Malama Mauna Kea

a plan for sound management

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Contents

"If the process has integrity the outcome will be right"

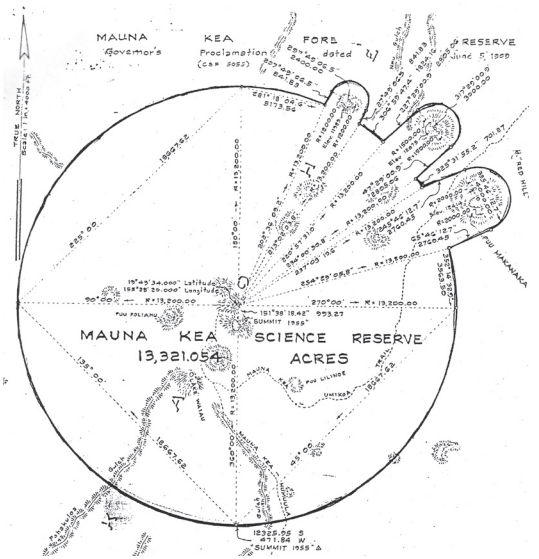
section one

Setting the Stage

Mauna Kea is *wahi pana*, a sacred landscape which links the Hawaiian people to their past and future. It is the site of the creation story for the Hawaiian Islands; a sacred burial site; a place of traditional and customary practice, a place of pilgrimage; and home to unique geological formations, endemic plant, and endangered animal communities. Mauna Kea is the tallest mountain in the Pacific Basin; its summit is 13,796 feet above sea level. A massive post-shield stage volcano, Mauna Kea covers a total area of 920 square miles. The sense of the enormous mass and power of the mountain is reflected in local people's descriptions of its presence being three-dimensional, going from the heavens deep into the ground.

For over four decades Mauna Kea has been at the center of an increasingly contentious conflict over land use and management. The astronomy community lays claim to the mountain as a premiere site for telescope development, while Native Hawaiian practitioners and environmentalists advocate for the protection of Mauna Kea's rich cultural and ecological resources. To date the debate has been dominated by astronomy despite the fact that the mountain is located in a conservation district which, as stated in HRS183C, is intended to " . . . conserve, protect, and preserve the important natural resources of the State through appropriate management and use to promote their long-term sustainability and the public health, safety and welfare". While astronomical development is currently allowed in this district as a subuse, a new comprehensive management plan for the area of use is required that revisits what is appropriate for the mountain. The importance of this requirement was underscored in a 2006 decision by the Third Circuit Court that revoked the CDUP granted to NASA because of the lack of a comprehensive management plan.

Despite the history of conflict, this document is put forth in the spirit of aloha. The Hawaiian way extends aloha to all, respects and protects the power of places, stewards the environment, and shares knowledge so that others may do the same. These are the values of the Mauna Kea Hui. In deciding to prepare a *haili moe* or vision for Mauna Kea, and a process for realizing that dream, the hui is establishing a course for developing a long-term plan for the mountain. This document represents a step toward that process.



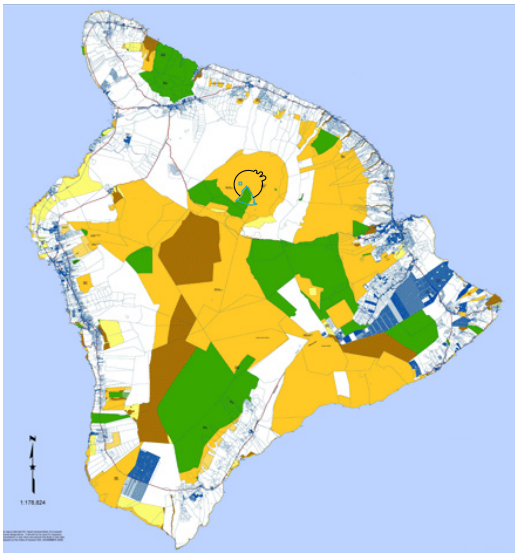
The purpose of this document is to establish a set of goals for the protection and sound management of Mauna Kea, summarize what is known about the mountain and what remains unknown, propose a fair and effective management structure, and provide a vision of what the future of this sacred place can be.

In calling for sound management, by definition this document is calling for accurate and thorough baseline data, rigorous monitoring of resources, respectful recognition of the needs of traditional and customary practitioners, a transparent and just management structure for the mountain, and a reassessment of the allowable uses in Hawaii's conservation district subzones.

To do this the issues on Mauna Kea must be understood at three scales. The smallest scale is that of the Mauna Kea Science Reserve (MKSR), Hale Pohaku, and Summit Road – the areas that University of Hawaii (UH) and the State should be stewarding but instead have exploited or ignored. The second scale is that of the whole mountain, defined by its geological extent which aproximates its watershed boundaries and aquifers. This scale contextualizes the summit and allows management to be based upon ecological function rather than jurisdictional boundaries. The largest scale is that of the Big Island. Working at an island-wide scale facilitates an understanding of Mauna Kea's place in the larger network of ecosystems, public open space, cultural resources, and access to those resources.

A detailed, whole-mountain plan for Mauna Kea that includes broad community input is a long-term goal, but the current situation at the summit demands immediate attention. The summit is where cultural and ecological resources are most endangered, and where contentious land use conflicts between culture, astronomy, and ecological process are most apparent.

Because of this, much of this document focuses on the summit area, while the larger planning scales represent the context for thinking about Mauna Kea and the desired management units for the future.



The following four goals have guided the planning process up to this point.

GOAL 1: Uncover and map the facts about Mauna Kea.

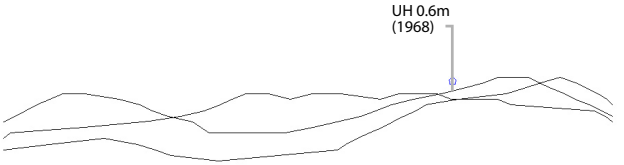
Although archeological, geological, and biological studies have been done on parts of Mauna Kea, spatial, temporal, and material gaps remain. Many of the maps in the public record frame the view to concentrate on the Mauna Kea Science Reserve, ignoring important ecological relationships, traditional and customary practices, and cumulative effects in order to promote astronomy. Many of the studies that have been relied upon thus far are outdated, some of the data that has been gathered was never mapped, some apparently purposefully misleading, and some has been dropped from the record over the years. Monitoring programs are essentially non-existent so impacts are not known.

With this in mind, one of the most important actions that must be taken to protect Mauna Kea is the establishment of accurate baseline data for ecological and cultural resources. This will require updating studies that have already been done and commissioning new studies. However, baseline studies separated by topic must also be subsequently integrated into a system-wide understanding. The mountain's wildlife, vegetation, wind, people, pu'us, gods, and water are bound together. The process of establishing a baseline includes understanding and respecting the interconnectedness of the mountain from base to summit.

