Wao Kele o Puna

Comprehensive Management Plan

Prepared for:

OFFICE OF HAWAIIAN AFFAIRS

August, 2017

Prepared by: Nālehualawakuʻulei

Nālehualawakuʻulei

Nā-lehua-lawa-kuʻu-lei is a team of cultural resource specialists and planners that have taken on the responsibilities in preparing this comprehensive management for the Office of Hawaiian Affairs.

Nā pua o kēia lei nani	**The flowers of this lovely lei**
Lehua aʻo Wao Kele	**The lehua blossoms of Wao Kele**
Lawa lua i kēia lei	**Bound tightly in this lei**
Kuʻu lei makamae	**My most treasured lei**
Lei hiwahiwa o Puna	**Beloved lei of Puna**
E mālama mākou iā ʻoe	**Let us serve you**
E hō mai ka ʻike	**Grant us wisdom**
ʻO mākou nā pua	**For we represent the flowers**
O Nālehualawakuʻulei	**Of Nālehualawakuʻulei**

(Poem by na Auliʻi Mitchell, Cultural Surveys Hawaiʻi)

We come together like the flowers strung in a lei to complete the task put before us. To assist in the preservation of Hawaiian lands, the sacred lands of Wao Kele o Puna, therefore we are:

The Flowers That Complete My Lei

Hoʻokuleana LLC
... to take responsibility ...

Forest Solutions Inc.

NOHOPAPA HAWAIʻI

Cultural Surveys Hawaiʻi, Inc.

Preparation of the Wao Kele o Puna Comprehensive Management Plan

In addition to the planning team (Nālehualawakuʻulei), many minds and hands played important roles in the preparation of this Wao Kele o Puna Comprehensive Management Plan. Likewise, a number of support documents were used in the development of this plan (many are noted as Appendices).

As part of the planning process, the Office of Hawaiian Affairs assembled the ʻAha Kūkā (Advisory Council), bringing members of the diverse Puna community together to provide manaʻo (thoughts and opinions) to OHA regarding the development of this comprehensive management plan (CMP). Regular meetings were held. Participation included:

Voting Members of ʻAha KūKā

Faye Hanohano
Charles Heaukulani
Jennifer Johansen
Luana Jones
Drew Kapp
Leila Kealoha
Terri Lei Napeahi
Lisa Hall-Peleiholani
Rene Siracusa

OHA Staff and Non-Voting Members

Jonathan Ching (OHA)
Olu Campbell (OHA)
Candace Wharton (OHA)
Pua Ishibashi (OHA)
Kalena Blakemore (OHA)
Jay Hatayama (DOFAW)
Palikapu Dedman (Pele Defense Fund)
Emily Naeole
Paula Kekahuna
Dana Keawe

The voting members of the 'Aha Kuka developed Core Statements for what they agreed should be the Vision and Mission of Wao Kele o Puna and its management:

Vision

Wao Kele o Puna will be locally and globally recognized for forest stewardship, conservation, and provision of customary practices through the application of a Native Hawaiian cultural perspective, and serve as a model and inspiration for indigenous communities worldwide.

Mission

Provide Native Hawaiians and the broader community with opportunities to interact with Wao Kele o Puna meaningfully and reciprocally. Educate the community about the importance of ʻāina and the benefits of engaging with ʻāina. Steward Wao Kele o Puna through the application of a Hawaiian cultural perspective that integrates traditional and modern Hawaiian science and best practices in conservation, while ensuring traditional and customary rights.

Public community meetings were held on January 5, 2017 and July 6, 2017.

Readers' Guide in Reading and Working with The Wao Kele o Puna Comprehensive Management Plan

As you read this Comprehensive Management Plan (CMP) you will see it is not 'typical' to other land use management plans in content, form or presentation; nor is it like typical real estate reporting.

This is intentional.

When we contracted to prepare the Wao Kele o Puna Comprehensive Management Plan for the Office of Hawaiian Affairs, we were directed to:

> (P)rovide a CMP that shall be a unique, innovative, and culturally competent CMP. The CMP shall not simply include culture as a component of the CMP, but feature culture as the driving force and lens through which the CMP shall be created, implemented, and allowed to evolve.
>
> While the CMP shall embrace modern day science, technology, and proven best practices in conservation, it shall do so through a cultural perspective. Ultimately, the CMP shall provide a culturally competent stewardship framework for the OHA to implement measures to protect, preserve, enhance, and perpetuate, the cultural und natural resources of Wao Kele o Puna for current and future generations.

We were tasked to comply with the 'Cultural Competence Reference Guide' that states that the CMP will be developed, implemented, and allowed to evolve, based in part, on the following: Cultural & Spiritual Base; Symbiotic Relationship; Personal Relationship; Ali'i Stewardship; Holistic View; Wai; Cultural Knowledge; Kapu System; Pono; Wahi Pana (storied place); Cultural Zones (Wao); Kanaka Maoli Interactions and 'Imi Na'auao (to seek, obtain, and utilize knowledge, intelligence, and truth). So, throughout the CMP you will see repeated references to these.

This CMP incorporates traditional knowledge, as well as modern management measures.

Cultural competence is the foundation of the CMP. Because all people do not have the same background and understanding of cultural practices, the initial sections of the CMP highlight some of these to make sure readers have a common baseline understanding of the forest in Hawaiian culture. This is purposeful.

While this is critical to help give the less-experienced some basic cultural context, it is believed that more-experienced readers will appreciate the recap. In part, this also helps to assure that those associated with the property will learn about and care about Wao Kele o Puna; in so doing, it helps to assure that they will work together to care for Wao Kele o Puna.

Readers of typical CMPs need to be patient in reading this planning document. In reading it, you will see that before getting into details of Wao Kele o Puna, we start at broad, higher level thinking and perspectives – this is to give the reader the appropriate cultural context and competence to this property, and, therefore, this plan.

In part, this considers the teachings of Dr. Pualani Kanaka'ole-Kanahele in her lecture series on Papakū Makawalu. It is how Hawaiians perceive their universe, seeing things with the depths of eight eyes.

In her teaching, Dr. Kanahele often refers to the three houses of knowledge. These knowledge houses are where kānaka maoli receive the teaching about the creation of our universe. These three levels are

levels of atmosphere in which the earth planet was created from the Kumulipo or creation story, from the darkness to the light, mai ka pō i ke ao. (Auli'i Mitchell)

As noted in the Edith Kanaka'ole Foundation website, the three major houses of knowledge are foundations for understanding existence and our place in it – these are:

> Papahulilani is the space from above the head to where the stars sit. It is inclusive of the sun, moon, stars, planets, winds, clouds, and the measurement of the vertical and horizontal spaces of the atmosphere. It is also a class of experts who are spiritually, physically, and intellectually attuned to the space above and its relationship to the earth.
>
> Papahulihonua is inclusive of earth and ocean. It is the ongoing study of the natural earth and ocean and its development, transformation and evolution by natural causes. It is also a class of experts who are spiritually, physically, and intellectually attuned to this earth and its relationship to the space above and the life forms on it.
>
> Papahānaumoku moves from the embryonic state of all life forces to death. It is the birthing cycle of all flora and fauna inclusive of man. It is the process of investigating, questioning, analyzing and reflecting upon all things that give birth, regenerate and procreate. It is also a class of experts who are spiritually, physically and intellectually attuned to things born and the habitat that provides their nourishment, shelter, and growth.

As such, the CMP purposefully starts with the gods; then speaks of the resources, including ongoing formation of the land; and continues with the growth of plants and animals on the land, first in broad cultural context, then as it relates specifically to Wao Kele o Puna.

Likewise, there are repeated references to appropriate attitude and activities on the property. These provide the context for recommendations later in the plan.

Just as you pause, then knock before entering someone's home (seeking permission to enter); exchange expressions of warm welcome; then remove your shoes (so as to not soil their home); behave with courtesy and respect while in someone else's home (courteously declining what is offered or only taking what you need, and repairing/replacing anything you break or take); and then departing with cordial exchanges and well wishes – so, too, is one expected to act accordingly in nature.

The reader of this CMP is reminded that all things are integrated, interrelated and interdependent - as a system, from the mountains to the ocean - irrespective of today's arbitrary jurisdictional or ownership lines. With the foundation of cultural context of appropriate attitude and actions in place, the CMP then goes into details of the property; challenges associated with it; consideration of alternative actions; and then specific actions in management.

The reader of typical land use plans will find comfort that the plan incorporates traditional and modern management measures in caring for the property. However, these are noted at the end of the document, rather than the beginning, or at the end of each section.

The plan is unconventional in its structure. Rather than the Western form of structured hierarchical chapter, paragraph and line separations, the CMP is written in sections that flow from one to the other, rather than as distinct, independent chapters.

Likewise, sections and subsections are titled/labeled through the use of 'Ōlelo No'eau – using Hawaiian

proverbs that have been handed down through the generations through Hawai‘i’s oral tradition. These were collected from the works of Mary Kawena Pukui. The reader is encouraged to pause after reading each to first interpret the literal translation (which is given), but also consider the Kaona (metaphorical messages) in each. Some of the messages of certain ‘Ōlelo No‘eau are repeated, for emphasis.

Throughout the CMP, challenges faced in management of the property are discussed, as are ranges of alternative means of addressing them. All recommended actions are noted in the last section of the CMP - these are listed under many of the typical headings of actions in conventional CMPs.

The CMP is unconventional in presentation, as well.

In typical land use CMPs, chapter, section and even paragraph separations are identified through progressive numbering. This Western approach is abandoned in this plan; here color coding symbolically separates hierarchical thoughts.

Deciphering the ‘Structure’ of the Comprehensive Management Plan

This plan does not necessarily have conventional ‘Chapters’ or conventional identification of the hierarchy of sections.

Rather, color coding is used to differentiate section headings and their subordinate subsections.

Think of ‘ōhi‘a lehua … the predominate tree in the Wao Kele o Puna forest. (Font size here is intentionally equivalent to the one found on each heading type throughout document)

At first, you are drawn to the top and see the red lehua blossoms (and hopefully an ‘i‘iwi or ‘apapane) …

Then, you are drawn down to the green leaves …

Then, of that, to the brown trunk …

Then, as at Wao Kele o Puna, the black lava.

Thus, the breakdown and coding of the sections and their subsequent subsections by this coloration pattern of the respective headings.

We hope readers will find value in reading this document. More importantly, we hope that it will motivate people to act, and in doing so incorporate appropriate and culturally competent behavior at Wao Kele o Puna, as well as elsewhere in the Islands.

Peter T Young

Wao Kele o Puna

Comprehensive Management Plan Summary

On August 25, 2005, the Board of Trustees of the Office of Hawaiian Affairs adopted an action item on that agenda dealing with the acquisition (and the purpose of the acquisition). The following was adopted by the OHA Board of Trustees:

> To authorize the Administrator to enter into agreements to acquire and manage two contiguous parcels of land in Puna, Hawai'i, known as Wao Kele o Puna (Tax Map Keys: 1-2-10-2 and 1-2-10-3) hereinafter referred to as the Wao Kele o Puna parcels. The purposes of this acquisition are to maintain the natural and cultural resources of the parcels, to protect the exercise of traditional and customary rights by Native Hawaiians on the parcels, and to ensure the parcels pass to the Nation.

Wao Kele o Puna is a 25,856-acre property; for OHA, the property reflects the weighted importance of 'āina and its connection to Native Hawaiian culture and people. OHA's acquisition of Wao Kele o Puna provides an opportunity for OHA to contribute to the protection of Hawai'i's natural and cultural resources through the lens of Hawaiian culture and practice.

Location:	Ahupua'a of Waiakahiula, Ka'ohe Moku of Puna Mokupuni of Hawai'i Puna district, island of Hawai'i
Acquired:	2006
Size:	25,856 acres
Zoning:	Conservation (protective subzone) State forest reserve
Cost to OHA:	$300,000. Federal Forest Legacy Program paid the balance of the $3.65 million purchase price
Tenure and use:	Owned fee simple
Acquisition objectives:	Protect natural and cultural resources Protect traditional and customary rights of Native Hawaiians on the parcels Ensure parcels pass to the nation
Features:	Forest Reserve; Puna Rainforest ne of few remaining tracts of lowland rainforest in the State of Hawai'i Many benefits to surrounding lands and communities of Puna (watershed recharge, native plant seed bank for Kīlauea volcano, endangered species habitat, forest resources for gathering and cultural practices) Sacred place for Native Hawaiians – part of the home of the Goddess Pele

Additional Facts:

Wao Kele o Puna is one of the largest tropical lowland rainforests in Hawai‘i. Office of Hawaiian Affairs (OHA) acquired Wao Kele o Puna to protect its natural and cultural resources as well as the traditional and customary rights of Native Hawaiians accessing the property.

Wao Kele o Puna is considered wahi pana due to past and current interactions kānaka maoli have with this ‘āina. There are ancient trails as well as complex cave systems that were used by ancient kānaka maoli to travel underground from one point to another. Finally, iwi kūpuna have been discovered within the boundaries of Wao Kele o Puna along with various artifacts. (OHA)

OHA had a 10-year Memorandum of Agreement (MOA) to co-manage the Forest Reserve with Hawai‘i Department of Land and Natural Resources (DLNR.) This Comprehensive Management Plan is prepared to help develop OHA’s future management strategies for Wao Kele o Puna.

The Comprehensive Management Plan:
This Comprehensive Management Plan contains suggested strategies and supporting information that is intended to serve as a guide to assist the Office of Hawaiian Affairs as it relates to the management of this important resource.

The CMP incorporates the best of traditional and contemporary knowledge to outline best forest management practices in an appropriate Native Hawaiian cultural context.
n the traditional context, kānaka are to mālama āina; that is, to care for the physical and spiritual aspects and resources of the ‘āina. In return the ‘āina will provide/bless kānaka with abundance (physically and spiritually). This relationship between kānaka and ‘āina is key for both to survive and be successful.
Mālama ‘āina includes understanding, respecting, protecting, preserving, enhancing and perpetuating the ‘āina, both physically and spiritually.
In addition, mālama ‘āina includes knowing and using the traditional names for places, features, winds and rains, associated with a particular ‘āina. This also includes knowing and using traditional chants, dances and/or stories of an ‘āina. (OHA)
The CMP includes:

1) Recommendatoins for entry and exit protocols that are aligned with both the Native Hawaiian (cultural) world view and best contemporary (scientific) management practices.
2) Recommendations for cultural, natural resource, safety and invasive species briefings that are recommended to be provided to all whom access Wao Kele o Puna.
3) A Listing of Traditional and Customary Practices that were documented to occur and/or currently occur at Wao Kele o Puna and the overwhelming need to replenish the resources that are needed;
4) Recommendations for access and uses that OHA should consider based on management needs and community input;
5) Recommendations for Community collaboration;
6) Background historical information to provide a cultural and historical context, uses that are currently allowed on the property, compliance and regulatory issues, and recommendations for moving forward.
7) Recommendations for additional staff to effectuate the implementation of the plan (with community involvement and contract services to provide the bulk implementation work). Staffing for implementation and management of the management plan include:

- Konohiki (Plan Coordinator)
- Kākau ʻŌlelo Palapala (Contract Management, Compliance and Grant Specialist)
- Makaʻāinana (Field Worker)

8) Recommendation for OHA to apply for and implement a Conservations District Special District Subzone designation for the site where identified actions in the CMP are incorporated as authorized uses.
9) Recommendations for OHA to consider gaining the authority to conduct rule-making and prepare kapu (rules and regulations) specific to Wao Kele o Puna. Investigate forming an Enforcement Division within OHA; however, for the immediate (and potentially long-term) timeframe, the existing overarching Forest Reserve and Forest Legacy rules provide adequate administrative enforcement measures
10) Forest Management measures that were developed through Best Forestry Management Practices; Information from Scientific Studies/Analysis; Cultural Influence; Ethnography/ ʻAha KūKā Input, that, among other issues, address:
    - Forest Management Unit designations
    - Accessibility
    - Invasive Species Removal
    - Rare Plant Species Restoration
    - Accommodations for ʻkuleanaʼ for community use
    - Monitoring
    - Education and Outreach
    - Signage
11) Recommendations for community use and gathering place at the existing cleared area

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List of images, Photographs and Maps

Glossary of Hawaiian Words

Hawaiian Word	Translation into English
ʻaʻā	Rough, stony lava Surface appearance is sharp and broken
ʻaʻaliʻi	Dodonaea viscosa, the fruit of which were used for red dye, the leaves and fruits fashioned into lei, and the hard, heavy wood made into bait sticks and houseposts
ahu	A shrine or altar
ahupuaʻa	Traditional Hawaiian land unit extending from the uplands to the sea
ʻai	Food, usually plant food
ʻāina	land
ākala	The endemic raspberries (Rubus hawaiensis and R macraei); and the thimbleberry (R rosaefolius); lit pink
ʻākepa	The scarlet or yellow green Hawaiian honeycreepers Loxops coccinea
ʻakia pōlāʻau	A sub species of nuku puʻu honey creeper (Hemignathus wilsoni), found on Hawaiʻi island in high elevations
akua	the gods
ʻalalā	Corvus tropicus, the endangered Hawaiian crow, formerly found only in forested areas on Hawaiʻi Island Wild birds are extinct and numbers in captivity are low
aliʻi	Chief, chiefess, monarch
ʻamakihi	Loxops virens, a category of honey creepers endemic to Hawaiʻi, known for their yellow and green feathers found mainly on the islands of Hawaiʻi, Maui, and Kauaʻi
ʻāpana	(1) lot (smaller sections of ʻili); (2) branch, such as small churches associate with a larger religious organization
ʻapapane	Himatione sanguinea, a species of Hawaiian honey creeper characterized by their black and red feathers found throughout the Hawaiian Islands
ʻaumakua	Family or personal Gods. The plural form of the word is ʻaumākua
ʻauwai	Irrigation ditch
ʻawa	The shrub *Piper methysticum*, or kava, the root of which was used as a ceremonial drink throughout the pacific
ʻeʻepa	Supernatural creatures
ʻelepaio	*Chasiempis sandwichensis*, an endemic bird part of the flycatcher family
hale	House
haole	White person, American, Englishman, Caucasian; American, English; formerly, any foreigner
hāpuʻu	Cibotium splendens, a fern endemic to Hawaiʻi; a forest fern to 5 m high
hau	The indigenous tree Hibiscus tiliaceous, which had many uses in traditional Hawaiʻi. Sandals were fashioned from the bark and cordage was made from fibers Wood was shaped into net floats, canoe booms, and various sports equipment and flowers were used medicinally

heiau	Place of worship and ritual in traditional Hawai‘i
hō‘io	*Diplazium arnottii*, a large native fern that grows at high altitudes The young fronds are often eaten raw with shrimp or salmon
ho‘okupu	Tribute, offering, religious gift
holoholo	To go out or go for a walk or ride
huli	The top of the kalo used for planting; shoot, as of the wauke
i‘a	Fish and other food from the sea
‘i‘iwi, ‘i‘iwi pōlena	*Vistiaria coccinea*, Hawaiian honey creeper whose red feathers were used in feather work
‘ie‘ie	The vine *Freycinetia arborea*, an endemic, woody branching climber that grows at altitudes of 300–600m In ancient Hawai‘i, vines were considered sacred and used in basketry and for ceremonial purposes
iholena	A common variety of banana with small bunches, thin skin, and pinkish flesh In traditional Hawai‘i, this was one of the few banana species that women were allowed to eat
‘ike	To see, know, feel; knowledge, awareness, understanding
‘ili	Smaller land units within or associated with an ahupua‘a
ili‘āina	Land area; a land section, next in importance to ahupua‘a and usually a subdivision of an ahupua‘a
‘ili kūpono	Lands worked by commoners for tribute to a konohiki or an ali‘i
‘ili lele	Lands with non-contiguous sections; “jump” lands
‘ili‘ili	Waterworn cobbles often used in floor paving
‘ilima	*Sida fallax*, the native shrub whose flowers were made into lei, and sap was used for medicinal purposes in traditional Hawai‘i
imu	Underground pit or oven used for cooking
‘io	The endemic and endangered Hawaiian hawk Buteo solitarius, that resides only on the island of Hawai‘i. The ‘io was a sign of royalty in ancient Hawai‘i because of its lofty flight; the gourd (Lagenaria siceraria), round in shape and measures approximately 30 cm in diameter; sometimes called the bottle gourd
ipu	General name for a vessel or container Also the bottle gourd Lagenaria siceraria or L vulgaris, which was used traditionally for containers, hula instruments, and for medicine
kahawai	Stream
Kahiki	A far away land, sometimes refers to Tahiti
kāhili	Feather standard; a symbol of royal Hawaiian status
kahu	Honored attendant, guardian, nurse, keeper, administrator, pastor
kahuna	An expert in any profession, often referring to a priest, sorcerer, or magician
kai	Water, usually referring to brackish or seawater
kalo	The Polynesian-introduced Colocasia esculenta, or taro, the staple of the traditional Hawaiian diet
kama‘āina	Native-born

kanaka	Human, person, man
kāne	Man
kaona	Hidden meaning in poetry, or concealed reference to a person, place, or thing
kapa	Tapa, cloth made from the bark of trees
kapu	Tabu, forbidden or restricted
kauila	The name for two types of buckthorn trees native to Hawai‘i (*Alphitonia ponderosa* and *Colubrina oppositifola*); produced a hard wood prized for spear and a variety of other tool making
kauwā	Slave class
kawele‘ā	Sphyraena helleri, a small relative of the barracuda
kī	Ti plant
kia‘i	Guardians
kimo	A traditional Hawaiian game that is similar to jacks. Players would often chant during the game
kino lau	The different forms that a supernatural being may take
kō	The Polynesian introduced *Saccharum officinarum*, or sugarcane, a large grass traditionally used as a sweetener and for black dye
ko‘a	Fishing shrine
koa	Acacia koa, the largest of the native forest trees, prized for its wood, traditionally fashioned into canoes, surfboards, and calabashes
konohiki	The overseer of an ahupua‘a ranked below a chief; land or fishing rights under control of the konohiki; such rights are sometimes called konohiki rights
kou	The flowering tree, *Cordia subcordata*, either native to Hawai‘i or introduced by Polynesians
kū‘aha, kua‘aha	Place of worship or altar within a private home
kuahiwi	The mountaintop. A very sacred area because of its height
kukui	The candlenut tree, or *Aleurites moluccana*, the nuts of which were eaten as a relish and used for lamp fuel in traditional times
kula	Plain, field, open country, pasture, land with no water rights
kuleana	Commoner (“tenant”) lands
kūlolo	Pudding made of baked or steamed grated taro and coconut cream
kupua	Demigod, hero, or supernatural being below the level of a full-fledged deity
kupuna	Elder; ancestor
lā‘au lapa‘au	Medicine
lā‘ī	Ti leaf
lauhala	Leaf of the hala, or pandanus tree (*Pandanus odoratissimus*), used for matting and basketry
laupapa	A broad flat area, such as a coral reef or lava field
lei haku	A braided lei, usually made with ferns and flowers
lele	Lands with non-contiguous section; “jump” lands

limu	Seaweed
loʻi	Irrigated fields, usually for taro
loko	Pond
loli	Sea cucumber, sea slug
loulu	The fan palm (*Pritchardia spp*), endemic to Hawaiʻi
lūʻau	(1) feast; (2) young taro tops
Māhele	The 1848 division of land
mahiole	Feather helmet
maiʻa	The banana, or *Musa spp*, whose fruit was eaten and leaves used traditionally as a wrapping for cooking food in earth ovens
maile	*Alyxia oliviformis*, a fragrant native shrub used for twining
makaʻāinana	Class of common people
makai	Toward the sea
māmaki	*Pipturus spp*, a small native tree Fiber from its bark was used to make a kind of coarse tapa Sometimes spelled mamake in old texts
mana	Spiritual power
manaʻo	Thoughts, opinions, ideas
mānele	The native soapberry trees, *Sapindus saponaria* as well as all varieties of *Zanthoxylum*, also known as aʻe in Hawaiian
mānienie	*Cynodon dactylon*, or Bermuda grass, often used in lawns
mauka	Inland, upland, toward the mountain
mauna	Mountain
mele	Song, chant, or poem
menehune	Legendary little people
moʻo	(1) garden; (2) lizard; (3) supernatural spirit that could change form from a human mōʻi
moʻolelo	A story, myth, history, tradition, legend, or record
moa	The green, leafless plants *Psilotum nudum* and *P complanatum*. The spore powder was used medicinally in traditional Hawaiʻi and children played a game with the plant
moi	The threadfish *Polydactylus sexfilis*, a highly prized food item
muliwai	Estuary, stream
niu	The Polynesian-introduced tree *Cocos nucifera*, or coconut
ʻohana	Family
ʻōhelo	*Vaccinium reticulatum*, a native shrub with small edible berries. Found in higher elevations
ʻōhiʻa	Two kinds of forest trees. See also oʻōhiʻaʻai and ʻōhiʻa lehua
ʻōkolehau	A liquor distilled from the kī root
ʻolelo	Saying, proverb
ʻōlelo noʻeau	Proverb, wise saying, traditional saying
oli	Chant
olonā	The native plant *Touchardia latifolia*, traditionally used for making cordage
ʻōmaʻo	The bird *Phaeornis obscurus*, or Hawaiian thrush

pahale	House
pāhoehoe	Smooth lava; surface unbroken
pala	The fern *Marattia douglasii*, used medicinally, ceremonially, in lei, and eaten in times of famine
palapalai	*Microlepia strigosa*, ferns can grow up to 4 to 5 ft in height Used traditionally to decorate hula altars Indigenous to Hawai‘i
pali	Cliff, steep hill
palila	*Psittirostra bailleui*, an endangered Hawaiian honeycreeper found only on the slopes of Mauna Kea Feeds on the seeds of the māmane tree giving the two close ecological ties
pau	Finished
pia	The Polynesian arrowroot *Tacca leontopetaloides*, traditionally cultivated for food and medicine
piko	A common taro with many different varieties: navel; summit; center
pili	A native grass, *Heteropogon contortus*
pōhaku	Stone
pōhaku	Rock, stone
pōhuli	Sprout, root, sucker; to sprout, often referring to bananas
poi	Food made from taro
poi	A staple of traditional Hawai‘i, made of cooked and pounded taro mixed with water to form a paste
pono	Correct, proper, good
pōpolo	The herb black nightshade (*Solanum nigrum*), traditionally used for medicine and in ceremony
pu‘u	Hill or peak
pua‘a	Pig
puaiohi	The small Kaua‘i thrush, *Phaeornis palmeri*
pūkiawe	Refers to a variety of native trees and shrubs (*Styphelia spp*)
pulu	Fern fibers obtained from the hapu‘u pulu (*Cibotium glaucum*), tree fern
pūnāwai	Fresh water spring
ti (kī)	The plant *Cordyline terminalis*, whose leaves were traditionally used in house thatching, raincoats, sandals, whistles, and as a wrapping for food
tutu	Grandparent, ancestor; kūpuna is the plural form
‘uala	The sweet potato, or Ipomoea batatas, a Polynesian introduction
‘ulu	The Polynesian-introduced tree *Artocarpus altilis*, or breadfruit
uhi	The yam *Dioscorea alata*, commonly grown for food
uka	Inland or mountainous area
ulana	To braid, weave, plait, or knit; plaiting, weaving
wahi pana	Legendary place
wahine	Woman, female
wai	Water, usually referring to freshwater

wao akua	A distant mountain region believed to be inhabited only by spirits; wilderness, desert
wao kānaka	The forested region makai (towards the sea) of the wao akua. This area was frequented by man
wao kele (wao maʻukele)	The region names because of the wet, soggy ground. This area is located in the rain belt of the island, especially on the koʻolau (windward side) side of each island
wauke	The paper mulberry, or *Broussonetia papyrifera*, which was made into tapa cloth in traditional Hawaiʻi

List of Appendices

1) Archaeological Condition Assessment Wao Kele o Puna Project Waiakahiula and Kaʻohe Ahupuaʻa, Puna District, Hawaiʻi Island (Cultural Surveys Inc.) (111 pages)
2) Burial Treatment Plan for the Wao Kele o Puna Forest Reserve, Waiakahiula and Kaʻohe Ahupuaʻa, Puna District, Hawaiʻi Island (Cultural Surveys Inc.) (53 pages)
3) Wao Kele o Puna Biological Management Plan (Julie Leialoha) (109 pages)
4) Wao Kele o Puna Biological Assessment (Forest Solutions Inc.) (69 pages)
5) Wao Kele o Puna Natural Resource Assessment (Forest Solutions Inc.) (27 pages)
6) Forest Management Plan Wao Kele o Puna (Forest Solutions, Inc.) (43 pages)
7) Wao Kele o Puna Invasive Species Management Plan (Forest Solutions Inc.) (83 pages)
8) Wildland Fire and Lava Management Plan Wao Kele o Puna (Forest Solutions Inc.) (21 pages)
9) E Nihi Ka Helena I Ka Uka o Puna Travel carefully in the uplands of Puna An Ethnohistorical Study of Wao Kele o Puna Moku o Puna, Hawaiʻi Island Summary for the Wao Kele o Puna Comprehensive Management Plan (Nohopapa Hawaiʻi) (17 pages)
10) Wao Kele o Puna Economic Analysis (Hoʻokuleana LLC) (18 pages)
11) Community Ethnography (Nohopapa Hawaiʻi) (34 pages)

He aliʻi ka ʻāina; he kauwā ke kānaka (The land is the chief; man is its servant)

(Pukui 1983:62, verse 531)
(Looking at the native Hawaiian cultural context of the gods, the land, land use and ahupuaʻa)

E ui no ka ʻae
Ask permission

E mahalo aku
Give thanks

E komo me ka hoʻano
Enter with reverence

I ka hele aku, e hoʻomaʻamau i ka wahi
When you leave, return it as you found it[1]

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.

It is the nature of place that shapes the cultural and spiritual beliefs, practices or life of our Hawaiian people. "Cultural Attachment" embodies the tangible and intangible values of a culture - howour Hawaiian people identify with, and personify the environment around them.

It is the intimate relationship (developed over generations of experiences) that people of a particular culture feel for the sites, features, phenomena, and natural resources, that surround them-their sense of place. This attachment is deeply rooted in the beliefs, practices, cultural evolution, and identity of a people. (cf. James Kent, "Cultural Attachment: Assessment of Impacts to Living Culture." September, 1995). (Kumu Pono)

Nā Akua

E hoʻoulu ana i kini o ke akua, ka lehu o ke akua, nā mano o ke akua
Invoke we now the 40,000 gods, the 400,000 gods, the 4,000 gods. (Beckwith 1940:82)

"The Hawaiian Kumulipo is a genealogical prayer chant linking the royal family to which it belonged not only to primary gods belonging to the whole people and worshiped in common with allied Polynesian groups, not only to deified chiefs born into the living world within the family line, but to the stars in the heavens and the plants and animals useful to life on earth, who must also be named within the chain of birth and their representatives in the spirit world thus be brought into the service of their children who live to carry on the line in the world of mankind." (Beckwith 1951:7)

When Hawaiians pray, in order to include all aspects of God (not to omit or offend any of the akua), we added to the prayer the words, "E hoʻoulu ana i kini o ke akua, ka lehu o ke akua, nā mano o ke akua" (Invoke we now the 40,000 gods, the 400,000 gods, the 4,000 gods.) (Kanahele 1986:70)

Hawaiians honored a kind of diffused hierarchy of gods, headed by Kū, Kāne, Lono and Kanaloa. Each has his areas

[1] These statements were part of testimony by the Maui Group Sierra Club (noted as 'Hawaiian Protocol for Sacred Places') and posted on the Kilakila ʻO Haleakalā website.

of responsibility or “departments.” (Kanahele 1986:70)

Kū

Akua of war, medicines and chiefs

Lit., upright

Kinolau (body forms) of Kū include: animal forms: kānaka (man), ʻio (hawk), ʻīlio (dog) and moa (chicken); plant forms: niu (coconut), ʻōhiʻa lehua, ʻulu (breadfruit) and noni.

Figure 1: Kū Bishop Museum (Honolulu Weekly)

In some accounts, Kū and Hina were the first gods to reach Hawaiʻi, and were followed next by Kāne and Kanaloa, and last by Lono.

Kū represents male generating power, and Hina (prostrate) is the expression of female fertility and the power of growth. Kū refers to the rising sun, and Hina to the setting sun; hence their realm includes the whole earth and the heavens and all generations of man born and unborn.

Various forms of Kū are appealed to for rain and growth, fishing, and sorcery, but he is the best known as the god of war. When gathering medicine with their right hands, people prayed to Kū for success. Reddish things are sacred to him.

The third, fourth, fifth, and sixth nights of the lunar month are sacred to Kū. He is also prayed to for canoe building. His body forms include forest trees (lehua, koa, etc.), the coconut tree, breadfruit (ʻulu), ʻieʻie (climbing pandanus), the dog, ʻio (hawk), fish (esp. game fish), and the ʻōʻō bird. (Kumupaʻa 2014: 68-69)

Kāne

Akua of all living things, waters of life, procreation, forests, certain plants and animals.

Lit., male

Kinolau (body forms) of Kāne include: wai (freshwater), ʻohe (bamboo), kō (sugarcane), kalo (taro), forests, animals, sunrise. (The following is from Kumupaʻa 2014: 65-66)

The “leading god among the great gods”; a god of creation and the ancestor of chiefs and commoners; a god of sunlight, fresh water, and forests to whom no human sacrifices were made.

He is a god of the male power of procreation, irrigated agriculture, fishponds, and sorcery. His body forms

include the emerged world, light, lightning, spring water (wai), the banana, sugarcane, bamboo, ʻawa (kava plant), the ʻamaʻama and āholehole fish, the rooster, and the pig. He is associated with the directions right, east, north and the colors red, black, and white (yellow). He also presides over dawn and the summer season (the sun's northern limit on eclipse).
The twenty-seventh night of the lunar month is sacred to Kāne. Kanaloa is his constant companion, but Kāne's name always precedes. The ʻawa plant is a form of Kāne and Kanaloa, both male. Water used for ʻawa drinking is also Kāne and Kanaloa. Fresh water is the manifestation of Kāne, and when preparing the ʻawa, Kāneikawaiola, or Kāne of the living water is summoned.

Kāne and Laka are male/female entities of many of the same forest plants, such as the ʻieʻie, pua (lehua blossom), halapepe (native tree, lily family), maile (native scented vine). Kāne and Lono are the deities most commonly addressed by those who offer prayers for the restoration of any one to health. The owl, Pueo...is a "body" of one of the Kāne of the Pele clan.

Lono
Akua of rains, harvest, peace, the weather and healing.
Lit., news, report, tidings, remembrance.
Kinolau (body forms) of Lono include: puaʻa (pig), kukui (candlenut), hāpuʻu (tree fern), ipu (gourd), ʻamaʻama (mullet), thunder, clouds, lightning, rain. (The following is from Kumupaʻa 2014: 72)

The last to come from Kahiki. Lono presides particularly over non-irrigated agriculture, because he is the god of rain.

Lono is also associated with fertility, birth, medicine, clouds bearing rain, thunder, and noise, the gourd, sweet potato, and kukui (Aleurites moluccana). Lono is associated with the black color of clouds that bring rain. He has the form of the pig man, Kama-puaʻa. He is the patron of the annual harvest makahiki festivals, and his image (Lono-makua) was carried on tax-collecting circuits of the main islands. Lono is associated with the "winds of Kona" [leeward winds].

The twenty-eighth day of the lunar month is consecrated to Lono. Kāne and Lono are the deities most commonly addressed by those who offer prayers for the restoration of any one to health.

Kanaloa
Akua of the oceans, voyaging and fishing.
Lit., secure, firm, immoveable, established, unconquerable.
Kinolau (body forms) of Kanaloa include: ocean, maiʻa (banana), mūheʻe (squid), heʻe (octopus), ocean winds, sunset. (The following is from Kumupaʻa 2014: 65)

He is associated with the sunset, winter season, the colors red and black, and the directions left, west, and south. Kanaloa is the god of the ocean, which is a symbol of death. Honu (sea turtle) is a probable form of Kanaloa. ʻEa (sea tortoise) is probably a form of Kanaloa. Nuʻao (porpoise) is probably a form of Kanaloa. Palaoa (whale) is a form of Kanaloa. Hahalua or hīhīmanu (spotted sting ray, Aetobatus narinari), is probably a form of Kanaloa.

His companion and leader was Kāne. They were renowned as kava drinkers, and they found water in many places. Three days of the lunar month were sacred to Kanaloa-the twenty-fourth (Kāloa-kū-kahi), the twenty-fifth Kāloa-kū-lua), and the twenty-sixth (Kāloa-kū-pau). Some considered him a god of the sea. Emerson gives a healing prayer to him as god of squids (he had this form, as well as that of the ʻalaʻala-pū-loa weed). The ʻawa is a vegetable manifestation of Kanaloa…Whether the ʻawa drinking is for ritual or social purposes, Kāne and Kanaloa are addressed as key deities. Water used for ʻawa drinking is also Kāne and Kanaloa.

In addition to these patron gods, many other deities are recognized who have their own responsibilities. Certain akua watch over certain professions (healers, dancers, canoe makers, tapa makers, astrologers, etc.) Of note, relative to Wao Kele o Puna, are Pele and Laka.

Pele

Goddess of fire.

Lit., lava, volcano, eruption. (The following is from Kumupaʻa 2014: 74)

Figure 2 Puʻu ʻŌʻō Eruption and Lava Flow (USGS)

A volcano goddess. Pele is vulcanism in all its forms. Epithets coupled with her name include Honua-mea (reddish earth), Ka-wahine-ʻai-honua (the earth eating woman), Ka-wahine-o-ka-lua (the woman of the pit), and, rarely, Ka-wahine-o-ka-ʻaʻahu-keʻokeʻo (the woman with the white garment)…She appears at different times as fire, a wrinkled hag, a child, and a beautiful girl.

The primary form of Pelehonuamea is the red-hot magma. Pele is land growth, the production of fresh lava. Okaoka is said to be the flame-body of Pele, or the small stones, ʻiliʻili, that entered into the composition of her body. Her body forms are the volcanic forces-eruptions, earthquakes, magma, and flowing lava steam. She also takes the form of an old woman or a beautiful young woman.

Terms for various forms of volcanic matter are: pāhoehoe-the smooth unbroken lava; ʻaʻā-the rough rocky lava; ʻelekū-pumice; one ʻā-cinders; ʻalā-basalt; lauoho-Pele's hair; waimaka-olivine crystals; pōpōahi-giant lava balls emitted by a shield volcano, usually on the Mauna Loa ridge.

Laka

Goddess of hula and the forest.

Lit., tame, domesticated, gentle, attracted to. (The following is from Kumupaʻa 2014: 71)

Laka is the primary deity of the hula kuahu. Laka is the female deity whose kinolau, or body forms, are some of the majestic and fragrant forest plants that are used on the kuahu, or hula altar. Laka is the goddess of the hula, maile, ʻieʻie, and other forest plants, often identified with Kapo-ʻula-kīnaʻu. A god worshiped by canoe makers; also known as Kū-ʻōhiʻa-Laka.

Laka, or Kūkaʻōhiʻalaka, is the forest deity of the ʻōhiʻa lehua, Metrosideros polymorpha, and its multiple cycles. Laka, goddess of the hula, is invoked as the goddess of the maile, which is one of five standard plants used on her altar. ʻIeʻie is one of five plants used on the hula altar. The palai (lace fern) is one of the important plants placed on the hula altar to Laka. Lama wood is used in medicine and placed on hula altars because its name suggests enlightenment. Kupukupu is sometimes added to the hula altar to Laka, for knowledge to kupu (sprout) (wehewehe.org).

Figure 3 ʻŌhiʻa Lehua (P. Young)

ʻAilāʻau Eruption - The Longest Kīlauea Eruption In Memory

While we may feel the present, ongoing eruption at Kīlauea, starting in 1983, is the longest, arguably it was the ʻAilāʻau eruption in the 15th century. It was the largest in Hawaiʻi in more than 1000-years.

It was named for ʻAilāʻau, The Forest Eater. When Pele came to the island Hawaiʻi, seeking a permanent home, she found another god of fire already in possession of the territory. ʻAilāʻau was known and feared by all the people.

ʻAi means the "one who eats or devours." Lāʻau means "tree" or a "forest." ʻAilāʻau was, therefore, the fire-god devouring forests. Time and again he laid the districts of South Hawaiʻi desolate by the lava he poured out from his fire-pits. In one of the Pele stories is the following literal translation of the account of her taking Kīlauea:

> When Pele came to the island Hawaiʻi, she first stopped at a place called Keahialaka in the district of Puna. From this place she began her inland journey toward the mountains. As she passed on her way there grew within her an intense desire to go at once and see ʻAilāʻau, the god to whom Kīlauea belonged, and find a resting-place with him as the end of her journey.
>
> She came up, but ʻAilāʻau was not in his house. Of a truth he had made himself thoroughly lost. He had vanished because he knew that this one coming toward him was Pele. He had seen her toiling down by the sea at Keahialaka. Trembling dread and heavy fear overpowered him. He ran away and was entirely lost.
>
> When he came to that pit she laid out the plan for her abiding home, beginning at once to dig up the foundations. She dug day and night and found that this place fulfilled all her desires. Therefore, she fastened herself tight to Hawaiʻi for all time.
>
> These are the words in which the legend disposes of this ancient god of volcanic fires. He disappears from Hawaiian thought and Pele from a foreign land finds a satisfactory crater in which her spirit power can always dig up everlastingly overflowing fountains of raging lava. (Westervelt 1916:3)

The ʻAilāʻau eruption took place from a vent area just east of Kīlauea Iki. The eruption built a broad shield, the shape of which is apparent when viewed from the overlook at Jaggar Museum.

The eastern part of Kīlauea Iki Crater slices through part of the shield, and red cinder and lava flows near the center of the shield can be seen on the northeastern wall of the crater. (USGS 2000:online)
Lava covered all, or most, of what are now Mauna Loa Estates, Royal Hawaiian Estates, Hawaiian Orchid Island Estates, Fern Forest Vacation Estates, Eden Rock Estates, Crescent Acres, Hawaiian Acres, Orchid Land Estates, ʻĀinaloa, Hawaiian Paradise Park, and Hawaiian Beaches.

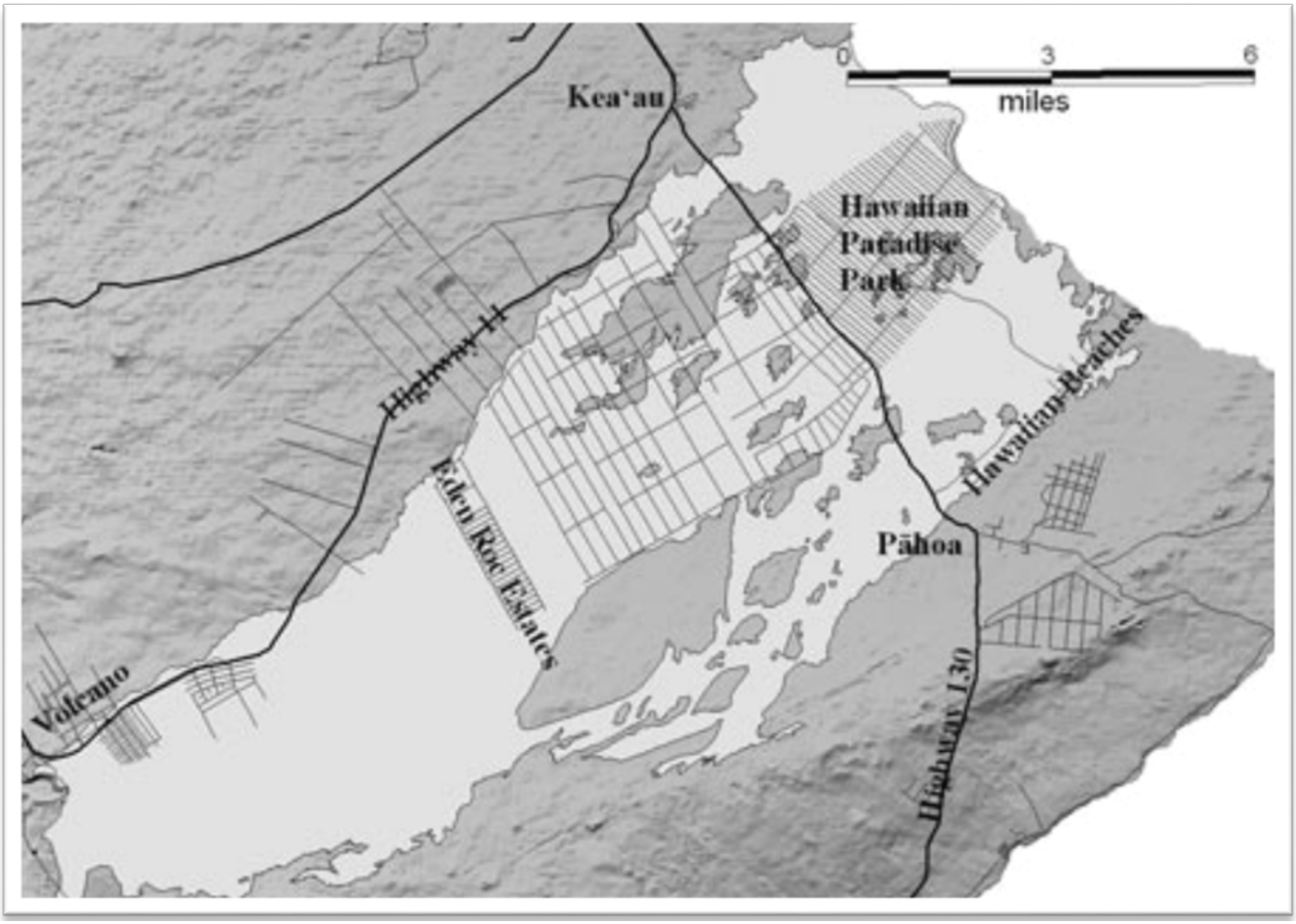

Figure 4 ‘Ailā‘au Flow noted in Lighter Color (USGS)

The radiocarbon data are supported by the magnetic declination and inclination of the lava flows, frozen into the flows when they cooled. Research found that these "paleomagnetic directions" are consistent with what was expected for the 15th-century. (USGS 2000 on-line search December 22, 2016)

The ‘Ailā‘au eruption probably lasted about 50-years, from about 1420 to 1470 (based on evaluation of radiocarbon data for 17 samples of lava flows produced by the ‘Ailā‘au shield - from charcoal created when lava burns vegetation). The ages obtained for the 17 samples were averaged and examined statistically to arrive at the final results. (USGS 2000 on-line search December 22, 2016)

Such a long eruption naturally produced a large volume of lava, estimated to be about 5.2 cubic kilometers (1.25 cubic miles) after accounting for the bubbles in the lava. The rate of eruption is about the same as that for other long-lasting eruptions at Kīlauea. (USGS 2000 on-line search December 22, 2016)

This large volume of lava covered a huge area, about 430 square kilometers (166 square miles). From the summit of the ‘Ailā‘au shield, pāhoehoe lava flows moved 40 km (25-miles) northeastward, making it all the way to the coast at Kaloli Point and at a number of other places from near Kalele to beyond ‘Opihi Rock.

Another lava flow headed south from the ‘Ailā‘au shield, crossing ‘Ainahou Ranch and reaching the south coastline between ‘Apua Point and Keauhou Landing. Much of the lava was transported in tubes away from the shield. (USGS 2000 on-line search December 22, 2016)

The ‘Ailā‘au flow created a Kīpuka within Wao Kele o Puna that would later play a major role in re-seeding the Puna area for years to come.

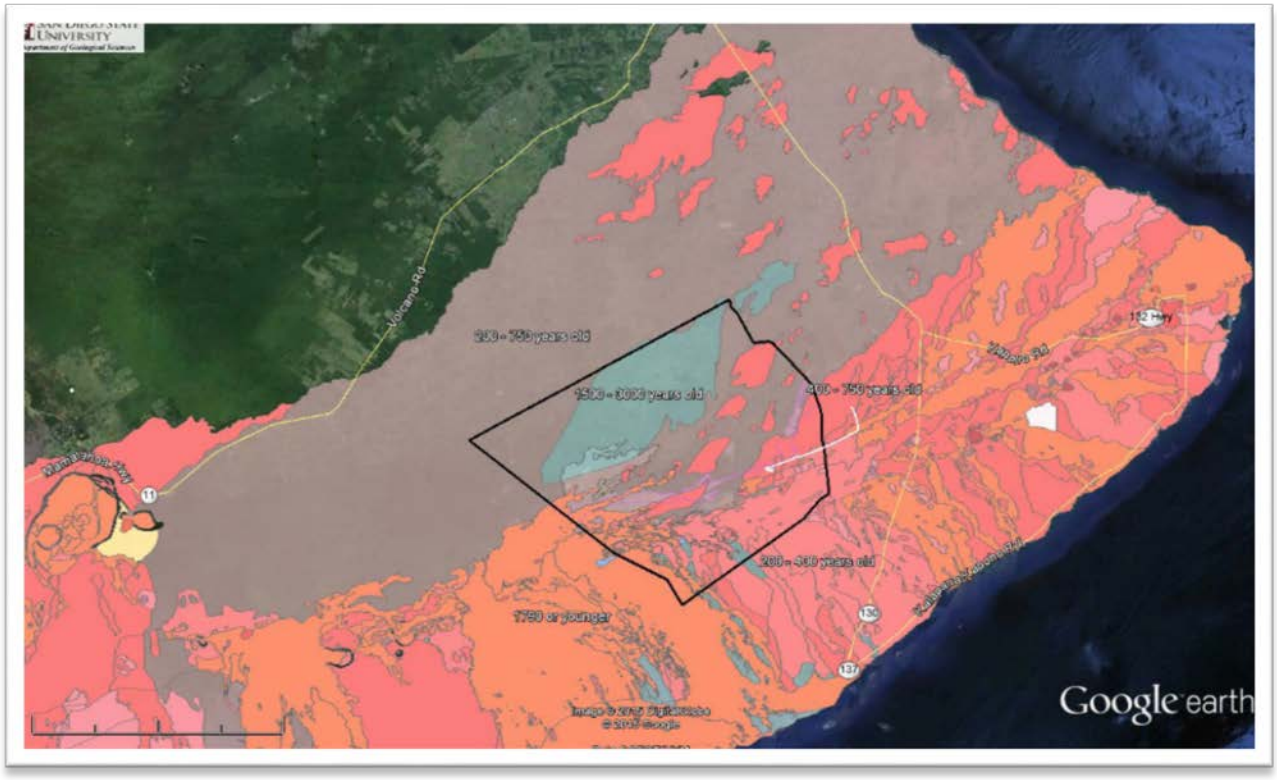

Figure 5 Illustration noting relative age of lava flows in the Puna District. Note the Kipuka in Wao Kele o Puna (San Diego State data GIS over Google Earth)

Kinolau

Nature's many forms, from the skies and mountain peaks, to the watered valleys and plains, to the shore line and ocean depths, were considered to be kinolau (embodiments of Hawaiian gods and deities).

> Puku'i and Elbert described kinolau as "the many forms [that might be] taken by a supernatural body." It is derived from the words kino, meaning "form or embodiment," and lau, meaning "many." Some believe that virtually every plant species known to the Hawaiians was considered kinolau of some spirit or deity. This concept helped to link the Hawaiian people to their gods.
>
> Thus Hawaiians might call upon the kinolau of their deities .... Lau-ka-'ie'ie has been described as a "beautiful demigoddess who was transformed into an 'ie'ie vine." The palai fern was a kinolau of Hi'iaka, a sister of Pele. The kī, or ti plant, was "not regarded as the kinolau of any forest god," and yet its leaves were considered essential for decorating the altar of Laka in the hālau hula (dancers' house).
>
> Kinolau could also be worn. Wearing a lei made of materials from a kinolau would allow Hawaiians to touch their gods in a literal sense, and be touched by them, since the plants were bodily forms of the akua. Sometimes, Hawaiians wore lei to show the akua their appreciation for the beauty of the plants that were their kinolau. Other times, these lei were worn in hopes of being enlightened or inspired by the deity.
>
> Kinolau were also placed on the altar (kuahu) of a hālau hula. Their presence on the kuahu was meant to honor the gods and goddesses of the hula and to inspire the haumāna (students) as they learned their art. Kūpuna (elder Hawaiians) born in the period between approximately 1885 and 1915 told us that the chants used in obtaining these offerings were so strong that the plants never wilted on the kuahu but remained green and fragrant.
>
> If any of the students broke one of the many strict rules of the hālau while in training, the plants would wilt, to show their disapproval. This example demonstrates that these kinolau (body form) offerings were not just decorative symbols but were powerful entities that were not to be taken lightly or treated with disrespect.
>
> Six plants commonly placed on the altar of the hālau hula

Hawaiian name	**Scientific name**	**Diety of which the plant was kinolau**
lama wood	Diospyros species	Laka (a female deity)
lehua	Metrosideros species	Küka'öhi'alaka (a male Laka deity)
halapëpë	Pleomele species	Kapo and Laka
palai (palapalai) fern	Sphenomeris chinensis	Hi'iaka
'ie'ie	Freycinetia arborea	Lau-ka-'ie'ie
maile	Alyxia oliviformis	Maile sisters(Anderson-Fung&Maly 2009:13-14)

Plant gathering for medicinal use was another occasion in which certain akua were called upon. For example, Kū and his wife Hina were invoked when medicinal plants were gathered, as they are the akua associated with the male and female properties in healing plants and in ritual (Pukui et al. 1972, vol.1:24). Overall, these examples highlight a few activities involving ritual practice that may have occurred in areas such as Wao Kele o Puna.

“For wild-collected plants the rule was: take some, but leave some; don’t take all. For those plants that could be propagated readily, the rule was to replant when you harvest wild items.” (Pukui, Kumupaʻa 2014:199)

ʻAumākua and the Akua

There are also family gods, and gods for individuals. Families have their own ʻaumakua (personal, ancestral gods) that watches over and protects them. For some it is the shark, others the pig, and so on. It is thought that spirits can communicate to the living through dreams and often appear in the form of the family’s ʻaumakua.

Hawaiian traditions surrounding ritual practice allow for the reciprocal exchange of mana (spiritual power) between the ʻāina (land, earth) the akua (the gods) and kānaka (man). These rituals vary from strict ceremonies accompanied by mōhai (offerings) of food and sacrifice, to the utterance of a chant or prayer (Pukui et al. 1972, vol.2:122).

Beckwith (1976:81) explains, “The great gods each had his own form of worship, his priests and heiaus, his own special symbols of ritual distinction…Besides the great gods there were an infinite number of subordinate gods descended upon the family line of one or another of the major deities and worshiped by particular families or those who pursued special occupations.”

Malo (1959:81) further explains, “Each man worshipped the akua that presided over the occupation or the profession he followed, because it was generally believed that the akua could prosper any man in his calling.” And so with this way of life, it became a custom for kānaka to approach any kind of undertaking with the acknowledgement of Hawaiian deities and their various manifestations.

In the upland forest, there are several cultural activities that involve ritual protocol. For example, the god Kū is invoked when gathering material for luakini (temple) construction, kālai kiʻi (image carving), and ritual objects.

Malo (1951:159) writes, “If the King was minded to worship after the rite of Kū, the heiau he would build would be a luakini. The timbers of the house would be of ʻōhiʻa, the thatch of loulu palm or of uki grass. The fence about the place would be of ʻōhiʻa with the bark peeled off. The lananuʻu-mamao had to be made of ʻōhiʻa timber so heavy that it must be hauled down from the mountains. The same heavy ʻōhiʻa timber was used in the making of the idols for the heiau.

Figure 6 Overlooking ʻŌhiʻa Forest (TPL)

Canoe construction is another activity that involved ritual practice in the upland forest. Malo (1951:127) explains that when a koa tree is chosen for a canoe, "the kahuna took the axe of stone and called upon the gods: ʻO Kū-pulupulu, Kū-ala-na-wao, Kū-moku-haliʻi, Kū-ka-ʻieʻie, Kū-palalake, Kū-ka-ʻōhiʻa-laka.' These were the male deities. Then he called upon the female deities: ʻO Lea and Ka-pua-o-alakai.'" In another instance, bird-catchers would appeal to the god Kū-huluhulu.

Figure 7 ʻIʻwi in ʻŌhiʻa Lehua (USGS)

It is written in the book titled, Nānā I Ke Kumu, "With little formality, the Hawaiian would ask forgiveness for taking from nature's bounty."

The bird-catcher would speak to Kū in his manifestation as a god of hulu (feathers): "Oh Kū-huluhulu, forgive me for catching this bird and taking his feathers. They are needed for a kīhei [mantle] for my chief [named]…" (Pukui et al. 1972, vol.2:134).

Plant gathering for medicinal use is another occasion in which certain akua are called upon. For example, Kū and his wife Hina are invoked when medicinal plants are gathered, as they are the akua associated with the male and female properties in healing plants and in ritual (Pukui et al. 1972, vol.1:24). Overall, these examples highlight a few activities involving ritual practice that may have occurred in areas such as Wao Kele o Puna.

ʻĀina

Ola ka ʻāina, ola ke kānaka
Healthy/Living Land, Healthy/Living People
The good of the land results in the good of the people. (Maly)

The Native Hawaiian relationship with the ʻāina is spiritually guided by reverence and a deep seeded respect. This connection is depicted in the Kumulipo, a highly detailed genealogical creation chant, where kānaka descend from Papahānaumoku, Earth Mother, and Wākea, Sky Father.

Therefore, to disrespect the land is to disregard one's ʻohana (family). Sustaining a pono connection to the ʻāina, or that which feeds, is essential to the balance of all life and to the well-being of our society.

