fence construction, boardwalk, and the native habitats and species of Kohala.

Photo 1: Fencing project in ‘Ōla‘a-Kīlauea area showing regrowth of native understory and forest once fencing was built and feral ungulates had been removed.



Photo 2: Fence construction projects on Maui and Hawai‘i.

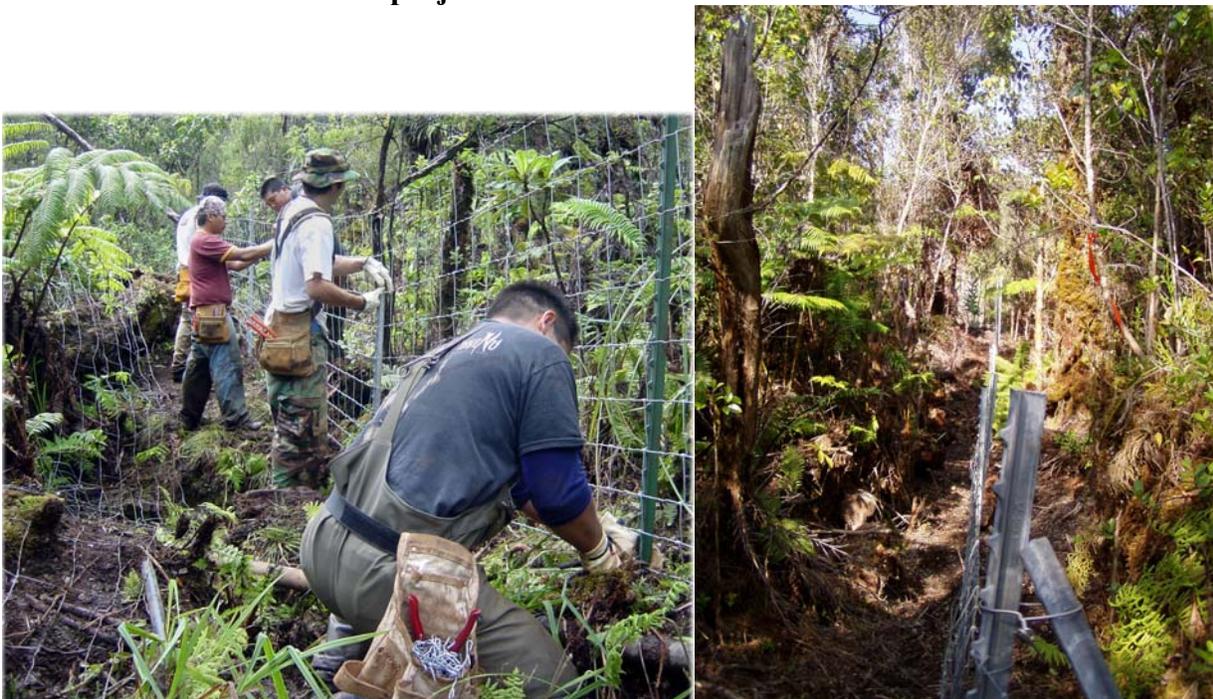


Photo 3: Boardwalks on Maui.



Photo 4: Native habitats and species in Kohala anticipated to benefit from proposed management actions.

Ohawai flower of the goddess Uli





Trematolobelia grandifolia



Partulina Physa

Appendix F: Revised draft Kohala Mountain Watershed Management Plan.

A full copy of the revised draft management plan on which this draft environmental assessment was based can be found at: <http://www.hawp.org>.

For a mailed copy, please contact Melora Purell, coordinator for the Kohala Watershed Partnership, at:

Mail: 19 E. Kawili Street, Hilo, HI 96720

Phone: (808) 333-0976

Email: Melora@Purells.net