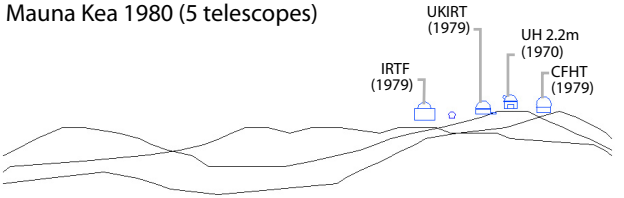
GOAL 2: Lead a community discussion about Mauna Kea.

For over a thousand years Mauna Kea was governed to protect the home of gods who in turn allowed mortals to use it wisely. But since 1983 astronomy has dominated land use at the summit while spiritual and community values have been largely excluded. While current practitioners, environmentalists, and the public have been asked to participate in the planning process for the science reserve, these invitations have been hollow. Valid views of the mountain have been largely ignored and stripped of legitimacy.

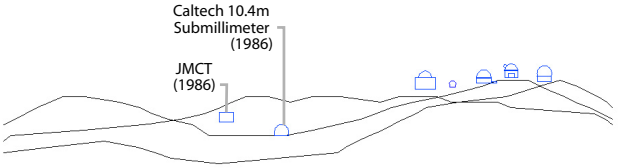
Mauna Kea 1970 (1 telescope)



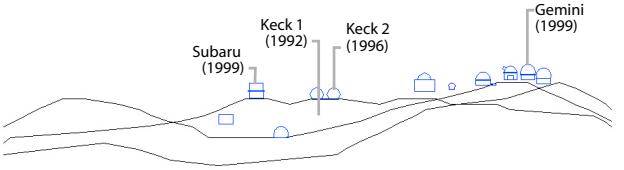
Mauna Kea 1980 (5 telescopes)



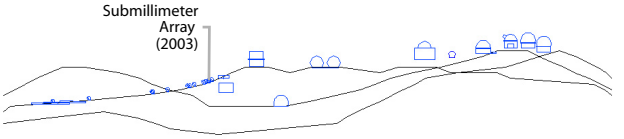
Mauna Kea 1990 (7 telescopes)



Mauna Kea 1999 (12 telescopes)



Mauna Kea 2006 (13 telescopes)



For this reason it is important to let people talk about Mauna Kea as they see it and articulate their wishes for the mountain. The Mauna Kea Hui wishes to *manawale'a ho'omakili* (open its heart) in order to *ike pono manawale'a* (to know a stranger's heart) and lead a process for the community as a whole. The goal is to facilitate the emergence of a positive collective vision for Mauna Kea. Such a process would serve to solidify the diffuse but palpable support for an alternative future on Mauna Kea, one that gives Hawaiian culture and the environment the respect and protection that they deserve.

GOAL 3: Develop a land use plans for Mauna Kea that reflects the community vision.

Once the hui completes the gathering of *mana'o*, it must be catalogued and shaped into a vision. This serves several purposes: it demonstrates to participants that they have been heard, it provides something concrete to respond to, it generates enthusiasm and optimism, and it can be used as the basis of land use planning.

GOAL 4: Redefine the management of Mauna Kea.

Once ruled by Papa and protected by the Hawaiian people, today the mountain is under siege by parties with interests other than its health. To ensure fair and effective management of Mauna Kea the balance of power on the mountain must be shifted away from the UH (the tenant), and toward Native Hawaiians, the public, and the State (the rightholders, stakeholders, and stewardship landowner). In addition, baseline studies, inventories, and consistent monitoring of cultural and ecological resources must become an integral part of an informed management process. Changes in the perception of management jurisdiction are also needed. The summit of Mauna Kea is, above all, ceded land, land that is held in the public trust, and land that is in a conservation district. These designations supercede its status as a site for astronomy, a science reserve, and a recreation area. The management of Mauna Kea should reflect this.

"Where mana is mana can leave."

section two

Mapping Mauna Kea:
what we know and what nobody knows

Decision-making on Mauna Kea must be based upon information that is rigorous in its method and complete in its scope. It is essential to assess what is known about Mauna Kea and identify the gaps so it can be well managed as a sacred place and ecological system. Joint fact finding to formulate a comprehensive, scientific base will go a long way to reduce conflict. The following section is as much about revealing what is unknown as it is about mapping what is known. For example, a comprehensive hydrology study of the summit region has never been done and must be. There are large spatial and temporal gaps in the vegetation surveys and there is no information regarding the introduction of invasive species through new management regimes. Studies of summit fauna, which includes twelve species of endemic arthropods and likely others that have not yet been identified, are incomplete. Contemporary cultural and religious practice have likewise never been mapped nor have the spatial needs for practice been determined or mapped.

In an effort to understand and protect ecological and cultural resources, the following subjects have been described and mapped: geology, hydrology, vegetation, religious and cultural resources, wekiu bug habitat, astronomy, infrastructure, recreation, and planning and management. These maps were based on information included in the 1985 and 2000 planning documents with additions from recent research, fieldwork, and interviews. Although the focus was on the MKSR, a broader ecological context was included where possible, recognizing that the ecological unit for sound management extends far beyond the MKSR.

At the end of this section, the maps listed above are layered one atop the other to create two overlay analyses, one showing the concentration of cultural and ecological resources, and one showing the concentration of uses. A visual assessment of the two overlays reveals that there are many areas of Mauna Kea still to be studied, and that the area of most intense use coincides with the highest concentration of ecological and cultural resources.