Kūkulu `ōpua ka`i	Clouds form on the horizon
Ma a lihi lani ka`i	Forming at the edge of heaven
Kū lālani kahiko ka`i	Parading in rows
`Elo`elo o lalo i ka wai o Kū-lani-hā-ko`i	Drenched by the water of Kūlanihāko`i
Kulukulu maila ua	Falls the kulukulu rains
Hawewe maila ua	Falls the hawewe rains
Lokuloku maila ua	Falls the loku loku rains
E ola ko lalo nei	Giving life below
I kupu a mu`o maila	The sprout forms the bud
Mu`o a lau la maila	The bud forms the leaf
Lau a lālā maila	The leaf forms the branch
Lālā a kumu maila	The branch forms the tree
Kumu a pa`a hina `ole!	A tree that never falls!

(Kekuhi Kanahele 1999: Hawaiʻi Community College, Hui kamaʻilio, translated by Aulii Mitchell)

This chant was shared with our hui kamaʻilio at Hawaiʻi Community College in 1999 by the composer, kumu hula Kekuhi Kanahele. It is a beautiful chant that relates to knowledge and the goals we seek in our lives as Hawaiians in today's changing world and challenges.

This chant guides us on how to understand and how the universe (ka pae ʻāīna o Hawaiʻi, our islands) continues to evolve in these changing times. This oli begins directly from our first house of knowledge, the heavens. It is the very movement of the celestial that causes the second house of knowledge, the earth to move and begin to form.

It is the very movement upon the earth that is vital for life to form, preparing the land base, that forms the foundation for the next house of knowledge to create, thus the third house of knowledge, papahānaumoku, that which births, human, plant and creature, thus the kumulipo in every wa or era something is birthed.

This chant is full of metaphors. It begins to form a picture. The picture describes the cloud forming along the horizon as it fills with the rains released from the mythical lake Kū-lani-hā-ko`i. When this lake fills up with water, it spills over towards the earth and is captured in the rains clouds.

These clouds parading along the horizon carry these particular kinds of rains (from which many other forms and have names specific to island and places) to the lands and releases them, thus falls these particular rains; kulukulu, hawewe, and lokuloku. It is these rains that feed the land below so life can grow, thus papahānaumoku is fed with this water and birth begins with the water of life. Thus, all three houses of knowledge are connected and the cycle continues. (Auliʻi Mitchell)

Traditional Ecological Zones

Pualani Kanakaʻole Kanahele shares her extensive knowledge about the horizontal and vertical land divisions in the Hawaiian landscape in the Wao Akua: Sacred Source of Life (Division of Forestry and Wildlife 2003:8-14):

> Horizontal and Vertical Land Divisions: the most familiar divisions when talking about the Islands are the vertical ones…common sections found on today's maps and the boundary lines run from the mountain to the ocean.
>
> The vertical boundaries depended upon the mountains, rivers, streams and cinder cones as the demarcation features. These were considered political boundaries because they separated the chiefdoms…some of these are known as ahupuaʻa…still smaller vertical land sections lie within an ahupuaʻa.
>
> Horizontal divisions, in contrast, did not use land features to demarcate boundaries but used instead the vegetation growth or the forest was the food source and therefore a vital system for the continuum of life and life cycles. The trees housed the seeds and/or spores for regeneration. They also acted as food sources for birds, insects, animals and man. The forest provided vegetation used for medicinal and spiritual purposes, adornment, housing, dyes, clothing, games and many more useful things.
>
> The typical horizontal divisions that were recognized by our ancestors are still recognized today. Here are the names of some of these horizontal spaces and the kinds of flora typical of each:
>
> **Kuahiwi.**
> The mountaintop. A very sacred area because of its height.
>
> **Kualono.**
> The region near the mountaintop. Very little vegetation grows in this area. The māmane (Sophora chrysophylla) and naio (Myoporum sandwicense) are the only hardy trees to grow here. Both of these are hardwood trees. The flower of the māmane was special to the aliʻi (chief, chiefess); when wanting a special lei he sent his runners to fetch this flower because of its shape and yellow color. ʻAʻaliʻi (Dodonaea, all species) can also be found at this height.
>
> **Wao maʻukele. (Wao kele)**
> The region is named because of the wet, soggy ground. This area is located in the rain belt of the island, especially on the koʻolau (Windward side) side of each island. The trees of this area are the very large koa (Acacia koa) and ʻōhiʻa (Metrosideros polymorpha), varieties of lobelia and māmane. These are the typical trees of the area. There are other trees but the koa and ʻōhiʻa dominate the canopy.
> **Wao akua.**
> The forested region below the wao maʻukele. This is said to be occupied by spirits of the forest. Mankind seldom ventured into this area during ancestral times, except when a particular kind of tree was needed and could not be found elsewhere. The large trees acquired from the wao akua and the wao maʻukele (Wao Kele o Puna Natural Area Reserve lies within these two horizontal divisions) deserved substantial offerings.
>
> This is the region where the forest had a greater variety of trees. The trees in this area should be healthy so as to supply seeds and regenerate new growth to keep the forest alive. Some of the trees and plants are alani (Pelea sandwicensis), hōʻawa (all Hawaiian species of the genus Pittosporum), koa, kōpiko (genus Psychotria), maile (Alyxia olivaeformis), maua (Xylosma hawaiiense) and ʻōhiʻa.

Figure 8 Overlooking the Wao Kele o Puna Forest (TPL)

Wao kānaka.

The forested region ma kai (towards the sea) of the wao akua. This area was frequented by man. He found wood for weapons, making his house, tools, surfboards and canoe accessories; he also harvested dye, collected medicine and bird feathers, gathered vegetation for lei, gathered vegetation for the kuahu (alter), material for making rope and many other useful things for everyday living. The trees in the wao akua are also found in this area but the trees may be smaller. Other flora found in this area are hāpuʻu (Cibotium splendens), hau kuahiwi (Hibiscadelphus), hōlei (Ochrosia compta), māmaki (Pipturus spp.), ʻōlapa (Cheirodendron), palapalai (same as palai, a fern), pāpala (Charpentiera obovata), pilo (Hedyotis), to name a few.

Kula.

The upland grassy plains. Some areas of an island had a very large kula area, as opposed to other areas that had very narrow or no grassy land section at all. A few of the most well known plants of the kula area are ʻaʻaliʻi, amaʻu (all species of an endemic genus of ferns, Sadleria), ʻilima (all spcies of Sida), maʻo (Gosspyium sandvicense), pili (Heteropogon contortus) and uluhe (all Hawaiian species of false staghorn fern).

Kahakai.

The edge of the ocean. At the kahakai were found the alaheʻe (Canthium odoratum), hala (pandanus, Pandanus odoratissimus), hau (Hibiscus tiliaceus), kamani (Calophyllum inophyllum), kaunaʻoa (Cuscuta sandwichiana), lama (all endemic kinds of ebony), milo (Thespesia populnea), naupaka (Scaevola) and niu (coconut). All these plants were useful to the Hawaiian and make life bearable for man on these islands.

Philosophy and Relationship to the Forest:

These divisions provide the following insights into what was and is important to the quality of life for the Hawaiian – his relationship to his environment and especially his relationship to the land – because he was and is a creature of the land. (Kumupaʻa 2014:192)

- Hawaiians recognized and acknowledged the importance of vegetation. Land sections are identified by the change of flora – thick vegetation in the lower forests to thin vegetation in the uplands and grassy upland plains to lowland/beach vegetation.

- Hawaiians put high cultural value on older or larger trees and thick kīpuka (opening in a forest; clear place or oasis within a lava bed where there may be vegetation) that normally housed older trees.

- Hawaiians did not as matter of course penetrate the wao ma‘ukele or wao akua if the trees they needed could be gotten elsewhere, because of the priority of promoting new growth through non-disturbance of seed-producing forest areas.

- Hawaiians realized the importance of the food source and the regenerative energy of the forest. Therefore it was necessary to leave some areas or groves of trees as they stood originally, thus the name wao akua. (Division of Forestry and Wildlife 2003:8-14) (Kumupa‘a 2014:192)

According to kānaka maoli thinking and cultural practices, Wao Kele o Puna lies within two horizontal divisions: Wao Ma‘ukele and Wao Akua, the rain belt of the islands, and is occupied by the akua of the forest. Wao Kele o Puna has great importance for kānaka maoli and is considered a rich gathering resource for traditional Hawaiian practices (Martin 2008:4).

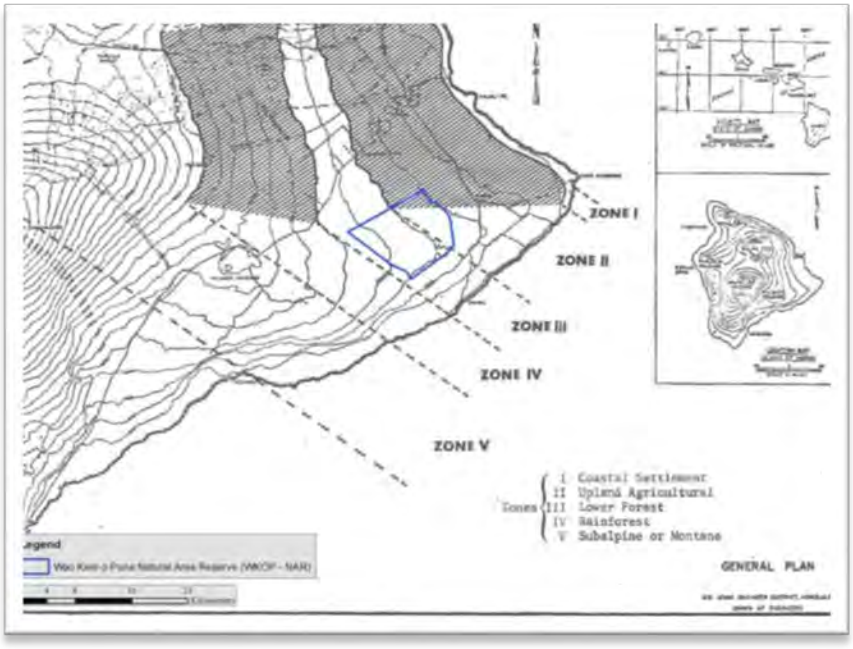

Figure 9 Land Use Zones for the South Hilo Puna area (adapted from McEldowney 1979)

Holly McEldowney developed what is currently the most thoroughly conceived and widely used land-use/settlement model for windward Hawai‘i Island (McEldowney 1979). While intended primarily to clarify settlement patterns in South Hilo District, McEldowney’s observations offer insight into use of the Puna District as well (Burtchard and Moblo 1994:21). These five zone classifications (McEldowney 1979:64) are listed below:

I. Coastal Settlement
II. Upland Agricultural
III. Lower Forest
IV. Rainforest
V. Subalpine or Montane

Ahupua‘a - Traditional Land Delineation

Traditionally, the Hawaiian Islands were separated into moku (districts) in which the ali‘i (chief) of the island selected ali‘i ‘ai moku (district chiefs) to oversee each moku. The moku were separated into ahupua‘a (land divisions) that were overseen by the ali‘i ‘ai ahupua‘a (land division chiefs).

Shaped by island geography, ahupua‘a varied in shape and size (from as little as 100-acres to more than 100,000-acres). A typical ahupua‘a (what we generally think of as watersheds, today) is a long strip of land, narrow at its mountain summit top and becoming wider as it ran down a valley into the sea to the outer edge of the reef. If there is no reef then the sea boundary would be about one and a half miles out.

The traditional land use in the Hawaiian Islands evolved from shifting cultivation into a stable form of agriculture. Stabilization required a new form of land use and eventually the ahupua‘a form of land management was instituted.

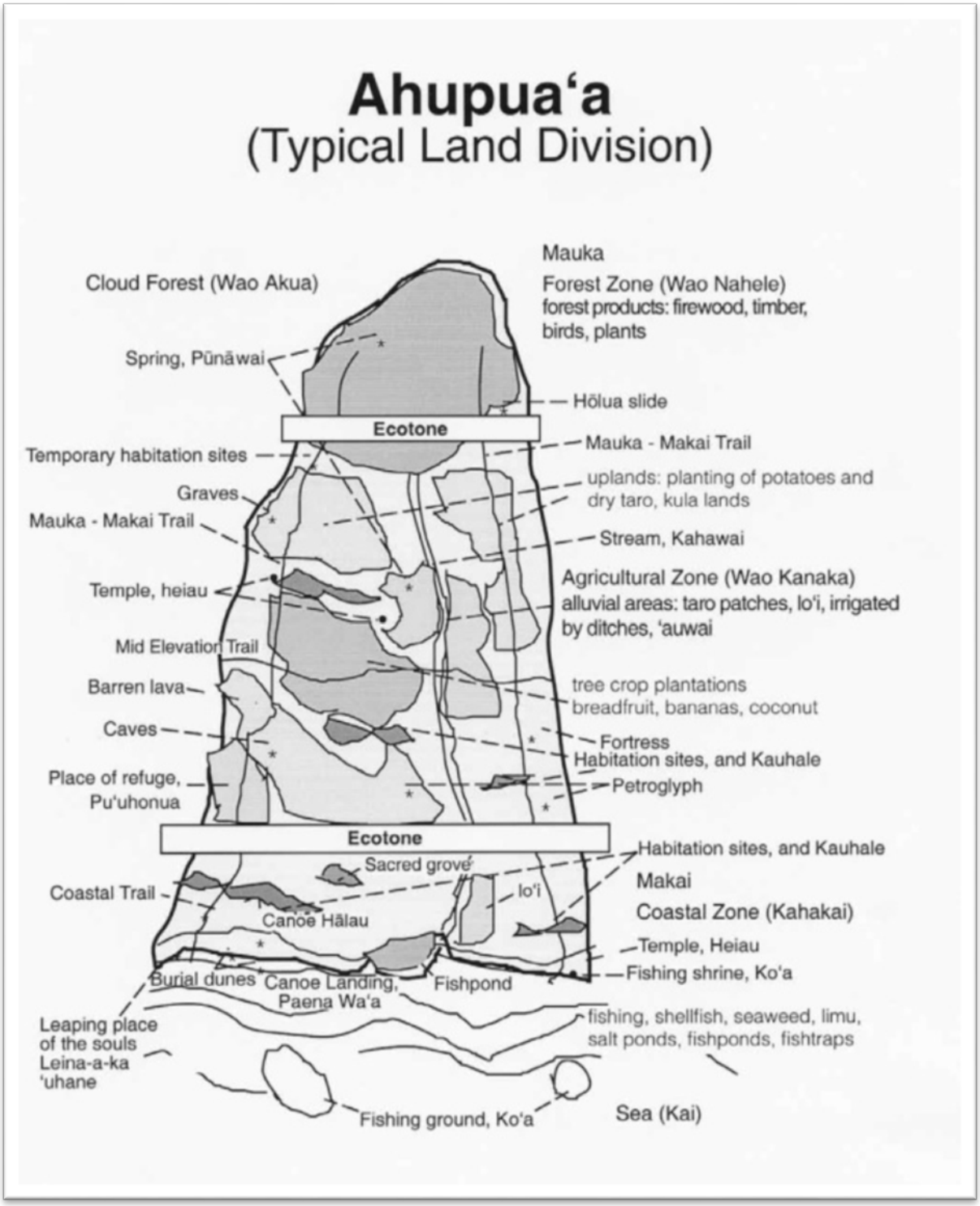

Figure 10 Illustration of a ‘typical’ ahupua‘a (Mueller Dombois)

The ahupua‘a system directly relates to understanding the topography and cycle of natural resources in Hawai‘i to manage land. This system was based on successful food production and resource sustainability.

The knowledge that resides in this type of management “reflects lifetimes of observations and experiences by many generations of Hawaiians in their quest for survival” (Edith Kanaka‘ole Foundation 1995).

In ancient Hawai‘i, most of the common people were farmers and fishermen. Tenants procured food from the ocean and cultivated smaller crops for family consumption, to supply the needs of chiefs and provide tributes. Kapu (restrictions/prohibitions) were observed as a matter of resource and land management, among other things.

Through the ahupua‘a, access to resources was generally tied to residency and earned as a result of taking responsibility to steward the environment and supply the needs of ali‘i. The social structure reinforced land management.

Oneha writes (2001:300), “Hawaiians acquired knowledge of every plant, stone, wind, cloud, and wave, along with the understanding to conserve, replenish, and restore what was used. They established an intimacy with their environment as if their place was part of their extended family”.

Additional markers were placed to note the ahupua‘a boundary - so called because the boundary was marked by a heap (ahu) of stones surmounted by an image of a pig (pua‘a), or because a pig or other tribute was laid on the altar as tax to the chief.

Within the ahupua‘a there were the konohiki (land agents) who resided on the land and worked together in consensus with the community to maintain a balance between land use and resource continuity. (Kumupa‘a 2014:198)

Each ahupua‘a was further divided into smaller sections and designated to ‘ohana. Some of these included ‘ili or ‘ili ‘āina (strips of land), ‘ili pa‘a (complete), or ‘ili lele (separated, leaping) with pieces of land both near the sea and in the mountains.

It is written about these land sections that, “The intent was to provide the ‘ohana with access to the resources of the mauka and makai (seawards) zones”. (Kumupa‘a 2014: 198)

Each ahupua‘a was ruled by a lower chief, or ali‘i ‘ai. He, in turn, appointed an overseer, or konohiki. The konohiki served as general manager responsible for the use of an ahupua‘a as a resource system. He, in turn, was assisted by specialists, or luna. For example, the luna wai was responsible for the fresh water flow and irrigation system.

The maka‘āinana (common people) never owned or ruled land. People living in one ahupua‘a were free to use whatever grew wild in that ahupua‘a. But a resident of one ahupua‘a could not take anything from another ahupua‘a without permission. Boundaries were important and people carefully learned their locations.

Ahupua‘a served as a means of managing people and taking care of the people who support them, as well as an easy form of collection of tributes by the chiefs. Ultimately, this helped in preserving resources.

In ancient Hawaiian times, relatives and friends exchanged products. The upland dwellers brought poi, taro and other foods to the shore to give to kinsmen there. The shore dweller gave fish and other seafood. Visits were never made empty-handed but always with something from one's home to give.

Ahupua‘a contained nearly all the resources Hawaiians required for survival. Fresh water resources were managed carefully for drinking, bathing and irrigation.

A main component of the ahupua‘a system was Hawaiian spirituality. Gon states, “All aspects of Hawaiian life including activities in agricultural and natural settings, required ritual protocol that integrates the spiritual and physical condition of the land and its living occupants, including people”. (Kumupa‘a 2014:198)

The ahupua‘a system was very complex with associated kapu. It guided the community to kōkua aku, kōkua mai

(help and be helped), but this community wasn't just restricted to people, this community also incorporated the ʻāina (land), the akua (elements) and the reciprocity of mana (spiritual power). (Kumupaʻa 2014:199)

Today, the knowledge that guided the ahupuaʻa system to function for generations can be reapplied in contemporary Hawaiʻi when managing resources. Watershed-based management is a modern term applied to the structure of the traditional ahupuaʻa system. (Kumupaʻa 2014:199)

It is stated that, "Already there has been an acceptance of the ahupuaʻa as a potential management framework by several state and federal agencies, at least on a theoretical level" (Derrickson et al. 2002:575). Many Hawaiian groups are increasingly focused on ahupuaʻa restoration as a means to conserve and utilize land through the practice of Hawaiian culture. (Kumupaʻa 2014:199)

Minerbi states that, "More protection can be achieved with Hawaiian conservation values and planning ideas based on the integration of traditional ahupuaʻa district planning with modern watershed and ecological planning". It is recognized that there is a great amount of Hawaiian knowledge that still resides throughout local Hawaiian communities and continues to be documented in literature. (Kumupaʻa 2014:199)

Kapu System

"The kapu system was the law that guided Hawaiian spirituality and regulated the ahupuaʻa system. These regulations were pre-determined by natural processes in Hawaiʻi that were observed daily, monthly, and seasonally for generations." (Poepoe et al 2001:328 found in Kumupaʻa 2014: 198)

There are many examples of natural processes that guided land management. One of these is the observance of the moon cycle and associated prohibitions. Each moon phase signaled weather cycles and growth patterns of native Hawaiian species. (Kumupaʻa 2014:198)

The kapu system insured that certain plant and animal species were collected only during specific times of the year when the specific specie was mature and abundant. This in turn conserved these resources for future harvest. (Kumupaʻa 2014: 198-199)

Gon recalls, "While there is no record of Hawaiians planting native trees for the purpose of forest reforestation or restoration of native vegetation, protocol has been recorded that indicates that native trees such as koa, ʻōhiʻa, and lama were not casually handled."

"Depending on the purpose of handling, protocol specific to major appropriate gods would be practiced (e.g., to Kū for ʻōhiʻa, to Laka for lama dedicated to the kuahu (altar of the hula hālau (hula school)". (Kumupaʻa 2014:199)

Pukui (1972) also mentions the appropriate edict for collecting plant material by writing, "For wild-collected plants the rule was: take some, but leave some; don't take all. For those plants that could be propagated readily, the rule was to replant when you harvest wild items."

McGregor states, "These Hawaiian rural communities are the cultural kīpuka (oases) from which the Hawaiian culture regenerates, as the native trees of the kīpuka propagate and, in time, re-establish the forest on the lava flow". By seeking out these cultural kīpuka, agencies in Hawaiʻi can benefit from local knowledge of a specific area. (Kumupaʻa 2014:198)

In addition, using traditional knowledge such as the moon calendar can improve restoration results. According to hundreds of years of test and trial, the Hawai‘i based ahupua‘a model is a considerable alternative to apply to land management in Hawai‘i. (Kumupa‘a 2014:198)

Figure 11 Overlooking Wao Kele o Puna (TPL)

I ali‘i nō ke ali‘i i ke kānaka

A chief is a chief because of the people who serve him (Pukui 1983:125, verse 1150))

McGregor and MacKenzie (2014:96-105) provide a general description of governance at the Island, moku (district), ahupua‘a and family scale.

> Although the ruling chiefs and their land stewards enjoyed certain appropriation rights over the land and the people, ... this was a system of mutual obligation and benefit between the chiefs and the people. The ali‘i nui (paramount chief) and ali‘i ‘ai moku (district chiefs) controlled the land that was distributed among the maka‘āinana (common people).
>
> The ali‘i nui (paramount chiefs) and ali‘i ‘ai moku (district chiefs) were obligated to manage and oversee the production on the land in a manner that provided for the well-being of all the people through pono or balanced and judicious rule.
>
> They regulated the use of scarce resources; apportioned these resources among the people according to principles of fair usage; regulated the use of water, which was the most valued resource of the land; assured that the irrigation systems were properly maintained; conducted proper rituals to the gods who embodied nature; and conserved the resources of the land through restriction and replacement policies. In return, the families of commoners were obliged to provide labor service and products of the land to the ali‘i (chiefs) and konohiki (land stewards).

Functionally, the stratified structure for land utilization and stewardship followed this following basic hierarchy:

- aliʻi nui (paramount chief) of the island
- aliʻi ʻai moku (district chiefs) to oversee each moku
- aliʻi ʻai ahupuaʻa (land division chiefs) overseeing the ahupuaʻa
- konohiki (land chief, headman) who resided in the ahupuaʻa
- luna (and stewards) who assisted with specific issues (i.e. luna wai was responsible for the fresh water flow and irrigation system)
- makaʻāinana (common people) never owned or ruled land

> While Native Hawaiian oral traditions record cases of arbitrary, irresponsible, and self-serving ruling chiefs who abused the people, they were clearly exceptional cases and such chiefs were quickly replaced with responsible chiefs who cared for the well-being of the people.
>
> The Hawaiian proverb, "I aliʻi no ke aliʻi i ke kānaka," "A chief is a chief because of the people who serve him," reflects the Hawaiian attitude that the greatness of a chief was judged according to the welfare of the people under him. (McGregor 2007:29)
>
> The Hawaiian historian David Malo wrote, "In former times, before Kamehameha, the chiefs took great care of their people. That was their appropriate business, to seek the comfort and welfare of the people, for a chief was called great in proportion to the number of his people".

As the Native Hawaiian society became more stratified, kapu (sacred restrictions) were employed to elevate and separate the aliʻi nui (paramount chiefs) from the lesser aliʻi (chiefs) and the makaʻāinana (commoners).

E Nihi ka Helena I ka Uka o Puna (Go quietly in the uplands of Puna)

(Pukui 1983:44, verse 360)
(Where people lived and gathered, and how they acted in the forest)

Nā ʻAumākua

Entrance chants were typical prior to entering the forest; the following is a general chant that was adapted from Hawaiian Antiquities by David Malo; Adapted by Aunty Edith Kanakaʻole)

Nā ʻaumākua mai ka lā hiki a ka lā kau!	Ancestors from the rising to the setting sun
Mai ka hoʻokuʻi a ka hālāwai	From the zenith to the horizon
Nā ʻaumākua iā kahina kua, iā kahina alo	Ancestors who stand at our back and front
Iā kaʻa ʻākau i ka lani	You who stand at our right hand
ʻO kīhā i ka lani	A breathing in the heavens
ʻOwē i ka lani	An utterance in the heavens
Nūnulu i ka lani	A clear, ringing voice in the heavens
Kāholo i ka lani	A voice reverberating in the heavens
Eia nā pulapula a ʻoukou ʻo ka poʻe Hawaiʻi	Here are your descendants, the Hawaiians
E mālama ʻoukou ia mākou	Safeguard us
E ulu i ka lani	That we may flourish in the heavens
E ulu i ka honua	That we may flourish on earth
E ulu i ka paeʻāina o Hawaiʻi	That we may flourish in the Hawaiian islands
E hō mai i ka ʻike	Grant us knowledge
E hō mai i ka ikaika	Grant us strength
E hō mai i ke akamai	Grant us intelligence
E hō mai i ka maopopo pono	Grant us understanding
E hō mai i ka ʻike pāpālua	Grant us insight
E hō mai i ka mana.	Grant us power
ʻAmama ua noa.	The prayer is lifted, it is free.

Ecological Systems and Pre-Contact Hawaiian Footprint

The Nature Conservancy and Office of Hawaiian Affairs collaborated on a mapping project that identified ecological regions and the pre- and post-contact ‘Hawaiian Footprint.’ Footprint notes the geospatial areas that were chronically occupied, directly manipulated, and significantly changed from pre-existing Hawaiian ecosystem types into traditional Hawaiian uses.

In ecological terms, a ‘footprint’ can be defined as a measure of human demand on ecosystems of any given area. It represents the estimated geographic area required to both supply the resources that are consumed by a population as well as assimilate the associated wastes that are produced by the production and consumption of those resources.

This includes house sites, agricultural fields, fishponds, religious sites, major roads and trails, etc. The geographic context for such Hawaiian cultural features is comprised of the ahupua'a traditional land divisions within their moku or districts. (Gon, Minutes from Commission on Water Resource Management 01/22/14) (KipukaGallery arcgis retrieved on-line December 21, 2016)

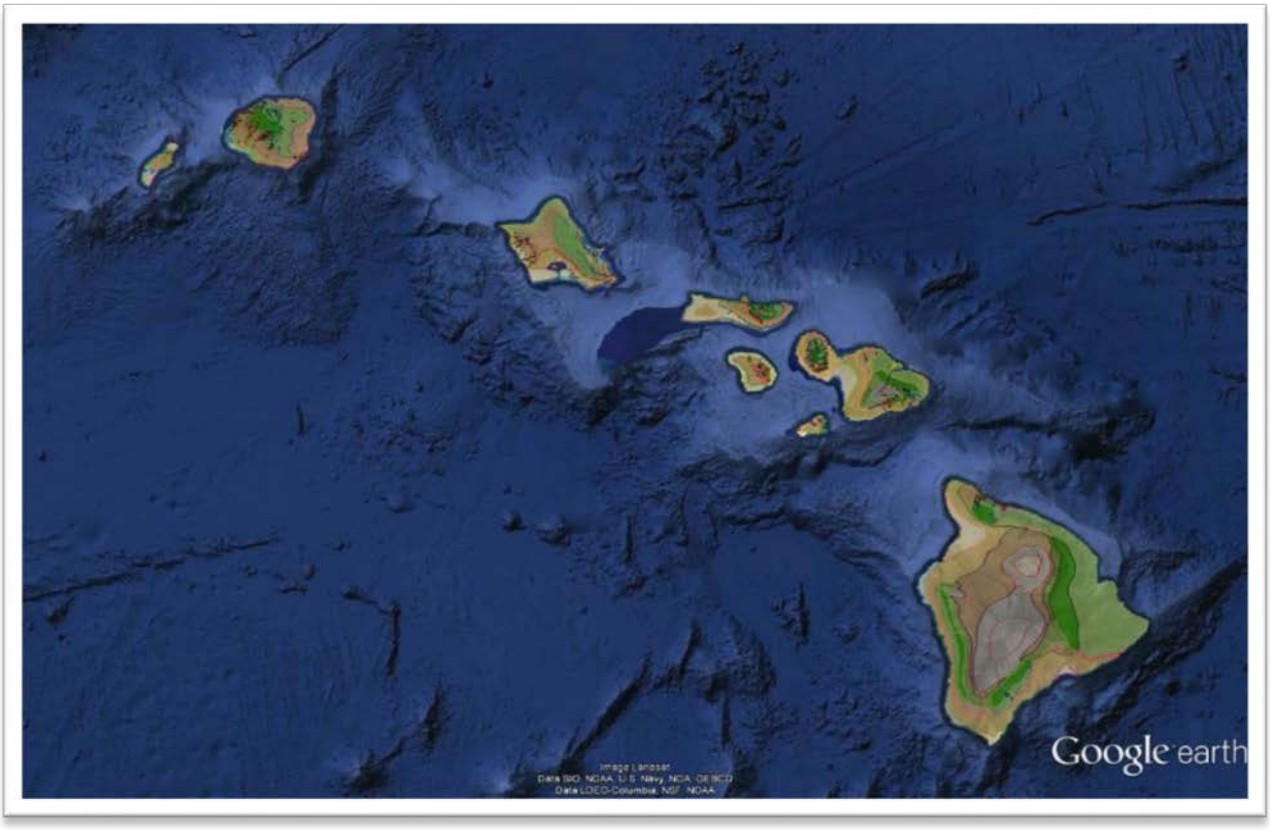

Figure 12 TNC-OHA ecosystem types (GIS over Google Earth)

Even though there are eight islands in the main Hawaiian archipelago, traditionally the islands are described as Nā Moku ‘Eha, the 4 islands. The four are Hawai‘i, Maui, O‘ahu and Kauai. The Hawaiian footprint makes it very clear why. It identifies those four islands as the ones that together providing over 90% of the footprint, and therefore a similar proportion of the population. (Gon, Minutes from Commission on Water Resource Management 01/22/14)

The Hawaiian footprint map shows not just the moku, the māla ‘ai (gardens) and the loko i‘a (fishponds), but also three other essential components of life on the island: the ala hele (trails), the heiau and other archeological sites such as houses and shrine. (Steele in Hana Hou April/May 2013, Issues 16:2)

The pre-contact Native Hawaiian Footprint of the main Hawaiian Islands are estimated to be approximately 382,000 acres or about 9.3-percent of the main Hawaiian Islands. The pre-contact footprint is remarkably smaller than the present-day footprint of approximately 2.1-million acres or over 52-percent of the main Hawaiian Islands. (KipukaGallery arcgis retrieved on-line December 21, 2016)

The ‘footprint’ was compiled from known historic and archaeological evidence. The Native Hawaiian footprint consists of the following components: historic habitation sites, religious sites, water sites, trails, wet and dry agriculture areas and fishponds. (KipukaGallery arcgis retrieved on-line December 21, 2016)

As such, the absence of a Native Hawaiian ‘footprint’ in a particular area does not imply the absence of culturally significant resources in that particular area. Moreover, the absence of a Native Hawaiian ‘footprint’ in an area does not imply that the area is less culturally significant to Native Hawaiians than areas that have a ‘footprint.’ (KipukaGallery arcgis retrieved on-line December 21, 2016)

As illustrated in the maps, Wao Kele o Puna was not heavily used in pre contact and post-contact timeframes.

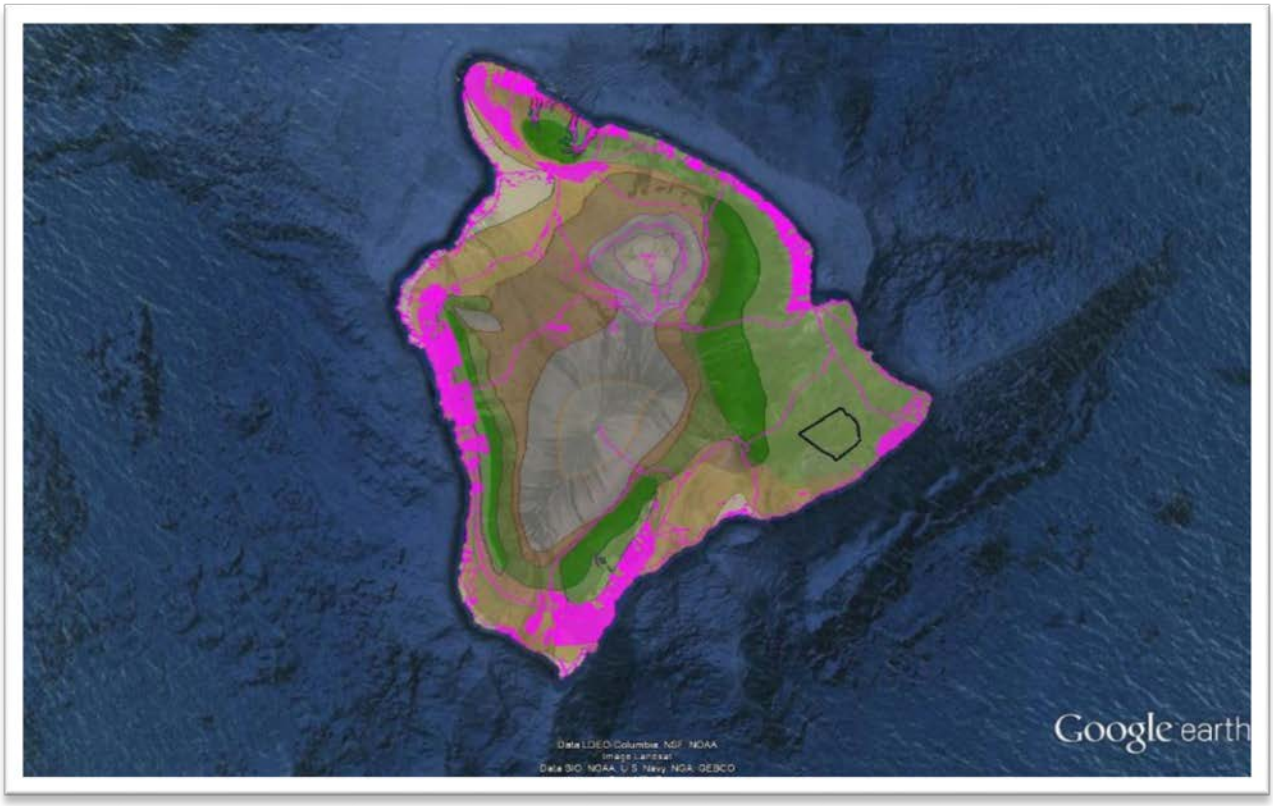

Figure 13 Pre-contact Hawaiian Footprint, Hawai'i Island – Wao Kele o Puna noted in black (OHA-TNC Google Earth)

Figure 14 Post-contact Hawaiian Footprint, Hawai'i Island – Wao Kele o Puna noted in black (OHA-TNC Google Earth)

Ka ua moaniani lehua o Puna

The rain that brings the fragrance of the lehua of Puna (Pukui 1983:172, verse 1587)

Puna is known for its groves of hala and ʻōhiʻa-lehua trees. This ʻōlelo noʻeau refers to the forests of Puna, which attract clouds to drench the district with many rains, refreshing and enriching the Puna water table, and sustaining the life cycle of all living things in Puna. (McGregor on-line search December 22, 2016)

Figure 15 Hawaiʻi Island with moku of Puna (yellow) and Wao Kele o Puna (white) highlighted (Google Earth)

While the Puna moku (district) does not have running streams, it does have many inland and shoreline springs continuously fed by rains borne upon the northeast tradewinds. (McGregor on-line search December 22, 2016)

Another ʻŌlelo Noeʻau notes "Puna paia ʻala i ka hala. Puna, with walls fragrant with pandanus blossoms. Puna, Hawai'i, is a place of hala and lehua forests. In olden days the people would stick the bracts of hala into the thatching of their houses to bring some of the fragrance indoors. (Pukui 1983:301, verse 2749)

"Puna on Hawaiʻi Island was the land first reached by Pāʻao, and here in Puna he built his first heiau for his god Ahaʻula and named it Ahaʻula [Wahaʻula.] It was a luakini (large heiau where human sacrifice was offered). From Puna, Pāʻao went on to land in Kohala, at Puʻuepa. He built a heiau there, called Moʻokini." (Kamakau 2000:100)

One story tells that Hāʻena, a small bay near the northern boundary of Puna, is said to be the birthplace of hula. The goddess Hiʻiaka is said to have been instructed to dance hula on the beach there. Puna is said to inspire hula because of the natural movements of waves, wind and trees. (Other stories suggest hula was started in other areas of the Islands.) (McGregor on-line search December 22, 2016)

Early settlement patterns in the Islands put people on the windward sides of the islands, typically along the shoreline. However, in Puna, much of the district's coastal areas have thin soils and there are no good deep water

harbors. The ocean along the Puna coast is often rough and windblown. (Escott 2014:11)

As a result, settlement patterns in Puna tend to be dispersed and without major population centers. Villages in Puna tended to be spread out over larger areas and often are inland, and away from the coast, where the soil is better for agriculture. (Escott 2014:11)

This was confirmed on William Ellis' travel around the island in the early 1800s, "Hitherto we had travelled close to the sea-shore, in order to visit the most populous villages in the districts through which we had passed. But here receiving information that we should find more inhabitants a few miles inland, than nearer the sea, we thought it best to direct our course towards the mountains." (Ellis, 1826:163)

Alexander later (1891) noted, "The first settlement met with after leaving Hilo by the sea coast road, is at Kea'au, a distant 10 miles where there are less than a dozen inhabitants; the next is at Maku'u, distant 14 miles where there are a few more, after which there is occasionally a stray hut or two, until Halepua'a and Koa'e are reached, 21 miles from Hilo, at which place there is quite a village". (Alexander in Escott 2014:15)

"Nearly all the food consumed by the residents of this District is raised in the interior belt to which access is had by the ancient paths or trails leading from the sea coast. The finest sweet potatoes are raised in places that look more like banks of cobble stones or piles of macadam freshly dumped varying from the size of a walnut to those as large as ones fist. In these holes there is not a particle of soil to be seen". (Alexander 1891 cited in Hammatt et. al. 2011:156)

Puna was famous as a district for some of its valuable products, including "hogs, gray tapa cloth ('eleuli), tapas made of māmaki bark, fine mats made of young pandanus blossoms ('ahuhinalo), mats made of young pandanus leaves ('ahuao), and feathers of the 'ō'ō and mamo birds". (McGregor 2007:154)

An historic trail once ran from the modern day Lili'uokalani Gardens area to Hā'ena along the Puna coast. The trail is often referred to as the old Puna Trail and/or Puna Road. There is an historic trail/cart road that is also called the Puna Trail (Ala Hele Puna) and/or the Old Government Road. (Escott 2014:15)

It likely incorporated segments of the traditional Hawaiian trail system often referred to as the ala loa or ala hele. The full length of the Puna Trail, or Old Government Road, might have been constructed or improved just before 1840. The alignment was mapped by the Wilkes Expedition of 1804-41. (Escott 2014:15)

With Western contact, extensive tracts of Puna's landscape were transformed, first with sandalwood export, which began in 1790 and reached its peak between 1810 and 1825. (Puna CDP 2008:1-2)

After Hawai'i's first forestry law in 1839 restricted the removal of sandalwood trees, cattle ranching and coffee cultivation became the leading commercial activities. By 1850, agriculture diversified with the cultivation of potatoes, onions, pumpkins, oranges and sugar molasses. (Puna CDP 2008:1-2 - 3)

Before 1900, coffee was the chief agricultural crop in the area. Over 6,000-acres of coffee trees were owned by approximately 200-independent coffee planters and 6 incorporated companies.(HSPA 1992:2)

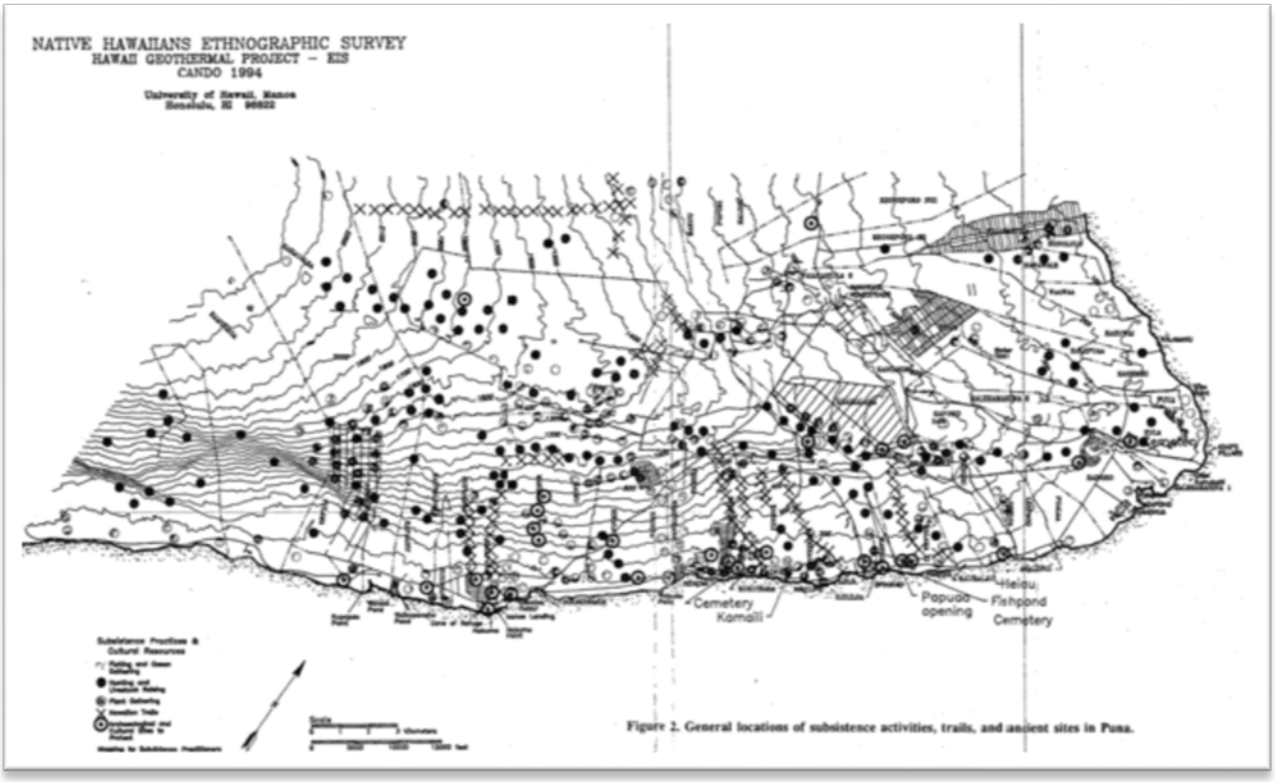

Figure 16 General locations of subsistence activities, trails and ancient sites in Puna (1990 CANDO study, Kumupa'a 2014,350, original scan)

Figure 17 Forest Scenery – Puna c. 1884 (Wikimedia Commons)

Soon, sugarcane was in large-scale production. The dominant operation in Puna was the Puna Sugar Company, whose plantation fields extended for ten miles along both sides of Highway 11 between Kea‘au and Mountain View, as well as in the Pāhoa and Kapoho areas.

Initially founded in 1899 as Ola‘a Sugar Company, it was later (1960) renamed Puna Sugar Company. The coffee trees were uprooted to make way for sugarcane.

‘Ōhi‘a forests also had to be cleared, field rock piled, land plowed by mules or dug up by hand with a pick. Sugarcane was in large-scale production; the sugar mill operation ran for just over 80 years, until 1984.

Macadamia nuts and papaya were introduced in 1881 and 1919, respectively. Since the closure of the Puna Sugar Company, papaya and macadamia nut production have become the leading crops of Puna. About 97% of the state’s papaya production occurs in Puna, primarily in the Kapoho area.

Another thing growing in Puna is housing. Between 1958 and 1973, more than 52,500-individual lots were created - at least 40-substandard Puna subdivisions were created.

As a comparison, O‘ahu is about 382,500-acres in size; the district of Puna on the island of Hawai‘i is about 320,000-acres in size – almost same-same.

Figure 18 Puna Subdivisions – subdivided lots noted in grey (DBEDT GIS over Google Earth)

Ka Wai Ola a Kāne

"Water of Life of Kāne" (Lānaʻi Cultural & Heritage Center)

Wai (fresh water) is the most important resource for life. As such, wai must be considered a top priority in every aspect of land use and planning. The kānaka maoli word for water is wai and the Hawaiian word for wealth is waiwai, indicating that water is the source of well-being and wealth.

The importance of the forest is that it plays a significant role in the water cycle, gathering moisture that is stored in the earth that ultimately finds its way to shore or the ocean, evaporated back into the sky to return as rain once again. As such, the relationship between the wai and the forest is an infinite cycle.

> Fresh water as a life-giver was not to the Hawaiians merely a physical element; it had a spiritual connotation. In prayers of thanks and invocations used in offering fruits of the land, and in prayers chanted when planting, and in prayers for rain, the 'Water of Life of Kāne' is referred to over and over again.
>
> Kāne - the word means "male" and "husband" - was the embodiment of male procreative energy in fresh water, flowing on or under the earth in springs, in streams and rivers, and falling as rain (and also as sunshine,) which gives life to plants.
>
> There are many prayers (referring to) 'the Water of Life of Kāne" ... We also hear occasionally of the "Water of Life" of Kanaloa, of Lono, and of Kū, and even of Hiʻiaka, sister of Pele, a healer. Lono was the god of rain and storms, and as such the "father of waters" (Lono-wai-makua).
>
> The old priests were inclined to include in their prayers for rain and for fertility the names of the four major deities, Kāne, Kū, Lono, and Kanaloa, whose roles, while on the whole distinct, overlapped in many areas of ritualistic and mythological conceptions.

The religion of the folk-planters and fishers - was sectarian to some extent; some worshiped Kāne, some Kū, some Lono, and some Kanaloa. Regardless of all such distinctions, life-giving waters were sacred. (Handy, Handy & Pukui 1972:64) Wao Kele o Puna is a kumu wai (water resource.)

Figure 19 Wao Kele o Puna as a kumu wai (CWRM)

Wao Kele o Puna

The region of forest called wao kele or wao maʻukele "the wet, moist realm" is situated along the rain belt of the island and known for its large canopy trees, including ʻōhiʻa (Metrosideros polymorpha).

George S.H. Kanahele wrote: "The Hawaiians were great ones for delimiting space, drawing imaginary lines on land, across the ocean, and upward through the atmosphere." Each named place was marked by boundaries and separated one space from another. (Kanahele 1986:176)

In many instances, each named space reflected the way Hawaiians and others related to or commemorated that particular space. It was not uncommon for place names to change over time as certain historical events proved significant enough that renaming a space was one way to give recognition to its importance.

Wao Kele o Puna is one such place that has taken on several names since kānaka began interacting with this area. The origin of the name Wao Kele o Puna is rooted in both traditional Hawaiian environmental land divisions as well as a modern parcel designation.

In 1996, Matsuoka et al. conducted an ethnohistory of both Puna and Southeast Maui for the proposed geothermal development in those areas. Pualani Kanahele was consulted to provide insight into the name of Wao Kele o Puna.

Mrs. Kanahele also explained how many of the chants that she is familiar with mention Keahialaka and the Wao Mau Kele O Puna. These are other manifestations of the Pele family. An aunt of Pele and Hiʻiaka is Maʻu. She [Maʻu] has to do with the deep, wet forest. Hiʻiaka has to do with the greenery that grows in the forest. (Matsuoka 1996:209)

Although wao kele and wao maʻukele are traditional Hawaiian terms, a search of early land records and Hawaiian language newspapers of Puna indicates that such terms were not used to demarcate this particular area. However, because wao kele is a traditional term to describe the rain belt region, people may have colloquially used the term wao kele to describe the general region. (Kumupaʻa 2014:223)

Although the name Wao Kele o Puna was legally used to demarcate this parcel of land in the 1970's, it is clear that the name originated from a more ancient Hawaiian understanding of environmental zones. Based on the nature of this area, the name Wao Kele o Puna appropriately describes this land as the area is heavily forested and lush. The forest density attracts rain that in turn provides Puna with an abundance of fresh water. (Kumupaʻa 2014:225)

These forested areas housed the vegetation and materials needed for many things such as voyaging, housing, spiritual and medicinal practices, clothing, adornments, and so forth. Therefore, when people gathered resources from these areas, they did so with certain ritual practices that addressed the spirits of the forest. (Kumupaʻa 2014: 59)

Kōkua Aku, Kōkua Mai (Help and be Helped)

(Reciprocal responsibility to care for the gods, the land, the chiefs, the people and Wao Kele o Puna)

Ko Koā uka, ko koā kai
Those of the upland, those of the shore (Pukui 1983:197, verse 1821)

Mālama - Respect and Care for All

> "E na kānaka, e malama oukou i ke Akua, a e malama hoi i kānaka nui, a me kānaka iki, e hele ka elemakule, ka luahine, a me ke kama, a moe i ke ala, aohe mea nana e hoopilikia. Hewa nō, make!"
>
> O people, respect the gods, respect also the important man and the little man, and the aged men and aged women, and the children sleep along the trailside, and not be bothered by anyone. Failure to do so is death! (Kānāwai Māmalahoe - Law of the Splintered Paddle cited in Kumupaʻa 2014:141)

Mālama nā Akua

> E noho ana ke akua i ka nāhelehele
> I ālai ʻia e ke kīʻohuʻohu, e ka uakoko
> E nā kino malu i ka lani
> Malu e hō ē
> E hoʻoulu mai ana ʻo Laka i kona mau kahu
> ʻO mākou nō ā ē.
>
> The gods dwell in the woodlands
> Hidden away by the mist in the low-hanging,
> blood-red rainbow
> O beings sheltered by the heavens
> Confer upon us your protection
> Laka inspires her kahu
> Free us. (DLNR, Wao Akua 2003:69)

Ola no ka mea akua, make no, ka mea akua ʻole.
He who has a god lives; he who has none, dies. (Pukui 1983:272, verse 2492)

Hawaiian traditions surrounding ritual practice allowed for the reciprocal exchange of mana (spiritual power) between the ʻāina, the akua, and kānaka. These rituals varied from strict ceremonies accompanied by mōhai (offerings) of food and sacrifice, to the utterance of a chant or prayer. (Kumupaʻa 2014:59)

Pualani Kanakaʻole Kanahele, a Kumu Hula, shares about the cycle of life and that Pele and her sister Hiʻiaka continue to play today:

> Pele's very important because she is very visible. And, you know, when there's an eruption, it's very impressive to go and see. And it makes you pay attention, and makes you stop and look and listen and pay attention.
>
> We only look at the Pele family as being the creation of new land. But the Pele family's also the creation of things which grow on the land. That, after Pele goes and spreads her lava all over the land, and the land looks devastated. If you have seen — everybody has seen new eruptions — the land looks devastated and it looks like it's in pain. And it needs to be healed.

Hi‘iaka is that healer. And Hi‘iaka comes and she heals the land. And wherever she walks, things would start growing. So Hi‘iaka then, what Hi‘iaka represents in that family is new vegetation, new growth.

That’s why things of the forest for the hula dancer is important because they represent Hi‘iaka, who in turn give respect to her sister, to Pele. And so this interplay between the two continues. And she continues because she continues the hula that we do. This respect that she keeps giving her sister has to do with the hula that we put on, because we continue to go into the forest and gather all of these things so that we can adorn ourselves with it. And in adorning ourselves with it, we again re-live this respect of Hi‘iaka to Pele, to the one that made the land.

So they’re telling us that the Pele family’s a holistic kind of family. They do all of these kinds of things. So we have to take care of not only the land, but we have to take care of the things that grow on the land.

And so the forest is very much alive for us. And I keep saying this word, that the forest is alive. But the forest is actually life itself, as the land is life itself. The forest is life like we are life. Like we are living, the forest is living. And in order to keep this part of our culture alive and whole, we need the forest. (Kumupa‘a 2014:362-363)

Figure 20 The Gods (Art by Herb Kane)

Malo explains, “Each man worshipped the akua that presided over the occupation or the profession he followed, because it was generally believed that the akua could prosper any man in his calling.”

And so, with this way of life, it became a custom for kānaka to approach any kind of undertaking with the acknowledgement of Hawaiian deities and their various manifestations. (Kumupa‘a 2014:59)

Mālama ka Honua

At the core of traditional Native Hawaiian spirituality is the belief that the land lives as do the ʻuhane, or spirits of family ancestors who cared for the ancestral lands in their lifetime. The land has provided for generations of Hawaiians, and will provide for those yet to come. (Becker & Vanclay 2003 :111)

The land or ʻāina was the provider, and the tenants who were beneficiaries of these resources were obliged to "mālama" or take care of the land. On some occasions, users would offer chants, "hoʻokupu," or a symbolic offering to pay respect to the deities; or in other cases, they would clean an area or even encourage the growth of a wild resource (e.g., maile) by providing food and water to insure its continued health and regeneration. (Kumupaʻa 2014:354)

E mālama i ka ʻāina, a e mālama hoʻi ka ʻāina iā ʻoe
(Care for the land, and the land, in turn, will care for you) (Maly)

"Mālama ʻāina from an Americanized vision is often about beautification, like picking up rubbish. But from a Hawaiian perspective it's a reciprocal relationship based on working with the land, getting to know it, tending it and harvesting food from it." (Johnson; Punahou)

While mālama means to take care of, it also suggests the responsibility to sustain positive patterns of reciprocal caring for the welfare for all. It is demonstrated in the reciprocal exchange between chief and makaʻāinana.

Hawaiian traditions surrounding ritual practice allowed for the reciprocal exchange of mana (spiritual power) between the ʻāina (land, earth) the akua, and kānaka. These rituals varied from strict ceremonies accompanied by mōhai (offerings) of food and sacrifice, to the utterance of a chant or prayer (Pukui et al. 1972, vol.2:122).

The practice of mālama ʻāina (caring for the land) recognizes the importance of collaboration and working as a community with shared interests to protect the land, water and all of its resources. It is the responsibility we individually and collectively share in recognizing the importance of collaboration and working as a community with shared interests to protect the land, water and all the natural and cultural resources in Hawaiʻi for future generations.

George Kanahele notes, "Echoes of the same moral imperative are heard today from naturalists, environmentalists, and poets, among others." W. H. Auden, the noted poet, said, "The great vice of Americans is not materialism but a lack of respect for matter" (i.e., nature). Christopher Derrick, in The Delicate Creation, wrote:

> A society in which Nature was deeply and genuinely respected ... would hardly desire to indulge in the activities that now cause such varied and frightening kinds of trouble .... The kind of society that is likely to survive and prosper is the kind of society in which men would never dream-individually or collectively-of treating Nature in the disrespectfully manipulative fashion, the essentially hostile fashion that we now take for granted ....
>
> Where we continue to fight nature ... humanity will continue to foul its own nest most suicidally, to saw away at the slender ecological branch upon which it perches. We are part of Nature.

Mālama ke Aliʻi

I aliʻi nō ke aliʻi i ke kānaka
A chief is a chief because of the people who serve him (Pukui 1983:125, verse 1150)

As chiefdoms developed, the simple pecking order of titles and status likely evolved into a more complex and stratified structure. This centralization of government allowed for completion and maintenance of large projects, such as irrigation systems, large taro loʻi, large fish ponds, heiau and trails.

On the family scale, ponds to supply the family unit were small and manageable by the family. However, as the population grew, more hands were needed for construction and maintenance. Government could compel the participation of many people to work on these public projects.

The actual number of chiefs was few, but their retainers attached to the courts (advisors, konohiki, priests, warriors, etc) were many. In addition to the expanded demand to provide food for the courts, commoners were also obliged to make new lines of products for the chiefs – feather cloaks, capes, helmets, images and ornaments.

Likewise, as challenges were made between chiefly realms, warfare and the resultant demand for services in combat increased.

The condition of the common people was that of subjection to the chiefs, compelled to do their heavy tasks, burdened and oppressed some even to death. The life of the people was one of patient endurance, of yielding to the chiefs to purchase their favor. The plain man (kānaka) must not complain. (Malo 1898:87)

If the people were slack in doing the chief's work they were expelled from their lands, or even put to death. For such reasons as this and because of the oppressive exactions made upon them, the people held the chiefs in great dread and looked upon them as gods. Only a small portion of the kings and chiefs ruled with kindness; the large majority simply lorded it over the people. (Malo 1898:87)

Mālama ke Kānaka

E mālama i ka mākua, o hoʻomakua auaneʻi i ka haʻi.
Take care of [your] parents lest [the day come when] you will be caring for someone else's.
Mākua includes all relatives of the parents' generation, including their siblings and cousins. (Pukui 1983:42, verse 347)

I kānaka nō ʻoe ke mālama i ke kānaka
You will be well served when you care for the person who serves you. (Pukui 1983:129, verse 1185)

ʻO kāu aku, ʻo kā ia la mai, pēlā ka nohona o ka ʻohana
From you and from him, so lived the family (Pukui 1983:266, verse 2441)

Nāna i waele mua i ke ala, mahope aku mākou, nā pōkiʻi.
He [or she] first cleared the path and then we younger ones followed. (Pukui 1983:247, verse 2265)
Said with affection and respect for the oldest sibling (hiapo).

ʻOhana represents a "sense of unity, shared involvement and shared responsibility. It is mutual interdependence and mutual help. It is emotional support, given and received. It is solidarity and cohesiveness. It is love – often; it is loyalty – always. It is all this, encompassed by the joined links of blood relationship." (Pukui et.al. 1972:171)

Figure 21 Hawaiian Settlement (Art by Herb Kane)

“While each person has their individual role to play within that family structure, they are united by particular obligations to one another, including the ‘obligation to forgive and release (mihi and kala) when asked for forgiveness’.” (Suzuki 2010:172)

“Additionally, the ‘ohana unit also encompassed not only the full extent of its living members but also its ancestors and spirits, thus giving to each member a sense of belonging to the supportive, here-and-now unit of family . . . [and] clear knowledge of his ancestry and an emotional sense of his own link and place in time between his ancestors-become-gods in the dim past and his yet-to-be-born descendants”. (Suzuki 2010:172)

Mālama Wao Kele o Puna

I hea ‘oe i ka wā a ka ua e loku ana?
"Where were you when the rain was pouring?"
A reply to one who asks his neighbor for some of his crop. If he answered that he had been away during the rains, he would be given some food; but if he said that he had been there, he would be refused. It was due to his own laziness that he did not have a crop as fine as his industrious neighbor's. (Pukui 1983:126, verse 1156)

Reciprocal Responsibility

Hawaiian traditions establish a reciprocal relationship between people and living systems. Hawaiian culture evolved in the embrace of native ecosystems, land and sea. As a result, Hawaiians developed an intimate relationship with their natural setting, marked by deep love, knowledge, and respect of these places. Exploring the Hawaiian relationship to the land reveals a service relationship; not land serving people, but people serving the land. (TNC website searched December 26, 2016)

If apathy is the enemy of positive action, then generating a caring relationship is the key to maintaining positive stewardship. Hawaiian cultural elements pertinent to this include the ʻaumakua (ancestral god) relationship, holding that deified ancestors can take the form of native plants and animals, and the related kinolau concept, wherein living plants and animals may be a physical manifestation of a god, and thus held sacred. (TNC website searched December 26, 2016)

The foundations for this relationship can be seen in the Kumulipo, the Hawaiian chant of creation, thousands of lines long, in which people appear long after other living things, which themselves precede even the gods. Hawaiian tradition holds we are the direct kin with the living elements of native ecosystems. Humans are the youngest siblings in the genealogy of creation, and the youngest are charged with care of the family elders. (TNC website searched December 26, 2016)

The natural world extends its kinship influence all the way up to the moral and spiritual basis for behavior; what is allowed and what is restricted. (TNC website searched December 26, 2016)

Wao Kele o Puna's post-Contact history includes activities such as gathering of pulu and sandalwood, ranching, sugar plantations, and logging. Today, remnants of these activities such as old railroad tracks and artifacts like historic glass bottles can still be found in Wao Kele o Puna. (Kumupaʻa 2014:413)

Currently, cultural traditions continue to be practiced and perpetuated within Wao Kele o Puna as illustrated in our ethnographic interview section. Notably, Wao Kele o Puna is still used to gather plants for medicinal and cultural purposes; to hunt pigs for food; and most importantly, to conduct cultural protocols to connect with nā akua, ʻaumākua, and kūpuna. (Kumupaʻa 2014:413)

Native plant restoration and use is intricately connected to the overall health of the Puna forest. Many of the participants noted that Wao Kele o Puna is a place that was traditionally accessed to gather lāʻau for a variety of uses and that these practices must continue to be exercised today. However, many of the native plants that were gathered by practitioners are rapidly dying off so action must be taken to reestablish these significant forest plants.

Many community participants acknowledged that Wao Kele o Puna must be open and accessible to hula hālau for gathering native plants. One hālau member shared that they want to use Wao Kele o Puna as a place to plant and grow native plants used for hula practices, such as palapalai and maile. This participant has also been in contact with other hālau that are interested in planting, gathering, working, and teaching at Wao Kele o Puna.

Other manaʻo shared by the community included the following:

- If people start to replant ʻawa and maile then people will start to use the forest again.
- OHA needs to figure out what can grow in this forest, with the local conditions. This will help them understand what plants should be restored here. They should also figure out why the maile is dying. This plant is so special to the forest and it needs to be protected so future generations have access to it.
- Need to replant native plants, especially plants that you can make crafts out of and sell such as ʻōhiʻa to make ʻōhiʻa posts.

- Have lāʻau lapaʻau and gathering workshops for practitioners.
- Use the forest to help support local food security and sustainability.
- Implement culture, cultural resources, practices, and restoration to make use of this place. Use the natural resources to strengthen one's connection with the place, and to their Hawaiian culture, which is a part of the practice to gather. But the process must be complete.
- So it's not okay just pick, you have to have some kind of way to reciprocate it, such as gathering and replanting someplace else or gathering to feed the trees or gathering to take out invasive plants/bugs.
- Gather and give back to the place for the next generations.
- Being a practitioner doesn't only come with gathering but it comes with taking care and kuleana. This part of the process is still missing. If the resources are being used, practitioners need to have some kind of responsibility to give back to the place.
- The Wao Kele o Puna Forest Reserve contains resources that are vital for maintaining Hawaiian culture and practices. Hawaiians consider native plants and animals as family and have a strong spiritual connection to the mountain landscape and the forest itself. Gathering plants such as ferns, maile, flowers, fruits, and other materials cannot be perpetuated into the future unless the forest remains relatively pristine. (Kumupaʻa 2014:397-398)

Hoʻokahi ka ʻilau like ana.
Wield the paddles together.
Work together. (Pukui 1983:114, verse 1068)

The combination of laulima and kōkua means 'teamwork.' Each member of the group has a clearly defined assignment, but all members are collaborating in lōkahi, or unity, reaching the goals of the whole group.

Figure 22 Canoe Paddlers (Art by Herb Kane)

For all their proofs of aloha, Hawaiians did not tolerate people who took advantage of the 'system.' To believe otherwise is to misread the Hawaiian sense of fair play and reciprocity. Whatever some modern Hawaiians may want to think, pure altruism was not the basis of sharing. Honest labor determined how much reward one man received as his share of the harvest. Given the size and intimacy of the micro-economy, in which no person's actions could go unnoticed, a laggard would not have profited from his laziness. Nonetheless, judging from the number of proverbs warning about the consequences of idleness, improvidence, duplicity, and other related faults, the people of old must have known enough misfits who tried to cheat the system. Still, the stability and vitality of the social economy were established on such values as fair play, reciprocity, and honest effort.

> All this confirms the impression of a society that was controlled and orderly. While some modern folk might prefer to believe that such a disciplined populace was the product of stern and oppressive overlords, credit for that discipline is better given to a willing and obedient people. In Hawaiian society the willingness to give was all-important. This, in turn, was related to two allied values: generosity and hospitality, because both meant sharing one's possessions with others. To the Hawaiian mind the leader of a group, particularly a chief, set the standard of generosity. (Kanahele 1986:347-248).

Wao Kele o Puna is in need of help, not only in order to protect the resources, but also to restore it back to a healthy, native state. It is expected that all who enter the forest will do their share:

- Participate - rather than ignore
- Prevent - rather than react
- Preserve - rather than degrade

No one constituency, no one community, no one resource management entity has the sole responsibility for and jurisdiction over the resources. Each of us shares the responsibility for the protection and preservation of our natural and cultural resources, and Wao Kele o Puna.

E Hoʻopono … E Nihi ka Hele (Behave Correctly … Walk With Caution)

(Appropriate behavior when gathering in the forest; summary of laws protecting gathering rights)

> E hoʻopono ka hele i ka uka o Puna,
> E nihi ka hele, mai hoʻolawehala,
> Mai noho a ako i ka pua o hewa,
> O inaina ke akua, paa ke alanui,
> Aole ou ala e hiki aku ai.
>
> Behave correctly while traveling in the uplands of Puna;
> Walk with caution, do not cause offense;
> Do not tarry and pick the flowers incorrectly,
> Lest the gods become angry and conceal the path,
> And you have no way out. (Emerson 1909:94) (Anderson-Fung & Maly 2009: 28)

Gathering Ethics and Beliefs

Aia nō ka pono - ʻo ka hoʻohuli i ka lima i lalo, ʻaʻole ʻo ka hoʻohuli i luna.
That is what it should be - to turn the hands palms down, not palms up. No one can work with the palms of his hands turned up. When a person is always busy, he is said to keep his palms down. (Pukui 1983:10, verse 71)

A fundamental tenet of Hawaiian belief was the ethical conviction that one must work for the privilege of taking. Hawaiian children were brought up with many ʻōlelo noʻeau (Hawaiian proverbs) that conveyed the same message. The right to use or collect resources was predicated by the responsibility taken in caring for it. (Anderson-Fung & Maly 2009:25)

Gathering of resources from the forest and other areas was strictly controlled by three main factors:

- the values and beliefs of the Hawaiian people;
- the strict, often specialized, gathering protocols; and
- the traditional system of land use, which limited the area from which people could collect

Anderson-Fung and Maly (CTAHR 2009:17-19) describe gathering ethics and beliefs:

> Every aspect of the gathering process, whether mental or physical, spiritual or practical, was reflected in a single guiding principle: “treat all of nature’s embodiments with respect.” The overall effect of this attitude was to minimize the impact of gathering on native ecosystems.
>
> ’Entry chants’ were offered to ask permission of the forest or other plant community for entry and to protect the collector from misfortune. The chants were an expression of the gatherer’s respect for and good intentions toward all of the beings that lived there, including the akua, plants, animals, rocks, streams, etc. Similarly, chants were offered before any plant was collected, out of respect for the plants themselves and for the akua to whom those plants were dedicated.
>
> A quiet demeanor not only displayed the appropriate attitude of respect, but it allowed the collector to be alert to signs that were ‘bad omens.’ For example, some signs might indicate that a particular plant should not be picked for medicinal purposes, as it might make the medicine bad. Other signs might indicate that this was not the right time for collecting anything at all, and that the collector should turn around and go home.

The Hawaiian people followed protocols when they gathered and harvested from native ecosystems. These required that the gatherers prepare themselves spiritually before setting out and that they maintain an appropriate mental attitude before, during, and after collecting the desired materials.

The physical process of gathering always involved going about one's business quietly, asking permission, giving thanks, and treating the plants or animals to be collected - and everything else in their environment - with respect.

Plants and plant parts were removed carefully, and one never took more than was needed. Ferns were broken carefully at the base of the frond, taking care not to uproot the plant. Besides showing appropriate respect for the plant, this conservation ensured that the plant would survive and remain healthy, so that it could produce more fronds later. Similarly, other plant parts were removed in ways that minimized the impact to the plant.

Gathering typically was spaced out in some way, taking a little here and a little there, as expressed just above. According to several other kupuna, the reasoning behind this practice was that it prevented the other plants of the type being collected from becoming lili (jealous) and squabbling among themselves. Ecologically, of course, this practice helped to ensure that no area was completely stripped of a certain plant species and that harvesting could be sustained.

Most people would agree that these gathering principles embody appropriate treatment of those we love and respect. For example, when we enter the home of a friend today, we usually ask permission; we try not to impose on their hospitality or damage their home. So it was that Hawaiians approached gathering from native ecosystems - good manners and plain common sense guided their behavior. (CTAHR - Anderson-Fung and Maly 2009:178-179)

E Nihi ka Helena i ka Uka o Puna

Walk carefully in the uplands of Puna (Kumupa‘a 2014:147)

Walking in the mauka regions of Puna can be extremely hazardous because of the numerous lava cracks hidden by vegetation in the forest (some with over 30-feet vertical drops and 30+ feet wide). Local residents have reported numerous incidents in which individuals and dogs have fallen into the lava cracks and suffered serious injury. In addition, in the event of an emergency, there is no cellular phone service, and difficulty of emergency rescue, etc.

Figure 23 Example of the many huge ‘cracks’ at Wao Kele o Puna (Forest Solutions)

Kīlauea Pu‘u ‘Ō‘ō Eruption

It is not just cracks from old flows that are a problem. Starting in June 27, 2014, lava from the Pu‘u ‘Ō‘ō vent had been over-running Wao Kele o Puna. We must also be cognizant of the ongoing eruption; the flow that headed to Pāhoa ran through Wao Kele o Puna. While the flow is not causing problems in Pāhoa at this time, outbreaks recently covered portions of Wao Kele o Puna. The flow has since been redirected makai of the vent and not affecting Wao Kele o Puna. (Information in this section is from the USGS website, searched December 27, 2016)

Kīlauea’s ongoing Pu‘u ‘Ō‘ō eruption, which began in January 1983, ranks as the most voluminous outpouring of lava from the volcano's East Rift Zone in the past five centuries. By December 2012, flows had covered 125.5 km2 (48.4 mi2) with about 4 km3 (1 mi3) of lava, and had added 202 hectares (500 acres) of new land to Kīlauea’s southeastern shore. Lava flows had also destroyed 214 structures, and resurfaced 14.3 km (8.9 mi) of highway, burying them with as much as 35 m (115 ft) of lava.

The eruption can be roughly divided in to five time periods. From 1983 to 1986, a series of short-lived lava fountains built a cinder-and-spatter cone later named Puʻu ʻŌʻō. In 1986, the eruption shifted 3 km (1.8 mi) northeastward along Kīlauea's east rift zone, where a nearly continuous outpouring of lava built a broad shield, Kupaianaha, and sent flows to the coast for more than five years.

In 1992, the eruption moved back uprift and new vents opened on the southwestern flank of Puʻu ʻŌʻō. Over the next 15 years, nearly continuous effusion of lava from these vents sent flows to the ocean, mainly within Hawaiʻi Volcanoes National Park. The most significant change during the 1992–2007 interval was a brief uprift fissure eruption and the corresponding collapse of Puʻu ʻŌʻō's west flank in January 1997.

In June 2007, an hours-long, unwitnessed eruption uprift of Puʻu ʻŌʻō led to renewed collapse within the cone and a brief hiatus in activity. When the eruption resumed in July 2007, new vents opened between Puʻu ʻŌʻō and Kupaianaha, sending flows to Kīlauea's southeastern coast until early 2011.

This activity was terminated by another short-lived eruption uprift of Puʻu ʻŌʻō in March 2011. Activity at Puʻu ʻŌʻō then resumed with a brief breakout from the western flank of the cone in August 2011, followed by the opening of a new, persistent vent on Puʻu ʻŌʻō's northeast flank in September 2011. Flows from this latter vent remained active on Kīlauea's southeastern flank as of December 2012.

On June 27, 2014, new vents opened on the northeast flank of the Puʻu ʻŌʻō cone that fed a narrow lava flow to the east-northeast. On August 18, the flow entered a ground crack, traveled underground for several days, then resurfaced to form a small lava pad. The sequence was repeated twice more over the following days with lava entering other cracks and reappearing farther downslope.

In this way, the flow had advanced approximately 8.2-miles from the vent, or to within 0.8-miles of the eastern boundary of the Wao Kele o Puna Forest Reserve, by the afternoon of September 3, 2014. Lava emerged from the last crack on September 6, 2014, forming a surface flow that initially moved to the north, then to the northeast, at a rate of 1,300-ft/day). This flow advanced downslope before stalling in Pāhoa on October 30 about 170-yards from Pāhoa Village Road. Breakouts upslope continued to widen the flow within the Wao Kele o Puna property.

Puʻu ʻŌʻō continues to erupt, but the lava flow from it has stopped running through Wao Kele o Puna, but remains as a reminder of the risks associated with the nearby Puʻu ʻŌʻō eruption.

Figure 24 Pu‘u ‘Ō‘ō Eruption / Flow (USGS)

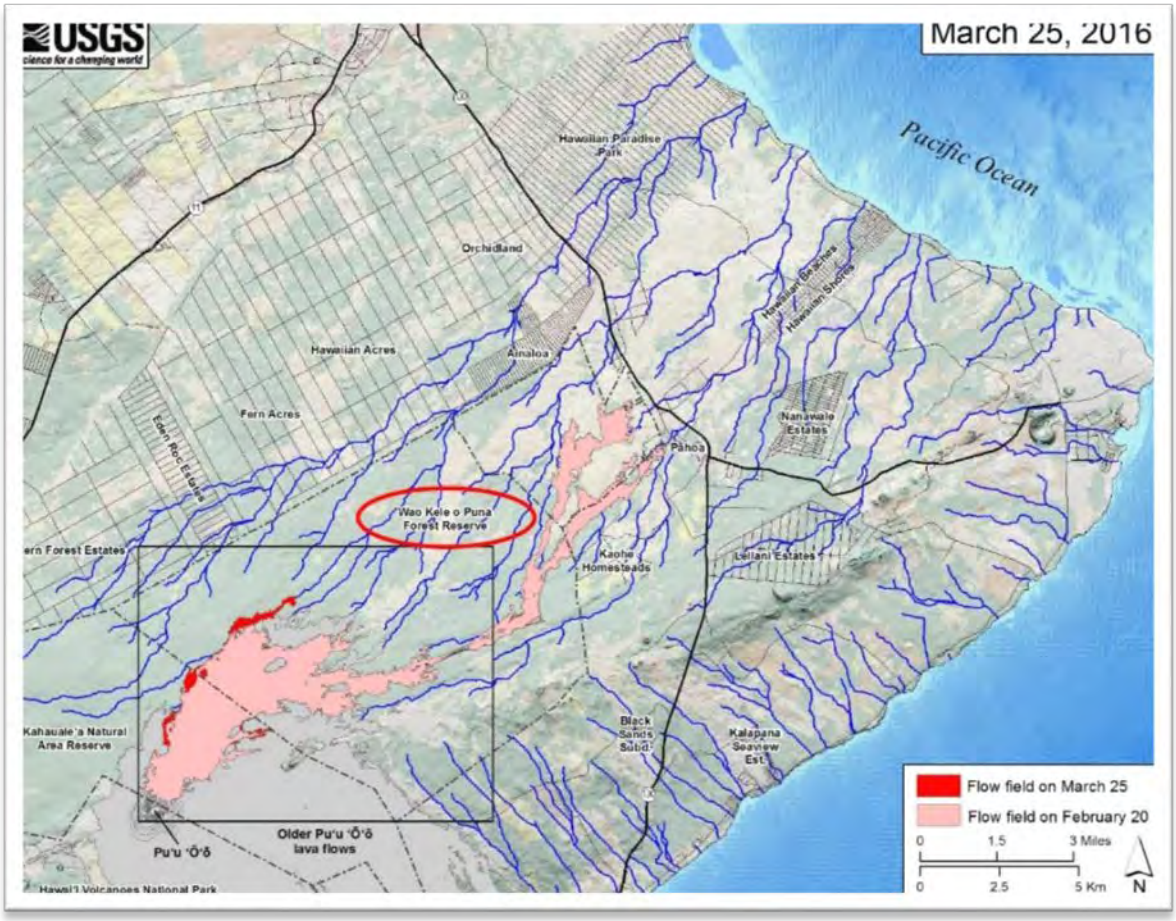

Figure 25 Pu‘u ‘Ō‘ō Lava Flow March 25, 2016 (USGS)

Lava Hazard Zones

The island of Hawai'i is divided into zones according to the degree of hazard from lava flows. Zone 1 is the area of the greatest hazard, Zone 9 of the least. Hazard zones from lava flows are based chiefly on the location and frequency of both historic and prehistoric eruptions. "Historic eruptions" include those for which there are written records, beginning in the early 1800s, and those that are known from the oral traditions of the Hawaiians. Our knowledge of prehistoric eruptions is based on geologic mapping and dating of the old flows of each volcano. The hazard zones also take into account the larger topographic features of the volcanoes that will affect the distribution of lava flows. Finally, any hazard assessment is based on the assumption that future eruptions will be similar to those in the past. (USGS Website)

Hazard Zones for Lava Flows on the Island of Hawai'i

Hazard zones from lava flows on the Island of Hawai`i are based chiefly on the location and frequency of historic and prehistoric eruptions and the topography of the volcanoes. Scientists have prepared a map that divides the five volcanoes of the Island of Hawai`i into zones that are ranked from 1 through 9 based on the relative likelihood of coverage by lava flows.

Zone	Percentage of area covered by lava since 1800	Percentage of area covered by lava in last 750 years	Explanation
1	greater than 25	greater than 65	Includes the summits and rift zones of Kīlauea and Mauna Loa where vents have been repeatedly active in historic time.
2	15-25	25-75	Areas adjacent to and downslope of active rift zones.
3	1-5	15-75	Areas gradationally less hazardous than Zone 2 because of greater distance from recently active vents and/or because the topography makes it less likely that flows will cover these areas.
4	about 5	less than 15	Includes all of Hualālai, where the frequency of eruptions is lower than on Kīlauea and Mauna Loa. Flows typically cover large areas.
5	none	about 50	Areas currently protected from lava flows by the topography of the volcano.
6	none	very little	Same as Zone 5.
7	none	none	20 percent of this area covered by lava in the last 10,000 yrs.
8	none	none	Only a few percent of this area covered in the past 10,000 yrs.
9	none	none	No eruption in this area for the past 60,000 yrs.

Reference

Wright, T.L., Chu, J.Y., Esposo, J., Heliker, C., Hodge, J., Lockwood, J.P., and Vogt, S.M., 1992, Map showing lava-flow hazard zones, island of Hawai'i: U.S. Geological Survey Miscellaneous Field Studies Map MF-2193, scale 1:250,000. (USGS, http://hvo.wr.usgs.gov/hazards/LavaZonesTable.html)

Hazard versus Risk

A volcanic hazard is defined as a destructive event that can occur in a given area or location, such as a lava flow or a volcanic earthquake, along with the probability of the event's occurrence. It is important to be aware of and understand the hazard, but, in a practical sense, nothing can be done to reduce the hazard itself—in other words, volcanic eruptions and earthquakes are beyond human control. Hazard assessments are done by physical scientists, such as the volcanologists at the USGS Hawaiian Volcano Observatory (USGS website searched December 27, 2016).

Figure 26 Lava Hazard Zones – Wao Kele o Puna is in Zones 1, 2 & 3 (Google Earth)

Risk, which is quite different from hazard, is defined as the hazard, multiplied by the vulnerability (the proportion of some resource, like people or land likely to be affected if the event occurs) multiplied, in turn, by the value (lives or property threatened).

In shorthand: Risk = Hazard x Vulnerability x Value.

Risk can be mitigated—i.e., people can take actions to reduce their risk to a particular hazard. Risk assessment and mitigation involve social scientists who have expertise in determining "value" and "vulnerability" as defined in the above formula. (USGS website searched December 27, 2016)
Example of hazard versus risk: In Washington, Mount St. Helens poses many volcanic hazards, such as lava flows and ash fall, as well as high risk, because nearby and surrounding communities (people) and associated infrastructure (homes, roads, schools, etc.) could be threatened by an eruption. On Jupiter's volcanically active moon, Io, there are abundant volcanic hazards, but no risk, because human lives and property are not threatened by the eruptions. (USGS website searched December 27, 2016)

US Department of Housing and Urban Development Policy (HUD) on Lava Flow Zones

As an indicator of the underwriting and conditions that entities face in respective lava zones, because of potential volcano activity, FHA mortgage insurance is not available in lava flow zones 1 and 2 Areas. This conclusion may affect underwriting that OHA may face if it intends to insure any improvements on the site. The site is within the Lava Hazard Zones 1, 2, and 3.

HUD, in consultation with USGS geologists at the Menlo Park Center in California and at the Volcano Observatory, reviewed 20 volcanic zones involving lava flows, subsidence and ground fracture, tephra falls, volcanic gas, and pyroclastic surge. Ultimately HUD identified two zones as being particularly hazardous. These are defined by the USGS Observatory as lava flow zones #1 and #2 ((http://quake.wr.usgs.gov/ http://hvo.wr.usgs.gov/hazards/lavazones/main.html).

- "Zone #1 consists of the summit areas and active parts of the rift zones of Kīlauea and Mauna Loa…"
- "Zone #2 consists of several areas that are adjacent to and downslope from the active rift zones of Kīlauea and Mauna Loa and therefore are subject to burial by lava flows of even small volume eruptions in those rift zones."

Figure 27 Lava Flow at Wao Kele o Puna – skirting the former Geothermal Site in the cleared area (Big Island Video News)

It was concluded that these two zones should be classified as non-participation areas for the purpose of HUD program assistance. For the purpose of simplification and ease of administration the two zones were integrated so that a single (composite) zone or non-participation boundary line provides the basis for HUD's volcanic hazard policy.

Hawaiian Lava Flow Maps and other information on this can be located on line at the USGS Hawaiian Volcano Observatory site (http://hvo.wr.usgs.gov/).
Select Lava Zones (http://hvo.wr.usgs.gov/hazards/lavazones/main.html).
(From HUD Website; http://archives.hud.gov/offices/hsg/sfh/ref/sfh1-18i.cfm)

He keiki aloha nā mea kanu

Beloved children are the plants (Pukui 1983:76, verse 684)

The forests, as the home of the akua, were seen as awesome and profoundly spiritual places. One did not enter them, or take from them, without first asking permission, and respectful behavior was always shown to all of the beings that lived there. (Anderson-Fung & Maly 2009:15)

The gathering of plants served many important cultural purposes. Plants were consumed for food and medicine (e.g., the bark of the root of the ʻuhaloa was used for sore throat), used as tools and building materials, art, and adornments. (Kumupaʻa 2014)Participants in the Wao Kele o Puna ethno-historical analysis noted that Wao Kele o Puna has been traditionally accessed to gather lāʻau (plants, wood) for a variety of uses, and these practices must continue to be exercised today.

1. Native Out-planting: Because many of the native plants gathered by practitioners are rapidly dying off, it was recommended that action be taken to replace and reestablish these valuable forest plants.

2. Cultural Access: Community participants recommended that Wao Kele o Puna be kept open and accessible to cultural practitioners such as hālau hula, artists, and lāʻau lapaʻau healers for native plant gathering. (Kumupaʻa 2014:15)

Papa Henry Auwae, a prominent Kahuna Lāʻau Lapaʻau (Hawaiian herbalist), spoke of some of the different medicinal plants and herbs at Wao Kele o Puna (and concern for the plants that had been impacted by the prior contemplated geothermal use):

> Plenty lāʻaus out here. Kōpiko. Oh boy. Oh my, the lama and the ʻōpikos are all down. You see this tree here? Oh, my goodness. This is ʻōpiko, this tree here. And the bark, all this bark here is all wasted already, you see. Poho, all this, all wasted.
>
> And this is, we can use this for — you know, a woman when they miscarriage, all the time miscarriage. And this is the kind of bark we use for tea, make it into a tea form. But this is all waste. How many years this thing old? Oh, my goodness, cannot get anything. Poho.
>
> You cannot get a tree like this to grow overnight. It takes years. And this kind of tree, they don't grow too fast, they grow real slow, very slow. That one here took about 300 years, 300, 400 years. This is all waste, waste, wasted forever.
>
> And this is the kind of thing, we should stop people like this desecrating the forest. Why don't they see people like us Hawaiians and we can help them, you know, go into a place like this and then try and save our herbs, out trees, you know, our lifestyle, instead of just waste it for themselves, through greediness. They like all the money. But how much life can they save? I can save life. Can they save life?
>
> And this tree is gone forever. We cannot get this tree back in life again. And how many more trees like this that they had damaged and wasted? Cannot tell. We have use of the forest, we have the use of all the herbs in the forest to save people, to save human life.
>
> And every time I walk and I see in a forest like this, I feel, I feel for the ʻāina. I feel what my grandmother taught me about the lāʻaus, how long it takes for the lāʻau to grow. And people just come over here with a bulldozer and just knock it down. They don't think, they don't have any feelings.
>
> You see that small leaves there? ʻOluʻolu. That's another medicine that we use. And it's very scarce and very

rare. This root here is important. This root here I would take this for medicine now. And I'm going to take this home for medicine right now. ʻOhu nui. See

For a person, I have a person coming up and he has been losing his voice; he cannot talk. So this is what we're going to use to try and bring his voice back again. In a forest like this, there are a lot of lāʻau that can cure people. People all over the world you can cure. (Nā Maka o ka ʻĀina 2005:7-8; Kumupaʻa 2014:364-365)

Forest Gathering

Hawaiians utilized upland resources for a multitude of purposes. Forest resources were gathered not only for such basic needs as food and clothing, but also for tools, weapons, canoe building, house construction, dyes, adornments, hula, and medicinal and religious purposes. (Kumupaʻa 2014:376) The majority of historical and archaeological research conducted in and around the current Wao Kele o Puna property describes the area as an isolated and inhospitable rain forest with only sparse human activity.

The limited types of activities occurring in the area included resource gathering, plant cultivation, bird catching, transportation trails, temporary habitation, and burials (and later pig hunting). However, despite these activities occurring in Wao Kele o Puna, most researchers agreed that limited archaeological evidence of these activities exist today. The two types of cultural sites that are most likely to be located in Wao Kele o Puna today are trails and lava tube features, such as burials. (Kumupaʻa 2014:336

Figure 28 Wao Kele o Puna (Kumupaʻa)

While most portions of the pre-contact trails would be grown over with thick vegetation, on ʻāʻa and pāhoehoe lava flows, the trails could be identified as worn paths, stepping stone paths, lined paths, or cleared paths. Locating campsites along the trails is also probable but highly unlikely. (Kumupaʻa 2014:337)

Campsites would contain evidence such as stone artifacts, shell or bone food remains, or fire pits. Burials in forest areas have been identified in two forms -- burials in caves and in stone platforms on cinder cones. Both types of burial features are likely to be uncovered as additional research and surveying occurs within Wao Kele o Puna. (Kumupaʻa 2014:336)

According to informants in the Wao Kele o Puna ethno-historical analysis, Puna was renowned throughout the Hawaiian Islands as a special gathering place for flora and fauna, especially for hālau hula. The plants in Puna were highly valued because of their colors, shapes, and fragrance, and because they grew in an environment fed by unique natural and spiritual elements. The following summary relates to gathering practices within the district of Puna. Plants gathered by community members in Wao Kele o Puna include:

- Maile - Fragrant maile leaves are used to make lei. Puna maile is renowned for its sweet fragrance.
- Māmaki – The māmaki leaves are dried out and prepared to make tea and dyes and for use as a tonic and laxative.
- ʻAwa – The narcotic ʻawa roots are used as medicinal remedies for a variety of ailments, and the entire plant is also a common offering in ceremonies.

- Palapalai – The fern, often gathered by hula practitioners, is used to make lei and other adornments.
- Hāpuʻu – In historic times, pulu was used to make pillows and mattresses. Today, hāpuʻu is more commonly gathered for the young fronds that are cooked and eaten.
- ʻŌhiʻa Lehua – The lehua flowers are gathered for hula adornments.
- ʻUkiʻuki – This plant is gathered to make wreaths.
- ʻIeʻie – The strong ʻieʻie vines are gathered to make fishing implements. (Kumupaʻa 2014:376)

Maile and Other Plant/Herbs

Plant gathering occurred throughout the year, although, some species had cyclical qualities regarding dormancy and regrowth. Maile had periods of regrowth according to the rains; yet if one picked its leaves throughout the year it would continue to provide new growth. It was important to not pick all of leaves so as to not kill the shrub. (Kumupaʻa 2014:356)

The various fruits were gathered seasonally according to when they ripened. Some respondents reported that they altered existing environmental conditions in order to create a habitat that was ideal for a particular plant to grow. For example, one respondent reported that maile thrived in wet places where it was not constrained by competing plants and he encouraged maile growth by clearing away other plants. (Kumupaʻa 2014:356)

Informants generally had distinct areas or secret places where they gathered plants; others who wished to venture into these areas were obliged to ask permission. (Kumupaʻa 2014:356)

Maile was often picked for occasions like birthday parties or graduations. One had to journey to the higher regions because it didn't commonly grow in the lower elevations and more people were picking it commercially. It was picked in numerous areas including the Kaimu forest and in Wao Kele o Puna. (Kumupaʻa 2014:357)

Some of the pickers said that they often gathered plants such as maile or lama because of requests by other Hawaiians from outside Puna who wanted to use it for decorations, festivals, temples, or "hoʻokupu" (offering).

Herbs were once gathered from all along the sea coast of Puna. One informant mentioned that they were no longer as plentiful because of recent land developments, but they were still plentiful in the forest reserve area.

Those who engaged in lāʻau lapaʻau (herbal medicine) were dependent upon a healthy forest where they could gather native herbs and plants.

They reported that the plants gathered in Wao Kele o Puna were essential to their practice and possessed a quality and potency unlike that found anywhere else.

Mats and Kapa Māmaki

The people of ʻŌlaʻa and other interior parts of Puna were known to produce very fine mats and kapa made from the bark of the māmaki, sometimes spelled māmake (Pipturus sp.) plant (Burtchard et al. 1994:48). Māmaki grew readily in the region and sparked another economic venture for those skilled in preparing kapa from the māmaki plant.

Figure 29 Māmaki (Kumupaʻa)

Around the late nineteenth century, as the Hilo-Kīlauea trail became more popular with visiting tourists, several Native Hawaiians and other foreigners established interim houses along the trail. In particular, one man by the name of Kanekoa was known to sell kapa māmaki as souvenirs to travelers.

Other accounts tell of kapa māmaki from Puna that were sold at markets in Hilo. Because māmaki can still be found growing vigorously in Wao Kele o Puna, it is likely that people accessed patches within the Wao Kele o Puna area to produce kapa and other items made of māmaki. (Kumupaʻa 2014:210)

Olonā Fiber

Cultivating and manufacturing olonā fiber was another well-documented Puna industry. Many accounts about olonā reference the interior parts of Puna as a place renowned for producing this highly valued fiber. In 2011, isolated patches of olonā were located within Wao Kele o Puna by Cheyenne Perry and colleagues (personal communication Cheyenne Perry, February 6, 2013). It is highly probable that these olonā patches played a role in Puna's historical industries as well as the various occupations that utilized this prized resource such as the kia manu and lawaiʻa (fishermen) from Puna.

In preparing an area for planting olanā, the ground had to be cleared by cutting ferns, weeds, and trees. Suitable localities were too wet for clearing. Shoots from roots, or cuttings, were planted so thickly that when the plants were in full growth a man could not pass through. Cultivated patches of two or three acres were common. The mature plants were from 4 to 8 feet high, and it took a year for them to mature. The stalks by then were woody and the bark would come off easily. (Handy & Handy 1977:225-226)

Kamakau provides a detailed description of a technique used to cultivate olonā in the forest:

> In the old days every chief had an olonā plantation somewhere in the mountains above the lower edge of the forest. The fiber was not derived from wild plants, but from semicultivated areas where the fern and underscrub has been cleared away to permit the better development of this shrub. The stems of the plant were cut partially through just at the surface of the ground and were bent over or broken down so that a multitude of slender shoots or suckers should be thrown up. (Kumupaʻa 2014: 212)

When the olonā reached about ten feet tall and about one to two inches thick, it was ready for harvest. A plant that was too old or too young was not preferred. The olonā was cut above the roots to encourage the growth of new shoots, and the bark that contained the prized fibers was stripped and made ready for processing. After the bark was rolled and soaked for several days, the outer bark was removed leaving only the fibrous tissues used for cordage. The fibrous tissue was then scraped with a shell scraper on a moistened board to remove the slimy substance covering the inner surface. Once scraped and free of slime, the fibers were hung in the sun to dry. (Kumupaʻa; 2014:212)
According to an article by Kamakau, translated by Thrum, when a plantation of olonā was ready for harvesting,

sheds were built nearby for storing the stalks. For processing the fiber, sheds were built near running water. Here men, women, and children gathered. The bark was stripped off the cut stalks and was hung to drain in the sheds. Strips of bark were laid in water, left for only a short time (a day or two) lest the bark become too soft, which would make the fiber brittle when dry. Kamakau then says:

> A narrow board a fathom and a half in length, about five inches in width, and a half inch or so in thickness is prepared, shaped tapering at one end so that it may be fastened to a stake driven in the ground to keep it firm, the upper end of the board resting on a block of wood to give it some slant, to free the work from undue moisture.
>
> The instrument with which to scrape the olonā bark, called the uhi, is made from the back-bone of the turtle or its shell. The sides of one end ... bevelled to the sharpness of an adz, after which it is rubbed down with a piece of hard coral. ... It was shaped and tested so as to fit closely on the board on which the olonā was to be prepared, so that the fiber would not be rendered short and stumpy.... Next, place the bark lengthwise on the board and with the scraper in the right hand, hold down the end of the bark upon the board. Then move the scraper forward and flatten the bark in front of it, continuing along in this manner until the whole bark has been scraped .... (Handy & Handy 1977:226)

Figure 30 Olonā (Kumupaʻa)

Olonā grows best on the windward slopes, above the 2,000 feet elevation, in regions with great rainfall (Kamakau 1976:52). Prior to the 1920's, Vaughan MacCaughey from the College of Hawaiʻi sought the skill and expertise of a kamaʻāina of ʻŌlaʻa on the harvest and preparation of the olonā fiber. (Kumupaʻa; 2014:212)

The olonā trade was a source of considerable profit to the king and his chiefs. An account written by Kamakau indicates that as late as the 1870s, Kalākaua levied a tax on olonā fiber from the natives of Puna and ʻŌlaʻa, which he sold at high prices to Swiss Alpine clubs, who valued it for its light weight and great strength. Holmes suggest that the olonā business in Puna was probably greater during post-contact times than pre-contact times due to the increase in foreign demand for this sturdy and lightweight fiber. (Kumupaʻa; 2014:214)

Native Plant ID Cards

The information presented below was gathered from educational flashcards that showcase a handful of Native Hawaiian plants found in Wao Kele o Puna. These flashcards were created as a sample educational tool that OHA could utilize to bring awareness to the native flora and fauna of Wao Kele o Puna. The focus of these flash cards is to integrate both scientific and cultural knowledge to create a foundation of information that can be explored and built upon.

Each card provides the scientific and Hawaiian names of the plant species, a photo of the plant, flower, and seed for identification, information about where the plant is typically found, information about when a seed is ready to be collected for propagation, and a brief innuendo of cultural information associated with the specific plant species. The plants that were chosen for these ID cards include: maile, lama, ʻōhāwai, pāpala kēpau, alani, hame, ʻohe, ʻahakea launui, manono, ōpuhe, and olomea. (This Plant ID section is entirely from Kumupaʻa 2014:43-49)

Maile

Apocynaceae, Alyxia olivaeformis
Ka makani hali ʻala o Puna

Figure 31 Maile (Kumupaʻa)

The fragrance bearing wind of Puna

Puna, Hawaiʻi was famed for the fragrance of maile, lehua and hala. It was said that when the wind blew from the land, fishermen at sea could smell the fragrance of these leaves and flowers. (Pukui 1983:158, verse 1458)

This is a Native Hawaiian endemic vine that is found on all of the main Hawaiian Islands except for Kahoʻolawe and Niʻihau. It is found growing in dry open sites, mesic forests, and closed wet forests from near sea-level to 6,500-ft. When fruits are mature and purplish they can be collected for propagation.

Maile is one of the five standard plants used for the hula kuahu (altar) in dedication to Laka, the goddess of Hula. Maile is also associated with the forest spirits of the four Maile sisters, famed in the moʻolelo of Lāʻieikawai. The Maile sisters include Maile Haʻiwale "the brittle maile", Maile Pākaha "the hedging maile", Maile Lau Nui "the big-leafed maile", Maile Lau Liʻi "the small-leafed maile". Sometimes Maile Kaluhea "the fragrant maile" was also believed by some to be a sister. This vine is also used to scent kapa and make fragrant lei.

Lama, Ēlama

Ebenaceae, Diospyros sandwicensis
Ka lama kū o ka noʻeau

Figure 32 Lama, Ēlama (Kumupaʻa)

The standing torch of wisdom

Said in admiration of a wise person (Pukui 1983:155, verse 1430)

Lama is an endemic Native Hawaiian tree that is found on all of the main Hawaiian Islands except for Kahoʻolawe and Niʻihau. It is found growing in low-land dry forests and mesic dry forests from sea-level to 4,000 ft. Each fruit contains one to three brown seeds. When the oval fruit are ripe and bright yellow to red in color they can be collected for propagation.

Lama meaning "light" is believed to have the quality of enlightenment. It is one of the five standard plants used for the hula kuahu (altar) in dedication to Laka, the goddess of Hula. A piece of lama wood was wrapped in yellow kapa and placed on the kuahu as an embodiment of Laka.

Lama wood was used for heiau construction, fencing for sacred sites, house posts, fish traps, and tide gates, lāʻau lapaʻau (traditional medicine), fruit for food and liko for lei making.

ʻŌhāwai, Hāhā
Campanulaceae, Clermontia parviflora
Kōkua aku, Kōkua mai

One who helps, receives help in return

Certain Hawaiian birds depend on ʻŌhāwai for food. As they eat, they also help to pollinate these plants. (Pukui 1983:130, verse 1200)

ʻŌhāwai is a native Hawaiian endemic understory plant. It is found growing in bogs, mesic, and wet forests within the 395-4,790ft. elevation. This plant is naturally pollinated by honeycreepers like the ʻIʻiwi and ʻAkialoa.

Figure 33 ʻŌhāwai, Hāhā (Kumupaʻa)

ʻŌhāwai can be propagated by seeds and cuttings. When fruits are ripe and yellow, orange, red, or purple they can be collected for propagation. ʻŌhāwai can be used as food for birds and humans. The leaves are boiled before eating and the fruits can be eaten fresh. This plant is also used for lāʻau lapaʻau.

Pāpala Kēpau or Pāpala
Nyctaginaceae, Pisonia brunoniana
Waiwai ke ola o ka Wao Kele o Puna, ke ʻume nei i ke aokū no ka wai o ka ʻāina

The health of Wao Kele o Puna is important, attracting the rain clouds that bring fresh water to the land.

Pāpala kēpau is an indigenous native Hawaiian tree that is found on Hawaiʻi Island, Maui, Molokai, Lānaʻi, and Oʻahu. This tree grows in dry and mesic forests. Pāpala kēpau can be propagated by seed. When the fruits are brown and dry they can be collected for propagation.

Traditionally, the kia manu (bird catchers) would place the sticky pāpala kēpau fruits on trees or tall poles to catch birds for their feathers.

Figure 34 Pāpala Kēpau or Pāpala (Kumupaʻa)

When a bird got stuck, the bird catcher would pluck the desired feathers, clean off the birds feet with kukui nut oil, and release the bird back to the forest. The feathers were used for feather work such as lei, helmets, and cloaks for the aliʻi.

Alani or Kūkaemoa
Rutaceae, Melicope clusiifolia
Hahai nō ka ua i ka ululāʻau

Figure 35 Alani or Kūkaemoa (Kumupaʻa)

Rain always follow the forest

The rains are attracted to forest trees. Knowing this, Hawaiians hewed only the trees that were needed. (Pukui 1983:50, verse 405)

Alani is a Native Hawaiian endemic tree found on all of the main Hawaiian Islands. It is found growing in mesic and wet forests within the 3,850-5,150ft elevation. This tree can be propagated by seed.

When the fruits are greenish-brown and dry they can be collected for propagation. Alani was one of the woods used for poles in rigging canoes. It is also used for lāʻau lapaʻau.

Hame, Hamehame, Mehame Haʻā, Haʻāmaile
Euphorbiaceae, Antidesma platyphyllum

Figure 36 Hame, Hamehame, Mehame Haʻā, Haʻāmaile (Kumupaʻa)

Hame is a Native Hawaiian endemic tree that is found on all of the main Hawaiian Islands except Kahoʻolawe and Niʻihau. It is found growing in mesic and wet forests. This tree can be propagated by seed. When fruits are mature and reddish-purple, they can 47 be collected for propagation. Hame wood was used to make house frames and anvils for preparing olonā fiber. The fruit can also be used to dye kapa dark purplish-red.

ʻOhe or ʻOheʻohe
Araliaceae, Tetraplasandra hawaiiensis
ʻĀina i ka haupo o Kāne

Figure 37 ʻOhe or ʻOheʻohe (Kumupaʻa)

Land on the bosom of Kāne Puna, Hawaiʻi.

It is said that before Pele migrated there from Kahiki, no place in the islands was more beautiful than Puna. (Pukui 1983:11, verse 79)

This native Hawaiian endemic tree is found on Hawaiʻi Island, Maui, Molokai, and Lānaʻi. It grows in mesic and wet forests within the 500–2600ft elevation. ʻOheʻohe can be propagated by seed. When the fruits are ripe, purple, and shedding from the tree, they are ready to be collected for propagation.

‘Ahakea Launui
Rubiaceae, Bobea elateor
‘O kane iā Wai‘ololī

Figure 38 ‘Ahakea Launui (Kumupa‘a)

Wai‘ololī is the product of males
‘O ka wahine iā Wai‘ololā Wai‘ololā is the product of females
Hānau ka Okea noho i kai Born is the Okea living in the sea
Kia‘i ‘ia e ka ‘Ahakea noho i uka Guarded by the ‘Ahakea living on land
(Kumulipo, line 431-433)

‘Ahakea launui is an endemic native tree that is found growing in mesic and wet forests on all main Hawaiian Islands except for Kaho‘olawe and Ni‘ihau. This tree can be propagated by seed. When fruits are soft and dark purple they can be collected for propagation.

‘Ahakea launui wood is yellow or reddish. It was used for papa ku‘i ‘ai (poi boards) and canoe construction. It was a favorite wood for making mo‘o (gunwale strakes of a canoe), lā‘au ihu (the bow end piece of a canoe), and lā‘au hope (the end piece of a canoe). This wood was also used for frames of doorways and doors. In addition, parts of this tree are used for lā‘au lapa‘au.

Manono
Rubiaceae, Hedyotis terminalis

Figure 39 Manono (Kumupa‘a)

Manono is a Native Hawaiian endemic understory plant that is found on all of the main Hawaiian Islands. It grows in mesic and wet forests. Manono can be propagated by seed.

When the small fruit capsules are dry, the seeds can be collected and used for propagation. Manono was one of the trees used for furnishing canoe timber. It was also used for canoe trim and rigging.

Ōpuhe, Hōpue, Hona
Urticaceae, Urera glabr

Figure 40 Ōpuhe, Hōpue, Hona (Kumupa‘a)

Mahea ka pūlelehua ‘o Kamehameha? Wahi a ka lohe, ‘a‘ole nui. Aia lākou e lele nei ma luna o ka ōpuhe o ka Wao Kele o Puna, ‘o ia ho‘i ka hale o ka pe‘elua.

Where are the Kamehameha butterflies? According to what people say there aren’t many left. They are found flying above the ōpuhe of Wao Kele o Puna, a home for the caterpillar.

Ōpuhe is a Native Hawaiian endemic tree that is found on all main Hawaiian Islands except Kaho‘olawe and Ni‘ihau. It grows on slopes and gulch bottoms in mesic and wet forests within the 500–5500-ft elevation. Seeds and cuttings can be used for propagation.

Ōpuhe is in the same family as Māmaki and can also be used to make kapa. The Kamehameha butterflies can use Ōpuhe to lay their eggs on and their caterpillars can eat the leaves for food.

Traditionally, fibers from the Ōpuhe bark were made into cordage and used for fishing nets. In addition, parts of the Ōpuhe are also used for lāʻau lapaʻau.

Olomea, Puaʻa Olomea
Celastraceae, Perrottetia sandwicensis

Figure 41 Olomea, Puaʻa Olomea (Kumupaʻa)

E ʻimi i ka olomea	Search for the olomea
E ʻimi i ka hau	Search for the hau
Inā loaʻa	If it is gotten
hiki ke hiʻa ahi	the fire can be started

Olomea is a Native Hawaiian endemic understory plant that is found on all main Hawaiian Islands except Kahoʻolawe and Niʻihau. It is found growing in wet forests within the 300-1,830-ft elevation.

This plant can be propagated by seed. When its fruits are bright red they can be collected for propagation.

Olomea is one of the plant forms associated with the pig god Kamapuaʻa. He took this form when he was pursued by Pele. The wood was used with soft hau wood to produce fire by rubbing (hiʻa ahi).

Large tracts of forest had vanished under recent lava flows or been plowed over in favor of subdivision development.

The disappearance of forested areas or the loss of access to traditional grounds placed a higher value on remaining areas**.**

Those displaced by the loss of plant resources, who were seeking new areas, and the intrusion of those from outside Puna placed greater strains on not only the resource but on traditional protocols regarding an understanding and respect for tenant rights.

Wild animals were also blamed by some gatherers for some of the damage. Pigs were not known to eat maile but sometimes dug them up by the roots. Wild cows ate the maile when they were desperate but became ill because of the sticky residue.

Many informants suggested that hunting was the most viable means to control the wild animal population and maintain a healthy rainforest. (Kumupaʻa 2014:357)

Hānai Puaʻa Wahine, Maloko ka Uku

Raise a sow, for her reward is inside of her
A sow will bear young. (Pukui 1983:55, verse 456)

Puna is well known for its fertile hunting grounds, and the hunters explain that they and their families had been hunting in Puna for decades – some, for generations. These hunters cautioned, however, that hunting in this area of the island is extremely hazardous because of the numerous lava cracks in the Wao Kele o Puna forest. (Kumupaʻa 2014:378)

They strongly cautioned individuals wishing to hunt in the area to become familiar with the dangerous environment and terrain. There have been numerous incidents in which individuals and dogs have fallen into the lava cracks and suffered serious injury. (Kumupaʻa 2014:378-379)

History of Ungulates in Hawaiʻi

Ungulate introductions to Hawaiʻi

- Polynesian pig – ca 1000 AD (Kirch)
- European swine – 1778
- Goat – 1778
- Sheep – 1791
- Cattle – 1793
- Horse – 1803
- Donkey – 1825
- Axis deer – 1868
- Mouflon sheep – 1954
- Pronghorn – 1959*
- Mule deer – 1961

* Now extirpated (Maly, Pang & Burrows 2010:3)

"Goats were introduced in Hawaiʻi nearly simultaneously with the European pig, followed shortly thereafter by sheep, cattle, horses and donkeys. Introduction of this working stock accelerated the spread of western agriculture in the islands." (Maly, Pang & Burrows, 2010:3)

"This change, along with a growing westernization of traditional concepts of property rights and the decline of the Hawaiian population helped contribute to the collapse of traditional Hawaiian land management systems." (Maly, Pang & Burrows 2010:3)

These introduced animals browsed, trampled, and rooted up sensitive native plant species, converting rich native forest into pasture land or worse. Together with unsustainable ʻiliahi (sandalwood) harvests, this animal-induced degradation of native forests took its toll and predicated the watershed crisis of the late 19th century. (Maly, Pang & Burrows 2010:3)

Widespread fencing, feral animal control and forest restoration were undertaken in an attempt to reverse the damage. On June 22, 1878, King Kalākaua himself led a group to plant trees: "We learn that His Majesty, the King, with a party of attendants, makes a visit to the head of Nuʻuanu Valley today for the purpose of setting out trees. A most praiseworthy undertaking on his part, and an excellent example to his people." (Pacific Commercial Advertiser, June 22, 1878)

Pigs are not native to Hawaiʻi. The first pigs were brought to the Hawaiian Islands by the early Polynesians that came

to the Islands. It is suggested that initial Polynesian discovery and colonization of the Hawaiian Islands occurred between approximately AD 1000 and 1200. (Kirch) The feral (wild) pigs that roam forests today are a cross between the Polynesian pig and the later-introduced European boar.

> "It is well documented that feral pigs ranging through Hawai'i's upland forests today bear little physical or cultural resemblance to the smaller, domesticated pigs brought to the islands by voyaging Polynesians. It remains a popular misconception that pigs are native to Hawaiian forests and that pig hunting was a common practice in ancient Hawai'i." (Maly, Pang & Burrows, 2010:1-5)

Figure 42 Pua'a in Forest (Hawai'i Volcanoes National Park)

"Originally, pua'a enjoyed a close relationship with their human families and rarely strayed far from the kauhale (family compound). Well developed taro and sweet potato agriculture in ancient Hawai'i was incompatible with uncontrolled pigs, and there is every indication that pigs were both highly valued and carefully managed sources of protein. Pua'a were an integrated part of Hawaiian households, and the common presence of pā pua'a (pig pens) reflects the controlled, physically compartmentalized nature of pig management in traditional Hawai'i."

"Notwithstanding, small populations of loosely controlled and free-roaming animals existed in ancient times. Traditional and historic evidence indicates that these animals remained largely domesticated, living mainly on the periphery of kauhale and extending into lowland forests."

"They continued to rely largely on the food and shelter provided by the kauhale. This is because in pre-contact times, native Hawaiian forests were devoid of large alien fruits such as mangos and guava, and major protein sources, such as non-native earthworms, that would eventually support the large feral

populations of pigs today. Without such fodder, these early roaming populations would have been chiefly dependant on people for their survival."

"In contrast, current feral pigs are largely derived from animals introduced after western contact. Captain James Cook, for example, brought European pigs during his first voyage to Hawai'i, and many other introductions of European and Asian swine followed. Over time, the Polynesian pua'a interbred with and were mostly displaced by these larger animals."

"As feral pig populations grew on all islands, they began ranging more freely in the forests. Concurrent but independent introductions of earthworms and introduced plant species, such as mango and guava, provided reliable protein and carbohydrate food sources and helped expand their range. Omnivorous and without any non-human predators, pigs began to thrive in the native forest and successfully established large populations. Within only a few generations, any escaped domesticated pigs reverted to a feral form, retaining the large body size of European swine, but severing their dependence on human beings."

"Clearly, domesticated pua'a carried strong cultural value in traditional Hawai'i. Aside from being an important possession and food source, a oral tradition describes the adventures of Kamapua'a (the pig child), a powerful demi-god who ranged over the islands and into the sea. Even the name of the traditional land management system, ahupua'a, refers directly to the pua'a and highlights the animal's importance among the variety of resources that were collected and offered during the annual makahiki tributes." (Maly, Pang & Burrows, 2010:1-5)

"Pigs were raised in great numbers for food and for religious and ceremonial purposes. They were free to roam about the village and its environs. Stone walls (pā pōhaku) and picket fences (pā lā'au) kept these animals from areas where they were not wanted."

"Mature hogs were penned in stone-walled enclosures and fattened. They were fed cooked taro (kalo), sweet potatoes ('uala), yams (hoi), bananas (mai'a) and breadfruit ('ulu). Some of these foods were the scraps and peelings not suitable for human consumption." (Mitchell 1982:121)

"Domestication, the great cause of degeneracy in so many of our animals, in the first place, is here confined to three species; the hog, dog, and cock; and secondly, it is in fact next to a state of nature in these isles: the hogs and fowl run about at their case the greatest part of the day; the last especially, which live entirely on what they pick up, without being regularly fed." (Forster's Observations in Polynesia, 1778)

"Now and then I observed the house open, but furnished below at the height of about one foot, with a fence of bamboos. Some small houses are likewise included in a kind of partition made of small sticks in the manner of hurdles. The natives commonly keep their hogs during the night, in the house, and have in one corner of it contrived an inclusure (pa booa (pā pua'a)) covered on the top with boards, on which they sleep." (Forster's Observations in Polynesia, 1778)

"Their gluttonous Chiefs and Arees (Ali'i) it is true, stuff themselves with immoderate quantities of food, but it causes no other inconveniencies than to make them fat and unwieldy. The finest fishes, and other marine productions, as cray-fish, shells, sea-eggs, cuttle-fish, and one kind of blubber, serve them instead of food; and though many of the latter are not eaten by us, they seem not however, to cause any diseases; especially as the common sort of people cannot have them in great abundance. As to animal food from hogs, dogs and fowls, I am certain that their meat is but sparingly eaten ..." (Forster's Observations in Polynesia, 1778)

Hunting of Ungulates

"The custom of recreational hunting evolved over the last hundred fifty years as native Hawaiians assimilated western traditions in the context of these introduced game animals. The earliest descriptions of western-style hunting occur in the opening decades of the 19th century, when outings were organized to control wild herds of cattle that threatened agriculture, residences, and forest resources. The practice increased in frequency and in popularity, with island hunters playing a key role in the state's response to the watershed crisis of the late 19th century. These state-sponsored control efforts resulted in the removal of over 170,000 introduced mammals in the first half of the 20th century." (Maly, Pang & Burrows 2010:3-4)

"Although hunting is not widely practiced in contemporary Hawaiian society – only two percent of the state's residents obtain a hunting license – it is a visible and common occurrence across the state. Pig hunting, in particular, is a cherished modern practice for island sportsmen, including some whose subsistence depends to greater or lesser extent on wild game." (Maly, Pang & Burrows 2010:3-4)

"Pig hunting in heavy cover is usually accomplished with the use of dogs, and the required training, feeding and care for these animals can be a difficult and expensive task. The dogs locate, chase, grab, or bay the game, which is then typically dispatched by the hunter with a gun or knife. These techniques are derived directly from western and European pig hunting practices, incorporated over the last 150 years in Hawai'i, and passed down through family generations." (Maly, Pang & Burrows 2010:3-4)

Palama Case

A recent Hawai'i Intermediate Court of Appeals decision (NO. CAAP-12-0000434:2-5) notes pig hunting is a customary and traditional practice for Kui Palama on the Island of Kauai. (The court specified, however, "that our decision here is confined to the narrow circumstances and the particular record in this case.")

Background on the case from the Intermediate Court of Appeals Decision includes: (NO. CAAP-12-0000434:2-5)

> On January 17, 2011, Palama entered Kupo Ridge, situated at the upland, or mauka, portion of Hanapepe Valley on the Island of Kaua'i to hunt for pig. The record reflects that the area in which Palama hunted is privately owned and is referred to generally by the parties as Robinson Family property or Gay & Robinson property (the subject property).