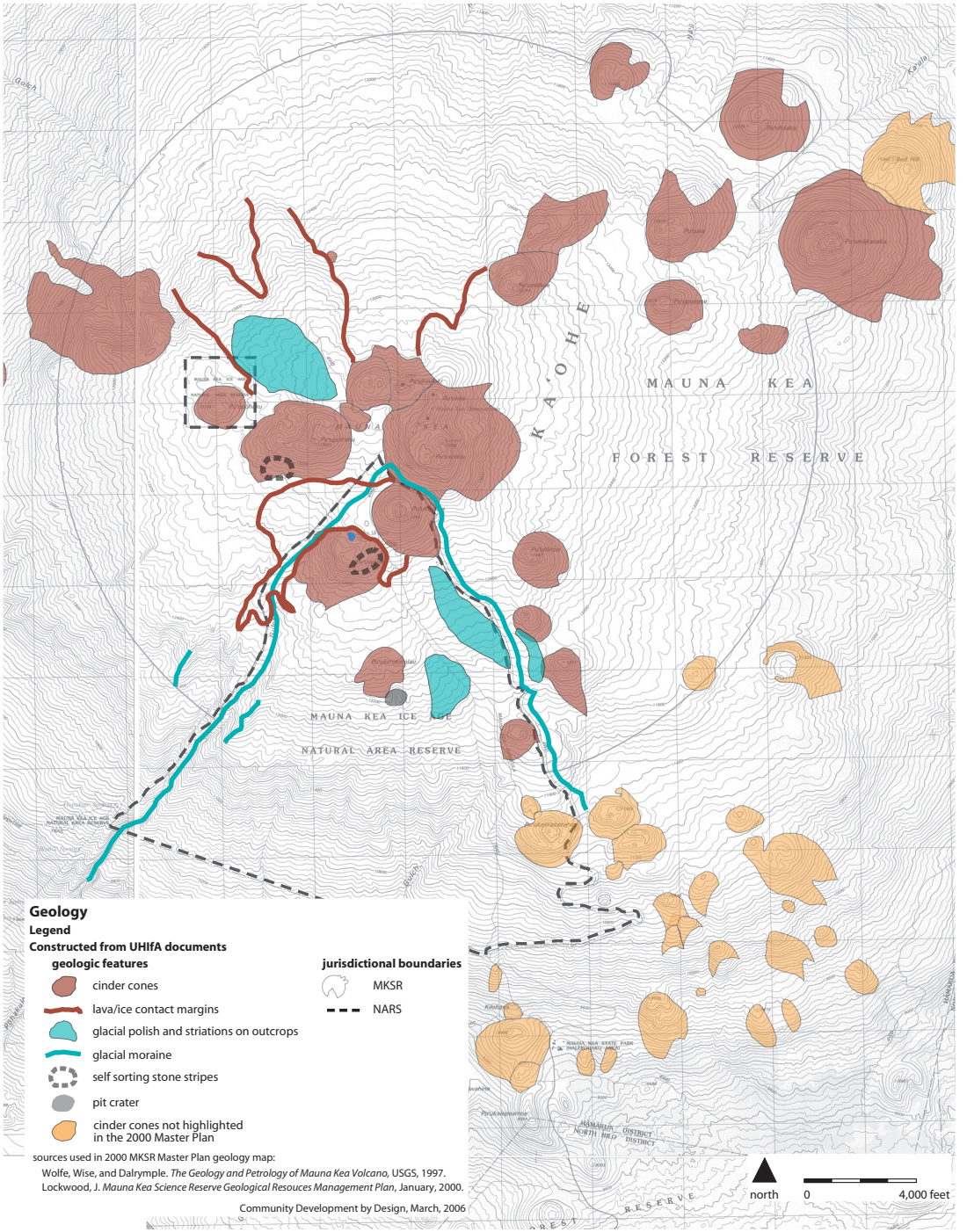
GEOLOGY

Geology is a critical factor in the struggle over future land use and management on Mauna Kea. Mauna Kea is the world's only example of a glaciated oceanic tropical volcano and it preserves the only glacial deposits and features in the State of Hawaii. Its geology is intimately tied to Hawaiian myth, to the structure of cultural practice, to the habitat of endemic species, to the layering of ecological systems, and to the material for traditional craft.

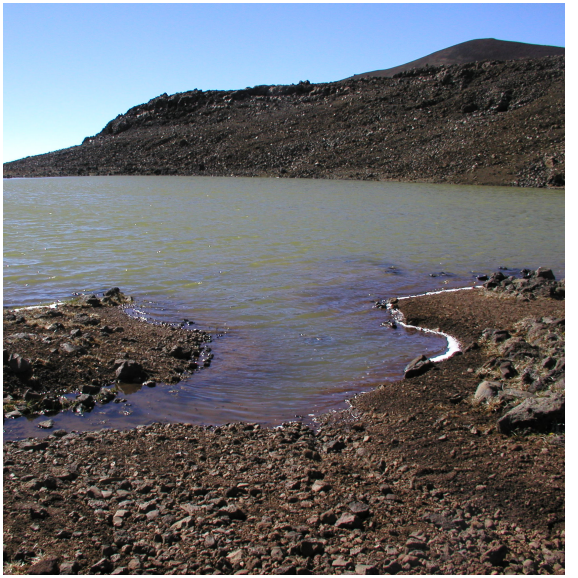
Mauna Kea, a dormant volcano created approximately 1 million years ago, is composed mainly of olivine basalts formed during the shield stage and andesine andesites characteristic of its post-shield stage. The mountain has been glaciated many times during the past 250,000 years, a process that left it a legacy of unique surface features including lava/ice contact zones, glacially polished rocks, glacial till and glacial moraines, two glacial valleys, an alpine glacier lake (Lake Wai'au), a pit crater, and self-sorted stone stripes. A few high cinder cones, known as 'nunataks', rose above the glacier escaping glaciation.

Eruptions on Mauna Kea generally occurred in the presence of water in the form of snow or ice. Examples of these lava/ice interactions can be found at the summit cinder cones of Pu'u Kea, Pu'u Hau'oki, and Pu'u Poliahu and on steep slopes to the south of Pu'u Poliahu. These well-preserved land forms are considered to be some of the best examples of lava/ice interactions in the world. Mauna Kea's summit has over 20 cinder cones which are considered some of the most pristine in Hawaii. Pu'us Poliahu, Wekiu, Kea, and Hau'oki have all been damaged during road and observatory construction for astronomy facilities.

The geology of Mauna Kea and the rarity and fragility of its features is clearly explained in easily-accessible plans and reports, including a description of the features that need protection in Appendix H of the unadopted 2000 MKSR Master Plan. However, the availability of this information does not translate to its use in policy making or resource protection. These features should be protected as part of the mountain's geologic history and to provide scientific and educational opportunities. Finally, Mauna Kea's subsurface structure, which has serious repercussions for understanding groundwater, is not known. This is critical to proper management.


MAUNA KEA
FOREST RESERVE
MAUNA KEA ICE AGE
NATURAL AREA RESERVE
Geology
Legend
Constructed from UHIfA documents
geologic features
cinder cones
lava/ice contact margins
glacial polish and striations on outcrops
glacial moraine
self sorting stone stripes
pit crater
cinder cones not highlighted in the 2000 Master Plan
jurisdictional boundaries
MKSR
NARS
sources used in 2000 MKSR Master Plan geology map:
Wolfe, Wise, and Dalrymple. The Geology and Petrology of Mauna Kea Volcano, USGS, 1997.
Lockwood, J. Mauna Kea Science Reserve Geological Resouces Management Plan, January, 2000.
Community Development by Design, March, 2006
north
0
4,000 feet