Figure 43 Pig Wallow (Hawai'i Volcanoes National Park)

Palama contends that he maintains taro patches on his kuleana land located at the lower end of the Hanapēpē ahupuaʻa and that he enters the subject property for a variety of activities, including to hunt pig and to inspect the river's water flow and quality for his taro patches.
Palama asserts the subject property did not have any fences or signs indicating that it was private property. Palama had a hunting license at the time but did not ask for permission from anyone before entering the subject property. He used a knife to kill two wild pigs while on the subject property. On his way out of the subject property, but before reaching his truck, Palama was confronted by two Robinson employees.

On March 2, 2011, the State filed a complaint against Palama for (1) simple trespass; and (2) prohibited hunting on private lands. ... Palama filed the Motion to Dismiss, asserting the constitutional defense of privilege under State v. Hanapi .... Palama brought his Motion to Dismiss based on article XII, section 7 of the Hawai'i Constitution, HRS § 7-1 (2009) and HRS § 1-1 (2009), claiming that his conduct was a traditional and customary native Hawaiian practice and therefore protected.

The State filed its Memorandum in Opposition on March 12, 2012, arguing, inter alia, that killing game mammals is not an enumerated right and that hunting is subject to State regulation.

The circuit court held evidentiary hearings on Palama's Motion to Dismiss. The circuit court heard testimony from: expert witness Jonathan Kamakawiwoʻole Osorio, Ph.D. (Dr. Osorio), a professor at the University of Hawai'i Center for Hawaiian Studies; kamaʻāina witnesses' Lavern Silva (Silva), Elvin Kaiakapu (Kaiakapu) and Herbert Kauahi (Kauahi); and Palama. The State did not put on any evidence.

On April 26, 2012, the circuit court dismissed the charges with prejudice, ruling that Palama's conduct was constitutionally protected.

(T)he circuit court concluded that Palama brought forward sufficient evidence to demonstrate that: (1) he is a native Hawaiian; (2) his claimed right was an established native Hawaiian custom or tradition practiced prior to 1892 and his family's pig hunting has been customarily and traditionally exercised on the subject property; (3) the subject property is not developed; and (4) his pig hunting on the subject property merited constitutional protection. (The State timely filed an appeal.)

In Hanapi, the Hawaiʻi Supreme Court identified a three-part test that a criminal defendant must meet, at minimum, to establish that his or her conduct is constitutionally protected as a native Hawaiian right. (NO. CAAP-12-0000434:9-10)

1. the defendant "must qualify as a ‘native Hawaiian’ within the guidelines set out in PASH
2. the native Hawaiian defendant “must then establish that his or her claimed right is constitutionally protected as a customary or traditional native Hawaiian practice.”
3. the defendant “must also prove that the exercise of the right occurred on undeveloped or ‘less than fully developed property.’”

The Circuit Court concluded that Palama’s pig hunting deserved constitutional protection and made several findings and conclusions on the issue, including: (NO. CAAP-12-0000434:11-12)

- The State offered no evidence to controvert that Defendant's pig hunting is constitutionally protected as a customary or traditional native Hawaiian practice.

- Defendant established, through kamaʻāina and expert testimony, that his hunting pig on the subject property is constitutionally protected as a customary or traditional native Hawaiian practice.
- Based on Dr. Jonathan Osorio's expert testimony, as well as the testimony of kamaʻāina witnesses, the Court finds that Defendant's pig hunting on the subject property constitutes an established native Hawaiian custom or tradition practiced prior to 1892.
- In the case at bar, pig hunting, while not specifically enumerated in HRS § .7-1, qualifies as a traditional and customary native Hawaiian practice deserving Constitutional protection, as Defendant brought forward evidence that hunting pig was an established native Hawaiian custom or tradition practiced prior to 1892.

The Intermediate Court of Appeals noted, in part: (NO. CAAP-12-0000434:13)

- Pig hunting may qualify as a traditional and customary practice if there is "an adequate foundation in the record connecting the claimed right to a firmly rooted traditional or customary native Hawaiian practice." (NO. CAAP-12-0000434:13)
- Our review of the relevant case law and legislative history leads us to the conclusion that the circuit court was correct in concluding, on the record in this case, that the State's efforts to regulate Palama's pig hunting on the subject property (by requiring permission from the private land owner) in effect operates as a summary extinguishment of Palama's constitutionally protected right to hunt pig on the subject property. (NO. CAAP-12-0000434:21)
- We acknowledge that to date, there have been no Hawaiʻi appellate cases directly addressing whether pig hunting is a constitutionally protected traditional and customary practice, and for this reason, we reiterate that our decision here is confined to the narrow circumstances and the particular record in this case. (NO. CAAP-12-0000434:15)

Some Suggest Pig Hunting is Not a Traditional Practice

"We believe that subsistence hunting of feral ungulates by native Hawaiians is NOT a traditional and customary right and therefore not protected under the state constitution or Hawaiʻi Revised Statutes. There is no evidence that pigs were hunted in ancient times. The Hawaiian diet was not dependent on pigs and they were only eaten for important occasions or as offerings to gods." (Benton Kealiʻi Pang, President of ʻAhahui Mālama I Ka Lōkahi; Environment Hawaiʻi, January 1997)

Hunting of ungulates was not in keeping with Hawaiian cultural traditions. Goats, sheep, European boar, and cattle are all "foreign to the native Hawaiian landscape and culture." The Hawaiians themselves used fences to create enclosures to protect native resources. The Hawaiian pig was traditionally raised and fattened in enclosures. (Kepa Maly; Environment Hawaiʻi, January 1997)

Gathering Rights – Protection of Traditional & Customary Practices

Several Supreme Court Cases have reviewed and clarified Native Hawaiian rights to Traditional & Customary practices. The Court noted:

> Our proud legal tradition in this State of protecting Native Hawaiian rights is not of recent vintage, for even as far back as the days of the Hawaiian Kingdom, protections have been in place to ensure the continued exercise of traditional Hawaiian rights amidst the pressures exerted by countervailing interests of a changing society.
>
> [A number of legal cases have been appealed to the Hawai'i Supreme Court. Decisions by the Court in those cases have defined, explained and clarified. The Supreme Court's] "evolving jurisprudence concerning Native Hawaiian traditional and customary rights has conceived of a system in which the State and its agencies …"
>
> "… bear an affirmative constitutional obligation to engage in a meaningful and heightened inquiry into the interrelationship between the area involved, the Native Hawaiian practices exercised in that area, the effect of a proposed action on those practices, and feasible measures that can be implemented to safeguard the vitality of those practices."
>
> "When an individual of Native Hawaiian descent asserts that a traditionally exercised cultural, religious, or gathering practice in an undeveloped or not fully developed area would be curtailed by the proposed project, the State or the applicable agency is "obligated to address" this adverse impact …" "Consequently, if customary and traditional Native Hawaiian practices are to be meaningfully safeguarded, "findings on the extent of their exercise, their impairment, and the feasibility of their protection" are paramount. … To effectively render such findings, it is imperative for the agency to receive evidence and then make "[a] determination . . . supported by the evidence in the record." (Pollack, SCAP-14-0000873 2015:3-10)

Following are some of the cases that address Native Hawaiian rights to traditional and customary practices.

Oni (1858)

(Oni v Meek) (Information in this section is from Hawai'i Judicial History Center)

In 1858, Oni, a tenant of the ahupua'a of Hono'uli'uli, O'ahu, filed suit against John Meek, who had a lease over the entire ahupua'a. Oni brought suit when some of his horses, which had been pastured on Meek's land, were impounded and sold.

Figure 44 Oni v Meek (Hawai'i Judiciary)

Oni claimed that he had a right to pasture his horses on the land division as one of his traditional tenant rights (by custom and by language in the Kuleana Act).

Oni notes, "We are hoa'āina. We live on the land and grow our crops, and in return we work for the konohiki a few days a week. We call these labor days. The rest of the week, we have the right to use the lands for certain things, like gathering firewood, fishing, and pasturing animals. It's our custom, our tradition."

“I take care of the land on labor days, so I can use the land to pasture my horses. Mr. Meek uses the Chief’s land like we do. We all take care of things together, so we should share the land, just like before.” (Judiciary History Center)

On September 22, 1858, the Police Court of Honolulu rendered a judgment for Oni. Meek was ordered to pay $80.00 for two horses and $4.00 in court costs. At the request of the defendant (Meek), the case was appealed to the Hawai‘i Supreme Court.

Oni was the first Hawai‘i Supreme Court case to discuss “the rights common people to go to the mountains, and the seas attached to their own particular land exclusively” in the 1850 Kuleana Act.

The Supreme Court noted, “the claim of a right of pasturage, put forward by the plaintiff, is made to rest upon far broader grounds than that just mentioned, which fact renders this case one of great importance, not only to the large landed proprietors throughout the Kingdom, but to thousands of the common people.”

“It is contended on behalf of the plaintiff that he, as a hoa‘āina of Honouliuli, has a right to pasture his animals on the kula land of that ahupua‘a, upon one or both of two grounds; first, by custom; or secondly, by statute law.

“It appears by the evidence that horses were first introduced on the ahupua‘a of Honouliuli about the year 1833; that within ten years afterwards they had become numerous; and that the horses belonging to the hoa‘āinas were allowed to pasture upon the kula land, in common with those of the konohiki.”
The Supreme Court was concerned with the right of a private property owner to use the land as he individually wished without having to share its use. The court said “the custom contended for is so unreasonable, so uncertain, and so repugnant to the spirit of the present laws, that it ought not to be sustained by judicial authority.”

The court also said “…it is perfectly clear that, if the plaintiff (Oni) is a hoa‘āina, holding his land by virtue of a fee simple award from the Land Commission, he has no pretense for claiming a right of pasturage by custom.” (Judicial History Center) The Supreme Court ruled in favor of Meek.

For over a hundred years, the Oni v Meek case appeared to foreclose claims based on custom. (MacKenzie 2010 & 2011, vols 13 & 14:120)

Common Law - Hawaiian Usage (1892)

In 1892, the legislature of the Hawaiian Kingdom and Queen Lili‘uokalani passed a law that recognized Hawaiian usage as part of the common law of the Kingdom, together with the common law of England. (McGregor & MacKenzie 2014:245)

Act to Reorganize the Judiciary Department, ch. LVII, § 5, 1892 Laws of Her Majesty Lili‘uokalani, Queen of the Hawaiian Islands, provided for exceptions to the English common law that were “established by Hawaiian national usage.” (McGregor & MacKenzie 2014:245)

This law, which is today known as Section 1-1 of the Hawai‘i Revised Statutes (HRS), provided the basis for the rights of the maka‘āinana (common people) beyond the rights reserved under the Kuleana Act, so as to include whatever was broadly customary as Hawaiian usage prior to 1892. (McGregor & MacKenzie 2014:245)

HRS §1-1 Common law of the State; exceptions, states, “The common law of England, as ascertained by English and American decisions, is declared to be the common law of the State of Hawai‘i in all cases, except as otherwise expressly provided by the Constitution or laws of the United States or by the laws of the State or fixed by Hawaiian judicial precedent, or established by Hawaiian usage; provided that no person shall be subject to criminal

proceedings except as provided by the written laws of the United States or of the State. (Hawai‘i Revised Statutes)

State Constitutional Amendments (1978)

(Hawai‘i State Constitutional Convention and Vote)
(Information here is Belatti & Garcia 2004:5, 32)

In 1978, the State convened a historic constitutional convention that included recommendations that reaffirmed its commitment to Native Hawaiian interests and values.

Figure 45 Bill Paty signing 1978 Con Con Document (Honolulu Advertiser)

Then-Governor Ariyoshi, in his opening address, set the tone and spirit of the Convention by stating: “[T]he Preamble to our present Constitution notes that the people of Hawai‘i are ‘mindful of our Hawaiian heritage,’” and urging delegates to “adopt Hawaiian solutions to Hawaiian problems.”
The 1978 Constitutional Convention recognized the need to “preserve the small remaining vestiges of a quickly disappearing culture [by providing] a legal means ... to recognize and reaffirm native Hawaiian rights.” Echoing this recognition, the Committee on Hawaiian Affairs, responsible for drafting Article XII, Section 7, acknowledged that “[s]ustenance, religious and cultural practices of native Hawaiians are an integral part of their culture, tradition and heritage, with such practices forming the basis of Hawaiian identity and value systems.” Hawai‘i’s Constitution places an affirmative duty on the State and its agencies to preserve, protect, and prevent interference with these traditional and customary rights. The Constitution was amended to specifically recognize traditional and customary Hawaiian practices by adopting Article XII, Section 7.

“The State reaffirms and shall protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by ahupua'a tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778, subject to the right of the State to regulate such rights.” (Hawai‘i Constitution, Section 7)

Kapili (1982)

(Kalipi v Hawaiian Trust Co) (Belatti & Garcia 2004:7)

In 1982, plaintiff William Kalipi, a Moloka‘i taro farmer, sought access to private land in order to gather “ti leaf, bamboo, kukui nuts, kiawe, medicinal herbs and ferns.”

The Hawai‘i Supreme Court held that “lawful occupants of an ahupua‘a may, for the purposes of practicing native Hawaiian customs and traditions, enter undeveloped lands within the ahupua‘a to gather those items enumerated in HRS § 7-1.” (Belatti & Garcia 2004:7)

The Court recognized that guiding its decision was an “obligation to preserve and enforce such traditional rights” pursuant to Article XII, Section 7.61. The court concluded that Kalipi’s gathering rights also existed under the “the Hawaiian usage exception to English common law found in HRS § 1-1 ... as customary rights which continued to be practiced and worked no actual harm upon the recognized interests of others.” (Belatti & Garcia 2004:7)

In the ‘Kapili’ case (dealing with entering undeveloped lands to gather, without unnecessarily disturbing the surrounding environment, natural products necessary for certain traditional native Hawaiian practices) the Hawai‘i

Supreme Court noted:

"The statutory exception to the common law is thus akin to the English doctrine of custom whereby practices and privileges unique to particular districts continued to apply to residents of those districts in contravention of the common law."

"This, however, is not to say that we find that all the requisite elements of the doctrine of custom were necessarily incorporated in § 1-1. Rather, we believe that the retention of a Hawaiian tradition should in each case be determined by balancing the respective interests and harm once it is established that the application of the custom has continued in a particular area." (Hawai'i Supreme Court, Kapili, 656 P.2d 745 (1982)

PASH (1995)

(Public Access Shoreline Hawai'i v Hawai'i Planning Commission) (This information is from MacKenzie 2011, Vol 33:447:456; MacKenzie 2010 & 2011, vols 13 & 14:120 and Belatti & Garcia 2004:7)

In PASH, developer Nansay Hawai'i, Inc. applied to the Hawai'i County Planning Commission for a Special Management Area permit to develop a resort community covering over 450 acres of shoreline area on the Big Island of Hawai'i.

Plaintiff Public Access Shoreline Hawai'i (PASH), a community organization whose members asserted traditional Native Hawaiian gathering rights on the lands proposed for development, opposed the issuance of the permit and requested a contested case hearing before the Commission. They were denied on the ground that they lacked standing because their interests were "not clearly distinguishable from that of the general public."

The Hawai'i Supreme Court explained in PASH case that "Oni merely rejected one particular claim based upon an apparently non-traditional practice that had not achieved customary status in the area where the right was asserted." The Hawai'i Supreme Court remanded PASH to the Planning Commission to conduct hearings and explicitly reaffirmed that Article XII, Section 7 "obligates the State to protect customary and traditional rights normally associated with tenancy in an ahupua'a."

Figure 46 Kohanaiki Beach Park (Live in Hawai'i)

The Court noted that "the State's power to regulate the exercise of customarily and traditionally exercised Hawaiian rights ... necessarily allows the State to permit development that interferes with such rights in circumstances. Nevertheless, the State is obligated to protect the reasonable exercise of customarily and traditionally exercised rights of Hawaiians."

In PASH, the court reaffirmed the State's affirmative duty to protect customary rights as it regulates the development of land "previously undeveloped or not yet fully developed" in Hawai'i. The court admonished State agencies, stating that they "[do] not have the unfettered discretion to regulate the rights of ahupua'a tenants out of existence".

Rather, they must find ways to resolve conflicts between developers and native tenants, giving full consideration to their statutory and constitutional obligations to Native Hawaiians. The court, however, was silent as to the manner by which state agencies are to enforce this mandate.

The PASH Court stressed that "the precise nature and scope of the rights retained by (HRS) § 1-1 ... depend upon the particular circumstances of each case".

The Court set out a test for the doctrine of custom, requiring that a custom be consistent when measured against other customs; a practice be certain in an objective sense, "(A) particular custom is certain if it is objectively defined and applied; certainty is not subjectively determined"; and a traditional use be exercised in a reasonable manner.

The PASH Court also clarified that "those persons who are 'descendants of native Hawaiians who inhabited the islands prior to 1778,' and who assert otherwise valid customary and traditional Hawaiian rights under HRS 1-1, are entitled to protection regardless of their blood quantum."

Pele Defense Fund (1992)

Pele Defense Fund v Paty

Plaintiff Pele Defense Fund challenged the exchange of more than 27,000 acres of public lands, including areas designated as Natural Area Reserve lands, between the State and a private landowner. As part of that challenge, plaintiff's Native Hawaiian members asserted access rights into the undeveloped areas of the Natural Area Reserve lands for traditional subsistence, cultural, and religious purposes. (Belatti & Garcia 2004:7)

Related to this, it was determined that, "The nature and scope of the rights reserved to hoa'āina (tenants) by custom and usage are to be defined according to the values, traditions and customs associated with a particular area as transmitted from one generation to the next in the conduct of subsistence, cultural, and religious activities."

That case also found that residency of a particular ahupua'a was not required for gathering, noting, "Unlike other areas in Hawai'i, Hawaiians historically crossed ahupua`a boundaries in the Puna district. …"

"…The hunting and gathering patterns in the Puna district are unique because they are influenced, to a large extent, by an active volcano, Kīlauea. It can be reasonably inferred that volcanic eruptions in the Puna area force hunters and gatherers to change areas to find plants and animals for subsistence purposes." (Circuit Court of the Third Circuit, Civil No. 89-089 2002)

Figure 47 Wao Kele o Puna Geothermal Well (Wao Kele o Puna Transfer Celebration)

The Pele Defense Fund decision extended rights to non-Hawaiians, noting, "Accordingly, non-Hawaiians could have the same right as Hawaiians, irrespective of Article XII, § 7, if they could prove that their rights were based on custom and usage."

"The Pele Defense Fund decision concluded with "a permanent injunction against excluding the following persons from entering the undeveloped portions of the land and using the developed portion for reasonable access to the undeveloped portions, to perform customarily and traditionally exercised subsistence and cultural practices: (a) Hawaiian subsistence or cultural practitioners who are descendants of the inhabitants of the Hawaiian Islands prior to 1778; (b) Person or persons accompanying Hawaiian subsistence or cultural practitioners described in (a); or (c) Persons related by blood, marriage or adoption to Hawaiian subsistence or cultural practitioners described in (a)." (Circuit Court of the Third Circuit, Civil No. 89-089 2002)

Water Use Permit Applications (2000)

(In re: the Water Use Permit Applications) (Information here is from 94 Hawai'i 97 Supreme Court of Hawai'i No. 21309)

"The Waiāhole Ditch System collects fresh surface water and dike-impounded ground water from the Koʻolau mountain range on the windward side of the island of Oʻahu and delivers it to the island's central plain."

"Beginning in Kahana Valley, the collection portion of the system proceeds along the windward side of the Koʻolaus, then passes under the Koʻolau crest to the leeward side at the North Portal. ... The ditch system was built in significant part from 1913 to 1916 to irrigate a sugar plantation owned and operated by Oʻahu Sugar Company, Ltd. (OSCo)."

"Until the plantation ceased operations in 1995, OSCo used much of the ditch's flow, in addition to a substantial supply of ground water pumped from the Pearl Harbor aquifer. At the time of this appeal, various leeward parties still retained, but were not using, well permits to pump approximately 53 mgd of leeward ground water."

"Diversions by the ditch system reduced the flows in several windward streams, specifically, Waiāhole, Waianu, Waikāne, and Kahana streams, affecting the natural environment and human communities dependent upon them. Diminished flows impaired native stream life and may have contributed to the decline in the greater Kāneʻohe Bay ecosystem, including the offshore fisheries. The impacts of stream diversion, however, went largely unacknowledged until, in the early 1990s, the sugar industry on Oʻahu came to a close."

On July 15, 1992, the State Water Commission designated the five aquifer systems of Windward Oʻahu as ground water management areas, effectively requiring existing users of Waiāhole Ditch water to apply for water use permits within one year of that date.

In June 1993, the Waiāhole Irrigation Company (WIC), the operator of the ditch system, filed a combined water use permit application for the existing users of ditch water. In August 1993, OSCo announced that it would end its sugar operations, signaling the imminent availability of the ditch water used by OSCo and raising the question of its future allocation."

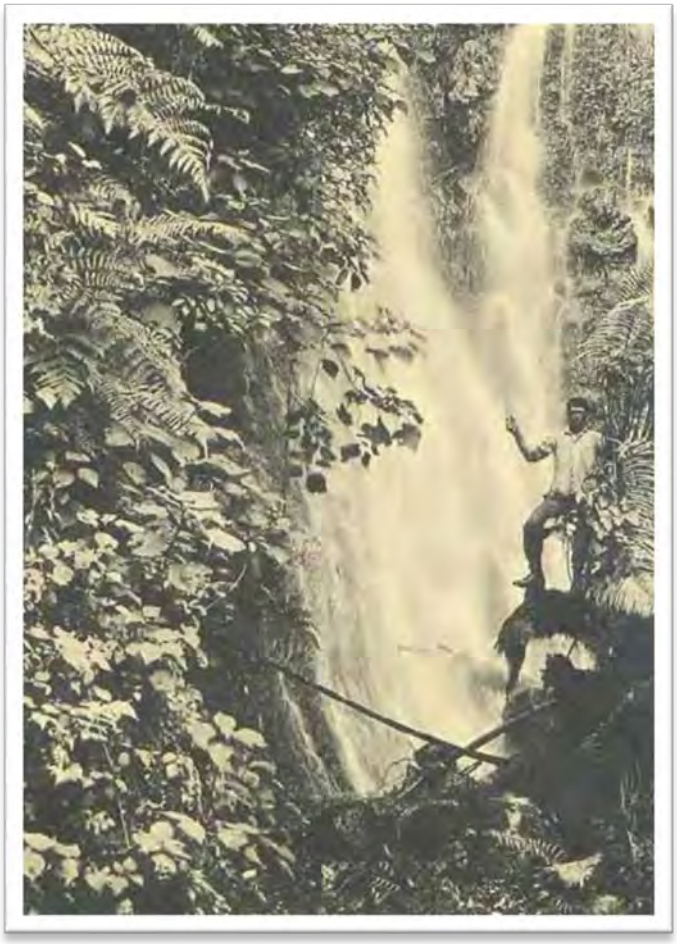

Figure 48 Waterfall believed to be at Waiāhole (CWRM)

In May 1994, the Commission received complaints that, with the close of OSCo's sugar operations, WIC was discharging unused ditch water into Central Oʻahu gulches. After holding an investigation and several meetings and considering an order to show cause regarding WIC's continuing waste of water, the Commission requested the parties involved to enter into mediation.

The mediation agreement and the Commission's subsequent order dated December 19, 1994, provided that WIC would continue to supply 8 mgd to the ditch, as measured at the North Portal, and release the surplus into the windward streams.

In 2000, the Hawaiʻi Supreme Court noted "we continue to uphold the exercise of Native Hawaiian and traditional and customary rights as a public trust purpose. … [T]he mandate of 'conservation'-minded use subsumed in our state's water resources trust contemplates 'protection' of waters in their natural state as a beneficial use. ... [T]his state bears an additional duty under Article XII, section 7 of its constitution to protect traditional and customary Native Hawaiian rights."

Ka Paʻakai (2000)

(Ka Paʻakai o ka ʻĀina v Land Use Commission) (Information here is from Belatti & Garcia 2004:10-11)

In the dispute before the LUC, Native Hawaiian community organizations opposed the re-classification of over 1,000-acres from conservation to urban lands for the Kaʻūpūlehu Resort Expansion, a luxury development project on the island of Hawaiʻi.

Within the reclassified lands, the Court noted that the coastal point known as Kalaemanō and the historic 1800-1801 Kaʻūpūlehu Lava Flow were two well-known physical features associated with native Hawaiian culture and history. The Court also noted the association of two historical figures to the petition area, Kameʻeiamoku and Kamanawa, two chiefs who served as advisers to Kamehameha I.

The Court reaffirmed special protections for Native Hawaiian cultural practices when it ruled that the State Land Use Commission (LUC) failed to satisfy its statutory and constitutional obligations to preserve and protect customary and traditional rights of Native Hawaiians.

The Court reiterated that "the State and its agencies are obligated to protect the reasonable exercise of customarily and traditionally exercised rights of Hawaiians to the extent feasible." Ultimately, the Court held that the LUC's determinations were "insufficient to determine whether [the LUC] fulfilled its obligation to preserve and protect customary and traditional rights of native Hawaiians."

The Court remanded the re-classification petition to the LUC for further fact-finding and conclusions about the petition area. First, the LUC was directed to identify specific "valued cultural, historical, or natural resources including the extent to which traditional and customary native Hawaiian rights are exercised."

Next, the LUC was directed to determine "the extent to which those resources – including traditional and customary native Hawaiian rights – [would] be affected or impaired" by the proposed luxury development. Finally, if Native Hawaiian rights were found to exist, then the LUC was directed to determine "the feasible action, if any, to be taken to reasonably protect native Hawaiian rights."

Kaiāulu Kahu ʻĀina (Community is one that oversees/stewards the land)

(Kumupaʻa)

(Review of some community-based management opportunities)

Community Recommendations in Management Direction

In anticipation of the preparation of this Comprehensive Management Plan for Wao Kele o Puna, OHA hired Kumupaʻa Cultural Resource Consultants, LLC, to complete an ethno-historical study.

OHA specifically requested that the study include community manaʻo regarding the proper care and protection for this wahi pana. Kumupaʻa completed its review, analysis, fieldwork, and interviews. Based on this effort, Kumupaʻa developed and offered recommendations for OHA regarding the appropriate and responsible management of Wao Kele o Puna.

Two very strong and consistent recommendations were made related to management of the property: Community-based management and culturally appropriate management practices using konohiki-like managers. The following are from the study.

Community Recommendations

Prior to and during the OHA acquisition of Wao Kele o Puna, native Hawaiian entities, community members, conservation organizations, even OHA representatives noted that (all information from Kumupaʻa 2014:396-413):

- Wao Kele o Puna is a wahi pana rich with precious natural and cultural resources and a unique spiritual and sacred site for kānaka maoli. Maintaining traditional and customary practices at places like Wao Kele o Puna connects kānaka maoli to the ʻāina and kūpuna and provides a paʻa foundation to journey into the future.
- Signs should state that access to Wao Kele o Puna is for traditional Hawaiian practices only and that there should be no gathering for commercial purposes, only for traditional practices.
- Signs could designate plant gathering areas and lists of plants that are acceptable to gather. This would allow certain areas of the forest to rest and rejuvenate from time to time.
- Community participants recommended that Wao Kele o Puna be kept open and accessible to cultural practitioners such as hula hālau, artists, and lāʻau lapaʻau healers for native plant gathering.
- Community members recommended establishing a cultural gathering place at Wao Kele o Puna to serve multiple functions such as a retreat for practitioners, a gathering site for community members, an outdoor classroom for students, and a cultural center for visitors. The gathering place and related activities be situated at and around the existing cleared site in Wao Kele o Puna.
- It was recommended that an open hale should be built using existing forest resources such as ʻōhiʻa wood for the posts and loulu palms for the roofing; participants also recommended building a hula pā (hula platform) and an ahu (alter, shrine) as appropriate cultural structures.
- Participants expressed that Puna kamaʻāina may be the best land stewards because of their historical connection to and aloha for their ʻāina. OHA should work directly with Puna residents and encourage their participation in the Wao Kele o Puna management team.
- More programs should be established to educate the children of Puna about place-based Hawaiian culture and the significance of the natural, cultural, and marine resources located in Puna. Participants suggested establishing a youth program where local keiki can experience and learn about the flora and fauna of Wao Kele o Puna.
- To better meet its management objectives, OHA should work with the invasive species program, US Forest Service, Carnegie Airborne Institute, community associations, and the Three Mountain Alliance. You don't need to re-invent the wheel -- work with the organizations and people who have decades of expertise in natural resource management.

- While some community members were adamant there should be absolutely no commercial activities at Wao Kele o Puna, others felt that culturally appropriate, small-scale commercial activities could provide financial support to the community and help the forest become self-sustainable.
- For centuries, Wao Kele o Puna has been continuously used by Native Hawaiians who rely on the rainforest for hunting, gathering, and religious practice. Respect for volcano deity Pele is widespread, and offerings are frequently left at a religious structure on site.
- Wao Kele o Puna contains the oldest substrate and therefore most diverse rainforest in Kīlauea. The area is a complex mosaic of different-age forests, ranging from just a few years of regeneration to established forests over 800 years old.
- Wao Kele o Puna is a key link in long term protection for forests in this region. Its geographic position provides a critical buffer from invasive species invasion into two large adjacent protected areas: the 333,000 acre HVNP, and 16,000 State Natural Area Reserve.
- Wao Kele o Puna serves as essential seed bank of native species for natural re-generation of the hundreds of native tree and plant species on new lava flow areas in HVNP and State Reserve. Native ʻōhiʻa species is only seedling strong enough to break up solid lava to begin process.
- "At Wao Kele o Puna, its richness is already apparent. It stands as one of Hawaiʻi's greatest shrines that connects not only the land to native people but native people to all living things. The sound we hear is the thread that ties everything together." (Reed Holderman, Regional Director of The Trust for Public Land)

Community-based Management

Almost all the participants offered valuable suggestions, ideas, and/or personal assistance in ways to help protect the well-being of Wao Kele o Puna.

They all recognized that to properly mālama such a large forest, a cooperative and open effort must be undertaken. Community groups and individuals could help: manage the forest, coordinate community volunteers, and engage Puna students in Wao Kele o Puna projects.

Figure 49 Pua Kanahele at Wao Kele o Puna Transfer Celebration (source unknown)

A number of participants explained that Puna kamaʻāina are in essence the best stewards of the land because they are historically connected to and care deeply for their ʻāina. Consequently, it was suggested that OHA should work with individuals from the Puna community and encourage them to participate in the Wao Kele o Puna management efforts. (Kumupaʻa 2014:401)

Other manaʻo that was shared by the community regarding collaboration includes the following:

- A Hawaiian group or groups need to take the lead with stewardship efforts at Wao Kele o Puna. Others in the community can then jump on board and help out.
- There needs to be collaboration between different organizations, families, and individuals in Puna to manage the forest.

- Get together local people with different skill sets and specialties - crafters, artists, builders, cooks, and kumu hula.
- OHA should partner with the Puna schools to empower keiki to be good land stewards. For example, at Hawai'i Academy of Arts and Sciences (HAAS) School each student has to do a mandatory 32 hours of community service per quarter. The school provides a lot of areas where the students are able to volunteer.
- The community should be responsible for their environment.
- OHA should empower the community. (Kumupa'a 2014:401)

Local volunteers represent a valuable resource and asset for forest management. One kamaʻāina explained, "Local volunteers are knowledgeable about the area, and they can bring in groups to help clear invasives; at the same time, they can teach others about the native plants in the forest and their uses." (Kumupa'a 2014:401)

Community members noted it may be more efficient and cost-effective, if OHA could fund a local non-profit or other group of community members to organize and oversee volunteers to, among other things, help clear invasive species from the forest and plant more natives.

It was strongly recommended by the community that volunteer programs be established and supported at Wao Kele o Puna. OHA could benefit on a number of levels from these volunteer resources, and such a program would provide an opportunity for local citizens to give back to the land and their community. OHA should work with local groups and organizations interested in volunteering their time, expertise, and service. Additionally, this process should be an open, simple, and flexible one to encourage rather than deter or restrict individuals from volunteering. (Kumupa'a 2014:402)

Culturally Appropriate Management

Kūpuna practiced mālama ʻāina and recognized the importance of collaboration and working as a community with shared interests to protect the land, water and all the natural and cultural resources in Hawai'i. Community members recommended that OHA should look at culturally appropriate management practices for Wao Kele o Puna.

Participants suggested having konohiki-like managers who are intimately in-tuned with the forest and its resources, as was the practice in traditional Hawaiian society. These individuals should have a resource management background coupled with a strong cultural foundation.

It was also recommended that OHA establish a form of the ancient kapu system in managing Wao Kele o Puna, and that konohiki managers enforce kapu restrictions in certain areas to allow resources to rest and rejuvenate. The idea of kia'i, or caretakers and guardians, was brought up by a few of the community participants.

More specifically, one participant discussed the idea of OHA working with the subdivisions that neighbor Wao Kele o Puna and have them serve as kia'i to help manage the forest. The community member explained:

> Different sections of the neighboring suburbs/communities could manage different areas of the forest and access to those areas.
>
> They would act as watchdogs for the areas that border the forest. A hot line could be set up to call in if there's any illegal activities or dumping of trash. This would be good so not just one group manages the forest, but it's more of a collective effort. Give every Hawaiian some kuleana in their community and give them a sense of pride.

Background on Community-based Process

The convergence of political, economic, environmental, and social issues, along with the rise of environmental movements notably from advocacy Non-Governmental Organizations (NGOs) and the media, had resulted in policy shifts toward community-based resource management, including the focus on biodiversity, ecological-based and landscape-based watershed protection and management, and multiple uses of forests and forest resources. (Guiang 2001:48)

Community-based management is a process that empowers local communities to manage their resources by letting individuals in the community contribute to the decisions that affect local resources. One of the major benefits of community-based management is the development of strategies compatible with the unique environment, with the specific resources, and with the cultural and historical context of the local areas.

Elinor Ostrom shared the Nobel Prize in Economics in 2009 for her lifetime of scholarly work investigating how communities succeed or fail at managing common pool (finite) resources such as grazing land, forests and irrigation waters.

Based on her extensive work, Ostrom offers 8 principles for how commons can be governed sustainably and equitably in a community.

1. Define clear group boundaries.
2. Match rules governing use of common goods to local needs and conditions.
3. Ensure that those affected by the rules can participate in modifying the rules.
4. Make sure the rule-making rights of community members are respected by outside authorities.
5. Develop a system, carried out by community members, for monitoring members' behavior.
6. Use graduated sanctions for rule violators.
7. Provide accessible, low-cost means for dispute resolution.
8. Build responsibility for governing the common resource in nested tiers from the lowest level up to the entire interconnected system. (On The Commons website searched December 26, 2016)

Factors that can likely detract from the success of community-based conservation programs include situations where:

- Local community members hold strong resentment about loss of rights in a protected area;
- Hopes are raised by donor investment that is not sustained;
- Rhetoric of community conservation is not reflected in changed ideologies and practices on the part of the resource management agency;
- A project fails to deliver on community hopes that have been raised by the rhetoric of community conservation;
- The resource management agency sets unrealistic limits on the extent to which they will share power with local communities; or
- Local people do not share the nonmonetary values placed on species or ecosystems by conservation planners, and where conservation education cannot persuade them to do so (NOAA Technical Memorandum NMFS-PIFSC-35 2012:6)

Community-based Management Structures

Information in this section is from National Council for Public-Private Partnerships, website searched December 26, 2016.

Community-based management can take on a format of a public-private partnership. A public-private partnership (P3) is a contractual arrangement between a public agency (federal, state or local) and a private sector entity.

Through this agreement, the skills and assets of each sector (public and private) are shared in delivering a service or facility for the use of the general public. In addition to the sharing of resources, each party shares in the risks and rewards potential in the delivery of the service and/or facility.

It is recognized that the methodology for implementing P3s can vary depending on the nature of a given project and local concerns. Given this, it is the position of the National Council for Public-Private Partnerships that these are "best practices" for implementation:

Public Sector Champion:
Recognized public figures should serve as the spokespersons and advocates for the project and the use of a P3. Well-informed champions can play a critical role in minimizing misperceptions about the value to the public of an effectively developed P3.

Statutory Environment:
There should be a statutory foundation for the implementation of each partnership. Transparency and a competitive proposal process should be delineated in this statute. However, unsolicited proposals can be a positive catalyst for initiating creative, innovative approaches to addressing specific public sector needs.

Public Sector's Organized Structure:
The public sector should have a dedicated team for P3 projects or programs. This unit should be involved from conceptualization to negotiation, through final monitoring of the execution of the partnership.

This unit should develop Requests for Proposals (RFPs) that include performance goals, not design specifications. Consideration of proposals should be based on best value, not lowest prices. Thorough, inclusive value for money (VFM) calculations provide a powerful tool for evaluating overall economic value.

Detailed Contract (Business Plan):
A P3 is a contractual relationship between the public and private sectors for the execution of a project or service. This contract should include a detailed description of the responsibilities, risks and benefits of both the public and private partners.

Such an agreement will increase the probability of success of the partnership. Realizing that all contingencies cannot be foreseen, a good contract will include a clearly defined method of dispute resolution.

Clearly Defined Revenue Stream:
While the private partner may provide a portion or all of the funding for capital improvements, there must be an identifiable revenue stream sufficient to retire this investment and provide an acceptable rate of return over the term of the partnership.

The income stream can be generated by a variety and combination of sources (fees, tolls, availability payments, shadow tolls, tax increment financing, commercial use of underutilized assets or a wide range of additional options), but must be reasonably assured for the length of the partnership's investment period.

Stakeholder Support:
More people will be affected by a partnership than just the public officials and the private sector partner. Affected employees, the portions of the public receiving the service, the press, appropriate labor unions and relevant interest groups will all have opinions, and may have misconceptions about a partnership and its value to all the public. It is important to communicate openly and candidly with these stakeholders to minimize potential resistance to establishing a partnership.

Pick Your Partner Carefully:
The "best value" (not always lowest price) in a partnership is critical in maintaining the long-term relationship that is central to a successful partnership. A candidate's experience in the specific area of partnerships being considered is an important factor in identifying the right partner.

Equally, the financial capacity of the private partner should be considered in the final selection process.

Examples of Community-based Management Actions

There are many examples and formats that Community-based management may take. The following are summaries on some of the options that could be implemented at Wao Kele o Puna.

International Community Based Forest Management (CBFM)

The CBFM legitimized the gradual shift from the "protect, prohibit, and punish" mode of forest management with communities to the "protect, participate, and profit" paradigm. It presently functions as a "social fence" and an umbrella for the recognition of individual property rights and claims within the communal tenure. This provides the communities with some degree of access to and control of forest resources. (Guiang 2001:49)

CBFM as a strategy is a viable model to ensure sustainable forest management. Policies and operational guidelines should be made based on local situations and to the satisfaction of the needs of local communities. (Bacalla, eastwestcenter:166)

It is believed that "responsiveness, effectiveness and efficiency are optimally obtained when decisions, programs and projects are done by those who should know them best – the people themselves." The rationale for this is both pragmatic and ideological. In the first place, forest-dependent communities have as large, or even larger, stake in sustainable forest management as the government bureaucracy for the simple reason that they depend on this resource base for their survival. (Guiang 2001:1)

In addition, living near or within forestlands, local communities are presumed to have greater knowledge and understanding of the terrain, the resources, and their constraints and opportunities, and are presumably in a better position to respond quickly to such emergencies as fire outbreaks, encroachment or poaching. (Guiang 2001:1)

This movement toward local forest governance reflects national and international tendencies toward decentralization and devolution, particularly in the field of natural resource management. It is a central feature of the international discourse on common pool resources, which encompasses concerns on property rights, collective action, and local institutions that sustain self-regulation. This discourse also implies the international community's influence on creating awareness of the value of indigenous knowledge, the existence of many sustainable indigenous systems, and the indigenous people's struggle to protect and reclaim their identities and homelands. (Guiang 2001:2)

The success of CBFM efforts is hinged on how well communities have exercised their right not only to participate in

forest governance but also to employ their internal cultural resources–such as indigenous knowledge systems and social organizations–toward attaining resource sustainability, as well as on how much space they are given for exercising this right. (Guiang 2001:2)
The following image is from 'A Community-Based Forest Management in the Philippines: A Preliminary Assessment.' This assessment helps to illustrate, not only the changing attitude in resource management to cooperative interactions with local communities, but also the benefits and outcomes of such shift in management paradigms.

For community forestry to effect sustainability and ensure the well-being of communities, a number of concerns have to be addressed, including the legitimization of rights and resource access, security of tenure, equitable allocation and distribution of resources and benefits, and clarity of individual property rights vis-à-vis collective rights or tenure. (Guiang 2001: 61)

Figure 50 Philippine Forest Management (Guiang)

Sound natural resource management largely depends on the capacity of communities for collective action and sustainable forest management. The State, as an absentee landlord of forests and forestlands, does not have enough resources to directly manage these areas. Under CBFM, therefore, the governmental entities rely on the capacities of communities for effective natural resource management on-site. (Guiang 2001: 63)

Thus, the sustainability of natural resource goods and services in community forestry is expected to be a function of existing natural resource management capacities (e.g., folk or indigenous forest management systems) as well as the communities' capacity to learn and apply the technical and organizational knowledge and skills imparted by capacity-building interventions of support organizations. (Guiang 2001: 63)

CBFM has come a long way in making natural resource assets available to upland occupants who depend on the forest. It has improved the situations of both the communities involved and the forests they depend on. Opening the door to community participation in forest governance provides opportunities for communities to learn to organize and manage themselves vis-à-vis their resource management practices. (Guiang 2001: 166)

For effective change, local communities need more formal involvement in rule making and increased bargaining power to ensure that policy changes will have positive impacts on their lives. Government must also not forget that policies that have been formulated with substantial involvement and inputs of local communities and other affected groups will have a long and lasting effect. But, how local communities influence those that make the policies will again depend on their strength and group cohesiveness. (Bacalla 2006:178)

Governance Models to Consider

Creating LLCs as Part of the Management Structure (Option)

Under Article XII of the Hawai'i Constitution and Chapter 10 of the Hawai'i Revised Statutes, OHA has the power to create and fund LLCs. It is a standard and prudent business practice to create LLCs to protect the member and its assets from liability.

A limited liability company is a legal entity that is formed when certain requirements in Hawai'i Revised Statutes Chapter 428 are met. It is similar to a corporation, in that it protects the owners of the company from liability for the debts and obligations of the company. Standard corporations have owners/shareholders; in limited liability companies the owners are called "members."

An LLC has a less cumbersome management structure than a corporation and is generally easier to administer than a corporation. Like a corporation, however, it must comply with applicable federal and state law and is subject to government oversight.

The move to create nonprofit LLCs, of which OHA is ultimately the only member, initially came up because of OHA's acquisition of Waimea Valley in 2006. OHA acquired Waimea at the request of beneficiaries and OHA was able to do so because OHA's partners covered the majority of the costs.

At the time OHA purchased Waimea, the National Audubon Society was the lessee, and OHA anticipated entering into a long-term lease (10-20 years) with them. After many months of difficult negotiations, OHA could not reach agreement and negotiated a transitional lease that expired on Jan. 31, 2008.

OHA then had three options before it:

1) To try and find another party to lease the Valley who could be excellent in their management of the cultural, business and botanical operations;
2) To manage it itself by hiring the 40-plus employees directly; or
3) To create an organization that could manage Waimea.

OHA found after searching that there was no other party to whom OHA wanted to lease this precious Valley. OHA also decided that keeping ownership and management of the Valley within OHA would mean that people could sue OHA if they were injured. If OHA owned and/or managed Waimea directly, OHA trust assets would be exposed to claims. The Trustees, having a fiduciary obligation to protect the Trust, decided to create an LLC to manage Waimea.

Hi'ilei Aloha LLC is a non-profit sub-entity of the Office of Hawaiian Affairs . Hi'ilei Aloha LLC's managing board consists of three executive positions from the Office of Hawaiian Affairs: Chief Executive Officer (CEO), Chief

Operating Officer (COO) and Chief Financial Officer (CFO).

Hi‘ilei Aloha LLC was created by OHA in October 2007 initially to serve as an umbrella organization for management of Waimea Valley and Makaweli Poi Mill, two acquisitions. The word hi‘ilei means to carry, hold, tend to, nurture, and cherish in the way a parent cares for a beloved child.

Since then, Hi‘ilei Aloha’s kuleana has expanded to include applying for federal and other grants to bring funding and programs into the Hawaiian community; assisting and supporting three new LLCs for land stewardship and community-based economic development activities; and assisting Hawaiian non-profit organizations and businesses by helping them build capacity.

In December 2007, Hi‘ilei Aloha LLC created a sub-entity non-profit, Hi‘ipaka LLC, to manage Waimea Valley, previously known as Waimea Falls Park. Other LLCs were also created including: Hi‘ipoi LLC, to manage Makaweli Poi Mill on the west side of the island of Kauai; and Ho‘okele Pono LLC and Ho‘okīpaipai LLC, both work to improve the economic condition of Native Hawaiians by facilitating the economic development nonprofit organizations.

OHA, through its Board of Trustees, is the only member of LLC. This means the OHA Board still has ultimate control over the LLCs – they decide who the managers are, they provide funding, and they can remove the managers or dissolve the companies. The LLCs and their managers are obligated and accountable to the OHA Board of Trustees.

Leases

‘Iolani Palace

The Friends of ''Iolani Palace (Friends) were issued a general lease beginning July 1, 1995 to operate and manage the ''Iolani Palace and certain related buildings within the ‘Iolani Palace State Monument. More specifically, the areas under lease include the ‘Iolani Palace, the Coronation Pavilion, the ‘Iolani Barracks and the Kanaina Building.

The premises do not include the Kekauluohi Building, the grounds, landscaping elements, driveway, parking areas and walkways. The Friends’ efforts include restoration work, interpretive activities, operating a venue for special private events and curation.

Other events are permitted by the Division of State Parks (State Parks) on a case by case basis and State Parks also permits events on the grounds independently of the lease.

The Board of Land and Natural Resources has authorized subsequent extensions to the lease. State Parks notes that over the past 20 years, the Friends have become financially self-sustaining and rely entirely on self-generated revenue to fund the operation and maintenance of ʻIolani Palace. State Parks has a good working relationship with the Friends and State Parks does not have the staff or operating funds to manage ʻIolani Palace on its own.

According to the Lease, the Lessee shall use or allow the premises leased to be used solely for educational purposes; provided, however, that the Lessee shall preserve, maintain, and operate the premises as a historical site for perpetuation of Hawaiian history, consistent with the guidelines as set forth in the lease.

The base rent the Friends’ is gratis; however, in the event annual gross ticket revenues are in excess of $1,000,000, fifty percent (50%) of the revenues shall be used in conjunction with State funds and other grants allocated for repairs and capital improvements.

(It should be noted that DLNR also has arranged for similar management of properties using lease agreements with the Daughters of Hawai‘i for the Queen Emma Summer Palace in Nu‘uanu and Hulihe‘e Palace in Kailua-Kona.)

Cooperative Stewardship Agreements

Agreements, like the KIRC-PKO Palapala ʻAelike Kahuʻāina, between governmental agencies, individuals and non-profits are not unique.

At DLNR, the first curator agreement began as a joint effort of State Parks and its Historic Sites Section in 1986 and 1987 to encourage community involvement in the care and management of historic and cultural sites on State-owned properties. Recently, curator agreements have been expanded to include the management and maintenance of natural features and facilities in the parks. In addition, the Department of Hawaiian Home Lands (DHHL) has a recurring Stewardship agreement.

Kahoʻolawe Island

Kaho'olawe Island is an example of a Stewardship Agreement between a governmental agency and a private non-profit.

Kahoʻolawe Island is one of the eight major Hawaiian Islands. It lies between Maui, Lānaʻi and Molokai. Today, the island retains its cultural significance as a place for the practice of traditional and contemporary Hawaiian culture, including religion. Kahoʻolawe possesses numerous unique archaeological, historical, cultural and environmental resources. It has a land area of approximately 28,800-acres, just a little larger than Wao Kele o Puna.

Like Wao Kele o Puna, attention to protection and preservation of Kahoʻolawe started with confrontation and conflict. Military use of Kahoʻolawe began in the early 1930s. Ship-to-shore bombardment of the island commenced in 1941 and intensified starting on October 23, 1943, when the USS Pennsylvania conducted rehearsals for the Gilbert Islands invasion. During the Korean War era, weapons usage shifted from naval projectiles to air-dropped bombs and missiles.

For training for the air war in Vietnam, the need for protection from surface-to-air missile led to the construction of surface-to-air targets and target airfields on the island. By the late- 1960s, various types of targets for both ships and aircraft were placed on the island. However, the accidental dropping of bombs on Maui, coupled with numerous noise complaints for the live fire, led the Navy to reevaluate target placements. (Protect Kahoʻolawe ʻOhana website, searched December 26, 2016)

On January 4, 1976, nine individuals made the first successful landing on Kahoʻolawe to protest the Navy's continued use of the island as a bombing target. (The 'Kahoʻolawe Nine' were Emmett Aluli, Walter Ritte, Ellen Miles, Karla Villalba, Steve Morse, Kimo Aluli, George Helm, Gayle Kawaipuna Prejean and Ian Lind.) The Protect Kahoʻolawe ʻOhana (PKO) was formed and filed a federal lawsuit charging the US Navy with violating laws pertaining to the environment, historic preservation and religious freedom. (Kahoolawe Island Reserve Commission Volunteer Packet:6)

In 1980, a settlement Consent Decree and Order was reached in the Aluli et. al. vs Brown civil suit. Under the Consent Decree and Order, the Navy agreed to survey and protect historic and cultural sites on the island, clear surface ordnance from 10,000-acres, continue soil conservation and revegetation programs, eradicate the goats from the island, limit ordnance impact training to the central third of the island and allow monthly PKO accesses to the island. (Protect Kahoʻolawe ʻOhana website, searched December 26, 2016)
Hawaiʻi Revised Statutes, Chapter 6K, created the Kahoʻolawe Island Reserve Commission (KIRC) to have policy and management oversight of the Kahoʻolawe Island Reserve. The statute requires that the island (including waters extending seaward 2-nautical miles from the shoreline) be used solely exclusively for the following:

1. Preservation and practice of all rights customarily and traditionally exercised by the native Hawaiians for cultural, spiritual and subsistence purposes
2. Preservation and protection of its archaeological, historical and environmental resources
3. Rehabilitation, revegetation, habitat restoration and preservation
4. Education

On November 11, 2003, the access control to the island was transferred from the US Navy to the State of Hawai'i. (Protect Kaho'olawe 'Ohana website, searched December 26, 2016)

Palapala 'Aelike Kahu'āina
KIRC – PKO Stewardship Agreement

Under the Consent Decree, the PKO was recognized as stewards for Kaho'olawe. Continuing from 1980, the PKO fulfilled the responsibilities of hoa'āina (tenants) and kahu'āina (cultural stewards) for the island of Kaho'olawe and exercised customary and traditional Native Hawaiian rights.

For more than 23 years, from 1980 through 2003, under the Consent Decree, the 'Ohana planned, coordinated, and safely implemented public access for more than 13,000 persons of various ages and ethnic backgrounds to Kaho'olawe for cultural, religious, revegetation, subsistence, and educational purposes. These accesses have been without major injury or fatalities due to unexploded ordnance (UXO).

Figure 51 KIRC logo

Section 6K-6(5) HRS, states that the KIRC may enter into curator or stewardship agreements with appropriate Hawaiian organizations such as the 'Ohana. On February 16, 1995, the KIRC and the PKO signed a Letter of Understanding (LOU), which recognized the ongoing role of the PKO as Ke Kahu O Ka 'Āina for The Reserve.

On October 14, 2003, the KIRC and PKO's non-profit Kohe Mālamalama O Kanaloa/Protect Kaho'olawe Fund (KOK/PKF), on behalf of the PKO, signed a Letter of Understanding which mutually recognized and reaffirmed the ongoing role of the 'Ohana as hoa'āina and kahu'āina for The Reserve.

On March 21, 2006, the KIRC and the PKO executed the first Palapala 'Aelike Kahu'āina Stewardship Agreement pertaining to the Reserve; it has been extended several times.

The parties share the following Vision for The Reserve as a cultural treasure:

> "The kino of Kanaloa is restored. Forests and shrub lands of native plants and other biota clothe its slopes and valleys. Pristine ocean waters and healthy reef ecosystems are the foundation that supports and surrounds the island.
>
> Na poʻe Hawaiʻi care for the land in a manner, which recognizes the island and ocean of Kanaloa as a living spiritual entity. Kanaloa is a puʻuhonua and wahi pana where Native Hawaiian cultural practices flourish.
>
> The piko of Kanaloa is the crossroads of past and future generations from which the Native Hawaiian lifestyle is spread throughout the islands."

The parties Support the perpetuation of aloha ʻāina through cultural, religious and healing experiences.

Consistent with the KIRC Use Plan, the parties will work toward the goal of resettlement in areas that are reasonably safe for human habitation.

The ʻOhana, will continue to fulfill its unique role as hoaʻāina and kahuʻāina of The Reserve in preparation for the eventual transfer of The Reserve to the sovereign Native Hawaiian entity. The KIRC, on behalf of the State of Hawaiʻi, holds The Reserve in trust for eventual transfer to the recognized sovereign Native Hawaiian entity upon recognition by the United States and by the State.

The parties agree to coordinate the programs and projects to meet the KIRC's statutory responsibilities regarding access and management of areas of The Reserve, for the preservation and practice of all rights customarily and traditionally exercised by Native Hawaiians for cultural, spiritual and subsistence purposes.

Programs and projects promote the preservation and protection of archaeological, historical, and environmental resources; rehabilitation, revegetation, habitat restoration and education. (All information in this section was from the Palapala ʻAelike Kahuʻāina)

Kaʻawaloa Curator Agreement

In 2006, a curator agreement was made between Hale Mua Cultural Group (a domestic non-profit corporation) and the State Parks division. The agreement involves the planning, care, maintenance, and management of Kaʻawaloa Village within the Kealakekua Bay State Historical Park.

Hale Mua Cultural Group is a domestic non-profit corporation, whose Board of Directors are all members of the Royal Order of Kamehameha I. Hale Mua Cultural Group works to preserve and perpetuate the culture of the native Hawaiian and to administer grants to stabilize, restore, and maintain Hawaiian historical sites, as well as Hawaiian educational programs.

Hale Mua Cultural Group's objectives are aligned with those of the Royal Order. The purpose of the Royal Order of Kamehameha I is to, among other things, preserve and perpetuate the ancient culture, customs, and traditions of Hawaiʻi.

Kaʻawaloa is viewed as one of Hawaiʻi's greatest cultural and historic resources. Many native Hawaiians express reverence for Kaʻawaloa and Kealakekua as a sacred place where their aliʻi lived, worshiped and died and whose life histories were repeatedly tied to events occurring on these lands both before and after westerners arrived in Hawaiʻi. Over time, Kealakekua became recognized as one of the seven royal centers of the Kona District.

Kealakekua served as the primary religious complex while Ka‘awaloa was more residential in nature.

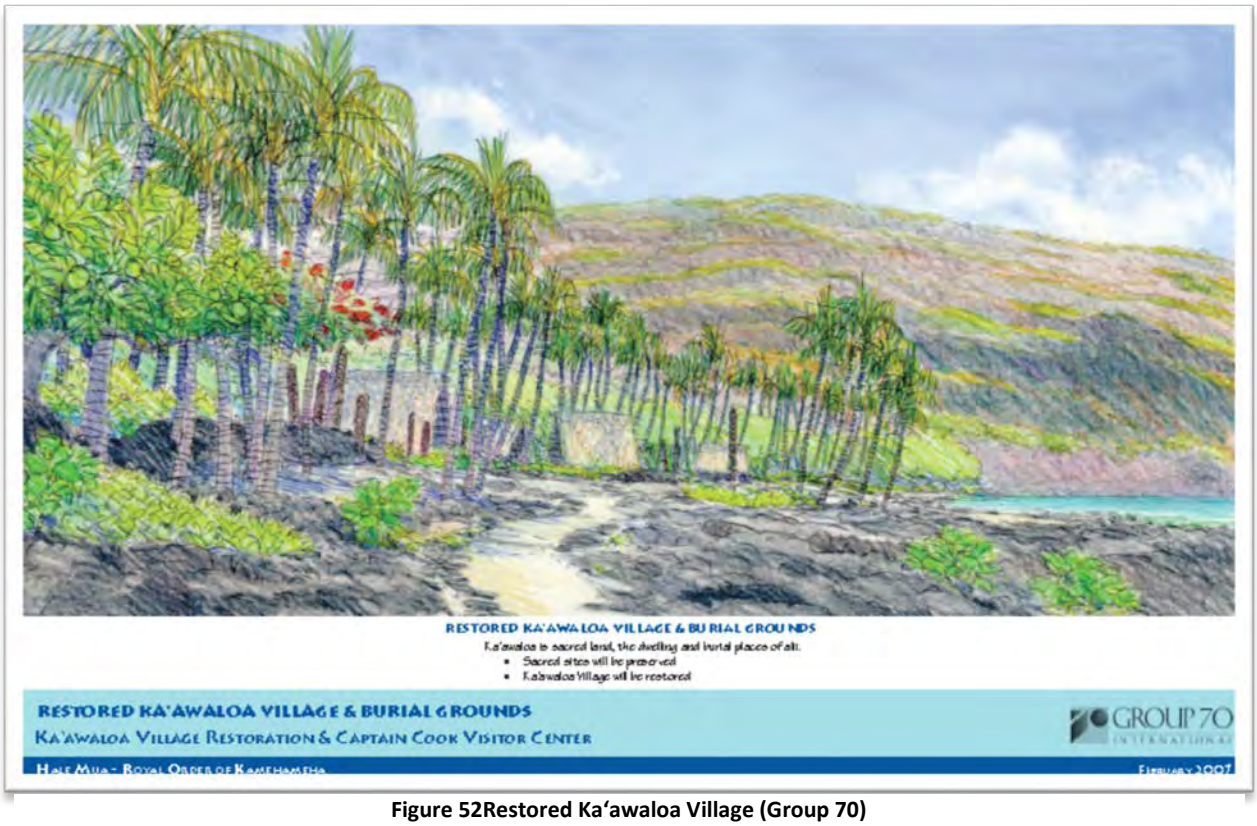

Figure 52Restored Ka‘awaloa Village (Group 70)

The curatorship agreement was for a 5-year period. During this time Hale Mua Cultural Group intended to work with DLNR in the development of a long-term management strategy for the Ka‘awaloa Village, which would guide the maintenance, management, and archeological restoration of the area.