HYDROLOGY

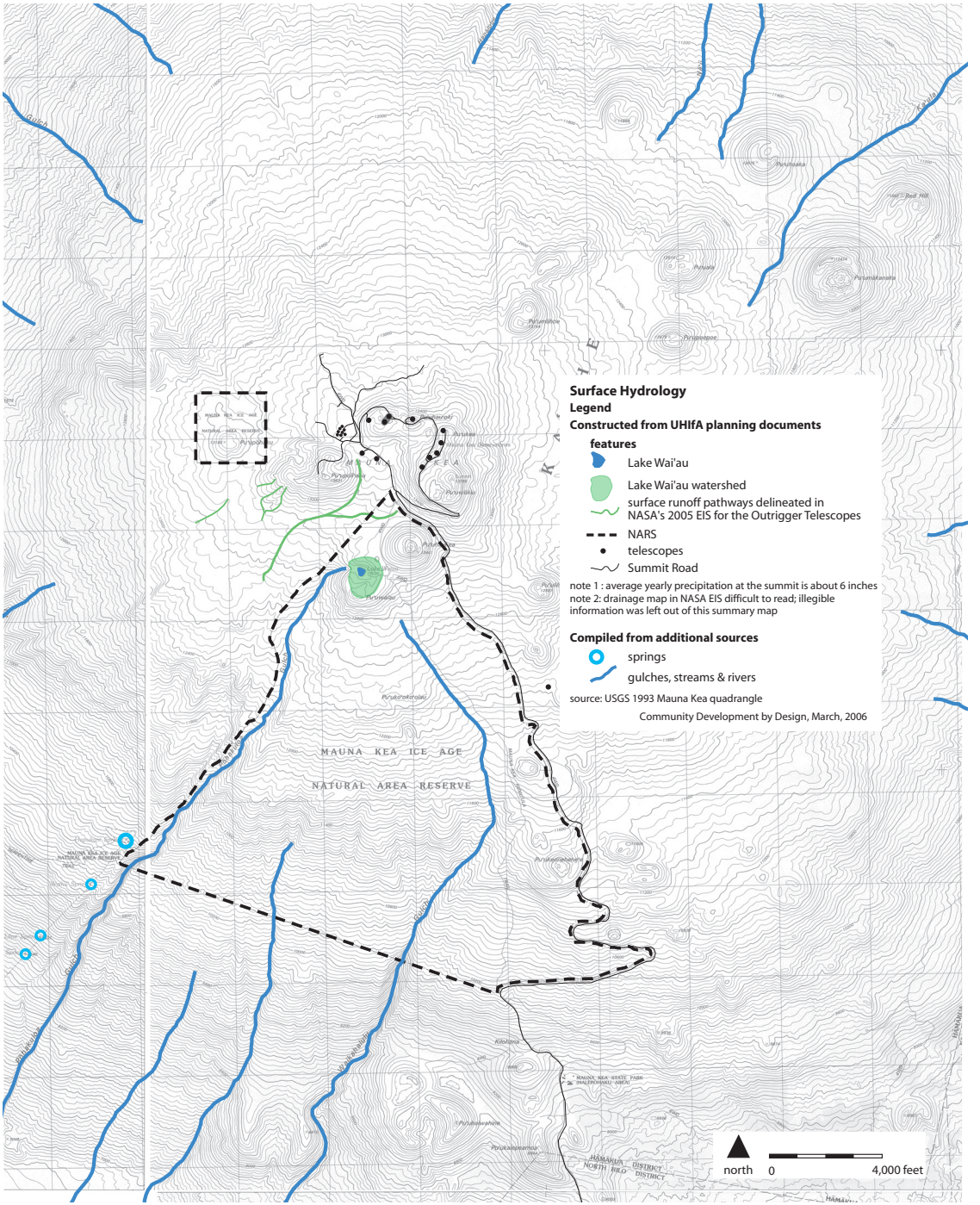


The water features on Mauna Kea including Lake Wai'au, gulches, permafrost, alpine and sub-alpine springs, and groundwater are uniquely linked to the mountain's glacial past. The desire to protect the water quality is tied both to demonstrating respect for a sacred landscape and to concerns about contamination of surface water and groundwater. There is no comprehensive hydrology study to address these concerns.

The lack of data on groundwater below the summit region is at the crux of concerns over water quality. The only near-surface groundwater in this region is perched in some of the cinder cones east of Lake Wai'au. Shallow groundwater below the summit is most prominent on Pohakuloa Gulch. High level groundwater is likely controlled by nearly vertical dikes of low permeability. No deep groundwater has been found in this region. Yet, the behavior of groundwater under the summit is inferred, not known.

Because of its cultural significance, there is more information about Lake Wai'au than other hydrologic features. Perched in Pu'u Wai'au in Mauna Kea Ice Age Natural Area Reserve, it is the only alpine lake in the Hawaiian chain. Its 35-acre watershed does not include the developed summit area. Water loss is due primarily to evaporation, not seepage. The impervious bed prevents polluted groundwater from entering the lake laterally or from below. Layers of algae in sediments suggest that high algae levels occurred historically and are not a recent incident.

Potential water quality impacts from new development include the generation and disposal of human waste, water supply and wastewater treatment needs, cinder washing for wekiu bug habitat restoration, increased surface runoff due to new impermeable surfaces, and an increase in the use of toxic substances with new development. A recent NASA EIS claims that threats to water quality from new development are slim to none, but this has not been confirmed with data. Until more is known about the hydrology of Mauna Kea, existing and potential impacts can not be accurately assessed and arguments on both sides will be purely speculative.


Surface Hydrology
Legend
Constructed from UHIfA planning documents
features
Lake Wai'au
Lake Wai'au watershed
surface runoff pathways delineated in NASA's 2005 EIS for the Outrigger Telescopes
NARS
telescopes
Summit Road
note 1 : average yearly precipitation at the summit is about 6 inches
note 2: drainage map in NASA EIS difficult to read; illegible information was left out of this summary map
Compiled from additional sources
springs
gulches, streams & rivers
source: USGS 1993 Mauna Kea quadrangle
Community Development by Design, March, 2006
MAUNA KEA ICE AGE
NATURAL AREA RESERVE
north
0
4,000 feet