State Parks encourages community involvement and assistance with the care, management and interpretation of natural and cultural resources in the parks through curator agreements. Hale Mua Cultural Group indicated a willingness to carry out their responsibilities as curators and to work closely with the DLNR to ensure that the guidelines established in the curator agreement were followed.

Moʻomomi Stewardship

Opened in 1924, Hoʻolehua Hawaiian Homestead was the second homestead established after the US Congress passed the Hawaiian Homes Commission Act in 1921 with the intent of returning Hawaiians to the land.

The first Hoʻolehua homesteaders were selected for their self-sufficiency and succeeding generations have endured, despite the harsh land and ocean environment. The coastal area is rich in artifacts and human burial remains dating mostly from prehistoric Hawaiian communities and activities back to the 11th century.

The Homestead community and others on Molokai have relied heavily for subsistence on the inshore marine resources of the Moʻomomi fishery, which encompasses a 12-mile stretch of coastline along Molokai’s northwest shores. It is estimated that the annual harvest by the subsistence fishery is 75,000 to 100,000 lbs, which is high yet to date “sustainable” in the sense that the fishery has persisted and still considered sufficient to support harvesting.

This fishery has been relatively protected from overfishing due to the isolation of the coastal area around Moʻomomi Bay and behavioral norms within the Hoʻolehua community that continue to be defined by traditional Hawaiian values and orientations.

Figure 53 Moʻomomi Entrance Sign (DHHL)

In 1993, in response to growing concern around Moʻomomi that mounting pressures from both inside and outside the community were leading to overharvesting, Hui Mālama o Moʻomomi, was formed by Hoʻolehua homesteaders. Its mission is to restore and maintain the health of the Moʻomomi coastline for all who live on Molokaʻi.

Residents had voiced concern about increasing competition from off-island fisherman and new residents from North America and the Philippines who were seen to not share Hawaiian subsistence values and practices. Community members feared the depletion of the natural resources upon which they relied for subsistence. They identified an emerging mentality that "if you don't take something when you see it, someone else will." (Food Sovereignty; Yale)

Starting in 1994, through a stewardship agreement with DHHL, Hui Mālama o Moʻomomi cares for approximately 385-acres of DHHL-owned land and nearshore waters along the Moʻomomi Coast on the island of Molokai. Protection of this place is to assure a reliable food source, as the community is very much subsistence-based; the ocean is their "ice box."

Co-founder of the Hui Mālama o Moʻomomi, Mac Poepoe, led the way toward educating others about the coastal resources found in Moʻomomi Bay and pono (proper) behaviors that ensure not only familial but community subsistence.

Poepoe established Hui Mālama o Moʻomomi in 1993 in order to teach younger generations the ancient practices of traditional Hawaiian fishing and how to become responsible marine citizens. It is a local marine subsistence/sustainability grassroots organization, assisting with management on the State's Hawaiian Homelands. The Hui oversees marine subsistence gathering and sustainability practices.

Important management lessons to learn from this are to recognize natural rhythms, do not disturb basic renewal

processes, monitor (moon, season, habitat, etc) and understand the resource. As a foundation to this, we need to recognize the interconnected link between the land and the ocean. Community-based management in the Moʻomomi area involves observational processes and problem-solving strategies for the purpose of conservation. The system is not articulated in the manner of Western science, but relies instead on mental models.

These models foster a practical understanding of local inshore resource dynamics by the fishing community and, thus, lend credibility to unwritten standards for fishing conduct. The "code of conduct" is concerned with how people fish rather than how much they catch. (Poepoe)

Through Poepoe's efforts, almost single-handedly, they rejuvenated Moʻomomi Beach by controlling erosion, reintroduced native plants and monitored fish populations. The beach is now rich with vegetation, and the moi are as big as small-kid time. (Cooke)

A code of conduct on appropriate behavior was designed to be true to Hawaiian values, to consider the community's culture and be biologically sound for resource sustainability.

- Rule 1 - Take only what you need. Share your catch with others.
- Rule 2 - Reserve inshore areas for children and novice swimmers and fishermen.
- Rule 3 - Education. Utilize traditional practices and science-based methods.
- Rule 4 - Community governing board.
- Rule 5 -Mālama. Care for the land; care for the people; care for all things; understand the land with the ocean.

Following are some of the highlights of the many years of work and contribution by the Hui Mālama o Moʻomomi members, leaders and supporters as the managers of a successful community stewardship program. With the help of community members, the Hui Mālama o Moʻomomi:

- Built pavilions one and two for the use of homesteaders and their guests;
- Maintains pavilions, recent painting of both;
- Has a fish tagging and monitoring program for tracking and information;
- Hosts educational groups from Molokaʻi and off-island;
- Has cleared and cleaned the beaches of the contaminated debris left by the dead whale (months);
- Has periodic beach cleaning of flotsam, driftwood and nets that clutter coastal areas;
- Regularly removes trash bags left by campers and beachgoers and hauls to the dump;
- Maintains the endangered species and indigenous/ endemic Moʻomomi coastal plant garden;
- Hosts UH and State scientists and officials studying environmental biota;
- Has negotiated for the return of Moʻomomi's historic Kalaina Wāwae stone, which was held for the better part of a century in the Bishop Museum basement;
- Set new roads for better access to fishing areas;
- Built berms and planted low growing plants to control erosion run-off;
- Has worked effectively with the neighboring Ranch and Nature Conservancy as needed to meet needs of membership;
- Built a boat ramp to ease access for fishermen to launch and remove boats;
- Provided trenching and pipe-laying for potable water to the camping/ beach areas;
- Maintained and landscaped camping areas;
- Consistently seeks legislation and stays current with issues that benefit Hawaiian subsistence fishing; and
- Brings awareness to the public about mālama ʻāina issues. (Poepoe)

Statewide Initiatives Between Government and Communities

Some broader, statewide initiatives between governmental entities are other examples of Community-based Management.

Mauka-Makai Watch

Police tell us that an engaged community is one of the best ways to reduce crime. The community then helps organize and support Neighborhood Watch programs across the Islands. It is a program that discourages preventable crime by organizing awareness meetings to help neighbors get to know one another and look out for each other, and recognize and report suspicious activity.
DLNR initiated the Mauka-Makai Watch program using the Neighborhood Watch program as a model. The intent is to get communities working with resource managers and enforcement. However, here community volunteers focus on natural and cultural resources, especially the coastline and nearshore waters, in partnership with DLNR enforcement officers.

The program incorporated experience DLNR had with the Miloliʻi community, with the assistance of The Nature Conservancy and the Community Conservation Network, as well as with the Wai ʻŌpae community.

The Mauka-Makai Watch program is based on the idea that the people who use, live closest to or are involved with the resources are in the best position to help in ensuring compliance with resource protection and preservation. Think of it as a community "watch" program in the forests and/or coastal areas.

It is not about vigilantism or exclusion, but simply a willingness to help prevent wrong-doing through presence and education, looking out for suspicious activity, monitoring and caring for the resources, and reporting inappropriate activity to law enforcement and to each other.

The program is flexible and versatile; it can focus on marine and coastal related context under a "Makai Watch" reference, or it can center on forest, hunting or other inland issues under a "Mauka Watch" reference. Or, it can incorporate a broad, comprehensive network linking inland and coastal matters under a Mauka-Makai Watch.

Most attention has been to the "Makai" aspect of the program. Makai Watch focuses on caring for near-shore marine resources with the active participation of local communities. Makai Watch volunteers in over ten communities across the State serve as the 'eyes and ears' for conservation and resource enforcement officials (DLNR-DOCARE), and help monitor and protect the resources.

The Makai Watch Program was initially created as a partnership effort by the DLNR and several non-governmental organizations including Community Conservation Network, The Nature Conservancy, Hawaiʻi Wildlife Fund and several community-based organizations. Community-supported natural and cultural resource protection and preservation programs represent a win-win opportunity. DLNR wants and needs citizens to take more personal and collective responsibility for protecting the resources.

Figure 54 Makai Watch Components (DLNR)

Over the years, DLNR has developed various programs to involve communities in resource protection and management. Until now, these programs worked interdependently and, although very successful, lacked a coordinated effort by the department. When the community is part of an ongoing stewardship-type presence and educational outreach, they can help monitor and care for the resources. This protection can also extend to being aware of suspicious activity, and reporting it to each other and law enforcement.

The Makai Watch Program has grown over the past 10-years and DLNR partners with communities and non-governmental organizations including The Nature Conservancy, Kua'āina Ulu Auamo, Hawai'i Wildlife Fund, and Project SEA-Link, with funding provided by Conservation International Hawai'i and the Harold K. Castle Foundation.

Watershed Partnerships

While not directly 'community-based' (in the conventional sense), Watershed Partnerships demonstrate the importance of working with others and collaborating with others and not duplicating efforts.

Watershed Partnerships are voluntary alliances of private and public landowners and others working collaboratively with common goals of conservation, preservation and management of Hawai'i's precious natural and cultural resources to protect forested watersheds for water recharge, conservation and other ecosystem services.

Hawai'i's native forests evolved over millions of years to become one of the most remarkable natural assemblages on Earth. Yet since the onset of human arrival, about 1,000-years ago, their history has largely been one of loss and destruction. (The Last Stand:1)

The worst damage occurred during the 19th century, when cattle and other introduced livestock were allowed to multiply and range unchecked throughout the Islands, laying waste to hundreds of thousands of acres of native forest. (The Last Stand:1)

The situation became so dire that the captains of government and industry realized that if the destruction continued there would be no water for growing sugarcane, the Islands' emerging economic mainstay. (The Last Stand:1)

On May 13, 1903, the Territory of Hawai‘i, with the backing of the Hawai‘i Sugar Planters’ Association, established the Board of Commissioners of Agriculture and Forestry. (History of Agriculture:5)

That year, the Territorial Legislature created Hawai‘i’s forest reserve system, ushering in a new era of massive public-private investment in forest restoration. (DLNR-DOFAW Forest Reserve website, searched December 27, 2016)

With Hawai‘i’s increase in population, expanding ranching industry, and extensive agricultural production of sugarcane and later pineapple, early territorial foresters recognized the need to protect mauka (upland) forests to provide the necessary water requirements for the lowland agriculture demands and surrounding communities. (DLNR-DOFAW Forest Reserve website, searched December 27, 2016)

After more than a century of massive forest loss and destruction, the Territory of Hawai‘i acknowledged that preservation of the forest was vital to the future economic prosperity of the Islands. (The Last Stand:10)

While forest reserves were important watersheds, their boundaries were drawn “so as not to interfere with revenue-producing lands,” and such lands were not generally thought to be useful for agriculture. (Cuddihy 1990:9)

Forest reserves were useful for two primary purposes: water production for the Territory's agricultural industries, and timber production to meet the growing demand for wood products. The forest reserve system should not lead to "the locking up from economic use of a certain forest area." (Board of Agriculture and Forestry Report 1905:9)

Even in critical watersheds the harvesting of old trees “is a positive advantage, in that it gives the young trees a chance to grow, while at the same time producing a profit from the forests.” (Legislative Reference Bureau 1965:10)

Forest Reserves are commonly known and were critical steps forward in protecting our mauka resources. But, while they are the foundation of the focus of this summary, it is what happened 100-years later, and that continues today, that folks should also be aware of … Watershed Partnerships.

The first Watershed Partnership was formed in 1991 on East Maui when several public and private landowners realized the benefits of working together to ensure the conservation of a shared watershed that provided billions of gallons of fresh water to the area.

In the following years, six more watershed partnerships formed including, Koʻolau Mountains Watershed Partnership, East Molokai Watershed Partnership, West Maui Mountains Watershed Partnership, Lānaʻi Forest and Watershed Partnership, The Kauai Watershed Alliance, and Kohala Watershed Partnership. The success of these partnerships highlighted the need to address watershed issues statewide.

On April 24, 2003, at the 100th-anniversary of Hawai‘i’s Forest Reserve System, Governor Linda Lingle and the seven existing watershed partnerships signed a Memorandum of Understanding (MOU) formally recognizing the State’s dedication to watershed protection and established the Hawai‘i Association of Watershed Partnerships.

Four additional watershed partnerships, Leeward Haleakalā Watershed Restoration Partnership, Three Mountain Alliance, Waiʻanae Mountains Watershed Partnership, and Mauna Kea Watershed Alliance have since been established. (Hawaii Association of Watershed Partnerships website)
Most management actions “blur” boundary lines (they are habitat, rather than ownership, based) and revolve around combating the main threats to forests: feral animals (such as goats, deer, sheep, pigs, etc) and invasive species.

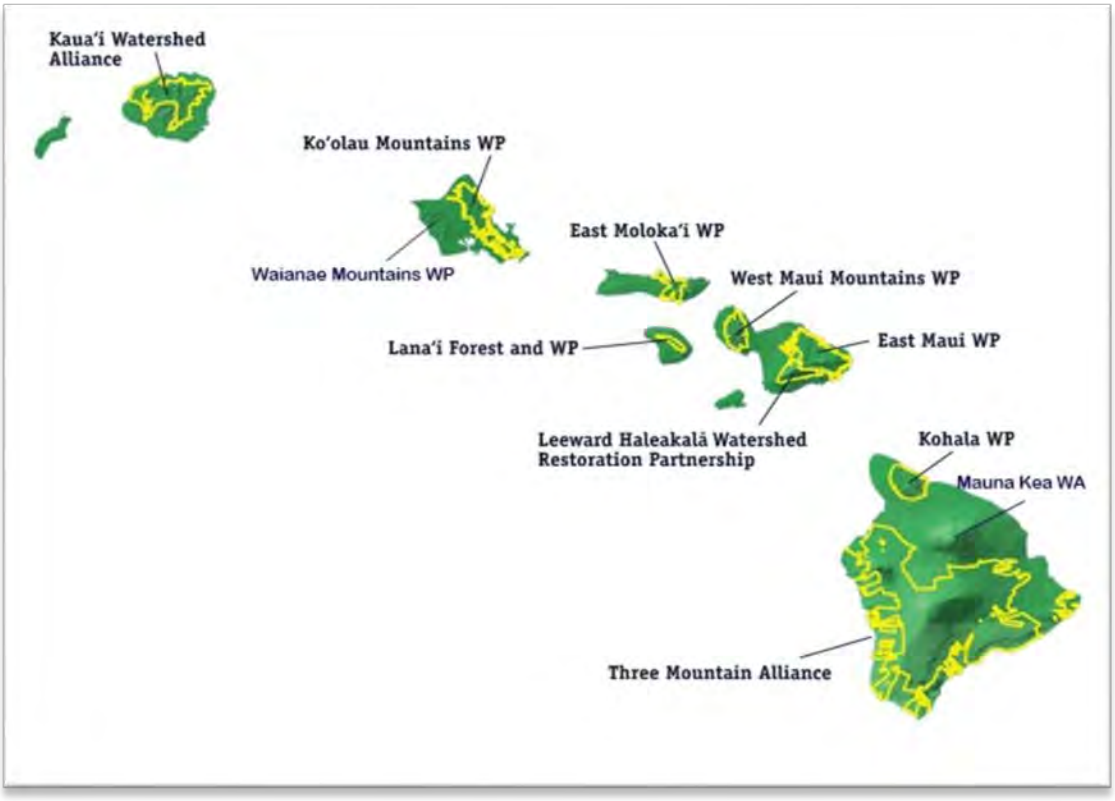

Figure 55 Watershed Partnerships Map (HAWP)

Actions include fencing and animal removal, invasive species control, rare plant outplanting and native habitat restoration, and outreach and education. These management actions make a critical difference by benefitting native forests, watersheds, coastal and coral reef areas by reducing erosion and sediment run-off into streams.

Together, the eleven separate partnerships involve approximately 75 private landowners and public agencies that cover nearly 2-million acres of land in the State (about half the land area of the State).

There is no model like it with respect to watershed management breadth, scope and success. There are three Watershed Partnerships on the Island of Hawai'i: Three Mountain Alliance, Mauna Kea Watershed Alliance, and Kohala Watershed Partnership. Wao Kele o Puna adjoins the Three Mountain Alliance.

Figure 56 Hawai'i Island Watershed Partnerships (DBEDT GIS data layer over Google Earth)

Funding - State Audit of OHA & Prior Recommendations Implementation (2013)

In 2013, the Auditor of the State of Hawai'i prepared a report entitled 'Audit of the Office of Hawaiian Affairs and Report on the Implementation of State Auditor's 2009 OHA Recommendations.' It was prepared pursuant to Sections 10-14.55 and 23-7.5, Hawai'i Revised Statutes. Section 10-14.55 requires the Auditor to conduct an audit of OHA at least every four years and Section 23-7.5 requires the Auditor to report to the Legislature annually on each audit recommendation more than one year old that has not been implemented by the audited agency. In part, that Audit noted:

> As of February 2013, OHA owned or leased 28,206 acres, making it Hawai'i's 13th largest landowner. While these numbers may be impressive, we found that the OHA's land management infrastructure is inadequate, unable to support the office's growing portfolio nor any future land involvements. Without the policies, procedures, and staff to help guide and support the increased real estate activity, OHA's Board of Trustees cannot ensure that its acquisitions are based on a strong financial foundation.
>
> For instance, we found that OHA's real estate portfolio is unbalanced, with revenues generated from commercial properties unable to offset expenses from legacy and programmatic land holdings. In 2008, OHA trustees disregarded a consultant's proposal to expand its Land and Property Management division as well as proposals for a real estate business plan and investment policy. Instead, in 2010, the trustees adopted a one-page real estate investment policy.

In response, OHA's Chair of the Board of Trustees noted:

> Regarding the significant stewardship costs of OHA-acquired lands, the chair said OHA will at times acquire land with the primary purpose of preservation and protection of "our ʻāina and rights," and that the goal of financial return and sustainability must not compromise that purpose. We maintain that OHA is not following best practices for a conservation land trust nor its own stated strategy to ensure financial sustainability.

The Auditor noted:

> Significant stewardship expenses are not offset by revenue from OHA's real estate portfolio.
>
> The office's executive policy requires trustees to exercise the highest standard of care and loyalty to OHA beneficiaries. This duty is consistent with REVMS, which directs OHA to create financially viable property involvements. The strategy also calls for building a strong financial foundation for all property involvements and notes that sacred lands are to have economic integrity and financial sustainability.
>
> For a land trust's real property holding to have economic integrity and financial sustainability, the land trust must have a source of funds to meet management expenses. The Land Trust Alliance's Standards and Practices state that land trusts should determine immediate and long-term financial and management implications and secure dedicated or operating funds needed to manage a property, either before or at transaction closing, or produce a plan to secure and commit funds for this purpose. According to OHA's chief operating officer, OHA's commercial properties are to provide financial support for its legacy lands.
>
> Despite this, we found that OHA's properties incur significant expenses, yet the office does not use revenue from other lands to pay for these costs and is not following best practices for a conservation land trust nor its own stated strategy to ensure financial sustainability. In sum, we found that trustees have not fulfilled their duty to engage in property transactions that are fiscally responsible and financially viable, leaving OHA with significant stewardship expenses. …

According to OHA’s chief operating officer, commercial properties are supposed to provide financial support for legacy lands, such as Wao Kele o Puna and Waimea Valley. However, OHA’s two commercial/investment transactions took place in 2012, six years after OHA acquired much of its legacy lands.

Based upon the Audit, a potential source of funding for stewardship in Wao Kele o Puna is revenue from OHA's commercial properties. In June 2017, OHA's Trustees approved a policy amendment that would contribute 30% of net revenue from OHA's Kaka'ako Makai properties to its legacy lands program, in compliance with this audit.

Waiwai ke ola o ka Wao Kele o Puna (The health of Wao Kele o Puna is important)

ke ʻume nei i ke aokū no ka wai o ka ʻāina

The health of Wao Kele o Puna is important, attracting the rain clouds that bring fresh water to the land.
(The importance of water; general biological description of Wao Kele o Puna)(Kumupaʻa 2014: 45)

The Kumulipo Wā ʻAkahi (Creation Chant) makes specific reference to the importance of water to the growth of life: (Beckwith 1940:110-114)

> He nuku, he wai ka ʻai aka lāʻau
> A spout, food of vegetation is fresh water
>
> ʻO ke akua komo, ʻaʻoe komo kānaka
> The god enters, man does not enter
>
> ʻO ke kane huawai, akua kena
> Man with the water jug, he is the god
>
> ʻO kalina a ka wai i hoʻoulu ai
> The shoots of the vine are propagated by water
>
> ʻO ka huli hoʻokawowo honua
> The progeny thrives and spreads

Maʻemaʻe Puna i ka hala me ka lehua

Lovely is Puna with the hala and the lehua (Pukui 1983:221, verse 2036)

Earlier surveys done in 1985 (UH Dept. of Botany, US Fish and Wildlife Service) broadly define nine ecosystem types at Wao Kele o Puna. However, these types are broadly defined and do not account for local variations throughout the forest, and are classified as follows:

1) Lava: Recent, barren flows as well as slightly older flows which support pioneer vegetation. These areas are important to plants & lichens that specialize in early succession, creating ecological niches for later plant communities. Moisture plays an important part in this succession. In a wet area such as Wao Kele o Puna, the development of vegetation is more rapid than in drier, hotter regions of barren lava flows. The whitish-gray lichen (Sterecaulong culcani), will often appear first, however, higher plants such as ʻōhelo (Vaccinium reticulatum), ʻōhiʻa (Metrosideros polymorpha) and swordferns (Neprholepis multiflora) may appear at the same time. ʻŌhiʻa is the most common pioneer among the flowering plants and may even appear before lichens, particularly on aʻa flows.

2) ʻŌhiʻa Woodland: ʻŌhiʻa woodland is composed of widely spaced trees with an almost continuous carpet of uluhe (Dicronopteris linearus), a matted fern between the trees. In moist mesophyllic conditions, a grass-shrub association co-occupies the space between the trees. The area may vary in size from low to tall stature trees in different localities but in any one stand, the trees are fairly uniform in size. Two sub-categories appear in the type.

    - ʻŌhiʻa woodland with uluhe: this ecosystem type tends to cover large areas particularly on younger flows and lower elevations (especially below 1,000 feet). This is especially true for the lower section of Wao Kele o Puna where dense mats of uluhe are interspersed with ʻōhiʻa of the relatively same size. However, there can be large areas of solid uhuhe before seeing any trees.

The dense fern cover prevents the establishment of many seedlings and as a result only a few scattered plants such as kopiko (Phychotria hawaiiensis), ʻuki (Machaerina angustifolia), and invasive species such as strawberry guava (Psidium cattleianum) and various species of melastome (Melastomoma spp.), can be found in the thick uluhe mats. Uluhe can be up to 3 meters (15 feet) tall and as a result, this ecosystem type is difficult and dangerous to traverse as matted ferns obscure large earth cracks, fissures, and even tree molds.

- ʻŌhiʻa woodland with grass: The total area of the ecosystem type is typically not large, with the exception of areas that may have been exposed to fire where invasive grass species such bush-beard grass (Andropogon glomeratus) tend to do very well in colonizing disturbed areas.

  Usually this ecosystem type will consist of scattered ʻōhiʻa with broomsedge (Andropongon virginicus). Bush-beard grass and smaller native species like ʻuki, and ʻohelo (Vaccinium reticulatum), kukae-nēnē (Coprosma ernodeoides), pūkiawe (Styphellia tameiameiae) and ama'u (Sadleria syatheoides) can also be found.

  There are usually a number of other grasses associated with this ecosystem type, including velvetgrass (Holcus lanatus), foxtail (Setaria spp.) and vassey grass (Paspalum urvillei), as well as some sedges such as tall fringe rush (Fimbristylis dichotoma), kuolohia (Rhynchospora lavarum) and Pycreus polystachyos (no common name).

  This ecosystem type is most common around areas of newer lava flows where areas have been burnt by lava intrusions. As mentioned, larger areas can also be found in areas that have been disturbed usually by fire.

  In Wao Kele o Puna, where this ecosystem type appears away from the lava flow, would likely have been caused by lightning strikes; there have been no known fires caused by man or any reports of areas showing areas exposed from lightening. In the nearby Kahauale'a Natural Area Reserve there are areas that clearly show lightning strike changes in the habitat.

3) ʻŌhiʻa Forest: This ecosystem type covers extensive portions of the island of Hawaiʻi and is the principal ecosystem type found within Wao Kele o Puna. This is the dominant tree species with typically three varieties of Metrosediros occurring.

   In wetter areas older ʻōhi'a forest commonly develop a dense understory of tree ferns (Cibotium spp.). There are other species of trees that often form a distinct sub-canopy layer. Areas least disturbed are the principal habitat for large numbers and a variety of native bird species. However, given that Wao Kele o Puna is at lower elevations subjected to mosquitoes, bird species richness is not as varied as at this ecosystem type at higher elevational gradients.

   Many rare plants are also found in this ecosystem type. In Wao Kele o Puna, rare plants in this ecosystem include the ʻahakea (Bobea timiniodes), hāhā or ʻakūʻakū (Cyanea tritomantha), ʻohe (Joinvellea ascendens ssp. ascendens), nānū (Gardenia remyil), a rare fern (Adenophorus periens) and two types of rare endemic mints (Phylostegia floribunda and Phylostegia vestita).

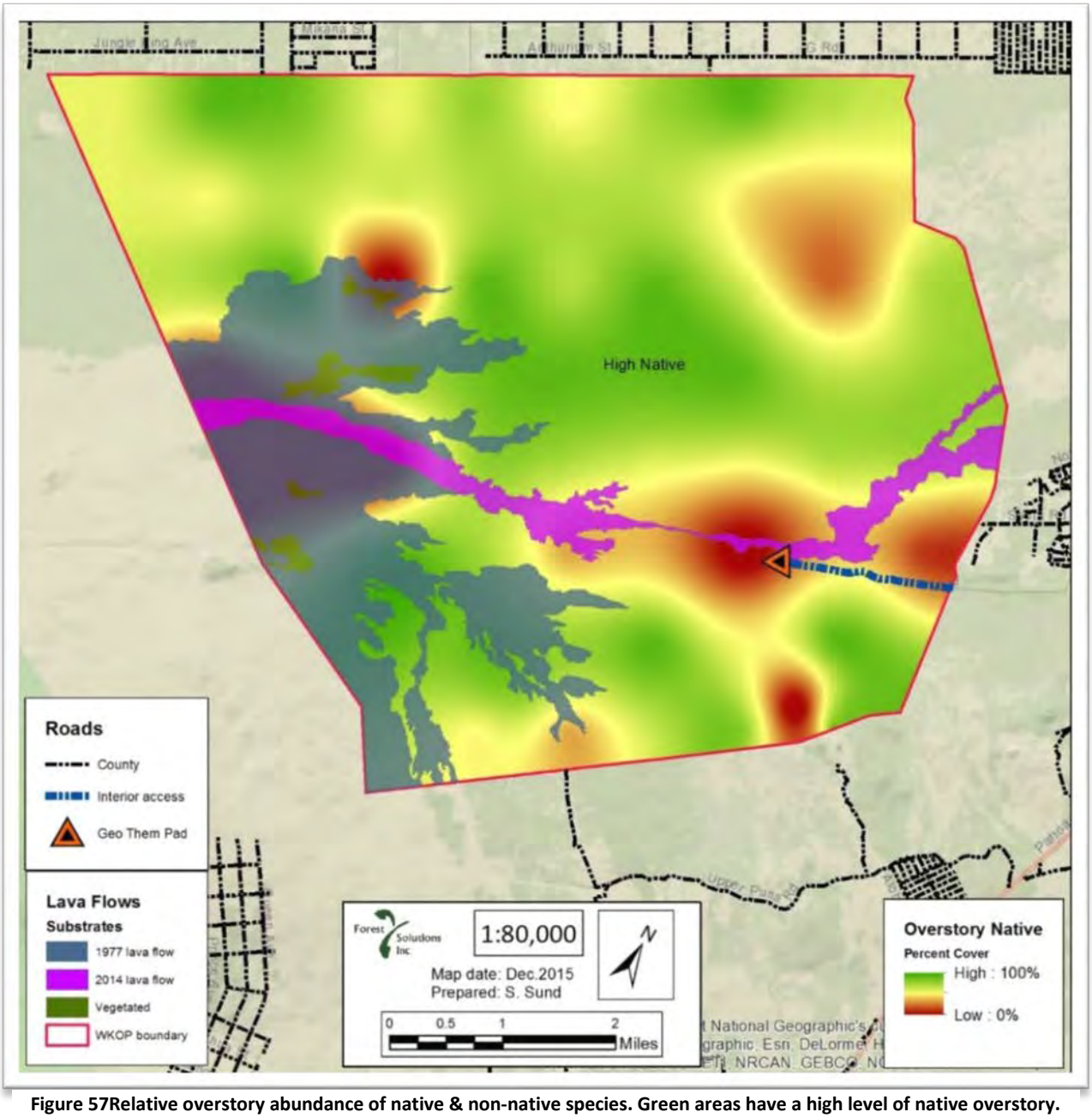

Figure 57Relative overstory abundance of native & non-native species. Green areas have a high level of native overstory. (Forest Solutions)

There are also sub-categories in this ecosystem type and are as follows:

- Wet ʻōhiʻa with native species: Consist of extensive unbroken tracts of wet ʻōhiʻa forest principally found in the upper elevations. In lower elevations they are more fragmented by either recent lava flows or forest which has been disturbedor taken over by invasive species. The canopy is usually closed (>60% cover) and are composed of largely mature, tall statured (>10 meters or 30 feet plus) ʻōhiʻa with trunks 1 to 1.5 meters (3 to 3.5 feet) in diameter are not uncommon. Sub-canopy trees consist of ʻōlapa (Cherodendron trigynum), kawaʻu (Ilex anomala), alani (Pelea clusaefolia) and kōpiko (Psychotria hawaiiensis).

  Other native trees include kōlea (Myrsine lesertiana), hame (Antidesma platyphyllum), alani (Melicope clusiifolia previously Pelea), ʻohe and ʻohe mauka (Tetraplasandra hawaiiensis & Tetraplasandra oahuensis),

ōpuhe (Urera glabra), pilo (Coprosma species), olomea (Perrotetia sandwicensis) and pāpala (Pisonia species).
Surveys in 2011 also found very large plants of the endemic ʻolonā (Touchardia latifolia) in a kīpuka within Wao Kele o Puna in an area with ti, wild banana and wild taro. There are indications at this particular site that the area was probably once used as a bird-catcher's camp.

The tree ferns create a third layer sub-canopy dominated by a hāpuʻu (Cybotium spp.) and other tree fern species (e.g. Sadleria spp.). Patches of uluhe are scattered throughout this ecosystem type. A large number of terrestrial and epiphytic ferns can be found here. Liverworts and mosses are abundant and form thick cushions on the trunks of trees.

- Wet ʻōhiʻa forest with native species and exotic shrubs: This ecosystem type covers a large portion of Wao Kele o Puna. The ʻōhiʻa is more-or-less smaller in composition and structure to the ecosystem discussed previously.

  However, it is generally an open canopy forest (<60% cover). Exotic or invasive shrubs, primarily strawberry guava and melastomes are found throughout the forest and is most abundant in disturbed areas, especially in areas were pig activity has occurred. Patches of uluhe and exotic grasses are also more frequently found here. The tree fern layer, is not as developed in this ecosystem type, and tend to be more scattered across areas.

  There are more signs of pig activity here, particularly in and around strawberry guava trees. The area closest to the now closed geothermal well site is a good example of this ecosystem type. In this area invasive melastomes, particularly the glory bush (Tibouchina herbacea) and strawberry guava nearly dominate the sub-canopy. It's also an area with lots of pig activity.

- Moderately moist ʻōhiʻa forest: This ecosystem type occurs in areas which receive slightly less rainfall (about 75 to 100 inches per year) than the wet forest but do not suffer an actual moisture deficit and occur on lava flows which have been rather well weathered. Forests are open (rarely closed) with medium to tall stature trees.

  ʻŌhiʻa is the dominant tree but a number of native tree species including lama (Diospyros sandwichensis) can be found. These other native tree species could be as tall as the ʻōhiʻa or they could form their own sub-canopy. A number of dry forest tree species can also be found here such as the rare endemic ʻahakea (Bobea timonioides), the olopua (Osmanthus sandwichesis), and ʻohe (Tetratplasandra hawaiensis).

  Unlike the wet ʻōhiʻa forest, this type of mesic ecosystem does not support a dense understory of tree ferns or shrubs. Instead shrubs species such as alahe'e (Canthium odoratum), māmaki (Pipturus hawaiensis), and kōpiko are usually scattered and the understory is fairly open. Exotic shrubs such as sourbush (Pluchea odorata) and lantana (Lantana camara) are also common in this ecosystem type. More recent invasions like the gunpowder tree (Trema orientalis) are creeping in from the lower elevations into the boundaries of Wao Kele o Puna. Ground cover may consist of various grasses and swordferns (Nephrolepis multiflora).

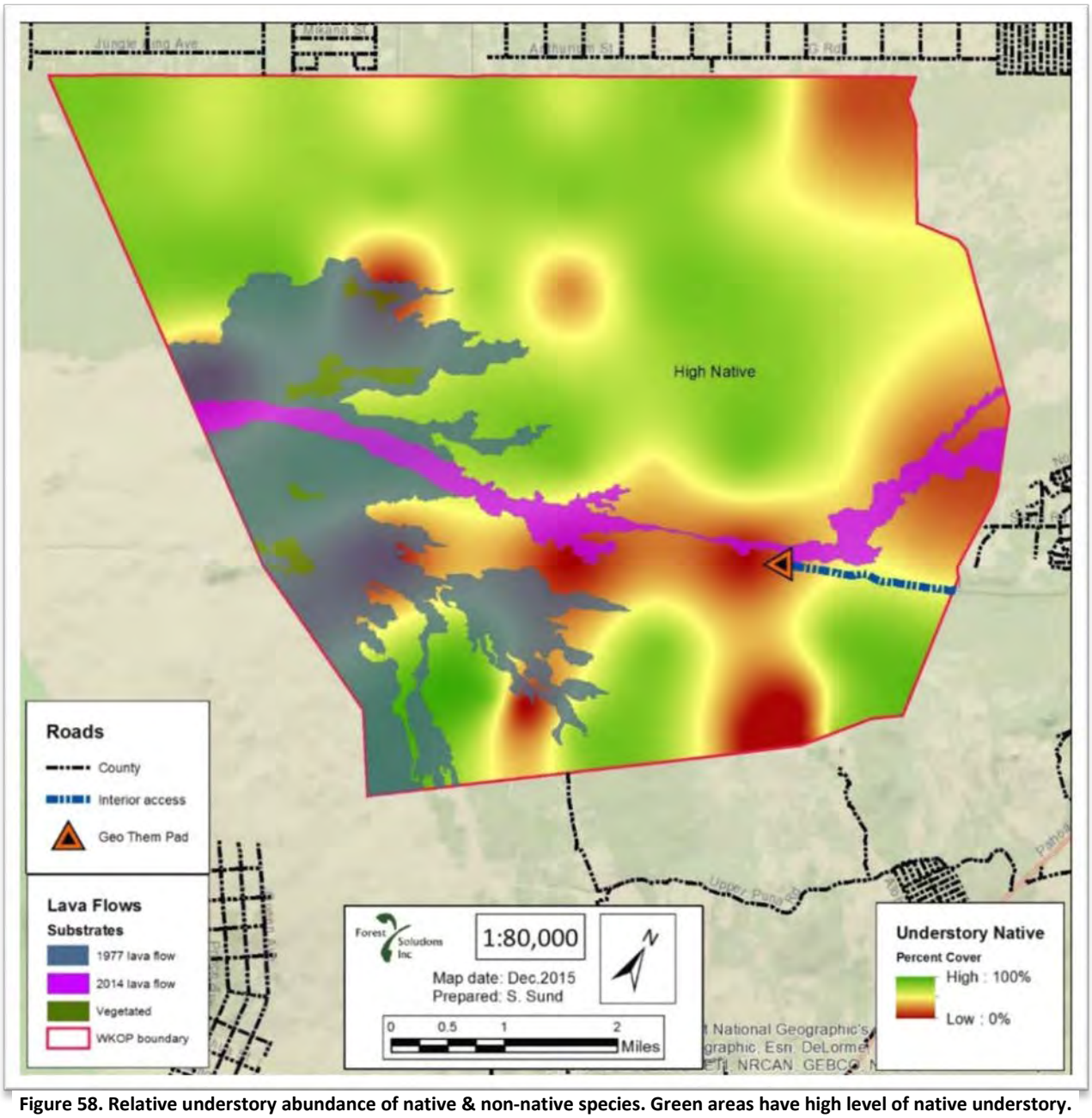

Figure 58. Relative understory abundance of native & non-native species. Green areas have high level of native understory. Compare this to the overstory map on previous pages. (Forest Solutions)

- ʻŌhiʻa forest with exotic sub-canopy and shrub layers: In Wao Kele o Puna this forest type can be dominated by the highly invasive strawberry guava intermixed with ʻōhiʻa and other native tree species. These forests may consist of medium to tall stature trees with open or closed canopies. The understory layers of this type of forest have at some time been greatly disturbed. In Wao Kele o Puna it is primarily pig disturbance.

  Tall strawberry guava forms a dense sub-canopy layer, 6 to 7 meters tall (18 to 21 feet). However, there are areas in Wao Kele o Puna where strawberry guava exceeds 10 meters (30 feet). Meslastome species are usually a common shrub component in the understory. The ground beneath is usually heavily shaded and groundcover often consists of grass, thimbleberry (Rubus rosaefolius) downy wood fern (Christella dentata) and ginger (ʻawapuhi-kua-hiwi), all considered invasive or exotic species. The more open areas tend to be filled with uluhe.
  Though strawberry guava is a serious threat to Wao Kele o Puna's overall ecosystem with nearly 5,000

established acres in the reserve, it serves to note here, that only 10% of these 5,000 acres consists of densities of 90% or more. Most of the strawberry guava areas are interlaced with multiple layers of native tree and shrub species.

4) Dry forest: Composed primarily of lama-ʻōhiʻa mixture with other dry forest species on ʻāʻā flows. The dry forest is usually open, the trees of medium stature and usually with rounded crowns. Alaheʻe (Canthium odoratum), ʻākia (Wikstroemia phillyreaefolia) and ʻaʻaliʻi (Dodonea sandwicensis) are the most commonly found shrubs in this ecosystem type.

   The amount of ground cover in the dry forest will vary depending on several factors such as open or closed canopy, amount of moisture available, age of lava flow, elevation etc. At lower elevations with less rainfall up to 40% of the ground is bare or lichen-covered.

   The lauaʻe fern (Phymatosorus scolpendria), is usually the most common species, with broomsedge (Andropogon virginicus) sword fern (Nephrolepis multiflora) and partridge pea (Cassia lechenaultiana) are also found here. Under slightly wetter conditions at higher elevations, gound cover may be 60% to nearly 100% cover. Sword fern will usually dominate mixed with lauaʻe and seedlings of dry forest tree and shrub species are also common. Other species encountered are Carex wahuensis (no common name), moa (Psilotum nudum, Spanish clover (Desmodium uncinatum) and Hilo grass (Paspalum conjugatum).

5) Dry scrub community: Usually a small area found primarily in much drier regions. This makes up less than 1% over all in Wao Kele o Puna. ʻŪlei (Osteomeles anthyllidifolia), ʻilima (Sida cordifolia), hiʻaloa (Waltheria indica) and puʻukiawe (Styphellia tameiameae) can be found in this ecosystem type.

   This ecosystem type is considered more xerophytic community type structure over rocky substrate areas with sparse ground cover more common in the lower Kalapana area.

6) Dry grassland: This ecosystem type is found in areas of low to medium rainfall, characterized by wide open grassy areas with rocky outcrops and scattered low shrubs and trees. A mixed association of the two Andropogon species (glomoratus and virginicus) along with natal redtop and pili grass (Heteropogon spp.) make up the dominate grass cover, with localized patches of molasses grass.

   Short to medium-statured trees of the xerophytic form of ʻōhiʻa can be found growing on pahoehoe knolls scattered throughout the grassland. Again, this ecosystem type make up less than 1% of Wao Kele o Puna and are confined primarily to older lava flow areas.

7) Mixed lowland forest: An area of varied mosaic of plant associations rather than integrated entity. Usually fragmented and not easily distinguishable from some of the other areas since they tend to merge together. Species found in this area can be xerophytic to moist mesophytic ʻōhiʻa forest in addition to hala (Pandanus tectorius) and kukui (Aleurites moluccana). Since this is one of the most commonly used areas of man, given the numerous archaeological sites in Wao Kele o Puna, human introductions can be found such as, ape (Alocasia macrorrhiza), noni (Morinda citrifolia) as well as wild banana (Musa spp.) and wild taro (Colocasia esculenta).

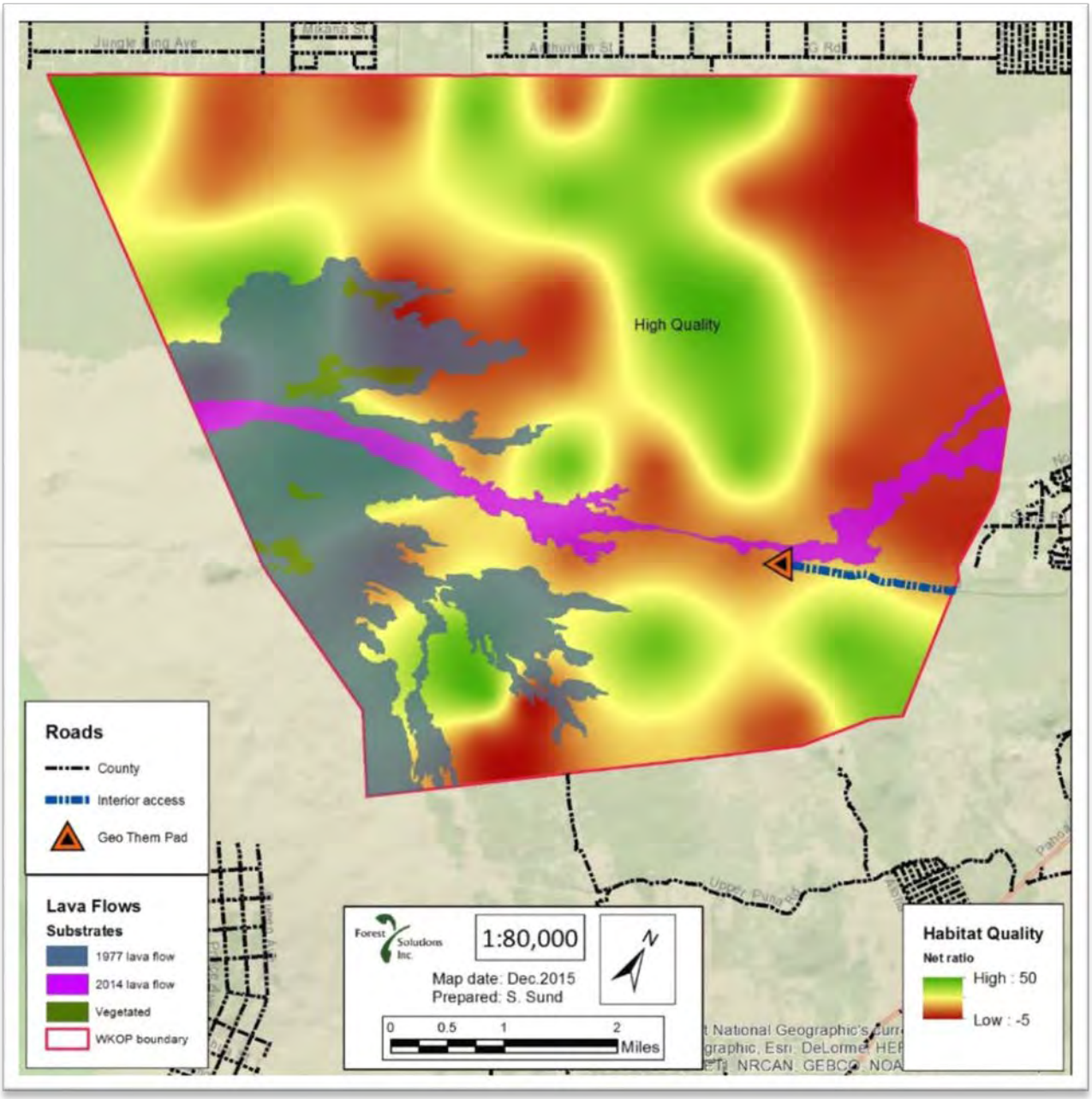

Figure 59 Gradient map joining the overstory and understory components of the forest into a general ecosystem quality assessment. Green areas indicate an intact native forest, red areas indicate a highly invaded native forest. Almost all areas within Wao Kele o Puna have some degree of invasive species present. (Forest Solutions)

These tend to be closely associated to old Hawaiian house sites or agricultural sites, even possibly temporary camp sites for bird catchers as what seems to have been found in one of the kīpuka in Wao Kele o Puna. The mixed lowland forests are composed most frequently of a mixture of native trees such as ʻōhiʻa and lama as well as a multitude of introduced species like the gunpowder tree (Trema oriantalis)

The height of the trees here greatly vary from low stature, almost scrub-like, disturbed forest to medium or tall stature older forest. Ground cover varies considerably depending on disturbances and the amount of canopy cover. Ground cover does tend to be sparse when the canopy is dense, and can be shrub thick when the canopy is open. In Wao Kele o Puna, open areas tends to be occupied by thickets of medium stature strawberry guava and glory bush (Melastoma herbacea) and maile pilau (Paederia foetida) is common.

8) Scrub: Usually dominated by exotic and invasive species. The structure of this exosystem type may vary from open, grassy areas with scattered shrubs and trees to dense, closed scrub. Broomsedge (Andropogon virginicus), molassesgrass (Melinis minutiflora), or Californiagrass (Brachiaria mutica) are usually the dominant grass species in open scrub. Napiergrass (Pennisitum purpurum), bush beardgrass (Andropogon glomeratus), and Hilo grass (Paspalum conjugatum) may be locally common in some areas.

   Melastomes, strawberry guava and guava (Psidium guajava) may also be abundant in scrub forest along with lantana. The herbaceous layer is poorly developed where scrub is dense, especially in strawberry guava thickets, however shade tolerant species such as basketgrass (Oplismenus hirtellus) and downy woodfern (Christella dentate) are more common.

   In less dense scrub areas, Glenwood grass (Saccciolepis indica), swordfern (Nephrolepis multiflora), thimbleberry (Rubus rosaefolius), honohono grass (Commelina diffusa), and Stachytarpheta species are present. Few native plants are found here, but ʻōhiʻa, ʻākia (Wikstromia sandwicensis), lama (Diospyros sandwicensis) and ʻuki (Machaerina angustifolia) can still be found scattered throughout this type of ecosystem.

9) Agricultural lands: Though the majority of Wao Kele o Puna has never been cleared for agricultural use, sections were cleared for the development of geothermal energy and a small section along the south boundary were cleared of old growth ʻōhiʻa in a injudicious effort to use as bio-fuel in the form of wood chips.

   Both these areas have been highly disturbed, however have very different outcomes. In the area cleared for geothermal, there are grass species and strawberry guava coming in. Continuous clearing and mowing is required to keep the grasses down in this area. Quite surprisingly, the opposite is true of the old wood chipping site.

   Scientist in partnership with DLNR-Division of Forestry Hilo, from the U.S. Forest Service, are finding incredible secondary ʻōhiʻa growth in this area and the tree stands are quite large and are clearly a dominate species in this area. This was not expected since the area was nearly completely razed during wood chipping efforts in the 1980s.

   This is a one-of-a-kind area, there is no other like in the State, and presents an unprecedented opportunity to study secondary regeneration of ʻōhiʻa. Also surprising is the number of native understory plants that have recovered in this area.

   Agricultural lands surround Wao Kele o Puna Forest Reserve and, with it comes the possibility of additional introduced species into the reserve. In the upper Puna area, there are multiple agri-business and plant nursery operations growing all types of flora. As an example, Miconia, a highly invasive melastome, was accidentally introduced into Wao Kele o Puna Forest Reserve from a now abandoned nursery in the Kopua Farm Lot area. This is just one of a number of agricultural communities that surround the reserve.

Pōkiʻi ka ua, ua i ka lehua.

The rain, like a younger brother, remains with the lehua.
Said of the rain that clings to the forest where ʻōhiʻa trees grow. (Pukui 1983:294, verse 2685)

ʻŌhiʻa and Lehua loved each other from the moment they first saw each other at a village dance. ʻŌhiʻa was a tall strong man with a handsome face and lithe form. He was something of a trickster and was first in all the sports played by all the young men. Lehua was gentle and sweet and as fragile as a flower. Her beauty was the talk of the island, and her father was quite protective of his only child.
When Lehua saw the handsome, bold ʻŌhiʻa speaking with her father beside the bonfire, she blushed crimson, unable to take her eyes from the young man. At the same moment, ʻŌhiʻa glanced up from his conversation and his mouth dropped open at the sight of the beautiful maiden. He was not even aware that he had stopped speaking right in the middle of his sentence, so overwhelmed was he by the sight of the fair maiden across the fire from him.

Lehua's father nudged the young man, recalling him to his duties as a guest. ʻŌhiʻa stuttered and stammered apologies, trying to continue his conversation while keeping one eye on the fair Lehua. Lehua's father was amused by the young man's obvious infatuation with his daughter. He quite liked this bold trickster, and so he offered to introduce ʻŌhiʻa to his daughter. The young man almost fell over in his haste as they walked across the clearing to where Lehua stood with her friends.

From that moment, there was no other woman for ʻŌhiʻa but Lehua. He had eyes only for her, and courted her with a passion and zeal that swiftly won her heart. Her father gave his only daughter gladly into the keeping of the strong young man, and the young couple lived quite happily for several months in a new home ʻŌhiʻa built for his bride.

Then one day the goddess Pele was walking in the forest near the home of the handsome ʻŌhiʻa and spied the young man at work. Pele was smitten by him, and went at once to engage him in conversation. ʻŌhiʻa spoke politely to the beautiful woman, but did not respond to her advances, which infuriated Pele. She was determined to have this young man for herself, but before she could renew her efforts, Lehua came to the place her young husband was working to bring him his midday meal.

When he saw his lovely wife, ʻŌhiʻa's face lit up with love. He dropped everything at once and went to her side, leaving a fuming Pele to stare in jealous rage at the young couple. Dropping her human disguise, the goddess transformed into a raging column of fire and struck ʻŌhiʻa down, transforming him into a twisted ugly tree in revenge for spurning her advances.

Lehua fell to her knees beside the twisted tree that had once been her husband. Tears streaming down her lovely face, she begged Pele to turn him back into a man or else turn her into a tree, as she could not bear to be separated from her beloved. But Pele ignored the girl, taking herself up to the cool heights, her anger satisfied.

But the gods saw what Pele had done to the innocent lovers and were angry. As Lehua lay weeping in despair, the gods reached down and transformed the girl into a beautiful red flower, which they placed upon the twisted ʻŌhiʻa tree, so that she and her beloved husband would never more be apart.

From that day to this, the ʻŌhiʻa tree has blossomed with the beautiful red Lehua flowers. While the flowers remain on the tree, the weather remains sunny and fair. But when a flower is plucked from the tree, then heavy rain falls upon the land like tears, for Lehua still cannot bear to be separated from her beloved husband ʻŌhiʻa. (Retold by SE Schlosser)

(http://americanfolklore.net/folklore/2010/10/peles_revenge.html)

O ka laʻau ma kai mai he ʻŌhiʻa, he laʻau nui no ia, malaila na kawili manu e kawi[-] Ii ai, he pua ulaula maikai kona, aolenae he hua, he laau' kalai nui ia, ina 'kua kii he laau maikai i pou, a i oa hale, I palaau heiau, a i wahie, a i lako kaulua, a meia mea aku, ia mea aku, he nui no na mea pono

Further down the mountain grows the ʻŌhiʻa, a large tree. In it, the bird-catchers practiced their art of bird-snaring. It was much used for making idols, also hewn into posts and rafters for houses, used in fencing the enclosures about temples, and for fuel, also from it were made the sticks to couple together the double canoes, besides which it had many other uses. (Malo, 1898:41)

> The native Hawaiian ʻōhiʻa (Metrosideros polymorpha) is the most abundant tree in the Hawaiian Islands, comprising about 62 percent of the total forest area. The name Metrosideros is derived from Greek metra, heartwood, and sideron, iron, in reference to the hard wood of the genus (Dawson and Stemmermann, 1991.) Known as ʻŌhiʻa Lehua, the species is found on all major islands and in a variety of habitats. (Friday and Herbert 2006:2)
>
> ʻŌhiʻa lehua is typically the dominant tree where it grows. Although the species is little used commercially, it is invaluable from the standpoint of watershed protection, esthetics, and as the only or major habitat for several species of forest birds, some of which are currently listed as threatened or endangered. (Friday & Herbert 2006:2)
>
> ʻŌhiʻa is a slow-growing, endemic evergreen species capable of reaching 75- to 90-feet in height and about 3-feet in diameter. It is highly variable in form, however, and on exposed ridges, shallow soils, or poorly drained sites it may grow as a small erect or prostrate shrub. Its trunk may range in form from straight to twisted and crooked. Because the species can germinate on the trunks of tree ferns and put out numerous roots that reach the ground, it may also have a lower trunk consisting of compact, stilt-like roots. (Friday & Herbert 2006:2)
>
> The hard, dark reddish wood of ʻōhiʻa lehua was used in house and canoe construction and in making images (kiʻi), poi boards, weapons, tool handles, kapa beaters (especially the rounded hohoa beater), and as superior quality firewood. ʻŌhiʻa lehua, though of a very nice color, cracks or 'checks' too easily to be useful for calabash making. The foliage served religious purposes and young leaf buds were used medicinally. The flowers and leaf buds (liko lehua) were used in making lei. (Friday & Herbert 2006:17)
>
> To Hawaiians of old, the gods were everywhere, not only as intangible presences but also in their myriad transformation forms (kinolau) and in sacred images (kiʻi). Most of the large images were carved from wood of the ʻōhiʻa lehua, an endemic species that is regarded as a kinolau of the gods Kāne and Kū. (Abbott 1992:113)
>
> They include akua kāʻai, a type of image explicitly designed to be portable; most of the akua kāʻai were also made from ʻōhiʻa lehua. The lower part of many akua kāʻai is a pointed stake to be thrust into the ground, making them usable almost anywhere. Akua kāʻai probably occupied set locations at most times and were removed only to be taken into battle or on other important occasions. (Abbott 1992:113)
>
> ʻŌhiʻa lehua grew on all the major islands and was widely used in housebuilding. Almost without exception, the trees used in house building were endemic species, and this use constituted the Hawaiians' heaviest reliance on the native flora - far heavier, for example, than their dependence on native plants for food, kapa, or cordage. Canoe decking, spreaders, and seats were commonly made of ʻōhiʻa lehua, as well as the gunwales. (Abbott 1992:68,81)
>
> ʻŌhiʻa lehua was very important to hula (and Laka, as noted below) and one of the five primary plants

represented at the hula altar (ʻōhiʻa lehua, halapepe, ʻieʻie, maile and palapalai.) The hālau hula, a structure consecrated to the goddess Laka, was reserved for use by dancers and trainees and held a vital place in the life of an ahupuaʻa. Some of them enjoyed the patronage of aliʻi families, but others seem to have been essentially self-supporting, maintained through the work of the dancers themselves and by contributions from their audiences. (Abbott 1992:117)

Inside a hālau hula was an altar (kuahu), on which lay a block of wood of the endemic lama, a tree whose name translates as "light" or "lamp" and carried the figurative meaning of "enlightenment." Swathed in yellow kapa and scented with ʻolenā, this piece of wood represented Laka, goddess of hula, sister and wife of Lono. (Abbott 1992:117)

Per Abbott (1992:127), the Hawaiians developed four basic lei styles (kui (flowers strung through the center,) wili (winding material that binds together the vegetation,) haku (braided together) and kipuʻu (flowers, leaves or vines, with long stems or vines, were loosely arranged in one plane) which they adapted to accommodate endless combinations of buds, blossoms, foliage and dried plant materials and to produce both lei poʻo (head let) and lei ʻāʻī (neck let). ʻŌhiʻa lehua blossoms, buds and leaves were important elements in lei of both wili and haku types.

ʻŌhiʻa is the first tree species to establish on most new lava flows. As the entire portion of eastern Hawaiʻi Island is a volcanic area, lava flows occasionally cover areas of forested land. Thus, while some forests are covered with lava, other forested areas serve as ‘seed banks’ and help to bring growth back life to the lava-impacted area. (Botanical World)

The ʻōhiʻa tree is one of the most abundant native trees in Hawaiʻi and represents the majority of trees in the Puna rainforest. Native Hawaiians consider the tree and its forests as sacred to Pele, the volcano goddess, and to Laka, the goddess of hula.

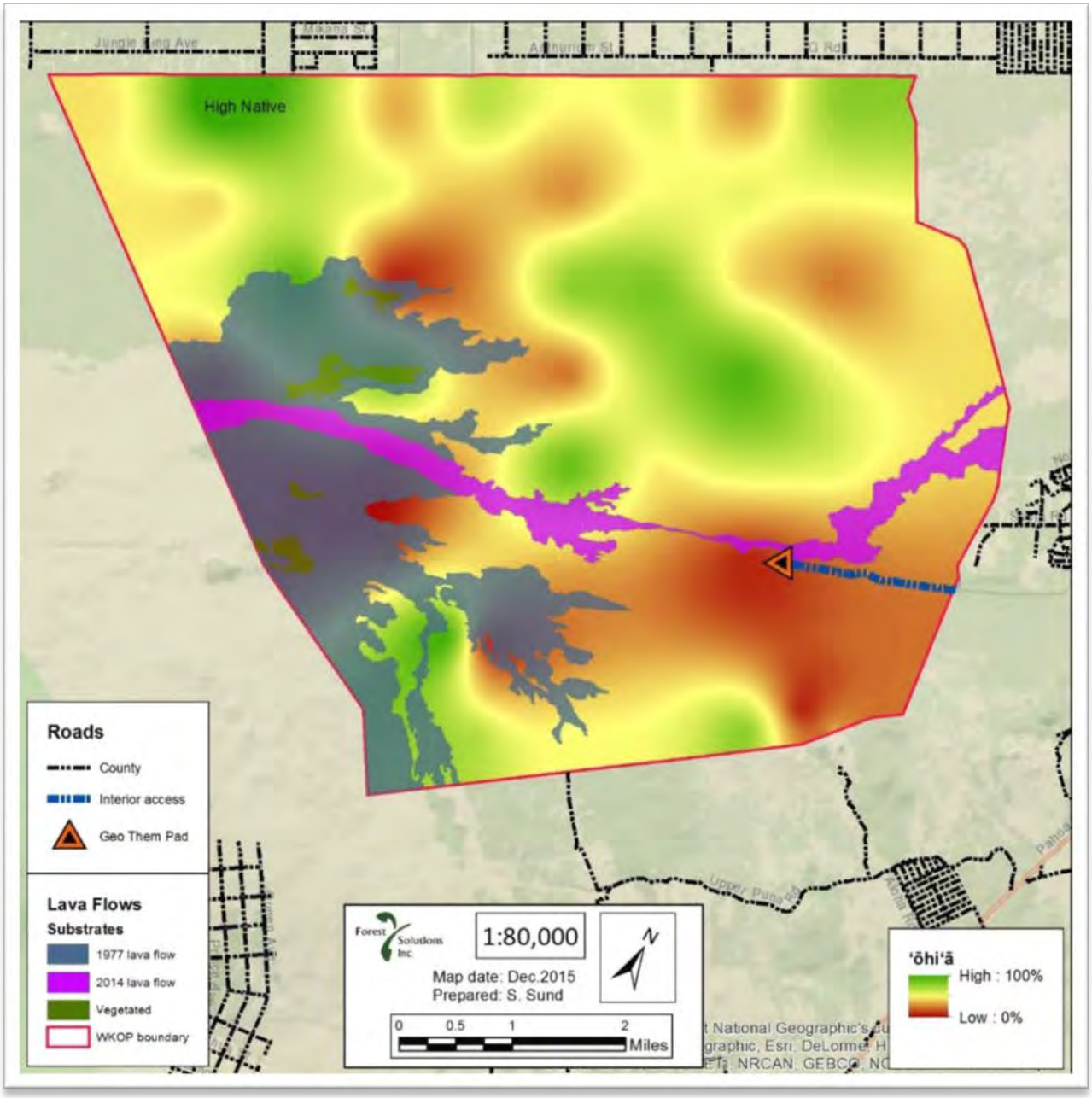

Figure 60 Distribution of ‘ōhi‘ā (Metrosideros polymorphia). Note that a high frequency of ‘ōhi‘ā is associated with a high forest quality in previous maps (Forest Solutions)

Resource Management Challenges

Wao Kele o Puna is the largest intact native lowland forest on the windward side of the Island of Hawai'i, and has some of the last habitat of its type in the State. In addition to this significant ecosystem value, this forest is also culturally significant as a place where Pele resides, and a location to gather plants used in cultural practices.

At the same time, however, Wao Kele o Puna faces a significant invasion of alien species and fungus that left unmanaged will result in the loss of this native forest ecosystem. To be effective environmental and cultural stewards of this sacred land of Wao Kele o Puna, the Office of Hawaiian Affairs is faced with four important resource management challenges:

1. The forest is very large. Wao Kele o Puna is is about 25,700 acres in size and has invasive species throughout in greater or lesser intensity.
2. Some areas have been completely replaced by non-native species. Left unmanaged, the forest will continue to degrade and be overtaken by non-native species. This will occur even in areas where invasive species are currently not frequent.
3. Rapid 'Ōhi'a Death has added to this challenge by killing large numbers of canopy 'ōhi'a trees.
4. It is difficult to get around the forest of Wao Kele o Puna. It is bisected by large cracks and faults, and the existing road only extends only 1.5 miles of the total 7-mile length and 6-mile width. Limited access has slowed human introduction of alien species. However, lack of roads also hinders effective forest management by making it difficult for forest managers to access areas for field work and emergency response.

The following goals guide this comprehensive management plan to perpetuate the ecosystem and cultural values of the Wao Kele o Puna forest by addressing the significant resource management challenges within the limitations of a finite budget:

1. Protect and assist the recovery of areas with existing high coverage of native plants.

2. Reduce the spread of alien invasive species within Wao Kele o Puna from areas with existing high coverage of invasive species.

3. Minimize further introduction of alien invasive species into the forest from elsewhere.

To protect Wao Kele o Puna forest against threats and assist the recovery of areas with existing high coverage of native plants, this plan recommends the following objectives:

1. Establish a forest management framework using a Forest Information Management System (FIMS) to manage the resources and work at Wao Kele o Puna. This will allow the coordinated use of multiple databases necessary for tracking and characterizing native forest resources, alien invasive species, fire, and other threats affecting native forest coverage, restoration efforts, levels of use, and other parameters useful to manage the forest. The FIMS will incorporate all the forest resource data already in the GIS database used to characterize the forest.

2. Improve access to Wao Kele o Puna for effective forest stewardship and emergency response by developing a simple network of narrow service roads. These roads would follow certain guidelines for the route selection, design and construction to minimize negative impact on the native forest.

3. Control the spread of invasive species through phytosanitary protocols that would be required by anyone before entering and upon leaving the forest to prevent spread of invasive species. These protocol help reduce the risk of introducing additional invasive species associated with increased access.

4. Manage and allocate natural resource use by requiring some cultural protocol of everyone entering or leaving the forest, and requiring all users to participate in an administrative arrangement with the landowner such as a kapu system, permit system, kuleana, cooperative agreements or other stewardship arrangements with users and stakeholder groups.

Establish a Forest Management Framework for Wao Kele o Puna

A formal forest management framework is needed to make sense of a forest as large and diverse as Wao Kele o Puna. To characterize the existing forest types, the forestry team conducted field surveys and input resulting data into a Geographic Information System (GIS) database. This GIS database and its related graphical maps identify where different types of forests are located, including areas with high coverage of native or invasive plants.

Based upon the habitat quality identified in these maps, Wao Kele o Puna was divided into Forest Management Classes (FMC). These FMCs were subsequently divided into Forest Management Units (FMU), around which a forest management, budgeting, and communication framework was created.

Forest Management Classes

This comprehensive management plan is being prepared at the larger forest level by initial surveys to identify Forest Classes throughout the forest. The classes designated for Wao Kele o Puna are: HC- high conservation value forest; IL- invaded, limited; IE – invaded, extensive; QZ –quarantine; and recent lava flow. Forest Management Units are smaller subdivisions within each Forest Management Class to allow practical management tracking.

Defining this mosaic of discrete Forest Management Classes which encompass the entire Wao Kele o Puna forest is essential to provide a simplified framework for management decisions and long term planning. The following table summarizes the different Forest Management Classes in Wao Kele o Puna showing its relative size and the percentage of native species cover.

The forest classification system is based on the forest types described in the Invasive Species Plan modified with information collected for the Biological Assessment. While the Forest Management Classes are based on scientific data collection, their role is practical. With limited resources and time, only certain forest management actions will be feasible. It makes sense, therefore, to prioritize based on the largest possible impact using the least resources.

Native species cover and relative size of Forest Management Classes in Wao Kele o Puna

Forest Management Class	Abbreviation	Native cover	Acres	% forest area
High Conservation Value Forest	HC	75-100%	4,206	16%
Kīpuka High Conservation Forest	KHC	75-100%	153	0.6%
Invaded, Limited	IL	55-75%	5,883	23%
Invaded, Extensive	IE	30-55%	2,235	8.7%
Quarantine Zone	QZ	15-30%	6,881	27%
Kīpuka Quarantine Zone	KQZ	15-30%	57	0.2%
1977 Lava flow	LV	0-10%	2,891	11%
2015-16 Lava flow	LV	0-10%	3,396	13%
Infrastructure	INF	0%	5	0.02%
		Total (rounded)	25,700	(Forest Solutions)

Actions by Forest Management Class Type

The following are summarized actions to take withing respective Forest Management Class:

High Conservation Value Forest & Kīpuka High Conservation Value

- Clean out weeds. Maintain weed free status
- Start with smaller kīpuka, move on to larger areas once there is experience and funding to do so
- Prioritize areas that are likely to have endangered and rare flora and fauna
- Build containment barriers pā pōhaku (stone walls) or pā lāʻau (picket fences) around select kīpuka

Puʻu

- Clean out weeds prioritizing less invaded puʻu. Maintain weed free status
- Prioritize areas that are likely to have endangered and rare flora and fauna
- Build containment barriers; pā pōhaku (stone walls) or pā lāʻau (picket fences) (or other fencing) around select kīpuka
- Puʻu are worth restoring as they will likely survive future lava flows, particularly less weedy ones.

Invaded limited

- Keep status quo for now until better options emerge. Areas are too large and too invaded to take head on. Keep new weeds and pathogens out. Control new habitat-altering weeds such as miconia and albizia
- Work with community to identify and use ‘kuleana’ (Community Plots) as gardens for Hawaiian medicinal plants

Invaded extensive

- Keep status quo for now until better options emerge. Areas are too large to take head on. Keep new habitat-altering weeds and pathogens out. Do not actively fight common weeds

Quarantine

- Test replacement of invasive weeds such as albizia and tibouchina with fruit bearing trees that are not invasive such as ulu, avocado, jackfruit. Potential for sustenance food and for increasing yield and flavor of pigs for hunters.

Lava Flow

- Lava flows represent about 24% of the land in Wao Kele o Puna. The management objective on lava flows should be focused only to prevent new aggressive invasive species from colonizing the lava.

Forest Management Units

The different areas of the same Forest Management Class are each labeled as Forest Management Units (FMUs) to help keep track of the specific resources and management measures taken in each FMU. Some of the initial FMUs like HC2 are large in size and will be subdivided later after the forest managers have worked on resource management activities in the field. FMUs are designated according to the expected management intensity.

Areas where there is a higher intensity of management activity, such as a high conservation value forest, may result in a smaller area being designated as a FMU. This is mainly for practical purposes including communication (reporting), budgeting, and work flow control. FMUs are semi-static.

Management actions completed within an FMU are easily tracked in a spatially related database system (GIS), allowing easy comparisons of activities across space and time in a unified system. As changes become necessary, FMU boundaries can be modified or split into smaller land management areas for practical purposes such as tracking species location, monitoring data from surveys, managing budgets, as well as tracking management activities. The overarching goal is to provide a data and spatial matrix in which management actions take place over time.

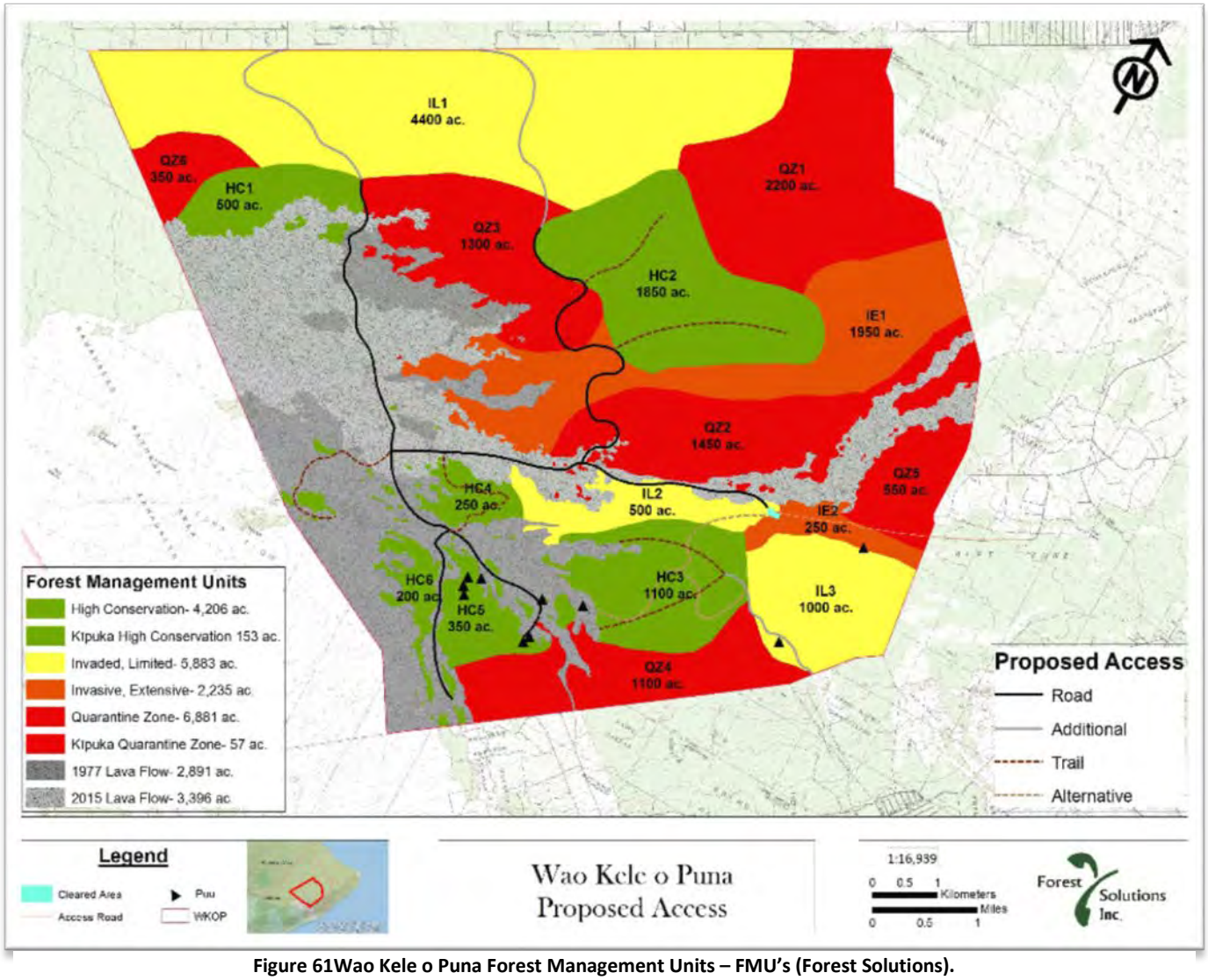

Figure 61Wao Kele o Puna Forest Management Units – FMU's (Forest Solutions).

Data management

The main benefit of using discrete Forest Management Units is the ability to keep track of activities that have occurred in the forest through a georeferenced database.

This is made up of an initial Forest Management Unit (FMU) spatially related database using individual identification codes for each forest stand called "Unique IDentification numbers" or UIDs. This initial FMU database is provided in the accompanying electronic submission.
This initial FMU database will be used to build a Forest Information Management System (FIMS), which allows managers to track a wide variety of spatially relevant information including:

- Resource data including baseline soils, flora, and fauna
- Forest type (i.e. high conservation, invaded limited, invaded extensive)
- Special management areas (SMA), such as cracks, pu'us, rare plant communities)

- Management Activities including weed management and native plant restoration
- Budget & expenditures by stand or groups of stands
- Staff time by area
- Spatially oriented access agreements & permits – i.e. which group has the kuleana for a particular stand
- Research agreements
- Infrastructure maintenance, distances on road segments
- Climate information
- Neighbors & neighboring land use

A geo-referenced integrated database allows a forest manager to link weed control efforts, which are kept in a weed control database, with volunteer days, which are kept in a community engagement database. These activities might all occur in a particular forest management unit. A report created from such information would describe the weed control work and volunteer days spent within that particular forest management unit.

The Unique IDentification numbers are an artifact of spatially related databases and not of everyday forest management. They are a practical way to bridge disparate conventional names with the need for a consistent identifier to track work done within each forest stand. This basic FIMS framework would be customized for use at Wao Kele o Puna, where icons represent categories of information available for each FMU.

Access

Legal access into Wao Kele o Puna is limited to a single 1.5-mile road that ends about 1/3 of the way into the forest at a 5-acre papa (a clearing previously used for geothermal development).

This forest road is in good condition, having been designed for heavy trucks and regularly maintained by OHA and DLNR since OHA's purchase of the property.

The road itself is subject to occasional, usually small, collapses of the wearing surface due to movements in the cracks that lay beneath it. As expected, these cracks in the road may open up at any moment depending on the geological conditions of Kīlauea. Naturally, this adds another complication to emergency access, which could, therefore, be compromised in a large earthquake or similar geologic event.

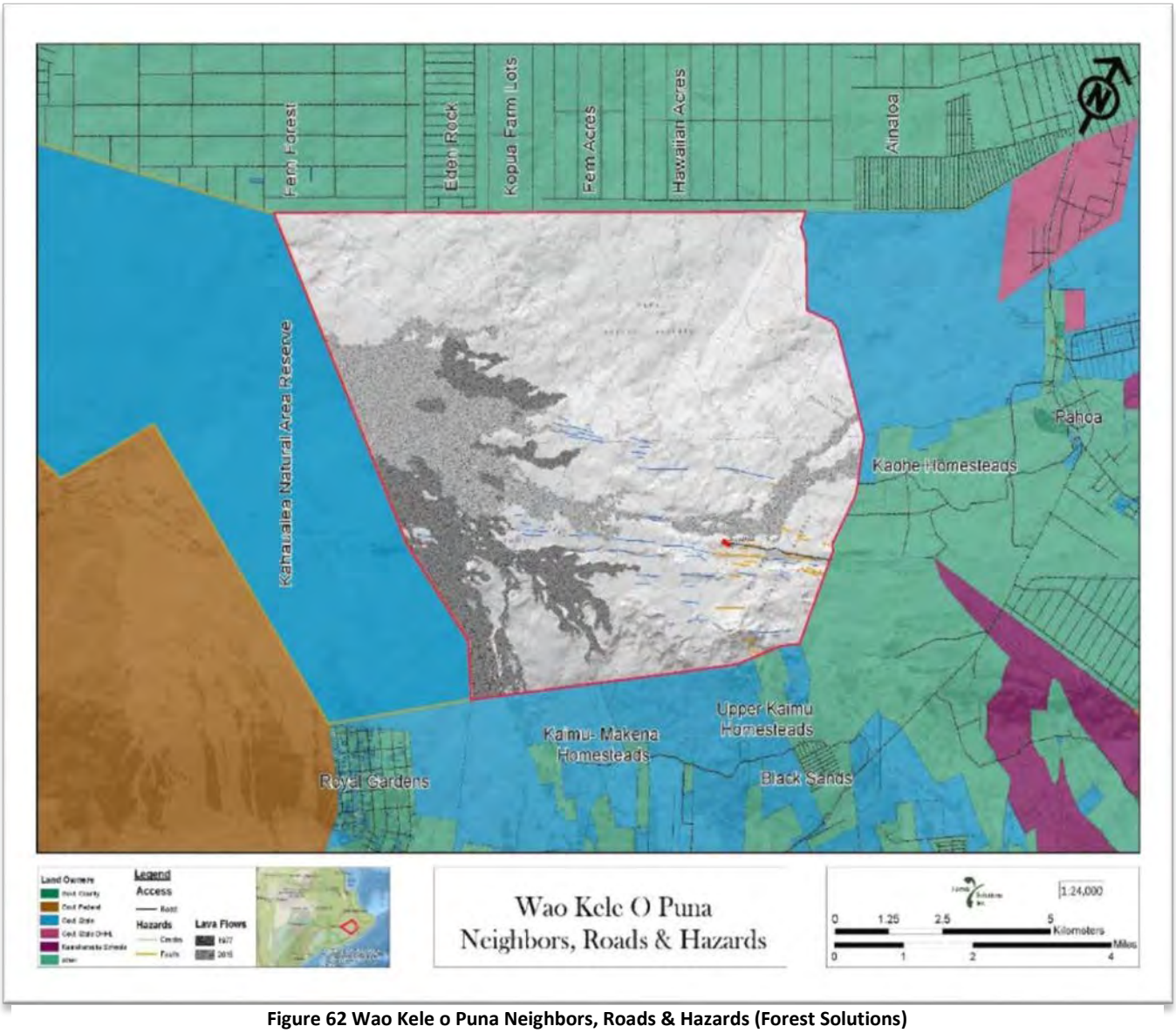

Figure 62 Wao Kele o Puna Neighbors, Roads & Hazards (Forest Solutions)

On either side of the road, however, the forest is bisected by faults and cracks of various magnitudes, as it is aligned with and built upon the East Rift Zone of Kīlauea. Vegetation obscures these cracks and faults from view, making foot travel from the road into the forest on either side very hazardous.

The rest of the forest is only accessible on foot, or via helicopter with prior permission from OHA for landing within the forest. There are, however, a number of roads and house lots in the area surrounding Wao Kele o Puna that touch the Wao Kele o Puna boundary. These roads are private and there are no existing agreements for their use by OHA or the public as access ways into Wao Kele o Puna.

Figure 63 The existing 1.5 mile road is subject to cracks opening on the wear surface, such as this one that appeared in 2015. The crack is at least 30 ft deep. These cracks obviously limit access to the forest and are a source of additional concern for evacuations during an emergency as they are unpredictable. (Forest Solutions) (Forest Solutions)

Once inside Wao Kele o Puna, traversing the forest is difficult and sometimes impossible due to a combination of thick vegetation (weeds and uluhe) and frequent ground cracks and holes (tree molds). The difficulty of moving around within the forest is exacerbated by the large distances that must be traversed within Wao Kele o Puna for effective management.

Travel time estimates for accessing different areas in Wao Kele o Puna can be determined using the average rate of travel that was achieved during the course of fieldwork for this plan. During fieldwork, the crew travelled about a mile per day by rotating the lead person in the crew.

At this pace, a hike/bushwhack/crawl from the geothermal pad to the northwest property border, such as Hawaiian Acres subdivision or Eden Roc could take 4 to 6 days, depending on the size of the crew. A larger crew is faster since more people can be rotated into the lead person role of cutting the trail and pushing vegetation.

Similarly, the route to the upper boundary of the forest (Kahauale‘a Natural Area Reserve) is over 5 miles, also representing a 3-5 day walk, somewhat facilitated by more recent lava flows, which in spite of being rough broken ground are at lease free of thick vegetation. At this pace, helicopter access is faster, safer, and more economical than the ground approach.

The Need for Roads in Wao Kele o Puna

Managing Wao Kele o Puna effectively will require improved access. Simply put, the landowner is faced with the option of either spending money to develop a simple system of roads and trails, or spending money for helicopter access. Roads are a necessity for the efficient and safe movement of resources and people within the forest. In order for forest management efforts to have a meaningful impact on weeds and other forest threats, road access will be needed.

While an improved road system in Wao Kele o Puna will improve access for forest management purposes, it also can increase the risk of introducing invasive species. This plan recommends improving access to the forest through the development of several low-impact narrow roads and trails that connect the various portions of the forest. In particular, the adherence to phytosanitary procedures is a key component to reducing this risk. Where serious weeds have been introduced in the past to native forests, phytosanitary procedures have either not been in place or

ignored.
These roads would be developed using specific guiding principles to minimize any potential negative impacts on environmental and cultural resources. Naturally, the negative effects of the road and trail development will need to be ameliorated and the resultant access path managed to avoid later introduction of weed species.

Illegal dumping occurs in areas where access has been created into Wao Kele o Puna. Illegal commercial activities have also occurred in Wao Kele o Puna including a tour operation that entered Wao Kele o Puna from a neighboring property using ATVs to approach the lava flow. Hunting is not currently a source of trouble, but it needs to be conducted in an orderly and fair framework that allows everyone to benefit.

Controlling access to and use of roads is critical to limit illegal dumping and the introduction of new weed or disease agents. To be effective limiting weed introductions, a multipronged approach to weed control is needed.

From a strictly ecological and practical perspective, the ability to access the forest and manage/restore it is superior to simply leaving the forest to fend for itself or trying to maintain it with air support.

From a social standpoint, one of the recurring themes of public and stakeholder comments is the need for community access to the forest. The current short road certainly provides access to that portion of the forest, yet falls far short of providing meaningful access to the rest of the forest. Having additional infrastructure improves community access to the rest of the forest, enhancing its social value to the people of Puna.

This is particularly the case for kupuna, who are a source of knowledge on traditional and customary practices, yet face difficulty moving around especially in a thick forest. What better solution than infrastructure to allow these and others with limited means of mobility the ability to visit Wao Kele o Puna. This is meaningful community access.

Guiding Principles and Objectives for Developing Roads and Trails

Based upon the benefits and concerns addressed in the last section, the following are recommended guiding principles for developing roads and trails to improve access into Wao Kele o Puna:

1. Build roads and trails with a reason in mind – why is access sought? Will this new road/trail benefit the forest and especially those who use it?
2. Keep roads and trails small, unobtrusive, and in conformity with natural features (i.e. not necessarily straight, this is not a subdivision)
3. Provide reliable access to High Conservation Value Forest areas of Wao Kele of Puna for forest management and community participation purposes
4. Stay on lava flows to limit the collateral damage to native stands, particularly ʻōhiʻa
5. Avoid special management areas – those that are ecologically, culturally or otherwise sensitive, such as High Conservation Value Forests and known archaeological sites

Road Development Plan

Two road development options are readily apparent and are covered in the next two subsections. The first, called the “independent road option,” is to develop an infrastructure network based on the existing access easements within the forest. The second, called the “neighbor road option,” assumes that some form of agreement can be crafted with the surrounding communities to provide access to Wao Kele o Puna through the neighboring subdivisions, homesteads, and pastoral leases.

A third option is some combination of the two approaches, such as developing the independent road system within Wao Kele o Puna, and then connecting to individual neighbor roads after these connections have been negotiated with neighboring landowners.

Independent road option

This suggested alignment that is shown as solid black lines on the following image provides access to the main portions of the forest via the existing main access road.

The final layout of the roads will be based on terrain, topographic features, and other factors that will be discovered by field work, yet the layout proposed here has already taken into account known land features such as cracks and faults, known lava tubes and high conservation forest plant communities.

Road length under this plan is approximately 13.7 miles depending on the final alignment once the pre-building considerations (discussed in the previous subsection) are included.

The benefit of this approach is that it can be implemented faster as it does not depend on the ongoing consent of neighboring communities. The effect of this approach is that it concentrates the access for the entire forest on a single road. The upside of a single access point is ability to control entry into the Wao Kele o Puna forest.

The downside is in the case of an emergency, there would be equally only one exit from the forest via vehicle. Considering the volcanism and hurricanes common to the area, this limitation is a serious consideration.

Neighbor road option

The second option is to connect the internal Wao Kele o Puna roads to the neighbor's roads (as several solid grey lines extending from the solid black lines of the internal roads to the borders of the Wao Kele o Puna forest.) This "neighbor road option" would require consent and agreements with neighboring communities and likely sharing the cost of maintaining neighbor community roads. This option adds 6.1 miles of roads to the 13.7 miles proposed as the "Independent Road Option" for a total of 19.8 miles of new road construction in Wao Kele o Puna.

The large benefit to this approach is that it provides several entry/exit points from the forest in case of an emergency, particularly a lava flow or similar volcanic emergency. It also allows for more rational road development plan by capitalizing on other roads in the area. Finally, it also provides a level of access to the forest to the surrounding communities that they do not enjoy today, which will benefit the people of Puna.

The downsides of this approach include the increased likelihood of noxious plant and disease introduction as well as the increased potential for illegal dumping and illegal commercial activity.

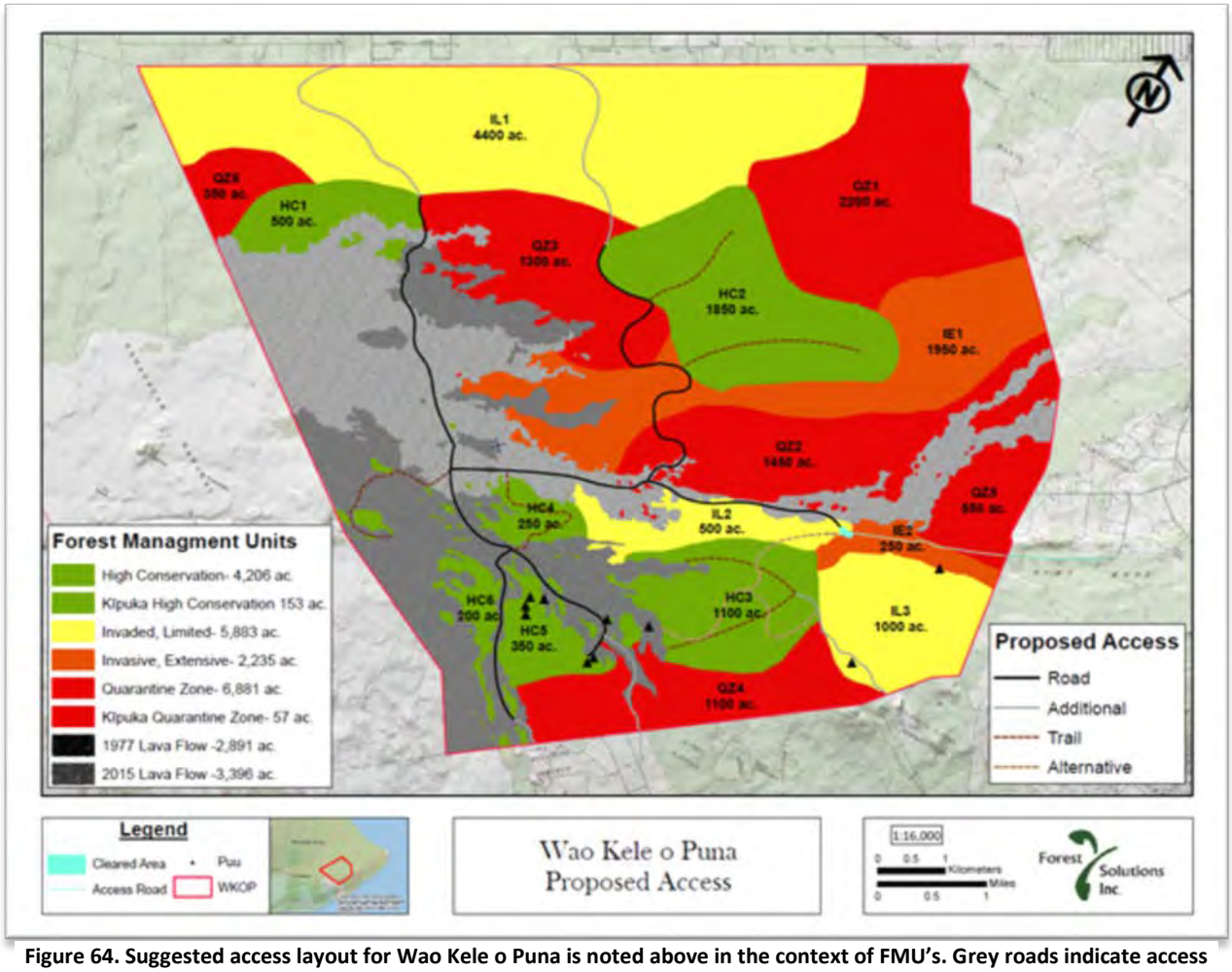

Figure 64. Suggested access layout for Wao Kele o Puna is noted above in the context of FMU's. Grey roads indicate access through neighboring properties, which would need to be negotiated. (Forest Solutions)

Proposed road access option lengths, in miles

Access type	Independent	Neighbor rd
Existing road	1.5	1.5
Road	13.7	19.8
Trail	8.5	

As more people use the forest, a result of its more open status, there may be an increase in indiscriminate clearing of native vegetation for trails. In other native forests of Hawai'i this has included painted/chopped blazes on native trees, aluminum cans left behind attached to vegetation among other impacts. Multiple access points also result in several access gates, which must be maintained and managed; all of which increases costs together with community access.

These options need to be vetted by OHA in consideration of community input. The more use the forest has, the more intrinsic social value it creates, providing support for its ongoing maintenance and improvement yet also the more risk it carries of deleterious effects.

Main Roads

Main roads are permanent roads that can carry weighted trucks and sustain frequent all-weather use. There is only one such road in Wao Kele o Puna which is the current main access road. No further development of main roads is planned.

Secondary Roads

Secondary roads are permanent roads that can carry trucks with moderate weights and a high frequency of use in all weather. The planned new roads for Wao Kele o Puna are secondary roads. Base material already on site can sustain weight and wear surface can be made wide enough to accommodate larger trucks.

Spur Roads

Spur roads can carry lightly loaded pickup trucks. These types of roads will have infrequent use by forest managers and users. Wear surface and base material are limited.

Road Development Best Practices

Roads should be designed in locations according to the following:

- A forester or road engineer should be responsible for the coordinated development of infrastructure including location of roads using GIS and data models such as Digital Elevation Models (DEM).
- A forester or engineer must approve the road line prior to commencement of construction and after undergoing pre-construction assessment.
- Roads should be located in areas of low side slopes to minimize side cutting.
- Roads should be located on elevated areas wherever possible to minimize side cutting, width of clearing, and drainage problems.
- Roads should be located so that no earthworks or soil spill falls into sensitive habitats or other Special Management Zones.
- Roads should be located on well-drained, stable soils with good load bearing capacity.
- The number of crossings over cracks and faults should be minimized.
- Cuts and fills should be balanced to minimize transport of road construction material.
- Existing roads should be used wherever possible.
- Roads should follow the natural contour of the land.
- Areas to avoid should be specified in the pre-construction assessment (including designation of areas under special management, such as endangered species habitat).
- Areas that are steep and unstable should be specified and avoided where possible, faults and cracks should be avoided.
- Minimize erosion by providing and maintaining good surface and side drainage during and after construction.
- Reduce collateral damage to native forests by staying on the lava flows as much as possible, with proper honor and respect paid to Tūtū Pele with gratitude to her for building the foundation on which a road network can be built.
- Minimize disturbance to any Special Management Zones like High Conservation Value Forest, rock walls, cracks, and endangered species habitat.

Typical road cross section

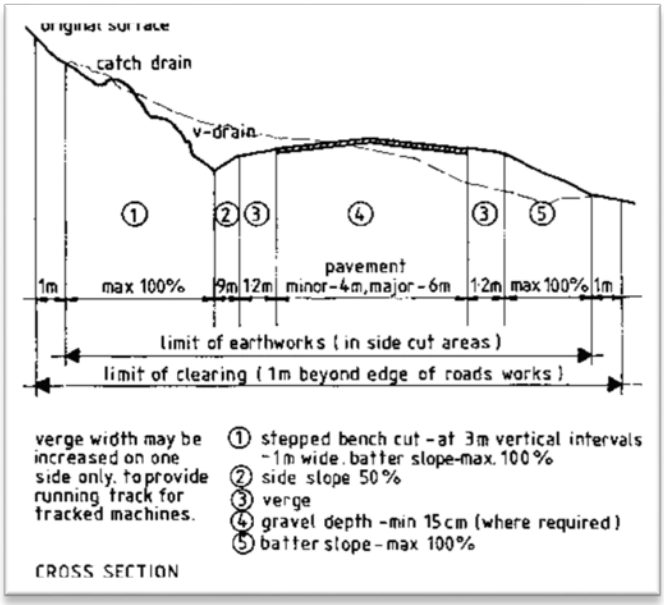

Figure 65 Example of ideal road layout. Wear surfaces and finished width will vary. (Forest Solutions)

A typical road cross section for Wao Kele o Puna will have:

- Surface crown to deflect the high rainfall
- Gravel wear surface to provide traction in all weather and prevent rutting and erosion
- Side ditches to improve road drainage where appropriate
- Noninvasive shade tolerant grass species to stabilize the road cut after construction

Pre-construction Assessment

Roads are disruptive to the forest ecosystem and natural structures in the path of construction. It is critical to limit this impact by doing a pre-construction assessment prior to road construction. The engineering of roads involves specifications in design, layout, construction, maintenance and rehabilitation. These specifications must be planned across the landscape in conjunction with other stages of forest activities.

Pre-planning of any road system and construction will result in lower costs and less environmental, archaeological, and social disturbance than without effective planning. All roads must be constructed in accordance to the guidelines set forth in the Forestry Best Management Practices for the State of Hawai‘i (DOFAW BMPs 1996).

Contours, digital elevation models (DEM), LiDAR, and other continuous and/or thematic maps should be used as available in the construction of all roads to avoid areas with sensitive native forest. Additional information such as easements, rights of way, and entry/exit points will also be delineated on maps when relevant.

Figure 66 Mini excavators are a good choice for trail development if manual options are not viable or not available. They can easily move around sensitive areas and do not cause extensive collateral damage. (Forest Solutions)

Forest Management Issues

The principal forest management issues for Wao Kele o Puna are Rapid ʻŌhiʻa Death, invasive weeds and ongoing management of feral pigs. These are common themes in native forests throughout the state, and addressing them will take up the majority of forest management effort. In the following subsection we set for the the recommendations for addressing these challenges.

Rapid ʻŌhiʻa Death - Greatest Threat to Wao Kele o Puna Forest

A newly identified disease has killed large numbers of mature ʻōhiʻa trees (Metrosideros polymorpha) in forests and residential areas of Hawaiʻi Island. Landowners have observed that when previously healthy-looking trees begin to exhibit symptoms they typically die within a matter of weeks.

The following is a summary from a UH College of Tropical Agriculture and Human Resources (CTAHR) website on Rapid ʻŌhiʻa Death (ROD) and Lyon Arboretum, 2017.

Pathogenicity tests conducted by the USDA Agriculture Research Service have determined that the causal agent of the disease is the vascular wilt fungus, Ceratocystis fimbriata (Keith and others 2015). Although a different strain of Ceratocystis fimbriata has been present in Hawaiʻi as a pathogen of sweet potato for decades (Brown and Matsuura, 1941), this is a new strain of the fungus and the first record of any Ceratocystis species affecting ʻōhiʻa.

Figure 67 Healthy ʻŌhiʻa on left / Dying ʻŌhiʻa on right (UH, Lyon)

It is not yet known whether this widespread occurrence of ʻōhiʻa mortality results from an introduction of an exotic strain of the fungus or whether this constitutes a new host of an existing strain. This disease has the potential to kill ʻōhiʻa trees statewide.

The disease affects non-contiguous forest stands ranging from 1 to 100 acres. As of 2014, approximately 6,000 acres from Kalapana to Hilo on Hawaiʻi Island had been affected with stand showing greater than 50% mortality. The disease has not yet been reported on any of the other Hawaiian Islands.

Crowns of affected trees turn yellowish (chlorotic) and subsequently brown within days to weeks; dead leaves typically remain on branches for some time. On occasion, leaves of single branches or limbs of trees turn brown before the rest of the crown of becomes brown.

Recent investigation indicates that the pathogen progresses up the stem of the tree. Trees within a given stand appear to die in a haphazard pattern; the disease does not appear to radiate out from already infected or dead trees. Within two to three years nearly 100% of trees in a stand succumb to the disease. Other trees in the forest such as kōpiko (Psychotria spp.), ʻohe mauka (Polyscias spp.), strawberry guava (Psidium cattleianum), Melastoma spp., and Koster's curse (Clidemia hirta) are not affected by the disease.

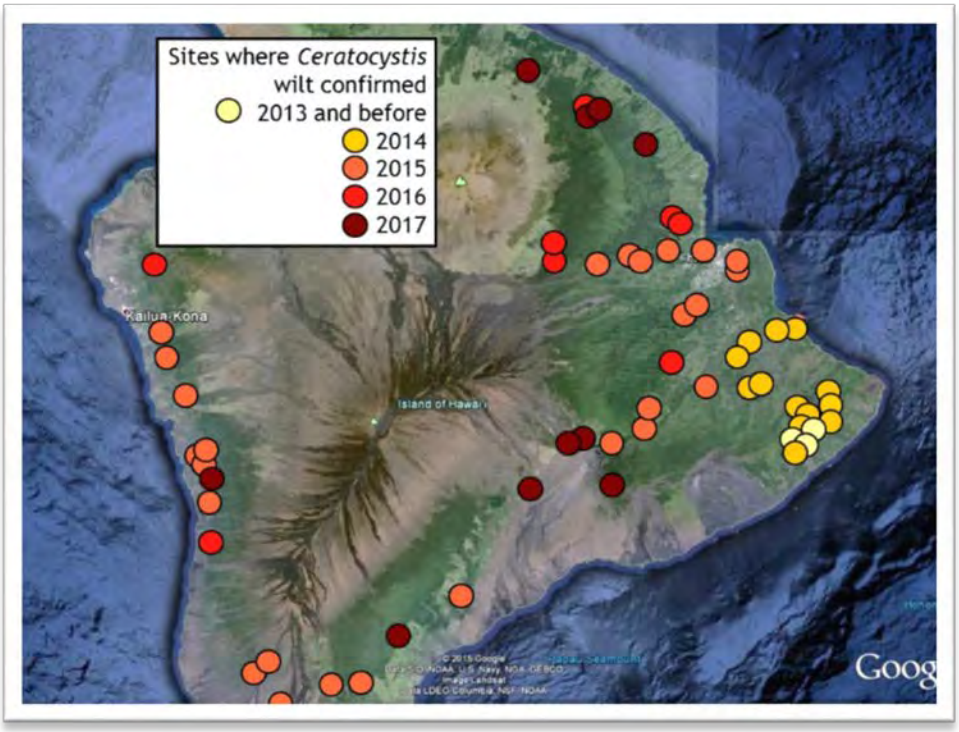

Figure 68 Sites where Ceratocystis wilt have been confirmed (UH CTAHR – March 20, 2017)

Ceratocystis manifests itself as dark, nearly black, staining in the sapwood along the outer margin of trunks of affected trees. The stain is often radially distributed through the wood. Wood samples incubated under moist conditions in plastic bags for a week produce characteristic fruiting bodies of Ceratocystis called perithecia.

Rapid ʻŌhiʻa Death is a very serious situation. While the crisis has not spread statewide (currently limited to Hawaiʻi Island), the numbers are concerning, with scary implications:

- >100,000 – number of ʻōhiʻa trees killed by ROD so far
- 34,000 – number of acres affected on Hawaiʻi Island
- 865,000 – acres of ʻōhiʻa trees statewide
- 50 – percentage of native trees on Hawaiʻi Island that are ʻōhiʻa
- A few weeks – amount of time before tree dies after it exhibit symptoms
- Uncountable – number of humans, animals, and other plants that directly rely on ʻōhiʻa trees for healthy ecosystems, clean water, clean air, native habitat, cultural value, or enjoyment!

It is not yet known how the disease spreads from tree to tree or from forest stand to forest stand. In other Ceratocystis plant hosts such as sweet potato, cacao, mango and eucalyptus the fungus is moved by insects, soil, water, infected cuttings, pruning wounds, or tools, and these modes of transmission may also be involved in infections of ʻōhiʻa trees and stands (Harrington n.d.). Ceratocystis has been found in soils under infected stands in Hawaiʻi and contaminated soil may transmit the disease.

As of early 2017 the disease has been confirmed on all districts of Hawai‘i Island except Kohala. Currently, there is no effective treatment to protect ‘ōhi‘a trees from becoming infected with Ceratocystis or cure trees that exhibit symptoms of the disease. To reduce the spread of Ceratocystis, landowners should not transport wood of affected ‘ōhi‘a trees to other areas. The pathogen may remain viable for over a year in dead wood.

Tools used for cutting infected ‘ōhi‘a trees should be cleaned either with Lysol ™ or a 70% rubbing alcohol solution. A freshly prepared 10% solution of chlorine bleach and water can be used as long as tools are oiled afterwards, as chlorine bleach will corrode metal tools. Chain saw blades should be brushed clean, sprayed with cleaning solution, and run briefly to lubricate the chain. Vehicles used off-road in infected forest areas should be thoroughly cleaned underneath so as not to carry contaminated soil to healthy forests. Shoes, tools, and clothing used in infected forests should also be cleaned, especially before being used in healthy forests.

Recommended Responses to Rapid ‘Ōhi‘a Death

Typical vectors for Ceratocystis in other systems are diverse, including insects, soil, or water transmission routes. At this stage, the vector for ROD is unknown. Given the high threat potential of the disease, we recommend a strong application of the precautionary principle, up to and including access restrictions to Wao Kele o Puna.

With the range of possible ROD vectors, there are a variety of responses or protocols that may be appropriate, but we must also stress the possibility that the vector may be unstoppable by any practical management options, and that any recommendations we may provide here could ultimately prove incapable of halting the advance of ROD.

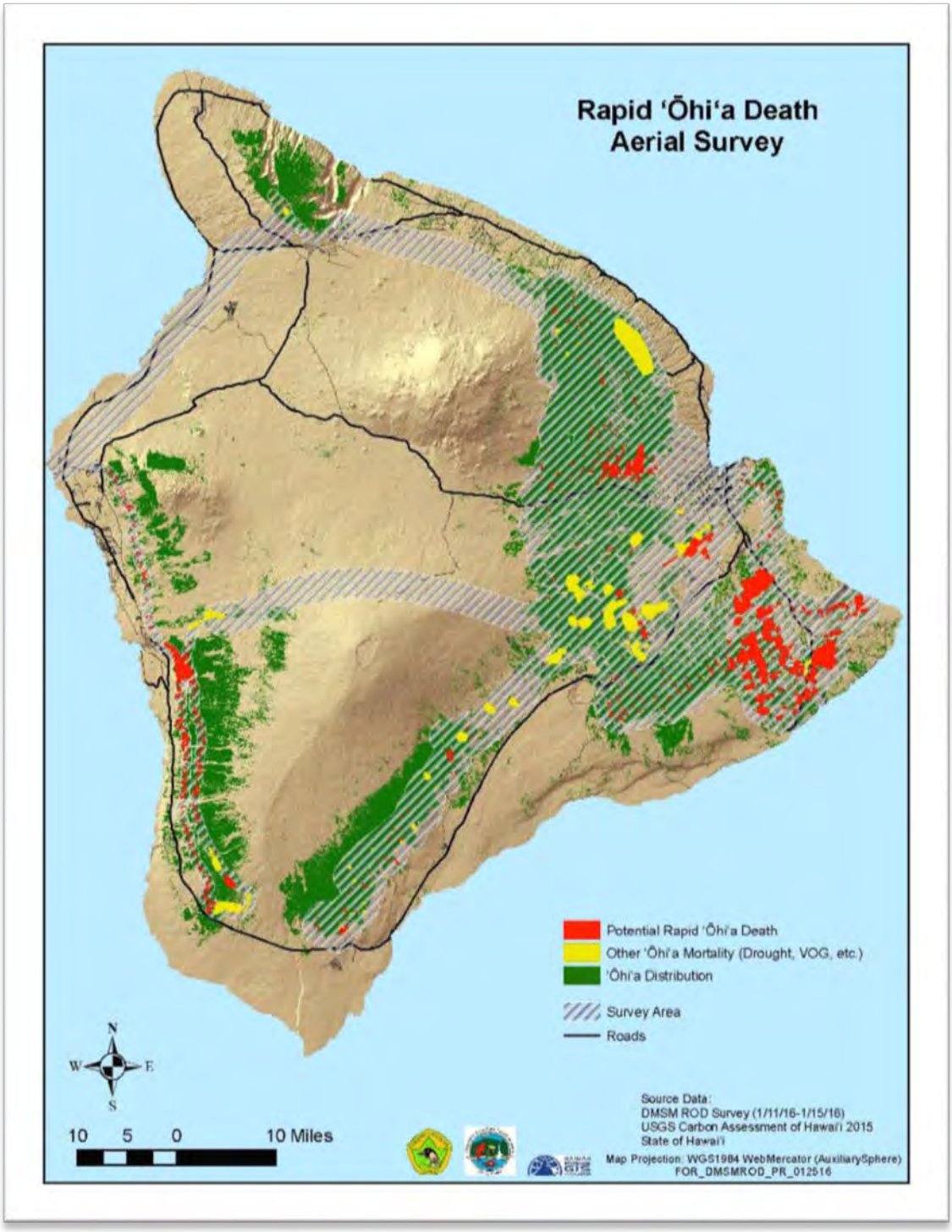

Figure 69 Surveyors estimated the current extent of the infestation at 34,000 acres (UH CTAHR)

If infection is caused by spore-contaminated soils being moved from place to place, for example, there are some protocols that could help (boot and tire washing), but some that are impracticable (large-area fencing to prevent pig incursions). The following is a list of potential responses to possible vectors, again emphasizing that responses may be futile, and that the ultimate cause may not even feature in this list.

If Ceratocystis infects ʻōhiʻa via a soil route, potential vectors could include human footwear and clothing, vehicle tires or undercarriages, and wildlife, including feral pigs and ground birds. Mitigation measures for a soil-borne pathogen should include a standard protocol for cleaning or isolating footwear, clothing, and vehicles. Prior to entering Wao Kele o Puna when coming from areas with potential ROD infection (i.e. anywhere in Puna or Hilo):

- Workers, visitors, or managers should wear clothing that has been machine washed in chlorine bleach (sodium hypochlorite), should wash footwear in a 10% bleach solution and should use plastic disposable footwear coverings.
- Vehicle tires and undercarriages should be pressure washed.
- All animals that may transport infected soils are feral species—there are no native Hawaiian animal species that would transport soils from infected areas to Wao Kele o Puna. As such, all animal soil vectors can be considered pests, and their entry to Wao Kele o Puna should be restricted. In practice, this recommendation will be virtually impossible to implement, whether from the funding perspective and from a logistics standpoint.

If there is a water-borne vector for Ceratocystis, such as a spore form that can be droplet-aerosolized and dispersed by wind, fog, or rain, management-based solutions would be essentially impossible. It is not known whether Ceratocystis is spread by moving infected tissues, including wood, roots or leaves, nor is it known whether trees that have been killed are still a source of viable spores.

The UH-CTAHR cautions that the pathogen may remain in dead plant tissues for up to a year, although this figure is an educated guess based on Ceratocystis in other systems. At minimum, a quarantine program should be implemented immediately:

- Wood-cutting moratorium throughout Wao Kele o Puna for ʻōhiʻa based on the conservative assumptions that (1) tools used by wood-cutters may import the fungus from other areas and (2) that any trees in Wao Kele o Puna may harbor Ceratocystis and thus should not be taken from the forest because they may be moved to uninfected areas.
- Quarterly monitoring program for known potential infection zones (see Figure 33), with semi-annual monitoring for the North half of Wao Kele o Puna (aerial survey).
- Cooperation with USFS and USDA researchers (F. Hughes, L. Keith) to (a) definitively diagnose ROD in Wao Kele o Puna, (b) continue to monitor the disease as it progresses in the forest

Lyon Arboretum ʻŌhiʻa Seed Bank Effort

University of Hawaiʻi scientists are working diligently to protect and preserve this keystone tree in Hawaiʻi's native forest. The Seed Conservation Laboratory at UH Mānoa's Lyon Arboretum launched a campaign in February 2016 to fund an effort to collect and bank ʻōhiʻa seeds.

They will collect and preserve ʻōhiʻa seeds from all islands for future forest restoration, after the threat of Rapid ʻŌhiʻa Death has passed.

Alternatives to ʻŌhiʻa Overstory in the Event of Significant Loss to Rapid ʻŌhiʻa Death

Koa is a potential, though imperfect, replacement species for Wao Kele o Puna ʻōhia lost to Rapid ʻŌhiʻa Death. Of concern is that at low elevations it suffers from a wilt of its own, which kills between 50% and 90% of live trees.

Efforts led by Hawai‘i Agriculture Research Center and Tropical Hardwood Tree Improvement and Regeneration Center are promising however, and there is a potential that resistant seed will become available. Provided that this is deemed culturally appropriate, this will enable the reforestation of Wao Kele o Puna with improved koa to replace ‘Ōhi‘a.

The more probable alternative is to manage the hāpu‘u (now part of the forest understory), as well as look to other native trees to replace the ‘ōhi‘a. This could include other substitute species known to the area such as lama (Diospyros sandwicensis), ‘ohe (Tetraplasandra hawaiensis) and possibly sandalwood (Santalum paniculatum).

Faster growing native species such as koa (Acacia koa), which is not known to the area should also be considered. Finally, non-native and non invasive species such as ‘ulu (Artocarpus altilis) and avocado (Persea americana) should also be considered and tested before widespread adoption.

Invasive Species

Many non-native species are common in Puna across the elevation gradient represented by Wao Kele o Puna. The invasive threat posed by each species has been quantified by the Hawai‘i-Pacific Weed Risk Assessment (HPWRA) score, and indicates the likelihood that combined life history traits of a species are indicative of certain invasive potential.

Species with high fecundity and a shade tolerant physiology represent the greatest threat, as these taxa are able to establish in closed canopy native forest. Such species include Strawberry guava (*Psidium cattleianum*,) Clidemia (*Clidemia hirta)* and Glory bush (*Tibouchina urvilleana*.)

Strawberry Guava (waiwī)

Hyperspectral analysis of Wao Kele o Puna, indicate that approximately 5,000 acres of dense strawberry guava are in the property. However, less than 10% of the total overall population have densities of 95% cover or more.Most of the strawberry guava populations are intermixed with native and non-native plant species, according to the State HI-GAP database in the State GIS system, cross referenced with LIDAR imaging and hyperspectral analysis by Dr. Greg Asner (Carnegie Airborne Observatory and Stanford University).

A highly invasive plant species, and habitat-altering pest, waiwī poses a major threat to native forest ecosystems. It forms shade-casting thickets with dense mats of surface feeder roots that make it difficult for other species to coexist. It is a prolific fruiting and aggressive vegetative growth species, which can displace entire plant communities in a relatively short period of time. Erosion is a serious threat in dense thickest where surface run off will diminish top soil. In addition, this run off prevents water from draining into potential aquifers (Tom Giamballuca; Leialoha).

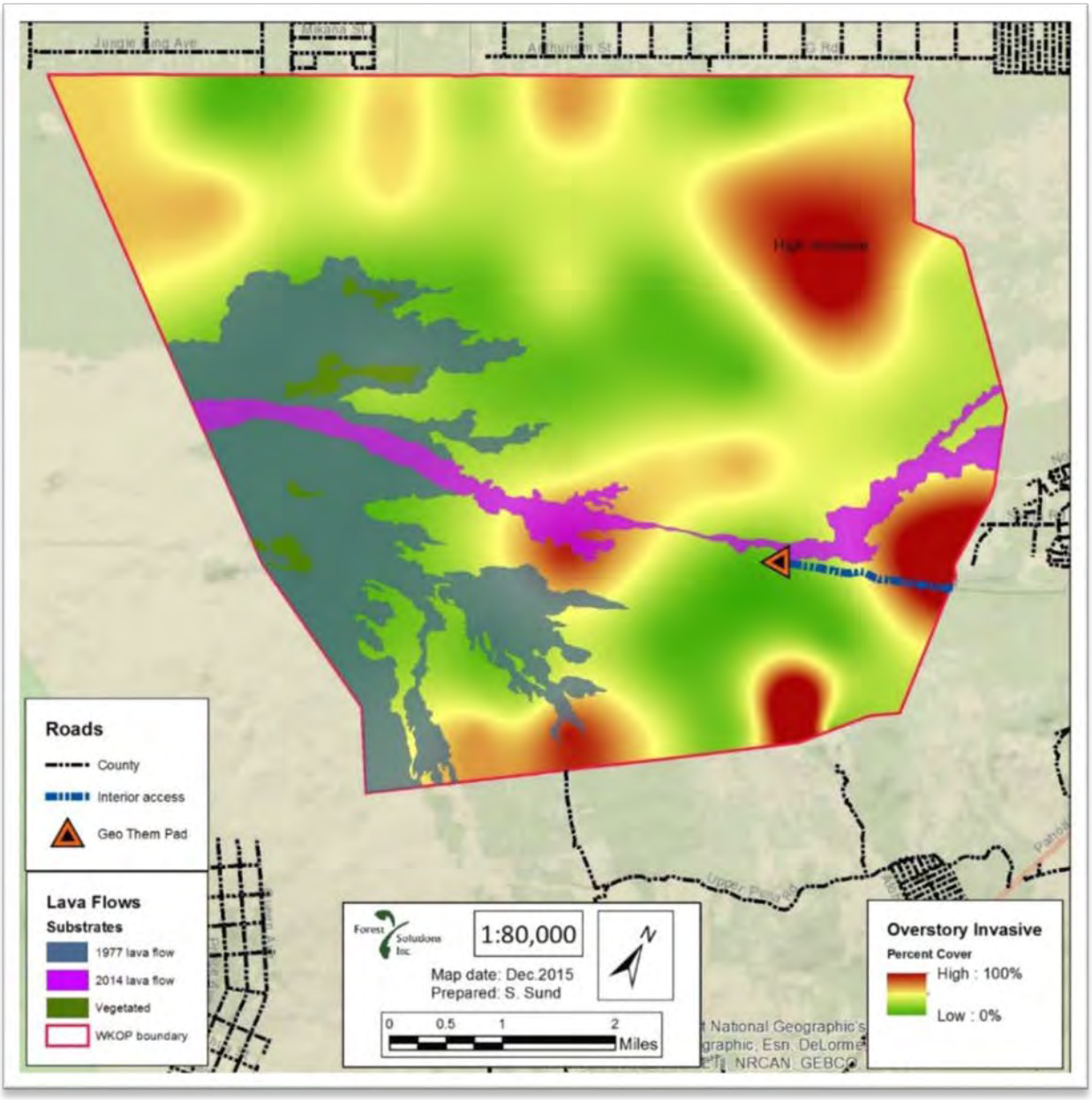

Figure 70 Raster map of invasive overstory measure as percent cover. (Forest Solutions)

Strawberry guava, by far the most pervasive and damaging weed at this juncture, continues its relentless advance throughout Wao Kele o Puna. While protecting the core of the forest is a realistic objective, addressing the source of the problem would improve prospects for the remaining native areas over the long term. Ultimately, there are no easy techniques for weed control in quarantine zone (QZ); without substantial additional work, these areas will most likely continue their transition to a guava-dominated state.