VEGETATION

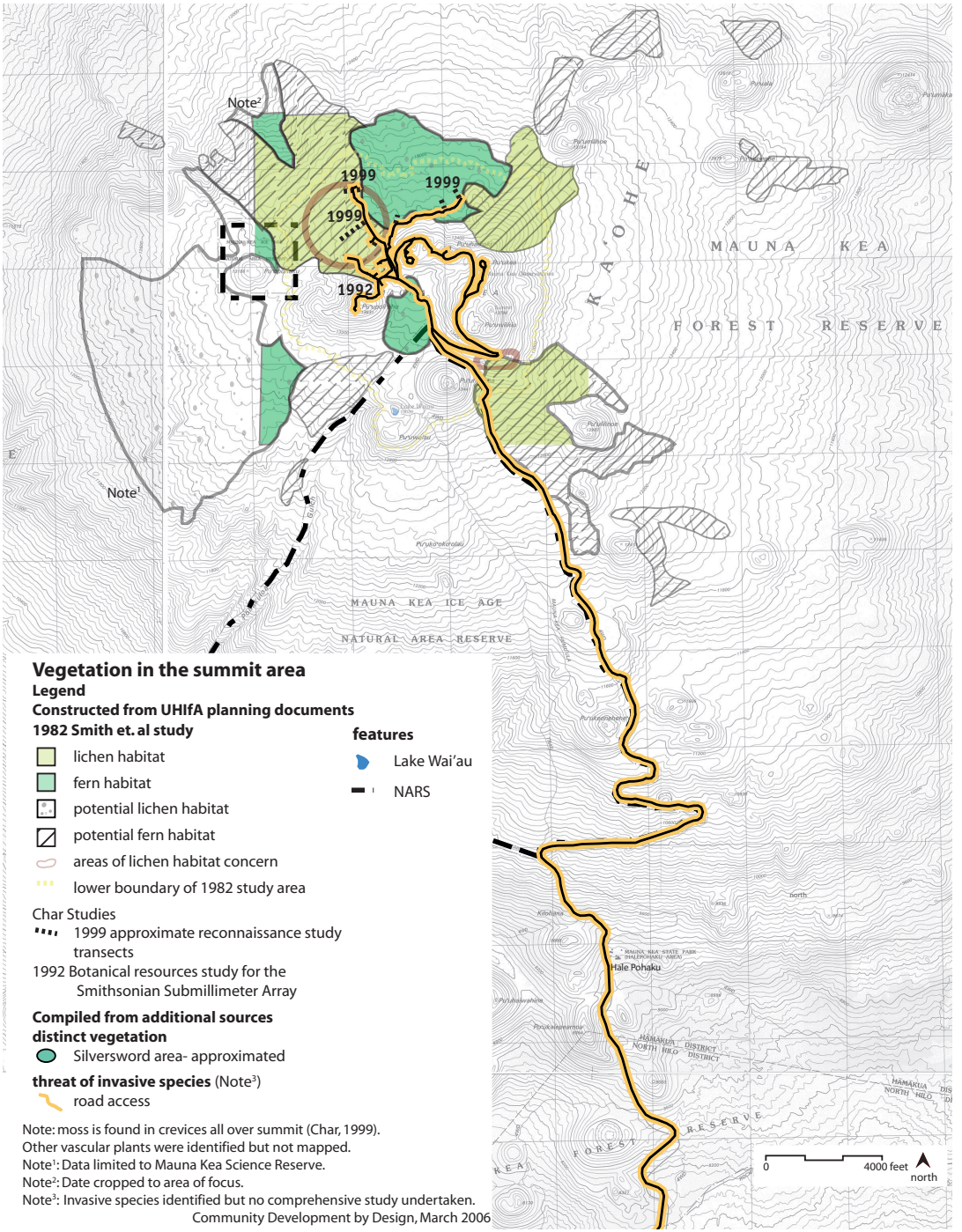
Although not evident at first, the summit of Mauna Kea is home to a diverse population of flora and fauna. While vegetation at lower elevations is well documented, there has never been a complete study in the summit area, only a general study conducted over 20 years ago. Risks could be destruction from development, use, chemical spills, or invasive species, however, a lack of data makes it unclear what threats the vegetative ecosystem faces.

The landscape of rocky outcroppings and smooth lava flows from volcanic and glacial activity affected by wind patterns, extreme temperatures, varying moisture levels, and snow fall create a unique community of plant life. This Aeolian alpine ecosystem, an increasingly rare condition in the tropics due to global warming, is characterized by a low number of primary producers, except for a few algae, mosses, and lichens, and a community of mostly arthropod predators and scavengers that feed on organisms blown up from lower elevations. Receiving only snow, temperature is extreme and solar radiation is high.

From 11,500 feet to the summit cinder cones at 13,400 feet, the landscape consists of scattered grasses, ferns, mosses, shrubs and lichens directly related to the surface geology of glacial till and ʻaʻa flows. Within this habitat there are several species of concern.

In the 1982 vegetation study, 26 species of lichen were found, all indigenous to Hawaii and half of which are endemic to Hawaii, including *Umbilicaria hawaiiensi* and *Pseudephebe pubescens* which are endemic to Mauna Kea. In 1982 two areas of lichenological concern were identified— the slope of Puʻu Wekiu below the switchback and the region that is proposed for the Optical Interferometer on the northwest slope. Additionally, 12 species of moss widely dispersed below 13,000 feet were collected. The mosses, several of which are endemic to Hawaii, occur in protected places, rock overhangs, deeply shaded pockets, and crevices.

The 1982 study identified six species of vascular plants within the MKSR: two common weeds, two native grasses endemic to Hawaii, *Agrostis sandwicensis* and *Trisetum glomeratum* and two ferns, *Asplenium adiantum-*



Vegetation in the summit area

Legend

Constructed from UHIfA planning documents

1982 Smith et. al study

- lichen habitat
- fern habitat
- potential lichen habitat
- potential fern habitat
- areas of lichen habitat concern
- lower boundary of 1982 study area

Char Studies

- 1999 approximate reconnaissance study transects

1992 Botanical resources study for the Smithsonian Submillimeter Array

features

- Lake Wai'au
- NARS

Compiled from additional sources

distinct vegetation

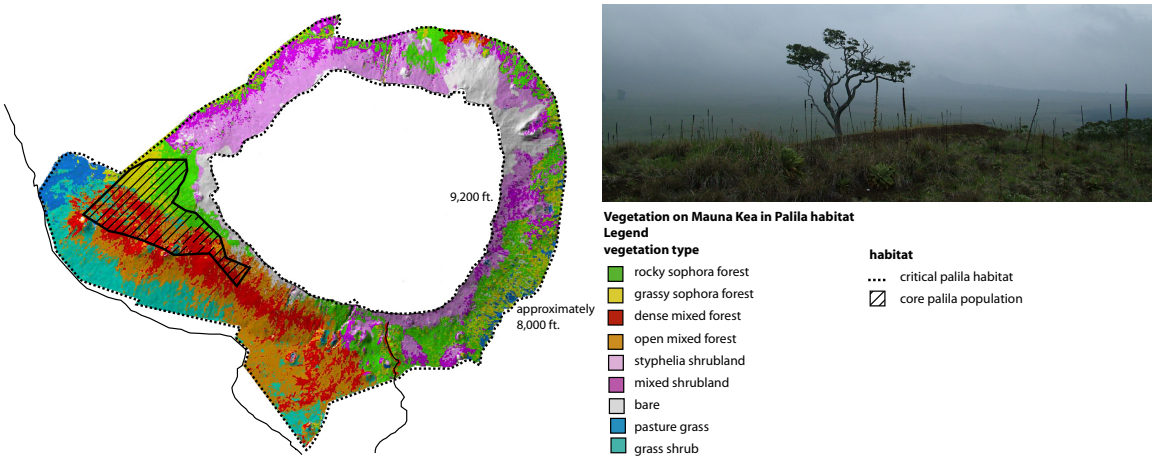
- Silversword area- approximated

threat of invasive species (Note³)

- road access

Note: moss is found in crevices all over summit (Char, 1999).
Other vascular plants were identified but not mapped.
Note¹: Data limited to Mauna Kea Science Reserve.
Note²: Date cropped to area of focus.
Note³: Invasive species identified but no comprehensive study undertaken.