Once established, strawberry guava quickly invades - and eventually dominates - native Hawaiian forests. A hardy plant, it is very difficult and extremely expensive to control. Cost is a significant factor in managing this species and in 2003 the Big Island Invasive Species Committee worked with an economics team from the University of Florida to evaluate the cost of controlling strawberry guava in east Hawai‘i conservation areas, including Wao Kele o Puna.

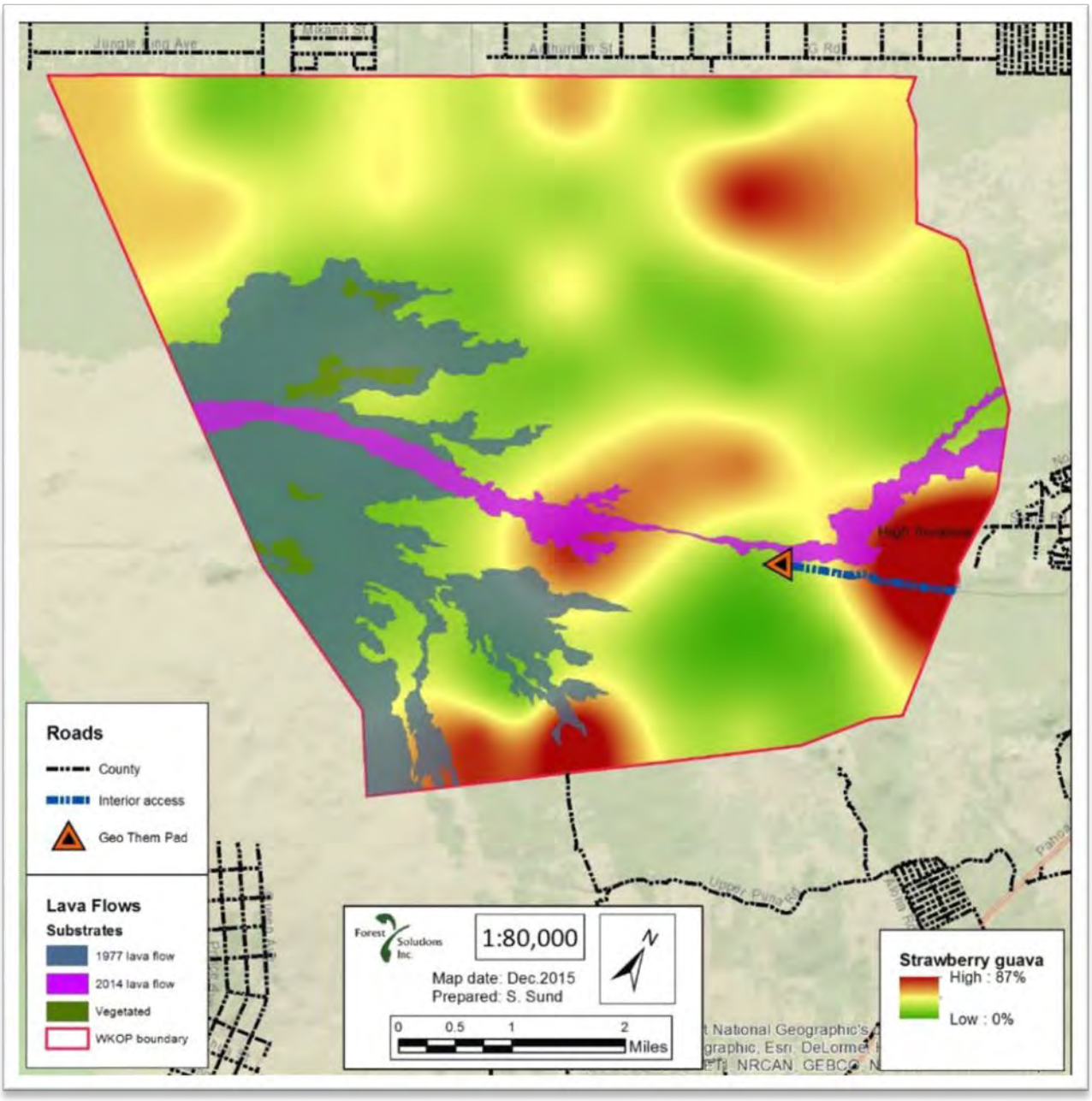

Figure 71 Relative distribution of Psidium cattleianum, also known as strawberry guava, waiwī. (Forest Solutions)

Bio-control has been suggested for Wao Kele o Puna Forest Reserve using a known natural enemy of strawberry guava, the gall-forming scale insect (Tectococcus ovatus). This is a recommendation to consider in consultation with the community. The insect reduces the overall vigor of actively growing portions of the tree, thereby reducing its ability to compete with native species. The insect has not been demonstrated to kill or even severely injure waiwī.

Figure 72 Aerial view of waiwī shown as dark, thick coverage; in Wao Kele o Puna (Carnegie Airborne Observatory)

Pua‘a – Pigs

Ungulates impede the progress of conservation and restoration of native Hawaiian ecosystems. Ungulate removal, in conjunction with other management actions, is necessary to ensure the success of ecosystem restoration and preservation of native Hawaiian ecosystems.

Non-native feral pigs in Hawai‘i are a major disruptive component of native rain forest. The pig is an omnivore and a scavenger. In the rain forest and grasslands, it feeds on vegetation, insects, earthworms, ground-nesting birds, eggs and rodents. It commonly scavenges on remains of dead cattle, goats and other pigs. In the rain forest, its chief diet is the starchy interior pulp of the tree fern.

The pig's habits of hollowing out interiors of tree ferns and making mud wallows creates micro-aquatic habitats for mosquitoes, other insects and various small crustacea. Because pigs create mosquito habitat in areas where these insects would not normally occur, the pig through spread of mosquito borne avian malaria and birdpox is an indirect threat to the extinction of native birds.

Pigs feed upon the interior pulp of hāpu‘u trunks by biting away the hard, bark-like, outer tissues; scraping away the fleshy pulp by use of scoop-shaped lower incisor teeth. A large trunk up to 12 inches in diameter and several feet in length will feed one to several pigs for several days.

In time, the interior of the trunk is completely hollowed suggestive somewhat of a hollowed dugout canoe. From feeding on the trunk the ground around becomes heavily trampled and fresh trails are established in the forest by movements of pigs to and from the trunk. Discovery of new trails in the rain forest often lead to a fallen hāpu‘u.

Captain James Cook introduced the first varieties of European pigs to Hawai'i. In the nearly 200 years since, large number of domesticated pigs have been introduced to upgrade the quality of pork raised in Hawai'i.

Boars of larger breeds were purposefully released into the wild to increase overall size of the much smaller Polynesian pigs. From these releases, and from other domesticated pigs which escaped into the wild, such mixtures of European/Polynesian stock have occurred that the Polynesian pig in Hawai'i is no longer recognizable.

On the island of Hawai'i the feral pig, along with the feral goat and sheep, is a major game animal of economic importance to hunters. Pigs are hunted and trapped by many as sources of meat for the table. Despite the popularity of the pig as a game animal however, free roaming wild pigs are considered pests in grassland, crop, forest and watershed areas. Their damages can be extensive through excessive rooting, the making of trails and wallows, and from inadvertent spread of weedy plants that follow in the wake of pig activities. (Baker, National Park Service)

The Hawai'i Conservation Alliance, a cooperative collaboration of conservation leaders representing nineteen Hawai'i focused government, education, and non-profit organizations, prepared a position paper 'Controlling Ungulate Populations in Native Ecosystems in Hawai'i' that addresses the impact pigs have in native forests.

The following are portions of that position paper:

> It is firmly established that the conservation and restoration of native Hawaiian ecosystems is unsuccessful in the presence of ungulates. Controlling ungulate populations, specifically goat, pig, cattle, sheep, and axis deer, is the vital first step; dramatic and otherwise unaided ecosystem recovery has been documented when it has been accomplished.
>
> Despite demonstrated success of eradication and in certain circumstances reduction and control of ungulates, some public groups strongly oppose ungulate population control. Clearly, there is a need to effect the control in the most efficient ecological, social, and humane manner possible. Finding the right balance between these needs is critical in preserving our ethical integrity as well as in preserving both the cultural and natural aspects of Hawai'i's rich heritage.

Components of Ungulate Removal

There are several areas in Hawai'i where goat, pig, sheep and cattle populations are successfully kept at zero population levels over large areas. In these cases successful control of ungulate populations involved:

1) establishment of barriers to isolate populations
2) barrier inspection and maintenance
3) removal of significantly greater percentages from populations than can be replenished by reproduction and ingress from adjoining areas
4) vigilance in monitoring of animal population increase and ingress

Figure 73Fencing in forest to protect sensitive, high conservation value areas from unmanaged pig populations. (DLNR)

However, in light of the pre-contact approach to forest management incorporated into this Comprehensive Management Plan, the following are the primary ungulate regimes to incorporate at Wao Kele o Puna:

- Construct rare plant exclosures (that may include using methods such as, pā pōhaku (stone walls) or pā lāʻau (picket fences)) when needed to protect individuals or populations of endangered plants.

- A primary control method of control for the feral pig population may be to allow subsistence and other hunters to hunt pigs throughout Wao Kele o Puna.

- Pigs will continue to be a part of the Wao Kele o Puna landscape. In a forest the size of Wao Kele o Puna, there is room for areas where the main management objective is pigs (such as highly invaded forests) and where they are excluded (high conservation forests).

Other Invasive Species

Miconia, a highly invasive melastome, was accidentally introduced into Wao Kele o Puna Forest Reserve from a now abandoned nursery in the Kopua Farm Lot area. This is just one of a number of agricultural communities that surround the reserve.

The Big Island Invasive Species Committee with support from OHA and the Hawaiʻi Invasive Species Council has since removed all large flowering Miconia plants including, the first round of seedling recruitment from the area.
The large umbrella-like tree species, albizia is highly invasive. Populations in Wao Kele o Puna are considered low

enough for complete eradication efforts. BIISC, in its efforts to control Miconia, simultaneously controlled albizia, using aerial control girdling techniques by hand. By mid-2012 all of the large trees in the remote areas of the reserve were killed.In 2013, BIISC crews with assistance from staff from U.S. Forest Service began an intensive control effort on the exterior boundaries of the reserve, particularly in the southwestern section of the reserve. Controlling Albizia on the perimeter of the reserve is imperative to keep this species from re-establishing in the reserve. (Leialoha)

Numerous other invasive animal species already exist in Wao Kele o Puna and are unlikely to be eradicable. The coqui frog (Eleutherodactylus coqui) has completely invaded all of Puna District and much of the rest of Hawai'i Island below 3,500 feet above sea level. It is virtually impossible to control the coqui frog, so this species will ultimately need to be considered naturalized and not a target for control efforts barring unforeseen large-scale remediation such as controlled release of a species-specific fungal disease.

Many non-native bird species are also so well established at this point in time that eradication is not feasible. For example, Japanese white-eye (Zosterops japonicus), cardinal (Cardinalis cardinalis), and the myna bird (Acridotheres tristis) have been established in Hawai'i for many decades. Removal of such species cannot be a realistic management objective at Wao Kele o Puna.

Invasive invertebrate species, which include giant African snails (Achatina fulcia) and little fire ants (LFA, Wasmannia auropunctata), and mosquitoes that carry avian malaria also threaten native Hawaiian ecosystems such as those within Wao Kele o Puna. At this time, there are limited options for controlling these invasive species. The giant African land snail, for example, can be controlled in small areas such as farms by deploying traps, finding individuals, or installing snail repellent surfaces on the base of trees.

While these methods may work for farms, they are impractical at the scale of Wao Kele o Puna. Biological control of snails is also problematic, as potential snail predators are typically indiscriminate and would therefore impact populations of native, endangered snails as well. Similarly, LFA may be controlled in limited areas using insecticides such as bifenthrin (Talstar), but deployment of controls across large areas like Wao Kele o Puna is economically and physical impossible. Other invasive species are noted in the Invasive Species Management Plan in the appendices.

Invasive Species Control Regimes

It is recommended that the management actions in controlling and eradicating invasive species as described in the Forest Solutions' Invasive Species Management Plan be incorporated and implemented through this Plan.

With the focus of management on invasive species control and eradication, weed species should be effectively quarantined in their current range, and suppressed or eradicated in strategic areas where favorable outcomes are likely. In terms of management activity, this prescription corresponds to weed control along boundaries with FMUs classified High Conservation Value Forest (HC).

For example, where HC borders quarantine zones (QZ), the invasion front between these two drastically different cover types represents a high ratio of return on resources invested. In contrast, where there are large, contiguous blocks of QZ or extensively invaded (IE) areas, it becomes less useful to suppress weeds because (1) the areas are too large to effectively treat and (2) the source populations for invasive species are too well-established.

There are notable exceptions to the focus on controlling invasive species in HC buffer zones, specifically the specter of high-threat species establishing outside of routinely controlled areas. Managers at Wao Kele o Puna had already addressed similar threats under DLNR supervision, particularly with suppression operations to control Miconia calvescens and Falcataria moluccana that were implemented by BIISC and DOFAW.

The Forest Solutions' Invasive Species Management Plan recommends that similar efforts continue, supported by regular, annual reconnaissance sweeps using helicopters or other imagery processing options (such as drones), followed by deployment of ground crews as necessary to eradicate new infestations of high risk species.

Preventative Phytosanitary Invasive Species Measures

Although much of Wao Kele o Puna is already occupied with a known set of invasive weeds, there is a considerable risk from incipient weed species. Any invasive species control work, including treatments and monitoring should be conducted in accordance with a phytosanitary protocol.

This protocol should acknowledge that access to the property poses a threat of vectoring weed seeds or plant pathogens from elsewhere on the island(s). Four measures are recommended to combat the incipient weed threat for all who enter:

1. boot scrubbers at trail access points
2. vehicle cleaning stations
3. tool cleaning requirements, and
4. a property-wide monitoring program

This plan recommends expanding the boot (footwear) cleaning protocol to the forest as a whole; requiring all who enter to thoroughly clean footwear will improve the chances of avoiding importation of high-threat, especially small-seeded species. Weed control tools should be thoroughly cleaned as appropriate for the implement, either with water and bleach (10%) for plastic implements or with solvents (kerosene, lubricants) for metal tools that cannot be subjected to bleach exposure.

Vehicle Washdown

To prevent the accidental introduction of invasive species during earth moving or maintenance activities, all equipment involved going into and out of Wao Kele o Puna shall be cleaned to remove plants, seeds, and other materials that may be hitchhiking before arrival and at departure of the site.

Figure 74 Power washer as a solution to quarantine contaminants. (Forest Solutions)

High-pressure washing is the most effective means of cleaning heavily soiled and contaminated items to eliminate invasive species materials and prevent their spread.

Concrete wash down sites will be located at each entry/exit point into Wao Kele o Puna.

Each will have rain captured water storage tanks and recapture systems, as well as gas-operated portable high-pressure washers. Waste-water would be directed to containment and settling basins.

Despite very careful efforts to capture and quarantine materials from cleaning operations, site-specific invasions are likely to occur;

therefore, part of the cleaning process should involve monitoring the washdown areas for invasive species and using appropriate control methods early to prevent additional spread.

O Ke ‘Ehu Kakahiaka No Ka Wa Loa‘a (The time to catch anything is in the early morning)

(Pukui 1983:268, verse 2457)
When you want to do something, don't wait. Get at it as early as possible.
(Specific actions to take in the management of Wao Kele o Puna)

The Hawaiian culture is never static and has and continues to evolve. One reason for this evolution is the value of “‘imi na‘auao” to kānaka maoli (native Hawaiians). The essence of “‘imi na‘auao” is to seek knowledge from a variety of sources. This principle encourages kānaka maoli to embrace modem technology, science, and best practices of land management and conservation. In conjunction with the value of mālama ‘āina, to nurture the reciprocal relationship between kānaka and ‘āina, this section of the Comprehensive Management Plan incorporates the best of traditional and contemporary practices in outlining the recommended management actions for Wao Kele o Puna, based upon all the information provided in the preceding sections of this Plan.

Note that the implementation of all recommended actions in this plan is subject to available funding and capacity. Implementation may also require additional subplans and budgets, permits, and approvals from other governmental agencies.

E Nihi ka Helena i ka Uka o Puna

(Go quietly in the uplands of Puna) (‘Ōlelo No’eau, # 360)

One method to ensure that all who enter Wao Kele o Puna, including traditional practitioners, visitors, contractors and staff, receive the information they need in order to better protect Wao Kele o Puna’s cultural and natural resources is to require everyone who enters the area to participate in mandatory Wao Kele o Puna entry and exit protocol and briefing (i.e. in person, printed, video, etc.).

The required Wao Kele o Puna briefings shall include these important components:

- Entry/Exit Protocols
- Cultural Briefing
- Safety Briefing
- Natural Resource Briefing
- Invasive Species Control Briefing

Entry/Exit Protocols

> “The Hawaiian people followed protocols when they gathered and harvested from native ecosystems. These required that the gatherers prepare themselves spiritually before setting out, and that they maintain an appropriate mental attitude before, during, and after collecting the desired materials. The physical process of gathering always involved going about one’s business quietly, asking permission, giving thanks, and treating the plants or animals to be collected - and everything else in their environment - with respect.”

The protocol conducted, however, must contain the following four components:

E Ui no ka ‘Ae
Ask Permission

E Mahalo aku
Give Thanks

E Komo me ka Hōano
Enter With Reverence

I ka Hele aku, e Hoʻomaʻamau i ka Wahi
When You Leave, Return It As You Found It[2]

One acceptable traditional form of protocol includes entry chants. “‘Entry chants’ were offered to ask permission of the forest or other plant community for entry and to protect the collector from misfortune. The chants were an expression of the gatherer’s respect for and good intentions toward all of the beings that lived there, including the akua, plants, animals, rocks, streams, and other natural features. Similarly, chants were offered before any plant was collected, out of respect for the plants themselves and for the akua to whom those plants were dedicated.” (Anderson-Fung and Maly 2002:18) Individuals may use any appropriate oli of their choice.

One example is Nā ‘Aumākua:

Nā ‘Aumākua

(Entrance chant adapted from Hawaiian Antiquities by David Malo; Adapted by Aunty Edith Kanakaʻole**)**

Nā ‘Aumākua mai ka la hiki a ka la kau!	Ancestors from the rising to the setting sun
Mai ka hoʻokuʻi a ka halawai	From the zenith to the horizon
Nā ‘Aumakua ia Kahinakua, ia Kahinaʻalo	Ancestors who stand at our back and front
Ia ka’a ‘ākau i ka lani	You who stand at our right hand
‘O kiha i ka lani	A breathing in the heavens
‘Owe i ka lani	An utterance in the heavens
Nunulu i ka lani	A clear, ringing voice in the heavens
Kaholo i ka lani	A voice reverberating in the heavens
Eia nā pulapula a ‘oukou ‘o ka poʻe HawaiʻI	Here are your descendants, the Hawaiians
E mālama ‘oukou ia mākou	Safeguard us
E ulu i ka lani	That we may flourish in the heavens
E ulu i ka honua	That we may flourish on earth
E ulu i ka paeʻāina o Hawaiʻi	That we may flourish in the Hawaiian islands
E hō mai i ka ‘ike	Grant us knowledge
E hō mai i ka ikaika	Grant us strength
E hō mai i ke Akamai	Grant us intelligence
E hō mai i ka maopopo pono	Grant us understanding
E hō mai i ka ‘ike pāpālua	Grant us insight
E hō mai i ka mana.	Grant us power
‘Amama ua noa.	The prayer is lifted, it is free

[2] These statements were part of testimony by the Maui Group Sierra Club (noted as ‘Hawaiian Protocol for Sacred Places’) and posted on the Kilakila ‘O Haleakalā website.

Cultural, Natural Resource, Safety and Invasive Species Briefings

Specific contents of the briefings will be determined by OHA and change over time as needs arise. At a minimum, the briefings will include the following components:

Figure 75 Waha'ula Heiau prior to impact by lava flow (USGS)

Cultural Briefing

- Provide guidance and information as to what constitutes respectful and sensitive behavior
- History of the area
- Concerns regarding sensitivity of cultural resources
- Specific guidelines for culturally appropriate behavior

Natural Resource Briefing

- Concerns regarding sensitivity of natural resources
- Describe the status, condition and diversity of natural resources present, including biotic and physical elements
- Outline the potential and existing threats to the natural resources
- Litter and debris handling
- Summarize the protection afforded the natural resources under various rules and regulations
- Provide expectations and requirements to avoid habitat damage

Figure 76 Forest Visit (Barbara Fox)

Safety Briefing

- Health and safety issues
- Lava hazard, fire hazard, cracks, faults, uneven ground
- Rules and regulations addressing permitted and prohibited activities
- Restrictions on smoking and other potential fire sources
- Steps to take and consider regarding personal safety and potential hazards
- Emergency procedures

Invasive Species Control Briefing/Procedures

The invasive species control briefing will educate all who enter Wao Kele o Puna on the status, condition, diversity and protection afforded the natural resources (Forest Management Plan in the appendices has details). Invasive species prevention and control measures are to be used upon entrance and exit from Wao Kele o Puna should include:

- Reporting any newly noted invasive species to OHA management staff
- Brushing down clothes and shoes to remove invasive plant seeds, and insects
- Cleaning shoes with alcohol solution to prevent transmission of rapid ʻōhiʻa death
- Washing all vehicles and equipment to remove seed, insects and pathogens

Community-based Management

Two very strong and consistent recommendations were made by community members related to management of the property: Community-based management and culturally appropriate management practices using konohiki-like managers. Such a structure is similar to other public-private partnerships and community-based participation in governmental operations.

As such, regardless of the overarching, long-term management structure for Wao Kele o Puna, a community-based management component should be included. Feedback from the ʻAha Kūkā notes that further discussion with community members should take place to determine the appropriate structure for community-based management and cooperative relationships.

One potential option is for OHA to arrange for cooperative management with a non-profit 501(c)(3) community group that has membership and leadership with substantial representation from the Puna district and whose members and leadership have significant familiarity with Wao Kele o Puna.

OHA may support the community group's management efforts financially by providing direct funding or matching funds where necessary for grants that the community group applies.

Some roles and responsibilities OHA could share and collaborate on with a community-based manager include:

General Administration

- Complement, participate in and facilitate one another's programs.
- Observe results, edit, improve and implement the CMP as a living document.
- Coordinate communication, transportation and logistical support to safely carry out services, programs and projects.
- Coordinate the design, construction, maintenance and use of structures and infrastructure.
- Coordinate the storage, maintenance and use of equipment and supplies.
- Coordinate safe and meaningful access to the reserve for cultural, subsistence, scientific, and educational purposes.

Cultural

- Implement the Wao Kele o Puna Burial Treatment Plan when necessary.
- Coordinate the protection, stabilization, dedication, re-dedication and use of cultural, religious and historic sites.
- Coordinate the protection and use of resources for religious, cultural and subsistence purposes, including mitigating potential conflicts between different forest uses.

Educational

- Complement education and outreach efforts.
- Develop a significant volunteer base for the purposes of cultural, natural and marine resource maintenance and restoration.
- Develop relationships with surrounding educational institutions and organizations.

Environmental

- Maintain a significant on-the-ground presence for the purposes of managing and protecting Wao Kele o Puna.
- Coordinate revegetation and habitat restoration programs, projects and activities.
- Coordinate training programs including but not limited to first responder training.

Other administrative community-based partnership actions include:

- Join the Three Mountain Alliance Watershed Partnership
- Initiate a community watch for the forest (similar to Mauka-Makai Watch-like Community involvement and similar in approach as noted by the Puna community)

OHA should also consider establishing a facility in the existing cleared area (discussed further below) that community-based management partners could use for a base, this could be as simple as dry storage to a more complete facility with toilets and office space. The widespread availability of solar power and abundant rainfall mean that there are no physical limitations to this taking place.

Education, Community Awareness, and Research Opportunities

The implementation of this Comprehensive Management Plan offers the opportunity for others to visit and experience the natural and cultural resources of Wao Kele o Puna and provide formal and informal educational opportunities for children and adults to:

- Connect people with the world around them
- Have hands-on experiences in a healthy Hawaiian native forest
- Foster awareness, appreciation and understanding of Hawai‘i and its natural and cultural environment
- Encourage wise stewardship of precious island ecosystems
- Provide a unique and educational experience for visitors to the Islands
- Document the successes and failures of land management activities via formal research

The educational programs in Wao Kele o Puna should consider involving native Hawaiian immersion charter schools, other organized public and private educational entities, and partnerships with existing private non-profit entities, such as Tropical Reforestation and Ecosystems Education (TREE), The Nature Center, and Hawai‘i Forest Institute (HFI).

Educating the public about the Wao Kele o Puna, its values, threats to these values, and management activities is vital.

Conservation education and watershed awareness will help reduce unwanted human impacts on the landscape. Greater awareness about the Wao Kele o Puna should also translate into greater support for management efforts, in the form of a greater community voice for conservation measures, less vandalism of infrastructure, and increased volunteerism.

Opportunities to Solicit Volunteers

There are a variety of opportunities to develop a broad base of volunteer support for the Wao Kele o Puna Comprehensive Management Plan and its implementation. Some initial ideas and places to consider are summarized in the following:

Creation of a “Friends of” Organization

- Web-based description/updates/pictures of activities
- Periodic updates/e-newsletter
- Web-based signup
- Participation in PreserveHawaii.org, VolunteerHawaii.org, KanuHawaii.org, Volunteer Resource Center, or others for volunteer sign-ups

Native Hawaiian

- Hula Hālau
- Canoe Clubs
- Immersion Schools
- Homesteader Associations
- Hawaiian Civic Clubs

Community/Business Organizations

- Churches and other religious groups
- Regular "Lunch" clubs (Rotary, Exchange, Kiwanis, Lions etc)
- Chambers of Commerce
- Hawai`i Island Economic Development Board
- Trade and Professional Groups (Contractors, Realtors, Carpenters, etc)
- Hawai`i Forest Industry Association

School/Youth Groups

- University of Hawai`i
- Public/Private Schools
- Charter Schools
- School Alumni Associations
- School PTAs
- School sports teams (football, soccer, baseball, etc)
- School groups/clubs (band, hiking, etc)
- Youth sports teams (AYSO, Little League, Pop Warner, etc)
- Boy/Girl Scouts
- 4-H
- Future Farmers

Cooperation/Participation from Environmental Groups

- Sierra Club
- The Nature Conservancy

Conservation District Special Subzone Designation

The feedback from the community and the kinds of uses they supported is problematic given that Wao Kele o Puna is situated completely within the Protective Subzone - the least permissive in land uses. As an example, the community's desire for a hale and accommodations for overnight use are not identified land uses in the Protective subzone in the Conservation district.

If a proposed use in the protective subzone is not an identified land use, an applicant may request a temporary variance, petition the land use commission for a land use district boundary change or initiate an administrative rule amendment to have the proposed use added to the identified land uses. Each of these has time, cost and probability of support concerns.

Given that "The objective of [the special] subzone is to provide for areas possessing unique developmental qualities which complement the natural resources of the area," it is recommended that Wao Kele o Puna be established its own 'Special Subzone.'

"The purpose of this Special Subzone is to protect, preserve and perpetuate the natural and cultural resources of the petitioned area; and to allow for land uses for educational, recreational and scientific purposes." (DLNR, Staff Submittal KA 10-1, September 23,2011)

When petitioning for a special subzone for Wao Kele o Puna, it will be helpful to review the documents from existing Special Subzones and their general uses, including: Hawaii Loa college special subzone, designated for educational purposes; Sea Life Park special subzone, designated for recreational, educational, commercial purposes; Miloliʻi-Hoʻopuloa special subzone, designated for fishing village purposes including fishing activities, residential, educational, cultural and recreational uses; and Lāwaʻi Kai special subzone, designated to "provide for areas possessing unique developmental qualities that complement the resources of the area."

For the Wao Kele o Puna Subzone, OHA should consider including all uses noted in this Comprehensive Management Plan, as permitted, additional uses and analysis of impacts of such uses as noted in a subsequent Environmental Assessment/Environmental Impact Statement, and 'identified land uses' in the Special Subzone, much like what Hawaiʻi Loa/HPU and National Tropical Botanical Garden did.

OHA should ensure that its Special Subzone designation supercedes the Forest Reserve rules to prevent any future conflicts.

Kapu, Kānāwai, and Enforcement

Kānāwai - rules and rulemaking - is complicated in today's society, with different layers of rules, depending on the entity. Likewise, conventional enforcement of rules requires consistency, transparency and reasonableness in the rules and rulemaking process. Nevertheless, rules are helpful in forest management by either prohibiting or allowing specific uses. Therefore, OHA should consider making rules for Wao Kele o Puna.

For an agency to promulgate rules and enforce them, the agency needs express statutory authority from the legislature. Some examples of statutory authority granted to other departments to adopt rules include:

> Department of Health
> §431N-5 Rulemaking authority. The director of health shall adopt rules in accordance with chapter 91 which are necessary to carry out this chapter.
>
> Department of Land and Natural Resources
> §171-140 Rules. The board may adopt rules in accordance with chapter 91 in order to effectuate the purposes of this part.
>
> Department of Transportation
> §264-126 Adoption of rules. The department may adopt rules pursuant to chapter 91 to implement this part.
>
> University of Hawaiʻi
> §304A-1903 Mauna Kea lands[;] rules. The board of regents may adopt rules pursuant to chapter 91 to regulate public and commercial activities on Mauna Kea lands.

If OHA were to receive rulemaking authority from the legislature, OHA's Board of Trustees would likely be required to follow the Hawaiʻi Administrative Procedures Act (HAPA), HRS, Chapter 91, similar to other government agencies. In such a scenario, OHA should prepare rules specific for Wao Kele o Puna. The initial rules OHA should consider include requiring the natural and cultural resource briefings, safety briefings, and entry/exit protocols for all who

enter (particularly phytosanitation protocols), as previously discussed. Rules for hunting and gathering should also be considererd with additional community input. The rules for Wao Kele o Puna should have civil, criminal, and/or other penalties associated with them. In advocating for rulemaking authority, OHA should ensure that the rules it makes for its own property supersede the rules for the Forest Reserve system.

If OHA is unable to acquire legislative authorization for rulemaking, OHA should continue to work with DLNR through its existing processes. Wao Kele o Puna can continue to be subject to the protections of the Forest Reserve system and OHA could advocate for DLNR to create more specific regulations for Wao Kele o Puna, if necessary.

The power to create rules, however, is useless without enforcement. To enforce rules, the legislature would have to delegate police powers to OHA or OHA can partner with another government agency that has police powers (DOCARE, State Sheriffs, County Police).

If OHA is able to obtain police powers, it should consider:

- Forming an Enforcement Division within OHA
- Appointing and commissioning enforcement officers (An officer could serve dual purposes if necessary. I.e. Project coordinator and enforcement officer)
- Delegating the police powers from OHA's Board to its enforcement officer for the specific purpose of enforcing OHA's rules
- Allow for paid and unpaid (volunteer) enforcement officers (each with full police powers)

If OHA is unable to obtain police powers, or forming an enforcement division is unfeasible, OHA should consider continuing working with DLNR-DOCARE to enforce rules in Wao Kele o Puna. DOCARE will continue to have enforcement jurisdiction over Wao Kele o Puna so long as it is a Forest Reserve. If OHA wants DOCARE to enforce additional rules, DLNR will likely have to promulgate them on its own. In this scenario, OHA should consider developing cooperative agreements with DOCARE to continue such enforcement.

Education and Outreach

Several community members discussed the importance of responsible stewardship for both the cultural and natural resources of the forest and the benefits of maintaining a healthy forest through outreach and educational efforts.

"The time is ideal to support and strengthen efforts to engage, educate, and collaborate with kamaʻāina of Puna. Have the community and children participate in a meaningful way. Teach them to become good stewards in their own back yard. Our future is the little ones. Get them excited about the rain forest." (Kumupaʻa 2014, 405)

In alignment with this thought, OHA should consider the following educational and outreach options:

Educational Programs

- Establish programs to teach about place-based Hawaiian culture and the significance of the natural and cultural resources of Wao Kele o Puna and the surrounding areas, including gathering, hunting, and mālama ʻāina practices
- Establish a youth program where local keiki can experience and learn about the flora and fauna of Wao Kele o Puna

Working with Educational Institutions

- Work with the local Department of Education (DOE) schools, private schools, Hawaiʻi Community College, and UH Hilo to incorporate forest education into their curriculum
- Establishing internships for high school and college level students studying forestry or other relevant subjects
- Support natural and cultural research projects

- Provide opportunities for field trips
- Support educational activities that facilitate forest stewardship
- Develop field projects that educational institutions can take part in

Working with Community

- Engage the community, particularly the neighboring road associations, hālau, non-profits, and other non-governmental organizations, in activities that provide a connection to culture and nature, and promote forest understanding and stewardship
- Facilitate community field trips or work days; provide opportunities for community to participate in forest stewardship
- Host or participate in community events to promote forest education and Wao Kele o Puna projects
- Create service learning opportunities

Field Schools and Internships

- Create a resource management field school to train youth to mālama the natural and cultural resources of Wao Kele o Puna from both a Hawaiian cultural and western scientific perspective

Educational Materials

- Create informational and educational materials suitable for non-professionals of all ages including pamphlets, books, digital media available online, signs (discussed more below), etc.

Other Educational Actions

- Encourage appropriate educational and cultural uses of Wao Kele o Puna through the development of general criteria, priorities and rules to effectively manage multiple educational uses
- Provide the natural and cultural resource and safety briefings, as discussed above, to all who enter the property, including appropriate protocol
- Serve as a demonstration site for land managers by providing culturally competent information, tools and techniques; engage land managers in the design and implementation of land management processes based upon Native Hawaiian culture and traditional and modern science

It is recommended that educational programs primarily target Puna youth. One kamaʻāina shared that he supports teaching the younger generation about local traditions and customs so that one day they can step up and take the lead in caring for the forest. (Kumupaʻa 2014, 404

Members of the different non-profit organizations in Puna also expressed an interest in stewarding the forest and educating people to properly mālama Wao Kele o Puna. Additionally, some kūpuna and kamaʻāina also offered to participate in outreach educational efforts in the forest. Developing a close working relationthisp with the community and its neighbors in these endeavors is critical to the overall success of protecting the forest. The need for regular education and outreach cannot be understated.

Signage

Signs are needed at Wao Kele o Puna to both educate visitors about the significance of the site and to deter people from conducting inappropriate behavior. OHA should consider the following when creating and installing signs:

- Signs should emphasize that Wao Kele o Puna is a place where traditional and customary practices are not only respected, but celebrated.
- Signs should include maps, which will not only help with safety but can also be used to provide the location of important areas such as authorized trails and roads, closed areas, community work sites, designated gathering and hunting areas, cultural sites, and more.

- Signs should include regulatory information such as allowed and prohibited activities and the associated penalties.
- Signs should promote pono forest practices such as phytosanitation, entry/exit protocol and proper gathering techniques
- Interpretive signs should be created to provide historical, cultural, and environmental information to educate visitors about the significance of the forest.
- Warning signs informing visitors of the dangers of Wao Kele o Puna should be created
- At minimum, signs should be placed at every authorized entrance to Wao Kele o Puna
- Additional signage may be placed throughout the forest as needed but should target areas frequented by visitors

Pu‘uhonua & Kīpuka

Throughout the ethno-historical study conducted by Kumupa‘a, the single most frequent community recommendation was to establish a cultural meeting place at Wao Kele o Puna. OHA should, therefore, consider the options in creating such a place, including reviewing the community input below and soliciting additional input along the way as needed.

According to the community, a meeting place could serve multiple functions such as a retreat for practitioners, a meeting place for community members, an outdoor classroom for students and a cultural center for visitors.

Community participants and Kumupa‘a recommend that the meeting place and related activities be situated at and around the existing cleared site in Wao Kele o Puna. Many people felt that the existing clearing should be used so no other clearing of the forest has to be established.

Additional meeting places may be considered for other areas in Wao Kele o Puna as needed. These areas should be chosen to mitigate damage to the forest, as is feasible. Construction on open lava flows may be one option to consider.

Regarding the actual building of structures at this gathering place, it was recommended that an open hale should be built using existing forest resources such as ‘ōhi‘a wood for the posts and loulu palms for the roofing. Participants also recommended building a hula pā (hula platform) and an ahu (alter, shrine) as appropriate cultural structures. We recommend OHA strive to use forest materials where possible, yet also consider using outside materials when these are needed to meet building codes or are more practical in the modern context. Images in this section from the Pele Defense Fund depict what such a meeting site may look like.

Community participants discussed their ideas about the education, teachings, and cultural practices that could occur at a meeting place, cultural learning center, and/or a pu‘uhonua located at Wao Kele o Puna:

- This space would not only be a place to physically gather or a place to gather plants, but to gather thoughts, feelings, and energies.
- A community member complained that there is no real place in Puna to hold celebrations. (i.e. the Pāhoa Community Center is always booked.) OHA should make Wao Kele o Puna available to the community as a gathering place.

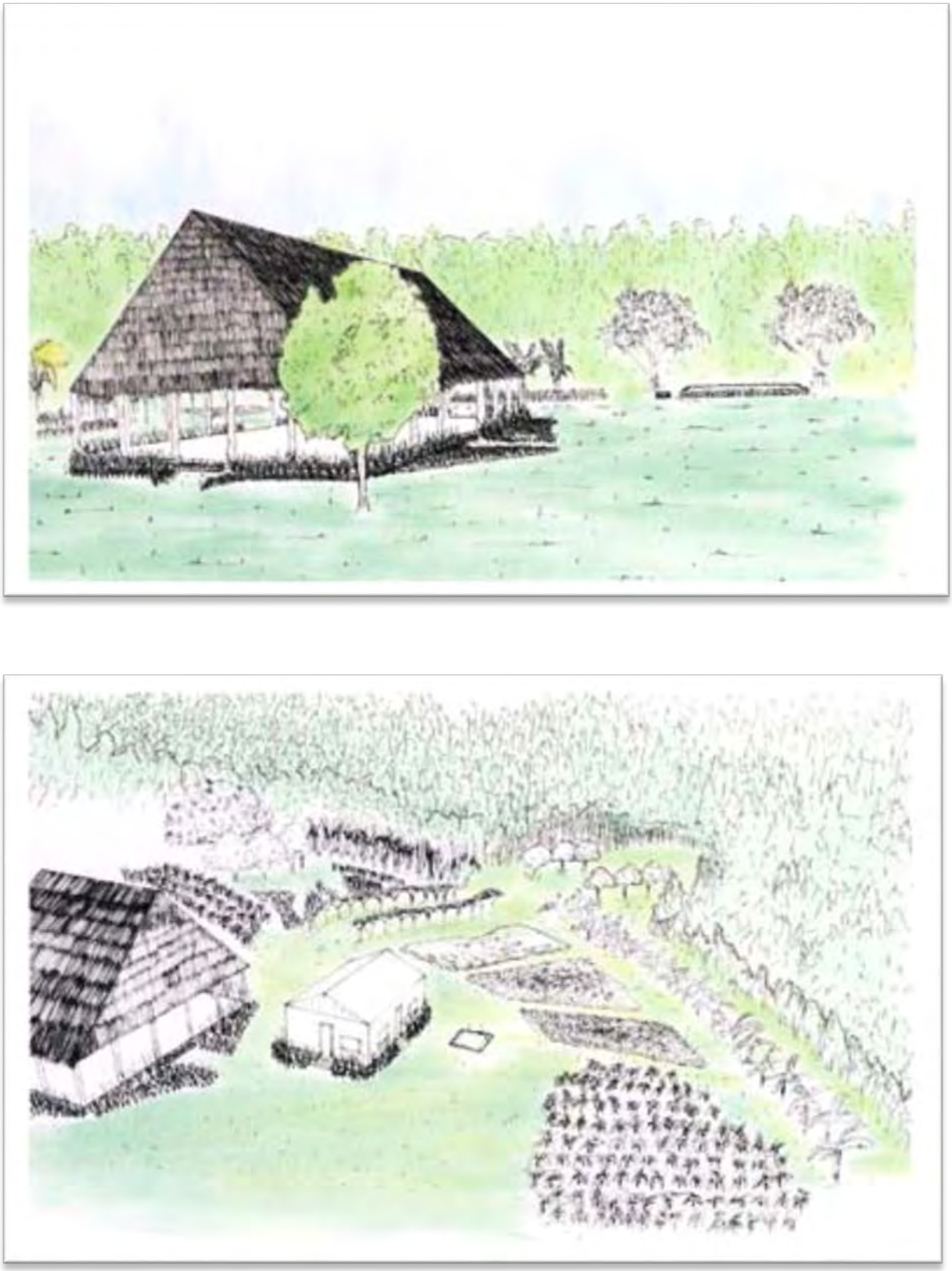

Figure 77 Proposed gathering places at Wao Kele o Puna (Pele Defense Fund)

- A place to host visitors that come to Puna

- A place to build a hale for hālau to come and relax, have a retreat to practice, and give back to the land by out planting.

- Grow culturally important plants and food gardens.

- Encourage Hawaiians to use the forest. The forest should stay as a place for hālau to gather and hunters to hunt. It should remain an area for us Hawaiians to gather & hunt. ("That's what we wanted all along and we will continue to fight for that!")

- Wao Kele o Puna could be an appropriate place to mālama the iwi kūpuna that are forced to be removed from their original resting places.

  If iwi kūpuna in Puna have to be moved and they can't find any 'ohana to rebury them in another place, Wao Kele o Puna could be an option for 'ohana to choose to reintern their iwi. Safe, protected place managed by a Hawaiian agency.

Figure 78 Proposed layout at Wao Kele o Puna (Pele Defense Fund)

Wao Kele o Puna Forest Products Gathering

As discussed further above in the "He ali'i ka 'āina; he kauwā ke kanaka" section, Native Hawaiians historically relied heavily on the endemic flora and fauna of the Hawaiian Islands for their daily needs, despite having extensive agricultural systems. What the early Hawaiians could not farm, they gleaned from nature: timber for housing and fuel; stone for infrastructure; and grass and reeds for thatch. (Dettweiler)

Gathering, howerver, was not limited to securing life's essentials. Hawaiian cultural development saw the blossoming of innovative and unique art forms, carved, sculpted and woven from the land's natural bounty. Even utilitarian items such as bark cloth garments were enhanced with vivid dyes drawn from numerous plant materials including berries and rhizomes.

As with nearly every aspect of prehistoric Hawaiian life, gathering activities were controlled by a triangular social system connecting man, gods and nature. At the pinnacle of this triangle were the gods, who demanded supplication in return for benevolence. Below that stratus were the chiefs and the priests, who were seen as the earthly conduit to the gods. (Dettweiler)

With the shift in government throughout the 1800s, these Traditional and Customary practices eventually became the rights of native tenants codifed in written laws meant "to ensure the continued exercise of traditional Hawaiian rights amidst the pressures exerted by countervailing interests of a changing society." (Pollack 2015)

As it applies to OHA today, the Supreme Court's

> "evolving jurisprudence concerning Native Hawaiian traditional and customary rights has conceived of a system in which the State and its agencies . . . bear an affirmative constitutional obligation to engage in a meaningful and heightened inquiry into the interrelationship between the area involved, the Native Hawaiian practices exercised in that area, the effect of a proposed action on those practices, and feasible measures that can be implemented to safeguard the vitality of those practices." (Pollack 2015)

Consistent with the decisions on numerous legal cases addressing Traditional and Customary Practices, the court in the Pele Defense Fund case declared "a permanent injunction against excluding the following persons from entering the undeveloped portions of the land and using the developed portion for reasonable access to the undeveloped portions, to perform customarily and traditionally exercised subsistence and cultural practices:

(a) Hawaiian subsistence or cultural practitioners who are descendants of the inhabitants of the Hawaiian Islands prior to 1778;

(b) Person or persons accompanying Hawaiian subsistence or cultural practitioners described in (a); or

(c) Persons related by blood, marriage or adoption to Hawaiian subsistence or cultural practitioners described in (a)."

OHA will uphold these constitutional protections throughout its implementation of this plan.

Community Stewardship Parcels

Small parcels ranging from 0.25 to 10 acres or larger, if well justified and vetted by OHA, should be considered for licensing to individuals or groups for their cultivation and use in their traditional practices. It would be the kuleana of these groups to clear their parcel of invasive species and to reforest with native or non-invasive introduced species which the groups could use for exclusive gathering purposes. This recommendation is intended to address the frequent community concerns of invasive species and a decline in traditionally gathered species. It also

addresses a common concern with the over-exploitation of naturally occurring gathered species by providing a means for both increasing the abundance through an exclusivity agreement.

The locations for such parcels would, initially, be within the "Invaded, Extensive" or "Quarantine" forest area, with the potential to expand into other zones. This expansion will depend on the compatibility of the intended cultivation practice and the forest area intended for use. They are not intended to convert native forestland to farms, but rather move weed infested forest into a forest garden condition.

We recommend that licenses be given to community groups based on a plot management plan specific to the parcel to be licensed. OHA will consider the following factors related to each prospective licensee's proposed plan:

- How will the native forest benefit?
- What is the benefit to Hawaiian culture by way of protection, perpetuation and enhancement?
- What is the benefit to the greater community?
- How will existing native species be protected?
- Who will be responsible for its implementation?
- Will there be barriers for animals? How will these be constructed in a manner that is compatible with the forest?
- Does this person/group have the capacity to take this project on responsibly?
- What is the exit strategy if the project does not work out? Who pays for the cleanup if there is any?

In addition, all the normal pre-action planning reviews are needed before issuing a license:

- Check for archaeological features and avoid harm
- Check for threatened and endangered species and avoid take
- Make sure the area is appropriate for the intended use; for example non-native plants are acceptable in the context of highly invaded forest
- Check if the area is at risk of lava inundation – is it low lying and near historic flows? Are the potential losses resulting from a flow acceptable?
- Ensure that the area proposed is appropriate for the intended use and help the group find success (i.e. is there enough soil? is the access sufficient? Are the goals reasonable?)

For community members to have meaningful opportunity to use this recommendation, the process needs to be as streamlined and simple as possible while providing basic safeguards to protect resources. Minimize the bureaucratic hurdles necessary to obtain consent.

In return, a group that has applied and gone through the process needs to enjoy ready access to their parcel for the collection and cultivation of their plants for a defined period that may be renewable upon successful completion of their plot management plan.

Community Stewardship Parcel assignments include a fundamental responsibility by licensees to keep the forest clean; use it or lose it. Minimize the procedures needed to remove non-performing groups in the same spirit of making it easy to get in. A dynamic process is what is intended in this management plan.

Forest Enrichment

It is recommended that OHA conduct or facilitate forest enrichment activities that help to fulfill beneficiaries' gathering needs. Although these activities could also be undertaken by a group with a community stewardship parcel, it is recommended that OHA take other approaches to this task to provide resources for those without the capacity to manage a parcel.

Forest enrichment activities can take place in any forest type except High Conservation forest, though as a starting method it should be limited to “Invaded, Limited”, "Invaded, Extensive" or "Quarantine Zone" forest until an understanding of the opportunities and limitations of this method are better understood.

This work should preferably be undertaken by community groups or members directly, as to promote a reciprocal give and take of forest resources. If community is not available, however, OHA should consider beginning the process on its own with the objective of an eventual hand-off to an interested user group.

If a community group is interested in conducting a forest enrichment project, the same process as the Community Stewardship Parcels would be used to analyze the project’s merit; however, the group would not necessarily be awarded a particular parcel.

While there are many resources that could be enriched in the forest, two examples of forest enrichment are provided for illustrative purposes:

1. Enhance maile production

   Maile can be propagated in a partially shaded environment. Through sensible reductions in non-native forest cover by removing some guava or albizia, enough light will reach the forest floor and lower canopy branches to provide ideal habitat for maile. This will enhance the ability of lei makers to gather this resource from wild populations.
2. Planting fruit trees to increase pigs hunted for subsistence

   An important community value for Wao Kele o Puna is the traditional use of the forest as an area to hunt pigs for sustenance. Planting non-invasive fruit trees will provide better food for the pigs in highly invaded portions of the forest, the “Quarantine Zone,”so that the harvested animals are healthier and of better quality.

   These species include avocado (*Persea americana*), ulu (*Artocarpus altilis*), banana (Musa spp), kukui (*Aleurites moluccana*), and potentially mango (*Mangifera indica*) and hala (*Pandanus tectorius*), among others. Not every tree species will fruit at the same time. So, a sequence of trees and their seasonal fruiting habits needs to be considered as part of this program.

   These trees will increase the frequency of pigs in the area where the trees are planted, reduce subsistence hunting effort, and increase the carrying capacity of the forest. We theorize that the fruit grove in the forest will also aggregate animals from the surrounding area, gathering pigs in a smaller area and thereby reducing the load elsewhere in the forest.

Forest Management

Wao Kele o Puna is the forested watershed of Puna and contains unique, native Hawaiian ecosystems. Many native, threatened and endangered species rely on Wao Kele o Puna for their survival. Additionally, the community of Puna relies on the forest's resources for traditional gathering and subsistence practices. The care of the remaining native forest plants and ecosystems is, therefore, imperative.

Forest Management Strategy

The map below summarizes the forest management strategy for Wao Kele o Puna and will be referenced to throughout this section.

Overall strategy

To effectively combat forest threats such as invasive species, Wao Kele o Puna requires active management efforts. Proactive management of Wao Kele o Puna will contribute to a continuous supply of fresh water for public use, reduced soil erosion, and improved coastal water quality, in addition to maintaining native forest ecosystems and traditional forest uses.

The overall strategy for active forest management is to maintain or improve areas with high-quality native forest while simultaneously reducing threats from in and outside of Wao Kele o Puna. This strategy accepts that, based upon existing capacity, it is not practical to control all weeds across all forest types and, therefore, focuses on smaller areas with a higher likelihood of success.

Forest Management Classes

To prioritize areas with higher concentrations of native species, this plan incorporates forest management classes and forest management units (FMU), which are noted in the Forest Solutions' Invasive Species Management Plan and in the Actions Summary map above. Forest management classes are determined by the percentage of native species cover described in the table below.

Forest management class	Abbreviation	Native cover	Acres	% forest area
High Conservation Value Forest	HC	75-100%	4,206	16%
Kīpuka High Conservation Forest	KHC	75-100%	153	0.6%
Invaded, Limited	IL	55-75%	5,883	23%
Invaded, Extensive	IE	30-55%	2,235	8.7%
Quarantine Zone	QZ	15-30%	6,881	27%
Kīpuka Quarantine Zone	KQZ	15-30%	57	0.2%
1977 Lava flow	LV	0-10%	2,891	11%
2015-16 Lava flow	LV	0-10%	3,396	13%
Infrastructure (road and pad)	INF	5	5	0.02%
		Total (rounded)	25,700	(Forest Solutions)

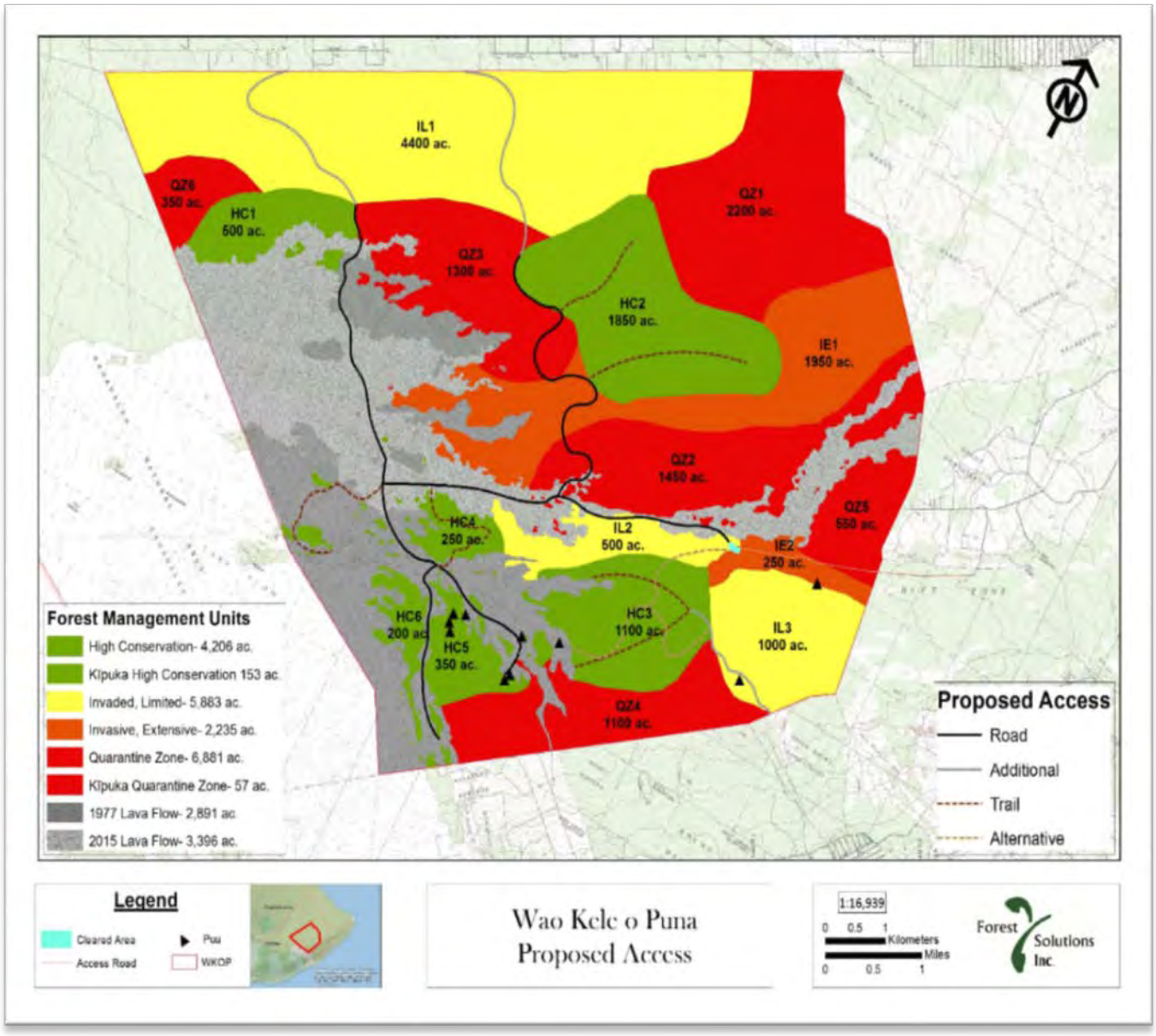

Figure 79 Proposed Access routes (Forest Solutions)

Strategy by Forest Class

Priority management recommendations for each forest class are provided below:

High Conservation Value Forest:

- Clear out the weeds to maintain native forest cover and groundcover.
- The initial focus will be on kīpuka areas that are small and manageable and work toward less invaded central boggy area.

Puʻu:

- Restore native forest cover on puʻu with largely intact native forest.
- Where there are already plantings of banana, ti leaf and related plants, determine if these plants should be kept and cultivated, or removed to restore it to native forest.

- Control weeds and replace with native species. Initial weed control efforts include removing habitat modifying species such as strawberry guava and glorybush (melastome).
- During the initial effort, leave in place those species that are not critical weeds, such as thimbleberry and grasses. As the forest recovers, these non-native species can be replaced with shrubs and groundcovers, such as māmaki.

Invaded, Limited:

- Keep weeds from moving around outside the area.
- Control outbreaks of new weeds and high-risk weeds such as miconia and albizia.
- Establish stewardship parcel agreements with community groups to remove weeds and reforest with resources gardens and native species in accessible areas.

Invaded Extensive:

- Keep the weed infestation in these lands from getting worse, while using it for community needs.
- Control only the high impact invasive species such as miconia and albizia.
- Emphasize the use of the area for hunting by developing limited trails.
- Educate hunters to prevent the introduction of new weed pests.
- Identify areas that need more protection or enhancement, such as pockets of native forest, rare plants, or nesting sites for native birds.

Quarantine:

- Keep the weed infestations from getting worse by only treating the highly invasive species like miconia and albizia, and preventing them from spreading out of this area.
- Conduct some limited experiments to test different methods to restore or rehabilitate this forest type.
- Experiment with a canopy replacement strategy using tree species such as ulu, avocado, jackfruit and niu.

Lava:

- Prevent new aggressive weed species that are colonizing the lava.
- Utilize lava flows as the preferred location to site roads to reduce collateral damage to native forests.
- Determine with community input the most culturally appropriate manner to build roads on lava flows.

Forest Management Units

After identifying which portions of Wao Kele o Puna fall into each forest management class, the forest is then divided once further into forest management units (FMUs), which form the basis for all management tasks. Although each FMU generally contains forest of the same management class, the boundaries of each forest management units are also determined by other managerial considerations, such as the ability to measure management progress or accessibility. Intensely managed areas have smaller forest management units than areas with low activity.

Weed control

The largest management task within each forest management unit is going to be invasive weed control. The list below provides recommended measures for weed control and is followed by a more detailed discussion of five major weed control prescriptions — High Conservation Value Forest weed eradication, access route weed control, incipient threat sweeps, strawberry guava control, and treatments by period.

The following measures are recommended for weed control:

- Invasive species should be controlled using a proven set of methods, today this means chiefly herbicide application, though this can change if more effective or environmentally friendly means are found. Naturally,

labels for such agents must be adhered to with an eye toward long term effects of chemical usage vs. the gain from removing invasive species.

- A suite of herbicide agents, further detailed in the Invasive Species Management Plan, have already been deployed successfully in Hawai‘i against all of the weed species encountered in Wao Kele o Puna.
- Manual removal should also be considered as a secondary control technique where feasible or otherwise appropriate due to sensitive native species or other special needs.
- Biocontrol is another option for some species and may be used as it becomes available. Although biocontrol may offer a definite cost advantage, biocontrol agents should be carefully considered for potential side-effects as effective “silver bullet” biocontrol agents are rare.
- Use volunteers and contractors, where budget is available, to assist in the removal of invasive species.
- Start volunteer projects along the current access road – which can demonstrate success and the challenges of landscape scale forest management to the community.
- Start contractor work in Kīpuka of High Conservation Value Forest and in areas with incipient weed threats.
- Use Community Stewardship Parcels to reinforce the reciprocal relationship and responsibility between kānaka and ‘āina.
- Create road improvements (discussed below) to reduce long-term costs and improve accessibility to larger areas of forest for invasive weed management.
- Maintain a Geographic Information System (GIS) based Forest Information Management System to track management activities over time.
- Coordinate with community groups and hunting stakeholders to manage feral pigs, particularly in high conservation value areas. Excluding feral pigs from certain high conservation value areas using fencing may be feasible.
- Support weed control with a framework of ecosystem monitoring plots (EMP) distributed across the forest, with particular focus on areas of intensive weed control operations to record improvements or gaps in management that need to be addressed.

High Conservation Value Forest Weed Eradication

The greatest threat to Wao Kele o Puna’s highest quality forest areas is the gradual encroachment by invasive plant species from adjacent areas. Therefore, invasive species control and eradication should be focused within and along the boundaries of forest management units classified as High Conservation value forest (HC) to effectively confine weed species in their current range and maintain HC areas in their current state of relatively high habitat quality.

Focusing weed control in areas where HC borders quarantine zones (QZ) allows for the highest ratio of return on resources invested because these areas have the greatest contrast in habitat quality. In contrast, where there are large, contiguous blocks of QZ or extensively invaded (IE) areas, it becomes less useful to suppress weeds because (1) the areas are too large to effectively treat and (2) the source populations for invasive species are too well-established.

The prescription for HC buffer areas is to control, on average, 75 acres of buffer area per year. Over the course of a 15-year planning horizon, this rate will treat the whole buffer area. Depending on the rate of invasion, however, it may be necessary to contract the buffer, reducing the treatment area.

Incipient Threat Sweeps

There are notable exceptions to the focus on controlling invasive species in HC buffer zones, specifically the specter of high-threat species establishing outside of routinely controlled areas. The Forest Solutions' Invasive Species Management Plan recommends regular, annual reconnaissance sweeps using helicopters or other imagery processing options (such as drones), followed by deployment of ground crews as necessary to eradicate new infestations of high risk species.

In the past, BIISC and DOFAW have been successful in suppressing the high-threat species miconia and albizia in Wao Kele o Puna. The locations of major existing or treated populations for these two species are well characterized, and can be prioritized for re-sweep and re-treatment as necessary to maintain this important gain.

It is likely that new weeds will establish with some proximity to agricultural areas but it is also possible for weeds, especially those with bird-dispersed seeds, to establish well inside the reserve.

To ensure comprehensive surveying for incipient weed threats, we recommend an annual aerial survey for incipient weed species either with conventional helicopter or, as the technology allows, drone surveys. Naturally, not every area needs to be surveyed to the same level of detail or objective. Quarantine areas of the forest are already engulfed in guava, so the objective is to find miconia and albizia. Conversely in the high conservation forest area, the objective is to find any new species. Lava areas will need cursory examinations at most.
The results of this annual survey serve to inform the weed control work (and budget) for the next year within the auspices of a long term weed control strategy already prepared for Wao Kele o Puna and presented as an appendix to this plan.

Once a weed threat is identified in the forest, containment and elimination are the two proactive management actions that should be taken. This requires two reinforcing principles to respond effectively:

- Early detection via monitoring (annual survey); and
- Rapid and decisive action to remove or contain the threat.

To promote early detection and rapid action, contact information for the appropriate land managers should be provided on signs at all authorized forest entrances. In turn, managers need to quickly respond to and eliminate incipient invasive species before they have a foothold on the property. By quickly, this plan recommends an annual cycle of response time.

Monitoring of new species, particularly weeds, should be a part of all forest management projects, whether in house or contracted. Due to the long periods between the formal monitoring cycles discussed above, the importance of constant monitoring should be emphasized to those who are in the field the most, including forest users, surrounding communities, infrastructure maintenance workers, and others.

Access Route Weed Control

To support the HC weed suppression and eradication work, it is necessary to improve access into the central portions of Wao Kele o Puna. This would require the construction of roads and trails as is discussed further in the forest management plan presented as an appendix to this plan.

Although roads and trails substantially improve the ability to conduct active forest management, they can also act as a pathway for weeds to spread. Therefore, conducting weed control efforts along these access routes is necessary once they are constructed.

As roads and trails are built, there will be an ongoing need for their maintenance, in accordance with the level of use intended. As a starting point for roads, we recommend a quarterly road inspection and removal of fallen trees by hand (forest manager can do this); and an annual maintenance entry consisting of either mowing or selective herbicide application and repair of the wear surface as needed (contracted).

For trails, we recommend and annual entry with hand chopping or brushing of the trail width, including removal of fallen trees or limbs. Herbicide use on trails should be limited to areas where their use is essential to preserve access. There is a potential to include community and/or hunting groups in this effort.

Recommended maintenance interval for roads and trails in Wao Kele o Puna

Access type	Length (miles)	Inspection	Maintenance	Type
Existing road	1.5	Quarterly	Quarterly	Mechanical
Roads	19.8	Quarterly	Annual	Mechanical
Trail	8.5	Annual	Annual	Manual

See the Action Summary map at the beginning of this section for potential road and trail locations that, if constructed would need to be maintained to prevent weed spread.

Sanitation

As it is important to cleanse one's mind and honor the land, it is equally important to clean one's body of any physical threats to the forest. The presence of invasive weed and pest species in forest areas adjacent to developments is a reminder of the importance of sanitation for the overall health of the forest. Greater access and activity within the forest increases the potential for introducing new weeds, diseases and pests. On the other hand, improved road access also provides the best means to contain existing weeds and eliminate new outbreaks as they occur. With these considerations in mind, sanitation methods to prevent the spread of forest threats will be discussed in this section. These methods were developed based on recommendations from the Hawaii Ant Lab and the Department of Land and Natural Resources protocol to reduce the spread of Rapid ʻŌhiʻa Death.

The intent is to provide an easy method for visitors to prevent the entrance of weeds and pathogens to the forest. In order to have a reasonable chance of adoption, the method should be easy and quick to use. The easier and more passive the system, the more effective it will be. In the ensuing pages we propose a more robust (yet more difficult to use) and a more advanced (and easier to use) options.

Threat index

Not all modes of transportation or access to the forest are equal when it comes to weed introductions. Overall exposure is determined by the means and the frequency in which the exposure is encountered. We therefore propose a graduated response to the level of threat. Most access to the forest is via light vehicle. As a result, most of the threat and concomitant effort to ameliorate the threat should be centered on vehicles and passengers/drivers.

Relative threat of introducing harmful agents to a native forest in Hawai'i (Forest Solutions)

Type	Relative impact	Agent introduced	Method of introduction
Foot	Low to very low	Seeds, fungi	Laces and treads
Car / light truck	**Low to medium**	**Seeds and fungi**	**Muddy wheel wells**
Animal: horse / pigs	Medium	Seeds and fungi	Stomach and hooves
ATV / UTV / Tractor	Medium	Seeds, fungi, sedge "nuts"	Mud clumps all over
Tracked machine: Bulldozer / Excavator	Very high	All + tubers (ginger),	mud in tracks & chasis

Heavy equipment cleaning – a must

While heavy equipment is not used frequently in the forest, each entry by a tracked machine has a disproportionate contribution to the spread of pathogens and weeds. Unfortunately, sanitation of heavy equipment is customarily neglected in Hawai'i. Given that the use is infrequent and that the threat is very high, it makes sense to take the highest level of precautions prior to allowing the entry to heavy equipment. This includes thorough hot water cleaning of all tracks and undercarriage, as well as sanitation of the operators' station. Supply and repair vehicles should also follow protocol appropriate for light vehicles.

Pre-entry sanitation kiosk

The best way to manage invasive species is to prevent their introduction in the first place. A pre-entry gathering area and cleanup kiosk is a simple way to encourage forest visitors to clean up their footwear and vehicles prior to entering the forest.
Regardless of the option selected below, additional vigilance is required in the area where cleanup occurs, as this is where soil, seeds, ants and other potential pathogens will be deposited when cleaning occurs. Since such a station will be located near the entrance(s) to the forest, this should not be overly onerous and form part of the entrance protocol.

Minimal option

At a minimum, pre-entry cleanup should be a part of the forest entry greeting sign that is recommended elsewhere in this plan, and made a condition of access to the forest. Together with this sign, the following items should be available at all times:

- stiff brushes with short handles to clean footwear
- stiff brushes with longer handles to clean wheel wells on cars
- peanut butter and chopsticks or toothpicks to set up bait tests for little fire ants which are deployed on all vehicles upon arrival to detect if the vehicle carries little fire ants
    - Action takes 15 minutes, during which visitors can conduct other portions of the entrance protocol,

such as the entry chant

- spray bottles with diluted rubbing alcohol to apply to footwear and wheel wells

The cost for the existence and continued maintenance of this system is minimal compared to the very large and very real cost for containment of invasive species once they are in the forest.

Improved option

A more robust option, that will prevent more injurious agents from entering the forest includes the items above but also includes a pressurized water system with mild detergent for vehicle wash-down. This system would be located within the locked gate at the entry to Wao Kele o Puna and will require:

- Small water tank (200 – 300 gallons)
- Small catchment surface (can be roof of interpretive sign)
- Solar panel for 12/24 VDC recharge
- High volume (3 gal/min or more) , medium pressure (50 psi +) water pump that runs on 12 or 24 VDC (See example: Shurflo model 4358-153-A09 in **Error! Reference source not found.**)
- Plumbing and hose for pump
- Enclosure to keep everything safe under a lock and key
- Gravel area to catch the rinse water resulting from cleaning vehicles

This system will have a higher initial cost for installation and protection against vandalism and theft. The wash-down system could be installed in a commercially available portable metal container that is secured to the ground and double as a water catchment surface. It will also require additional maintenance, but is again far less expensive than dealing with the pests/diseases once they invade the forest. The advent of reliable solar panels and wide availability of commercial 12 volt pumps make this an ideal solution for a remote location such as Wao Kele o Puna.

Figure 80 Washdown kit (Forest Solutions)

Washdown kits designed for boats, such as this Shurflo model #4358-153-A09, operate on 12 or 24 V DC. This is a practical option for a vehicle washdown station to provide a means for users to clean up before entering Wao Kele o Puna. Cost for such an installation is nominal, though it will require more maintenance than a passive system such as scrub brushes, yet will be more likely adopted by visitors.

Threat containment/control

Once the threat is in the forest, containment and elimination are the two proactive management actions that should be taken. This requires two reinforcing principles to respond effectively:

- Early detection via monitoring; and
- Rapid and decisive action to remove or contain the threat.

To promote early detection and rapid action, contact information for the appropriate land managers should be provided at the pre-entry sanitation kiosk. In turn, managers need to quickly respond to and eliminate incipient invasive species before they have a foothold on the property.
Monitoring of new species, particularly weeds, should be a part of any access maintenance procedures, whether these are in house or contracted out. Rather than relying on a long period between formal monitoring cycles, the emphasis should be on those who are in the field the most, including users of the forest, surrounding communities and those who maintain the infrastructure.

Feral Pig Management

Uncontrolled feral pig populations diminish native plant species, enhance growth conditions for invasive non-indigenous plants, threaten native forest birds and people by creating mosquito breeding areas, and increase soil erosion resulting in watershed degradation. Managing the feral pig population in Wao Kele o Puna is therefore important to the long-term health of the native forest, especially in the high conservation value forest area.
At the same time, pigs are also an important source of subsistence meat and customary practices for local communities. These two aspects of feral pigs call for careful consideration of the benefits of hunting for the community while also considering the damage pigs cause.

The size of Wao Kele o Puna provides room for both to coexist. In areas with a high degree of native forest cover and limited weeds pig populations should be removed to prevent further damage. Guava infested and highly invaded landscapes (herein called quarantine areas) on the other hand, call for management and even intentional improvement of the pig stocks and concomitant hunting opportunities. These recommendations are detailed elsewhere in this plan under management prescriptions for high conservation, invaded limited and quarantine forest management units.
We recommend adopting the following guidelines for managing feral pig populations

1. Allow and encourage subsistence and other hunters to hunt pigs within Wao Kele o Puna as the primary management method of population control
2. Hunters must have a valid current hunting license.
3. Hunters in Wao Kele o Puna should have a revocable OHA permit with the object of providing information about who is hunting and to keep a record of the number and weight of hunted pigs and discourage inappropriate behavior.
4. Establish reasonable hours and days for hunting in consultation with community members. By law, hunting can only take place during daylight hours.
5. Appropriate disposal of the non-useable portions of hunted animals should be a part of the permit conditions, at a minimum this means burying remains in the forest where the animal is hunted, not at roadside or in neighboring properties
6. Hunters may not leave their dogs behind in the forest. Dogs must be micro-chipped.

Managing the pig populations will also require some degree of measurement, we recommend keeping track of evidence of pig pressure in the forest while conducting other work. Excessive plowing and fern consumption means that the population is in more need of control, for example. As technology allows, this informal pig population census should also be improved to include estimates for carrying capacity and actual numbers present.

Reforestation

Rapid ʻŌhiʻa Death

The chronic threat from aggressive weeds has been joined in the last 5 years by a new threat to the forest, a fungal wilt, *Ceratocystis fimbriata*, that is commonly referred to as Rapid ʻŌhiʻa Death (ROD). As the name suggests, this disease quickly kills ʻōhiʻa trees by restricting water and nutrient flow through the bole (stem or trunk of a tree). The upper portion of the tree, devoid of water, dries up and perishes within weeks, providing its eponymous name. The evolution of this disease in Wao Kele o Puna will determine the trajectory for reforestation in the coming decade.

The entire Wao Kele o Puna forest is already infected with ROD to some degree. Unfortunately, this will result in widespread mortality of ʻŌhiʻa in coming years and potentially kill all trees. At this time, there is no way to effectively stop ROD on a landscape scale. As ʻōhiʻa stands decline, there will be an immediate replacement by weed species that are already in the sub-canopy, mostly strawberry guava, glory bush and in some areas, albizia. In areas that have significant hāpuʻu or uluhe understory, this species replacement will be delayed and may even be forestalled by taking specific management actions to limit the spread of invasive species in this sub-canopy.

The following strategy is offered in response to ROD:

1. Participate in the ROD monthly calls where scientists and practitioners discuss the latest in the knowledge of the disease
2. In areas that are already affected, the following alternatives are offered, in order of importance, to serve as potential substitute canopy species:
    a. Other native species found in Wao Kele o Puna
    b. Other natives not found within the forest. e.g. koa & ʻiliahi
    c. Non-native and non-invasive species, particularly those that could be used for forest enhancement activities such as fruit trees, such as ʻulu or avocado
3. Based on community input, test the effectiveness of natural farming pro-biotic bacteria in the soil as a possible preventative method in healthy forests.
    a. Make sure that there is a control, a fungicide option, and the natural farming option. Replicate several times – 10 or more.
    b. Test results should be implemented immediately, as timely action will be essential to preserving what is left of the forest.
4. Avoid the introduction of more pathogens, including more strains of the same disease.
5. Prevent the spread from Wao Kele o Puna to other native forests in Hawaiʻi.

Although the immediate management focus should be on protecting the best areas at Wao Kele o Puna from invasive species and cooperate with others in finding a landscape scale solution to Rapid ʻŌhiʻa Death, OHA should also consider immediate, small-scale (5 to 100-acres), experimental reforestation efforts. Experimental planting could be conducted in various parts of the property and will help identify species that may successfully sustain the native ecosystems in mauka Puna into the future.

Reforestation for future harvest

Not only may other trees provide a dominant overstory tree at Wao Kele o Puna, ultimately, these trees could be considered for future commercial or community harvesting, especially if planted in a plantation-like pattern, rather than a more random native forest distribution. Although small-scale harvesting by community members may be possible, there are many limitations that would make commercial tree harvesting in Wao Kele o Puna difficult, if not unfeasible all together. These limitations include dangerous terrain, lack of access and high cost to create access, public opposition, active lava flows, and more.

An example of the difficulties of commercial timber harvest is DLNR's Waiākea Timber Management Area (WTMA). In 1959, WTMA was planted to provide a consistent supply of forest products to Hawai'i's forestry industry. The management area encompasses over 12,000-acres of timberlands of various tree species including Eucalyptus species, Queensland Maple, and Toon. The trees have grown to maturity and are ready to be harvested.

Attempts to issue timber licenses to harvest trees from WTMA started in the 1990s. A license was issued in the early-2000s, but has subsequently ended. In 2016, DLNR issued a Request for Information (RFI) that seeks guiding information on the resources of interest, markets, products, harvest practices, processing, transportation, financing, etc. that would minimize the impact of harvest and replanting operations there.

Although WTMA has significantly better access than Wao Kele o Puna, is closer to markets, is competitively significantly ahead of any other contemplated forest harvest, has mature trees, and has existing environmental reviews addressing impacts from harvesting and replanting, to this day, no harvest has occurred. This certainly discourages any thought of reforesting with the intent of an eventual commercial today, although this option should be left open in this plan if appropriate for reconsideration at a future time.

Access – Roads and Trails

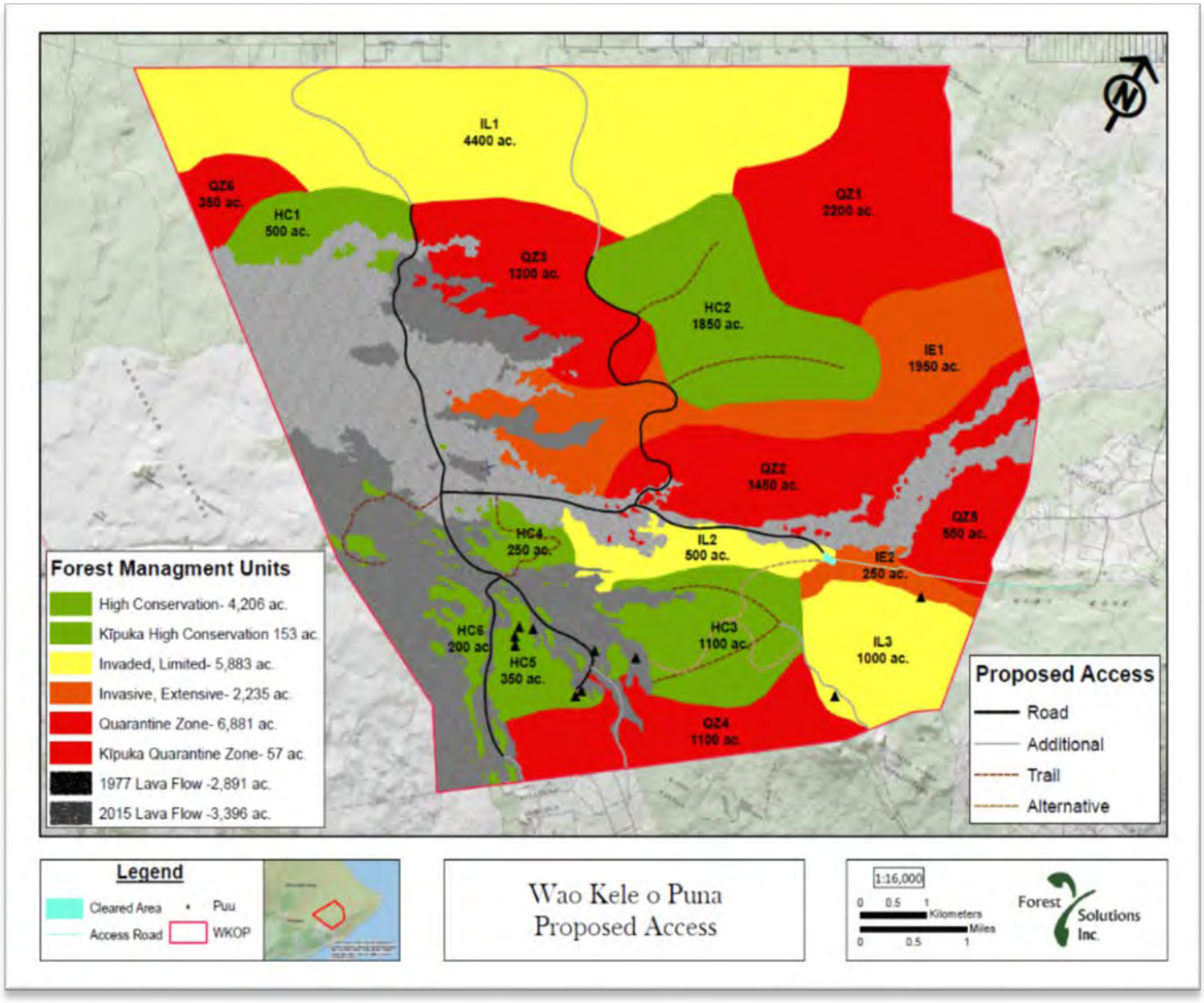

Figure 81 Wao Kele o Puna proposed access expressed with FMU's (Forest Solutions)

There is currently limited public access to Wao Kele o Puna. The only legal public access route is located above Pahoa town, goes through Ka'ohe Homesteads, and ends at the prior geothermal well site. There are no other official roads or trails in the forest.

The construction of roads and trails is disruptive to the forest ecosystem and natural structures. Creating access to and through the forest, however, is necessary to conduct active forest management. Therefore, it is recommended to build roads and trails in Wao Kele o Puna with the objective of providing safe, reliable, and economical access to serve the needs of forest management, protection, and use.

To achieve this objective, a number of associated actions must be taken:

1) Minimize the introduction of invasive weeds and pests by implementing effective sanitation protocols at all access points, as discussed above
2) Improve access to the site

- Work with adjacent landowners to the North (Kopua Farm Lots) and South (State pastorial leases) to formalize access routes to Wao Kele o Puna over adjoining private and state-owned lands
- Work with the County to ensure all future subdivision plans in the area include public access to Wao Kele o Puna
- Pursue potential land acquisitions through fee-simple purchase of appropriate lands to increase access (after conferring with road associations to ensure this is feasible)

3) Improve access through the site
   - Construct internal forest management roads and trails as noted in the Forest Managament Plan and as show in the figure above
   - Maintain and improve existing and new roads and trails; prioritize maintaining existing roads and trails before constructing new ones
4) Develop shelters and helicopter landing zones for resources management actions and safety in the case of an emergency

Road pre-building considerations

Before any roads or trails are created it is critical to conduct pre-construction planning and assessments to limit the potential negative impacts of construction. These proactive steps will result in lower costs and less environmental, archaeological, and social disturbances.

The following steps, adapted from the Code of Practice for Forest Harvesting in Asia-Pacific (FAO, 1999[3]), with specific improvements for application to Wao Kele o Puna, are to be used in road planning and engineering:

Steps to be taken during prior to and during road construction:

1) Road mapping;
2) Drafting road standards of design;
3) Ground truth characterizing the proposed road route, including:
   a) Physical attributes (slope, cracks, etc);
   b) Environmental survey including threatened and endangered plants; and
   c) Archaeological and cultural survey;
4) Re-evaluation and adjustment planning (adjust road in response to survey findings);
5) Marking;
6) Building; and
7) Road rehabilitation and resting of the road surface for at least 6 months prior to use to promote wear surface stability

All roads must be constructed in accordance with the following list of best practices, which were adopted from DOFAW's 1996 study titled, "Best Management Practices for Maintaining Water Quality in Hawaii"[4] and amended to fit the situation of Wao Kele o Puna:

- An experienced forester or road engineer or equivalent professional should be responsible for the coordinated development of infrastructure, including the location of roads using GIS and approve the road line after undergoing the pre-construction assessment.

[3]Food and Agriculture Organization of the United Nations (UN-FAO). 1999. Code of Practice for Forest Harvesting in Asia-Pacific. Available: ftp://ftp.fao.org/docrep/FAO/004/AC142e/ac142e00.pdf checked: 21 Sep 2016

[4]Department of Land and Natural Resources Division of Forestry and Wildlife. 1996. Best Management Practices for Maintaining Water Quality in Hawaii. Available: http://dlnr.hawaii.gov/forestry/files/2013/02/Hawaii-BMP.pdf checked 21 Sep 2016.

- Contours, digital elevation models (DEM), LIDAR, and other continuous and/or thematic maps should be used in the construction of all roads to avoid areas with sensitive native forest or cultural sites.
- A pre-construction assessment must be conducted and should specify areas to avoid to ensure that there are no archaeologically or environmentally sensitive areas in the planned road way.
- Roads should be located in areas of low side slopes to minimize side cutting.
- Roads should be located on elevated areas wherever possible to minimize side cutting, width of clearing, and drainage problems.
- Roads should be located so that no earthworks, rocks or soil falls into sensitive habitats or other important areas.
- Roads should be located on well-drained, stable soils with good load bearing capacity wherever feasible.
- The number of crossings over cracks and faults and lava tubes should be minimized.
- Cut and fill on side slopes should be balanced to minimize transport of road construction material.
- Roads should follow the natural contour of the land, working with the terrain.
- Minimize erosion by providing and maintaining good surface and side drainage during and after construction.
- Reduce collateral damage to native forests by staying on the new, unvegetated lava flows as much as possible, with proper honor and respect paid to Pele with gratitude to her for building the foundation on which a road network can be built.

Mini excavators, now widely available, are a good choice for trail development if manual options are not viable or not available. They can easily move around sensitive areas and do not cause extensive collateral damage. For Wao Kele o Puna, the use of steel tracks will be necessary due to rocky soils.

Figure 82 Mini Excavator

Road and trail building standards appropriate to the expected light use in Wao Kele o Puna

Access type	Intended use	Track width (ft)	Cleared width	Aggregate	Aggregate Depth (in)	Max slope & distance
Main road (existing)	Light and heavy vehicles, no semi	15	20	Yes	10-12	12% < 50 ft
Minor road	Light vehicle only, 4wd, no trailer	8	12	Yes &/or corduroy[5]	6-8	20% < 75 ft
Trail	ATV or foot traffic	4 variable	5 variable	No or corduroy	N/A	40% any

Corduroy is widely used in wet locations as a replacement for costly aggregate, where anaerobic conditions prevent wood decay. It also allows the community to participate in building the road of trail. These examples are from Mexico (top left) and Volcano (below). The initial log layout is bound by either soil or sand to provide a smooth wear surface. This method is recommended for light use roads and wet areas within trails to prevent ponding water. In Volcano, the logs used were from invasive *Morella faya* trees.

Figure 83 Corduroy road construction

[5] Corduroy road construction refers to the technique of building roads by placing numerous logs parallel to each other and perpendicular to the direction of travel.

Additional access considerations

Neighboring land acquisition
Kamaʻāina familiar with the Wao Kele o Puna access road suggested that OHA acquire the parcel to the East of Wao Kele o Puna currently owned by the Olson Trust. OHA currently holds an easement for access over this property from the end of Middle Road into Wao Kele o Puna. Acquiring this property, or a portion of it, would give OHA ownership to the entire access road, ensuring that access to the forest remains intact and that incompatible land uses immediately adjacent to Wao Kele o Puna are avoided.

Access to the forest
Community members commented that many areas in Puna are fenced, gated, and closed. Some of the participants were frustrated that places they once hunted, fished, and gathered resources have been blocked and access has been denied. Consequently, it was recommended that reasonable community access be provided for Wao Kele o Puna via a simple permit system.

Work with the surrounding communities on a common access plans.
This not only benefits OHA, but also the communities who now have meaningful access to a once difficult forest. This process will take time and commitment from OHA.

Rare Plant Species Restoration

Wao Kele o Puna is or was the home to a number of threatened or endangered native plants. To ensure the survival of these species, rare plant restoration efforts are recommended in Wao Kele o Puna.

These rare plant restoration efforts should:

- Focus initial actions in the High Conservation Value FMUs through fencing, feral ungulate control, invasive plant control, and preventing the introduction and establishment of other habitat-modifying species and new threats.
- Map, monitor, and protect existing wild populations of rare and endangered species to contribute to their population recovery and stabilization. Identify and remove threats to these species and ensure their long-term survival in secure and self-sustaining wild populations.
- Construct rare plant exclosures (using pā pōhaku (stone walls) or pā lāʻau (picket fences)) when needed to protect individuals or populations of endangered plants.
- Re-introduce certain species of rare and endangered plants in appropriate protected habitat through outplanting. Some of these species are being propagated at the Volcano Rare Plant Facility.
    - Coordinate rare plant management actions with agencies and organizations working on rare plant recovery.
    - Survey rare plants to locate wild individuals, collect propagation and genetic storage materials and reintroduce through outplanting.
    - Provide additional management of wild and/or reintroduced populations if needed (e.g. small fences around wild plants and populations that are not within fenced management units; control of damaging weeds, insects, slugs, plant diseases and/or mammalian predators).

Many community participants acknowledged that Wao Kele o Puna must be open and accessible to hula hālau for gathering native plants. One hālau member shared that they want to use Wao Kele o Puna as a place to plant and grow native plants used for hula practices, such as palapalai and maile.

This participant has also been in contact with other hālau that are interested in planting, gathering, working, and teaching at Wao Kele o Puna.

Other mana‘o shared by the community included the following:

- If people start to replant ‘awa and maile then people will start to use the forest again.
- OHA needs to figure out what can grow in this forest, with the local conditions. This will help them understand what plants should be restored here. They should also figure out why the maile is dying. This plant is so special to the forest and it needs to be protected so future generations have access to it.
- Need to replant native plants, especially plants that you can make crafts out of and sell such as ‘ōhi‘a to make ‘ōhi‘a posts.
- Have lā‘au lapa‘au and gathering workshops for practitioners.
- Use the forest to help support local food security and sustainability.
- Implement culture, cultural resources, practices, and restoration to make use of this place. Use the natural resources to strengthen one’s connection with the place, and to their Hawaiian culture, which is a part of the practice to gather. But the process must be complete.
- So its not okay just pick, you have to have some kind of way to reciprocate it, such as gathering and replanting some place else or gathering to feed the trees or gathering to take out invasive plants/bugs. Gather and give back to the place for the next generations.
- Being a practitioner doesn’t only come with gathering but it comes with taking care and kuleana. This part of the process is still missing. If the resources are being used, practitioners need to have some kind of responsibility to give back to the place.
- The Wao Kele o Puna Forest Reserve contains resources that are vital for maintaining Hawaiian culture and practices. Hawaiians consider native plants and animals as family and have a strong spiritual connection to the mountain landscape and the forest itself. Gathering plants such as ferns, maile, flowers, fruits, and other materials cannot be perpetuated into the future unless the forest remains relatively pristine.

Monitoring

Monitoring the current status and trends of natural resources and forest use throughout Wao Kele o Puna is an important management function and tool for decision-making.

Proposed monitoring actions:

- Implement monitoring programs for ungulates, invasive plants, and rare plants to measure the success of ongoing management activities and to detect changes in abundance and distribution.
    - Monitor ungulates in fenced management units to detect their presence or absence.
    - Rare plant monitoring is conducted to assess the survival and growth of wild and reintroduced rare plants. Monitor rare plants to assess their survival and reproduction, collect propagation materials, search for additional wild individuals, and determine if additional management is necessary.
- Implement a monitoring program for forest birds. Provide monitoring data to the Hawai‘i Forest Bird Interagency Database Project for analysis of bird population densities and trends.
- Develop improved monitoring protocols, data management and analysis for existing monitoring programs and review and summarize past monitoring data and inventories.
- Develop and/or identify appropriate monitoring protocols and implement monitoring for key community indicators that are not currently being monitored (i.e. native vegetation communities, invertebrates, etc.)

Archaeological Sites

There are a number of archaeological features in Wao Kele o Puna documented in the Archaeological Condition Assessment and Burial Treatment Plan. These include several mounds at Pu‘u Heiheiahulu and burials and other features in Wao Kele o Puna’s three lava tube systems. For all archaeological sites in Wao Kele o Puna, it is recommended that access be heavily regulated.

The archaeological features within the lava tubes are heavily protected by natural controls. One such natural control is the time and effort necessary to travel through the vegetation to these sites. Another is the inherent danger of approaching a skylight hidden by dense vegetation and potential falls into the lava tube. Therefore, no additional protection methods are recommended for these sites.

The Pu‘u Heiheiahulu mounds, not including the National Geodetic Survey Station, is the only other known archaeological site that should be avoided or considered off-limits until a research design is completed to determine whether or not burials are present. Previous studies suggest the mounds may be for human interment, for ritual purposes, or as territorial markers.
It is recommended that OHA institute strict permissions for helicopter access to the property, especially in the areas of the lava tubes and on Pu‘u Heiheiahulu. In all other areas, the likelihood of encountering significant archaeological sites is remote.

Nonetheless, documented uses within the forest include traditional practices exemplified by bird catching, historic commercial endeavors, and prominent travel routes. Therefore, persons engaged in activities in Wao Kele o Puna should be aware of notification procedures should any previously unknown archaeology finds be encountered.

Burial Sites

The three lava tubes in Wao Kele o Puna all have burial sites within at least certain sections of each tube. The North Lava Tube and the South Lava Tube were used exclusively for burials with minimal evidence that the burial practice continued into the early post-Contact period. Field inspections at portions of the South and Middle tubes strongly suggest entrances makai or northeast of the Wao Kele o Puna project area are filled with new lava, thus making the tubes naturally sealed outside the project area and the burial sites protected. There are no known entrances to the South Lava Tube within the project area. The North Lava Tube, as presently known, contains only burials, while the Middle Lava Tube contains, in addition to burials, other archaeological features, paricularly refuge-type structures.

It was recommended by community members that access to these tubes in Wao Kele o Puna be restricted except for in outstanding circumstances. It is believed that what may be found if additional archaeological studies of these tubes were conducted would not substantially contribute to the archaeological understanding of traditional burial practices. Therefore, there is no reason to disturb these burial sites at this time. A further description of burial treatment in Wao Kele o Puna is articulated in the Burial Treatment Plan.

Eco- and Volun-tourism Opportunities

Eco-tourism, Volun-tourism and recreation related activities, a growing sector of the island's visitor industry, have potential here due to the natural resources of these lands. However, before initiating anything, OHA should have further discussions and engagement with the Puna community.

Other than providing an area, either off-site or within the cleared area at the former geothermal site, to service and manage these activities, these uses and activities could be integrated and managed with other uses on the property.

However, given the strong, unanimous opposition to commercial activities at this time, OHA should continue discussion with the Puna community on what, if any, ecotourism should occur.

Community Concerns Related to Commercial Activities

During the Ethno-historical Review, community representatives weighed in on the prospect of commercial activities at Wao Kele o Puna. Part of that report noted, “The commercialization of resources was cited as a primary cause for

the decline in the availability of resources. Both locals from outside of Puna and newcomers were held accountable for taking too much and making a profit from sales, which came at the expense of long-time subsistence practitioners." (Kumupa'a 2014:353)

"Community participants ... expressed mixed feelings regarding OHA potentially starting commercial ventures in the forest. While some community members were adamant there should be absolutely no commercial activities at Wao Kele o Puna, others felt that culturally appropriate, small-scale commercial activities could provide financial support to the community and help the forest become self-sustainable." (Kumupa'a 2014:410)

Where physically feasible and culturally appropriate, the eco-tourism and related opportunities may be considered, but continued discussion with the community must be conducted before any decision-making. Eco-tourism activities can draw on the unique history and cultural connection that the area has.

'Focal Point' Feature

In discussions with an experienced eco-tourism provider on the Island, his immediate response on eco-tourism opportunities at Wao Kele o Puna was 'there's no waterfall'. This is consistent with the findings in the Townscape review: "The most common [eco-tourism activities] are hiking tours of the volcanoes, waterfalls, gardens, etc. The challenge is to offer an experience that cannot be found elsewhere on island."

A possible temporary 'feature' is a future lava flow in Wao Kele o Puna. During the most recent flow in Wao Kele o Puna, government agencies restricted access to the forest for safety reasons. This restriction did not stop individuals or commercial tour operators from continuing to access the property.

The Townscape analysis of revenue opportunities suggests the "basic experience would be to offer guided hikes through the rain forest." Rather than calling for experienced operators to provide the guest experience, Townscape recommends that OHA form an entity and be responsible to plan, permit, construct and operate the eco-tourism program - which includes transporting guests from Maku'u to Wao Kele o Puna. Doing so, however, puts OHA at financial risk for an activity that it has no experience in and distracts from OHA's core mission, as well as the needs of Wao Kele o Puna.

Rather than conduct eco-tourism activities on its own, it is recommended that OHA initiate a commercial operator process similar to DLNR's Nā Ala Hele program or through a broad Request for Proposals for an experienced operator(s) to be responsible for those activities. The requirements for the Nā Ala Hele program are listed below to provide an idea of the potential paramenters of a similar OHA program.

Nā Ala Hele Conditions for Allowing Commercial Tour Activity
To be eligible, the commercial tour operator must:

- Have liability insurance for one million dollars that includes the State of Hawai'i as an insured party.
- Have all other appropriate State and County permits and licenses (examples: PUC, GET).
- Have no outstanding departmental violations within one year of the application period.

The commercial tour vendor and the proposed activity will be reviewed and may be approved based upon the:

- Ability to meet the eligibility criteria and ensure public safety.
- DLNR's ability to manage and regulate potential tour impacts.
- Tour's sensitivity to and reasonable knowledge of the natural and cultural resources.
- Potential economic benefit to the local economy through employment and revenue.
- The commercial trail tour operator's record of operation (it is understood by the applicant that an approved permit may be terminated or amended upon the determination of impacts associated with the activity or non-compliance with permit conditions).

Upon approval of the permit, permittees are given a website access code to access Nā Ala Hele's on-line trail reservation system. Reservations are only for trails designated for commercial use and are on a first-come-first-serve basis. Permit holders are invoiced based on number of reservations placed.

Under this program, DLNR's Nā Ala Hele program receives $5 per commercial customer. With the exception of Mānoa Falls, all of the Nā Ala Hele trails within the State have the same set number for group sizes and number of allowed groups.

The group size is 12 people including the leader and the number allowed groups is 3 groups per day per trail. Therefore, allowing 36 commercial people on the trail per day. This can be changed via board approval. Mānoa Falls allows 6 groups a day. This was established because of the demand and the fact that trail has been armored to withstand high use.

Assuming a similar daily capacity of 36-people per trail per day (1-guide and 11 guests per party of 12), total potential revenue is $165.00 per trail per day, or $60,225.00 per trail per year. The responsibility of marketing and operation is on the vendor with permitting for trail use handled via website. There is, therefore, very little administrative costs associated with this system.

RFQ/RFP Process in the Procurement of Commercial Services

The suggestion of using a broad RFQ/RFP process in the procurement of services for the commercial enterprises does not in any way limit the opportunity for OHA beneficiaries to be involved in the process. The comparative proposal evaluation process promotes the selection of the "best" proposal based on a set of defined criteria. The specific criteria can be tailored to meet OHA and community goals.

Potential criteria to be considered in the evaluation process may fall into the following groups:

- Qualifications, experience, and capability to achieve stated management objectives in the proposal;
- Experience and involvement in projects of similar scope, size and complexity;
- Creditworthiness and ability to secure a commitment letter or other evidence to insure financing and bonding;
- Successful experience in obtaining land use entitlements and government approvals/permits;
- Past work experience in the State of Hawai`i;
- Demonstrated knowledge of Hawai`i's natural and cultural resources.

Entry/Exit Protocols - Briefings

Individuals and entities with OHA Commercial Activity Permits will be required to adhere to numerous equipment and procedural requirements for the health and safety of guests, as well as protection of the area's natural and cultural resources. This includes the entry/exit protocols and briefings previously discussed.

Other Procedures/Equipment

In part, the following lists some of the procedures and equipment that each Commercial Activity Permittee could be required to follow or have:

- Adequate supply of water available per guest
- Proof of CPR and First Aid training for all employees working within the subject property
- Ability to communicate (via cell phone, radio/satellite phone) with emergency services while conducting activities within the subject property

- Conducting cultural and natural resources and safety briefing with all guests before beginning eco-tourism activities
- Provide portable toilet facilities and disposal of all waste properly (composting may be considered)
- Provide liability insurance
- Provide proof of vehicle insurance for all vehicles accessing the subject property
- Provide demonstrations on use of all equipment used by guests before commencing an activity
- Conduct activities only on designated trails and roads

Volun-Tourism

A relatively new segment of eco-tourism, dubbed by some as "Volun-tourism," integrates volunteering activities into tourism activities. These volunteer "service" trips, allow participants the opportunity to volunteer at the site they are visiting and thus give back to the community. Part of the focus of management at Wao Kele o Puna is management, protection and restoration of the native ecosystem - in part, this may be accomplished using volunteers.

The notion of tourists "doing good" or "giving back" as an integral part of their vacation experience is not a completely new concept, as tourists have often sought to donate some resource to destinations they visit. Just as community volunteers benefit from assisting in the implementation process, tourists involved in service-oriented activities have often come away with a renewed sense of purpose and well-being for having made a positive contribution towards the local area and people.

Given the cost associated with professional planting and other activities in the implementation process, it is clearly evident that the use of volunteers is one of the key mechanisms to meet the implementation needs. The recruitment of tourist volunteers to assist in the implementation process will save OHA significant funds.

OHA Employees to Oversee Plan Implementation

The Land and Property Division within OHA will oversee all work within the plan and will reach out to other divisions within OHA for expertise as needed.

To support the implementation, we recommend that three new positions be added within the Land Management Division (position titles may change to fit OHA's organizational structure):

- Konohiki (Plan Coordinator);
- Kākau ʻŌlelo Palapala (Contract Management, Compliance, and Grant Specialist); and
- Makaʻāinana (Field Specialist).

There could be more than on person hired for a particular position, particularly Makaʻāinana. Additional work that exceeds the capacity of these positions would be conducted through community-based management or contracted out. Many state agencies currently use contracts to expand on-site field work. Organizations such as the research Corporation of the University of Hawai`i, Pacific Cooperative Service Unit, Youth Conservation Corps, etc. are avenues that OHA may use to expand its field work for specific areas or needs.

Konokihi (Plan Coordinator) – 1 position

The Konohiki will primarily be working in and on issues related to this CMP including:

- Supervising
    - Supervise staff, including field workers and office staff
- Administration

    - Establish relationships and collaborate with community on implementation recommendations as they relate to cultural values, research interests, educational opportunities, and more
    - Coordinate with various state agencies such as DLNR-DOFAW, the University of Hawai'i, research entities, and local communities to understand and collect and incorporate their input
    - Manage all budgets related to the program
    - Manage all contracts, licenses, permits, etc. for work within Wao Kele o Puna
- Outreach/Education
    - Act as a community liaison; conduct and attend community meetings associated with plan issues
    - Respond to public concerns, comments, and suggestions
    - Assist in attaining favorable public relations and quality control of actions by the team
- Field Work
    - Assist in translating the plan into appropriate action
    - Conduct and manage field work
    - Oversee natural resource data collection efforts including ground surveys, remotely sensed data, and others as appropriate
- Performs miscellaneous related duties, as required

Kākau 'Ōlelo Palapala (Contract Management, Compliance and Grant Specialist) – 1 position

The Kākau 'Ōlelo Palapala will manage procurement and compliance functions for plan staff including:

- Contract Management
    - Prepare all procurement documents and contractual instruments including RFP's, professional service contracts, proposals, technical specifications, bids, third-party agreements and contract modifications
    - Prepare and administer correspondences, negotiations and award memoranda, and contract documentation to ensure timely and coordinated submittals
    - Evaluate responses to solicitations
    - Conduct vendor meetings, site inspections and pre-bid conferences
    - Respond to information requests, protests and complaints orally and in writing
    - Work closely with attorneys in contract preparation and resolution of procurement issues and contract disputes
    - Identify, develop and implement new contract/procurement policy and processes as necessary
    - Assist and support staff in property investment contract related projects as necessary

- Contract Compliance
    - Ensure contractual requirements of all procurement processes are satisfied
    - Ensure all procurement activities including review, approval and execution, are done in compliance with appropriate laws, regulations, policies, procedures and guidelines
    - Provide authoritative guidance and communicate procurement policy and practices to all staff on issues relating to procurement activity
    - Compliance and Tracking of Enforcement Actions
        - Ensures timely issuance of notices of default and other appropriate correspondence for noncompliance with contractual requirements of leases, permits, and other encumbrances
        - Upon expiration of the cure period, follows-up on breaches which have not been cured
        - Notifies staff of compliance actions
        - Works with and responds to inquiries by tenants and staff to resolve compliance issues
- Grants
    - Grant Writing
    - Grant Management
    - Grant Compliance

    - Collaboration with Federal, State and Local entities
- Outreach/Education
    - Assists in attaining favorable public relations and quality control of action by the team
    - Assists in translating the plan into appropriate action
- Performs miscellaneous related duties, as required.

Maka'āinana (Field Worker) - 2 positions or more

The Field Worker will assist in conducting operations to implement the Plan, as part of a team, including:

- Fieldwork
  - Assists in translating the plan into appropriate action
  - Oversee project based field activities
  - Plant maintenance, surveys, and monitoring
  - Fence-line route determination, construction and logistical coordination
  - Invasive species surveying and control
  - Inspects contractor performance for quality and completion
  - Education of staff with regard to invasive species monitoring, control, and fence inspection and maintenance
  - Follow phytosanitary procedures
  - Out-planting installation and monitoring
  - Propagation and maintenance of plants for out-plantings:
    - Perform routine maintenance and repairs
    - Manage plant pathogens and insect pests
    - Keep accurate nursery/planting records and assist in the maintenance of the plant propagation data base.
  - Coordinate volunteers and "volun-tourism" activities in the field
- Administration
  - Adherence to herbicide use/equipment guidelines
  - Assists Konohiki in keeping records of treatment and control
  - Management plan development for control and monitoring, scheduling, database entry, and year-end report coordinating and writing
  - Keeps records of treatment/control, assuring employee safety, and implements protocol to prevent seed dispersal
  - Coordinate Volunteer Activities
    - Volunteer training
    - Volunteer recruitment
    - Volunteer scheduling, planning, logistics and documentation of field work
    - "Volun-tourism" activites
  - Assist in scheduling, planning, logistics and documentation of field work and operations.
  - Consistently and accurately record, enter, edit, and analyze data.
  - Maintain field gear, equipment, vehicles, and facilities.
- Outreach/Education
  - Assists in attaining favorable public relations and quality control of actions by the team.
  - Partner coordination, public outreach and education.
- Performs miscellaneous related duties, as required.

Initiate Grant Applications to Support Resource Restoration

Grants, other types of outside funding, and partnerships will be a critical part of implementing this plan. OHA has already established partnerships with a number of agencies and these partnerships will continue and be expanded. Possible options for funding include the following programs (information is from 'Forestry Related Assistance Programs in Hawai'i: Current programs and future trends'):

Forest Stewardship Program (FSP) Hawai'i's Forest Stewardship Program, administered by the Department of Land and Natural Resources, Division of Forestry and Wildlife (DLNR-DOFAW), provides technical and financial assistance to owners of nonindustrial private forest land that are interested in conservation, restoration, and/or timber production.

(Up to 50% cost-share, usually limited to $75,000/year; Time frame - 10 years of cost-sharing with a post 10 or more year maintenance period. Minimum 30-year contract if involves timber production.)
http://dlnr.hawaii.gov/forestry/lap/fsp/

Conservation Reserve Enhancement Program (CREP) The Conservation Reserve Enhancement Program (CREP) is a federal-state natural resources conservation program that addresses state and nationally significant agricultural related environmental concerns.

The program restores degraded agricultural lands to native forest communities. The program will improve wildlife habitat, improve water quality and quantity, reduce and control invasive species, enhance coral reef habitat, and reduce sedimentation and nutrient runoff. Through CREP, program participants receive financial incentives from U.S. Department of Agriculture (USDA) and the State to voluntarily enroll in the Conservation Reserve Enhancement Program in contracts of 15 years.
http://dlnr.hawaii.gov/forestry/lap/crep/

Watershed Forestry Assistance Program (WFAP) - On December 3, 2005, the President signed the Healthy Forest Restoration Act (HFRA). The Act contains two watershed forestry assistance programs (WFAP), State Watershed Forestry Assistance and the Tribal Watershed Forestry Assistance Programs, that are to be administered by the Secretary of Agriculture through the Chief of the Forest Service. The Forest Service is working with State Forestry Agency personnel and with Indian Tribes to develop separate guidelines for the State and the Tribal Watershed Forestry Assistance Programs.
http://www.fs.fed.us/cooperativeforestry/programs/wf/wfa.shtml

Youth Conservation Corps (YCC) – The Hawai'i Youth Conservation Corps (HYCC) programs (HYCC Summer and HYCC Community) provide short-term opportunities for participants to learn about conservation in a collaborative group setting. Participants will work alongside one another on a team for the duration of the program, which is 2-4 months long. Team-based programs are ideal for youth ages 16-24 who are eager to spend time outdoors participating in restoration efforts with a variety of organizations and are seeking academic support through mentorship in order to complete a secondary education degree or have an interest in earning college credit and/or education award stipends. http://www.kupuhawaii.org/

Hawaii Invasive Species Council (HISC) – The Hawaii Invasive Species Council is an inter-departmental collaboration that was established in 2003 for the special purpose of providing policy level direction, coordination, and planning among state departments, federal agencies, and international and local initiatives for the control and eradication of harmful invasive species infestations throughout the State and for preventing the introduction of other invasive species that may be potentially harmful.
http://dlnr.hawaii.gov/hisc/

Conservation Innovation Grants (CIG) - The purpose of CIG is to stimulate the development and adoption of innovative conservation approaches and technologies, while leveraging the Federal investment in environmental enhancement and protection in conjunction with agricultural production.

USDA Natural Resources Conservation Service (NRCS) accepts proposals for single or multiyear projects, not to exceed 3 years, submitted by eligible entities from any of the 50 States, the District of Columbia, the Caribbean Area (Puerto Rico and the U.S. Virgin Islands), or the Pacific Islands Area (Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands). Eligible entities include Indian Tribes, State and local units of government, non-governmental organizations, and individuals.
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/pia/programs/?cid=nrcs142p2_037350

Partners for Fish and Wildlife Program - The Partners for Fish and Wildlife Program was established to offer technical and financial assistance to landowners who wish to restore wildlife habitat (native ecosystems) on their property. The assistance provided by the U.S. Fish and Wildlife Service (Service) can range from informal advice on the design and location of potential restoration projects to cost-share funding of project implementation under a formal cooperative agreement with the landowner.

The Service can also provide participating property owners with technical assistance to develop Safe Harbor Agreements that cover habitat managed for endangered or threatened species, and provide assurances that additional land, water, and/or natural resource use restrictions will not be imposed as a result of their voluntary conservation actions to benefit covered species.
https://www.fws.gov/pacificislands/partners.html

Safe Harbor Agreements (SHA) - The SHA program was developed to encourage the voluntary participation of non-Federal landowners in the conservation and recovery of Threatened and Endangered (T/E) species on non-Federal lands. A SHA is developed by the non-Federal landowner and the Service and may include third party participants, such as state or local agencies.

The agreement concisely describes the property to be covered by the agreement, identifies the species that are the recipients of the conservation benefits, sets a "baseline" for those species (how many, if any, are already present prior any conservation actions), the conservation actions that will be provided, any activities that may result in incidental take of the species, and the responsibilities of the all the participants. The intent of the SHA and the criterion that acts as the standard for this type of agreement is the provision of a net conservation benefit to the T/E species for which it has been developed.
https://www.fws.gov/pacificislands/sha.html

Environmental Quality Incentives Program (EQIP) – Cost-Share 75/25. This program is a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land. http://www.nrcs.usda.gov/programs/eqip/

Summary of Initial Recommended Actions

In a broad context, Landscape-Scale Forest Management can be simplified to 4 themes and 12-words:

- Work with Community
- Protect the Best
- Kill the Weeds
- Manage the Pigs (Ungulates)

With those, two other words are important:

- Management Matters

This means, doing something is more important than doing nothing; but it doesn't mean doing anything. Actions need to be thoughtful and strategic.

As an example, if you simply grade 100-acres of invasive species and do nothing else, in time they and other invasive species will grow back in the area cleared. Instead, clearing a portion (say 30-acres) and replanting native species, then clearing another block and tending it will result, in the long run, with removal of invasive species and restoration of the native forest.

Moving forward, while land use regulatory restrictions limit some of the broad management recommendations in the CMP, there are a number of immediate actions that OHA and others can implement to move toward those long-term goals.

Long-term Regulatory Management

First, as the long-term management solution to regulatory limitations in Wao Kele o Puna is to establish a Wao Kele o Puna Special Subzone where actions called for in the Comprehensive Management Plan are permitted uses, it is important to get this process underway as soon as possible. It is recommended that OHA immediately prepare and process the following:

- An Environmental Assessment to accompany the Subzone application will be needed

Immediate Actions

While the process towards a special subzone is underway, the following are recommended initial/immediate actions to take at Wao Kele o Puna:

- Immediate application to DLNR for permits to conduct the following activities along the access road, cleared area, & kīpuka:
    - Construct a traditional meeting house and hula mound in the cleared area with space for community uses (use material from the forest where feasible; built in traditional manner)
    - Invasive vegetation removal/management using hand power tools (chainsaws, weedwhackers, etc.) and herbicide, extending approximately 300-feet along the access road & cleared area in all directions and in kīpuka
    - Planting of experimental trees (extending approximately 300-feet along road and cleared area in all directions and in kīpuka)
- It is recommended that OHA continue to contract out many of the larger scale forest management measures and those that are perhaps too dangerous for direct community-based management. As community groups gather resources and abilities, contracting can be rolled back

In addition, it is recommended that OHA implement the following management measures:

Work with Community

- Allow for continued use of the forest for Traditional and Customary Practices (per Pele Defense Fund and other landmark cases)
- Establish a relationship with key community members to provide input in implementation
    - Depending on structure – Advisory Council; Board of Directors, Lessee, etc.
- Work with Community to define the long-term use of the cleared area in line with recommendations presented elsewhere –a place for the community to gather
- Attend Puna Community meetings
- Attend neighboring Road Committee meetings
- Prepare guidelines/criteria/relative mapping on making community stewardship parcels available to community groups
- External Access
    - Negotiate with neighboring properties for access
- Seek legislative authorization for rulemaking
    - Start to prepare draft rules

Protect the Best

- Periodic helicopter flights to kīpuka High Conservation Value units
- Improve access through the property
  - Identify priority road alignments from cleared area in direction of HC4 over lava flow
  - Identify Trails through HC4 to HC5 & HC6
- Fencing of important habitat areas

Kill the Weeds

- Helicopter to Kīpuka
  - Invasive vegetation removal using hand power tools (chainsaw, weedwhacker, etc.) and herbicide applications

Manage the Pigs

- Establish guidelines/requirements for hunters
- Resolve any potential conflicts between DLNR's hunting regulations and the Pele Defense Fund case
-

Estimated Unit Costs (Construction and Management/Maintenance)

The following is a table of generalized costs associated Construction and Management/Maintenance in forested areas. Following this table are Management Alternatives related to actions within the Wao Kele o Puna property.

Category	Type	Unit	Cost / unit
Helicopter	Access support	Round Trip (2 hour)	$3,000
Roads	Construction	Mile	$100,000
	Maintenance	Mile per year	$6,500
Hale	Construction	Unit	$100,000
	Maintenance	Unit, Year	$6,000
Trails	Construction	Mile	$25,000
	Maintenance	Mile	$2000
Fence	Construction	Mile	$45,000
	Maintenance	Mile	$3,500
Weeds	Eradication (no Road)	Acre	$800
	Maintenance (no Road)	Acre	$600
	Eradication (w/Road)	Acre	$300
	Maintenance (w/Road)	Acre	$150
	Incipient Scan (Entire Forest)	Year	$12,000
	Reforestation	Acre	$2,000

Time Period	Management Strategy	Actions	Operating Budget (Annual)	Improvements (Roads, Trails, Fencing, etc)
Pre-Special Subzone Designation	**Minimal**	Invasive vegetation removal/management Planting of experimental trees along road Maintenance of select kīpuka via helicopter Construct traditional Hālau meeting house	$250,000	$100,000
	Limited	**The above actions plus**: Build road access to mauka kīpuka areas Additional staff technician to coordinate work Fencing or other protection of select kīpuka	$400,000	$300,000 initial, then $50,000 per year thereafter
Post- Special Subzone Designation	**Baseline**	**The above actions plus**: Building road to middle High Conservation Forest Fencing/protection of larger forest areas Reforestation of select High Conservation zones	$600,000	$600,00 initial, then $125,000 per year thereafter
	Recovery	**The above actions plus**: Full road access build-out in a period of 10 years Additional (second) staff coordinator Fencing of all High Conservation Forest Enrichment planting in High Conservation Forest Reforestation within select areas of invaded forest	$800,000	$800,000 initial, then $200,000 per year thereafter

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