Community Development by Design, March 2006



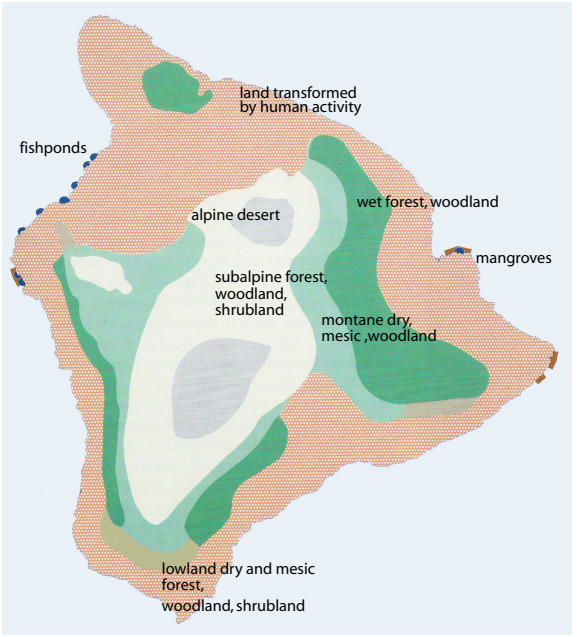
nigrum and *Cystopteris douglasii*. This last species found below 13,500 feet is listed only as a species of concern by the USFWS and is therefore not federally protected. This fern may represent a new taxon, which can only be determined with further study.

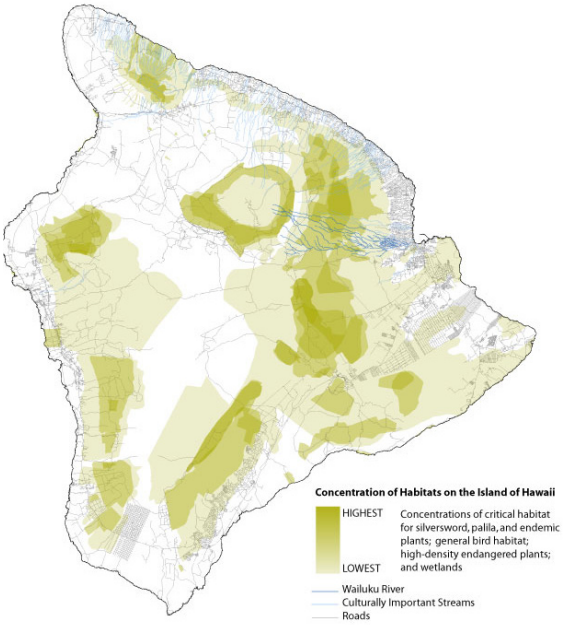
Once abundant on Mauna Kea, the silversword (*Argyroxiphium sandwincense*), a low-growing plant endemic to Hawaii with rosettes of narrow pointed silver-green leaves and spectacular clusters of profuse red-purple flowers on a tall stem, is now a federally endangered species. Over several decades, the plants were trampled by feral ungulates and vandalized by people. Current restoration and protection efforts include a protective fence around the largest population of 30 wild plants near 9,350 feet above the Wailuku River and 25-50 plants established through planting efforts in a fenced area near Hale Pohaku. The gene pool for cross-pollinating silversword may not be viable to sustain the population.

The mamane tree forest (*Sophora chrysophylla*), extending from Saddle Road to 9,200 feet, is considered rare on a global level and vulnerable to a variety of threats. Historically, the blooming mamane created a yellow lei around Mauna Kea much revered by Native Hawaiians. Decades of cattle grazing on State lands, over a century grazing by feral ungulates, fire, alien species, and increased visitor traffic have damaged and destroyed much of the forest. Restoration efforts, driven by the endangered listing of the palila bird (*Loxiodes bailleui*), are on the north slope and part of the west slope at 9,000 feet and below and include 30,000 acres of critical habitat below the MKSR. Mitigation monies from the Saddle Road realignment funded 20 miles of fencing to keep sheep out of the mamane forest allowing restoration efforts to begin.

Between Saddle Road and 7,800 feet the forest is referred to as the mamane/naio forest due to the coexistence of the two trees. Hawaiians continue to visit these forests to collect materials for construction, traditional and customary practice, and medicinal purposes.

At Hale Pohaku (9,200 feet) the vegetation is described as open-canopied mamane tree with a ground cover of bunch grasses and no identification of endangered or threatened species. Yet, the surrounding mamane and nearby silversword are vulnerable species. Using vehicle trips as an indicator, intensity of use increased by 15%





from 1998 to 2003 in this area. The transport of invasives by scientists, reserve workers, tourists, and their vehicles, and damage from overuse are likely to increase over time.

There are four critical issues in regards to the vegetation on Mauna Kea. First, the information on botanical resources gathered in the most threatened area is insufficient and too dated to make decisions. With the comprehensive documentation of existing, threatened, and invasive species the risks of development, chemical storage, and transportation to vegetation could be accurately assessed. Second, the missing information on threatened and invasive species is especially alarming. With the increase of access to Mauna Kea, fountain grasses as well as ants and spiders are expanding rapidly up the mountain. Once invasive species are identified, action from the Big Island Invasive Species Program is required and appropriate management and monitoring will follow. Third, the current representation of the vegetation is misleading. Understanding the vegetative mosaic of Mauna Kea requires understanding its transect which illustrates the interconnectedness of the ecosystems and culture, a concept that is missing from public documentst. This omission has served piecemeal decision-making ruled illegal in other situations. Fourth, a comprehensive natural resources management and monitoring plan at Hale Pohaku and the summit was recommended by Char in the unadopted 2000 Master Plan because none exists. Until such a conservation plan is developed for the summit, Hale Pohaku, and areas along access roads, the conservation of rare, endangered, and endemic vegetation and ecosystems cannot be ensured.

TRADITIONAL AND CUSTOMARY PRACTICES

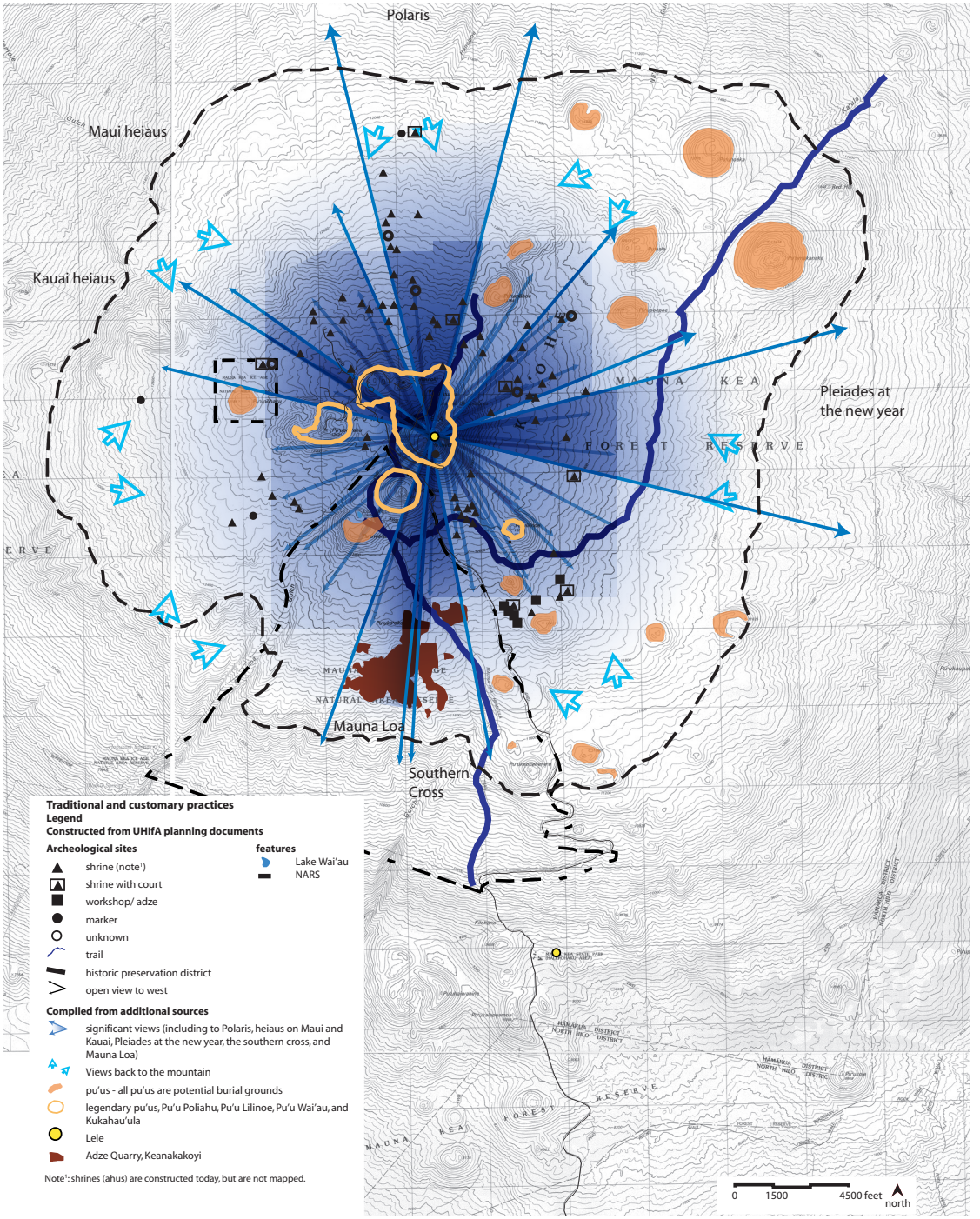
Mauna Kea is a part of a cultural landscape that holds religious significance across the Hawaiian Islands and Polynesia. It is where Wakea and Papa-hana-moku came together and formed the Great-Expanse-of-Space and the Heavenly realms. The summit area is the sacred realm, wahi pana, where divine entities lived and people did not. It is a burial ground embodying the Hawaiian gods and the most sacred divine ancestors.

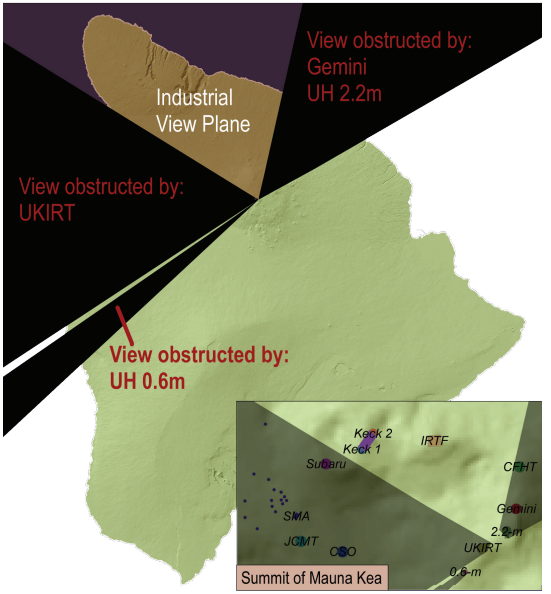
For over a thousand years, people have come to the mountain for healing, inspiration, clarity, prayer, to make memorials, to deposit *piko* (umbilical cord), walk, release ashes of family members, and conduct ritual and ceremony. Historically these activities were religious in nature. While some of these practices continue today, observing the old ways, other practices have evolved. Both types of practice are important and must be recognized as a present-day culture, not a culture only of the past.

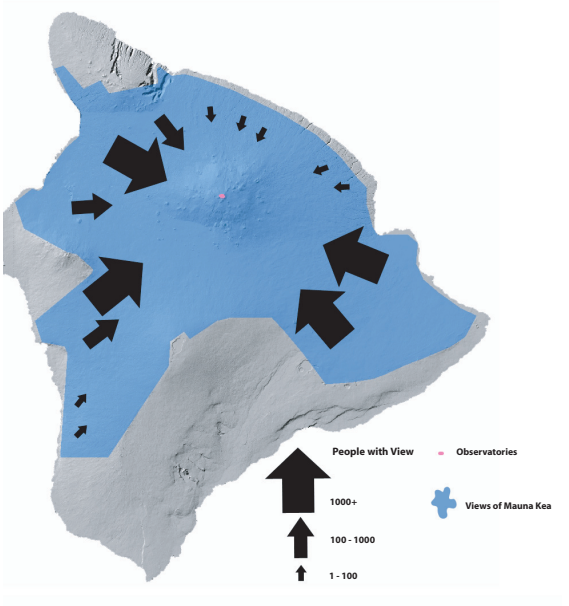
Cultural resource assessment for Mauna Kea did not begin until an archeological survey was conducted in 1975, nine years after the first construction began on the summit. Surveys undertaken between 1975 and 1997 identified 93 sites (including shrines, adze workshops, and burial sites) in about 3,000 acres, representing 27% of the 11,288 acres of the MKSR. A new GIS-based assessment to update and expand upon the previous study is currently being done.

In past studies 83 shrines were found in the survey area. There is a significant absence of shrines at the summit – the area was the abode of the gods, too sacred to build upon. Additionally, no known shrines are located on top of cinder cones – these were reserved for burial. A historic and cultural preservation plan for Mauna Kea that would preserve sites as well as their context was proposed following the surveys. A historic district line has been drawn to capture these sites, the larger landscape, and the experiential qualities of the place.

This historical district, however, does not address contemporary cultural practices or the evolution of tradition. A 360˚ viewplane from the summit is essential for alignment to other mountains, sacred sites, and heiaus. In


Polaris
Maui heiaus
Kauai heiaus
Pleiades at
the new year
Mauna Loa
Southern
Cross
MAUNA KEA
FOREST RESERVE
Traditional and customary practices
Legend
Constructed from UHIfA planning documents
Archeological sites
shrine (note1)
shrine with court
workshop/ adze
marker
unknown
trail
historic preservation district
open view to west
features
Lake Wai'au
NARS
Compiled from additional sources
significant views (including to Polaris, heiaus on Maui and Kauai, Pleiades at the new year, the southern cross, and Mauna Loa)
Views back to the mountain
pu'us - all pu'us are potential burial grounds
legendary pu'us, Pu'u Poliahu, Pu'u Lilinoe, Pu'u Wai'au, and Kukahau'ula
Lele
Adze Quarry, Keanakakoyi
Note1: shrines (ahus) are constructed today, but are not mapped.
0
1500
4500 feet
north





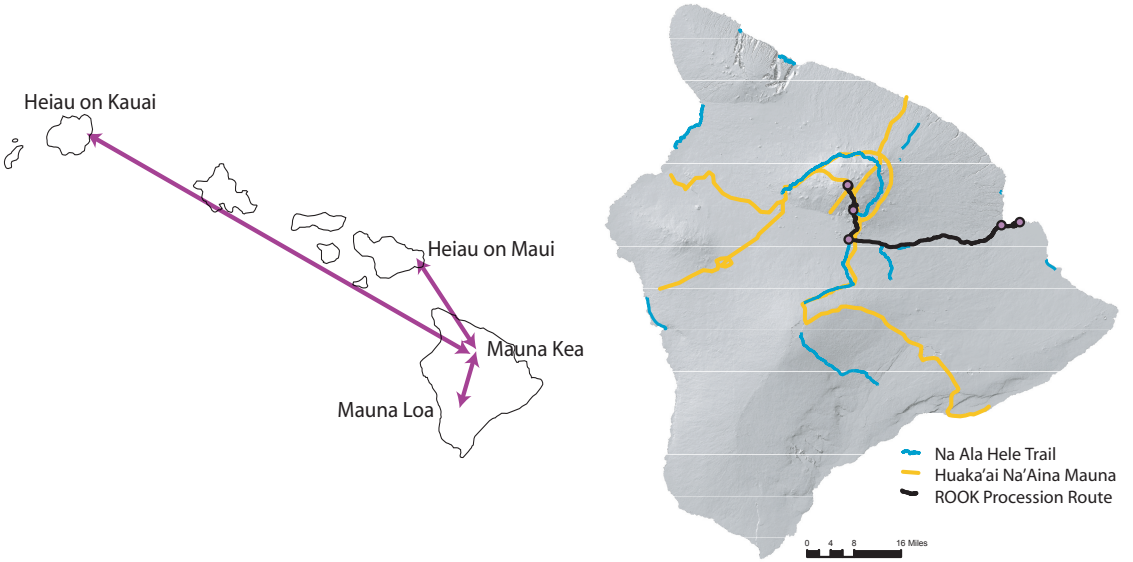
Hawaiian culture there are universal practices of alignment, but not necessarily universal view planes - these differ by genealogy. The views are critical for alignments of the eight points of the solstice and equinox to record the 26,000-year procession of the earth. Many of these important views are currently blocked by telescopes. Being able to view the mountain and summit from lower elevations is also necessary for cultural practice, allowing practitioners to practice without being on the mountain. However, the silhouettes of telescopes on the mountain significantly diminish these sacred views.

Historically physical access to the mountain was difficult, but today Summit Road makes access possible for many people. While most people now drive to the summit, some Hawaiians continue to walk the older routes, including the Humu'ula trail, where people often go to release ashes.

Cultural practitioners emphasize that Mauna Kea is not just sacred at its summit. The Mauna Kea landscape encompasses 12 levels from the sea to the summit delineating increasing levels of sacredness. People go to the mountain with reverence to take the mana from the top and bring it back down through the levels. The most sacred area begins at the inversion layer (6,000 feet above sea level).

Burials (*'iwi*), traditionally unmarked, are located in cinder cones and the surrounding summit area-— the entire summit are is considered a burial ground. Numerous individuals interviewed are identified as cultural and lineal descendents of individuals buried in the upper regions of the summit area.

The sacred water at Lake Wai'au is used for numerous traditional and cistomary practices including ritual and healing. The *piko* of children were and continue to be deposited at the lake in a ceremony. Today the lake can be accessed by a trail that starts at the road.



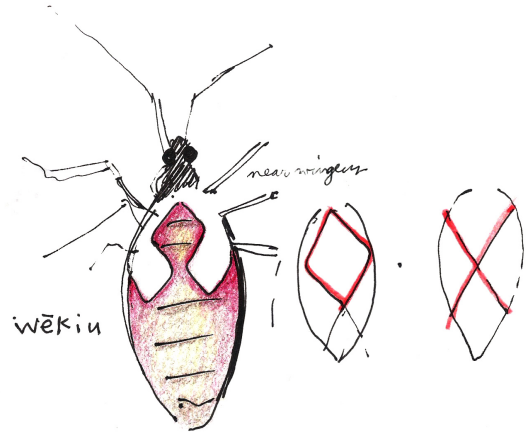
The adze quarry, *Keanakakoyi*, located in the Mauna Kea Ice Age Natural Area Reserve was designated as a national landmark in 1962. As early as 1100 AD the quarry was used to craft tools from the glaciated basalt. Adze makers would come to the mountain for a short period of time to quarry and work their stones at various workshops, often erecting shrines to the gods for taking the basalt. Today traditional adze making is a dying art.

In addition to leaving offerings at sacred places like Lake Wai'au and the adze quarry, practitioners construct *ahus* (stone alters) and *leles* (a four-post wooden frame anchored by rocks) to offer up prayers. There are many *ahus* built for ancestral worship on Mauna Kea.

There are three *leles* on the mountain: one at Pu'u Huluhulu at the base of Summit Road, another in the silversword enclosure beyond the Visitor Information Station at Hale Poahku, and one at the summit on Pu'u Wekiu, built in 1997 by the Royal Order of Kamehameha 1.

There are many critical issues surrounding Mauna Kea's cultural resources, as it is a culturally rich and complex place that calls for respectful and well-thought-out protection measures. The customs of tradtional and customary practitioners are not protected and their spatial are just now being mapped as part of this process. Moreover, the religious and spiritual ambience of the mountain has not been adequately expressed in the public record, archeological studies of the summit remain incomplete, criteria for determining impacts on sacredness have not been clearly defined, protocols for respectful access to the summit region have not been established, and the cumulative impacts of astronomical development on cultural resources has not been assessed. The complex issue of allowing access to the adze quarry in a way that protects the resource yet allows the continuation of the custom of adze making has not been resolved. Protecting unmarked burial areas is another unresolved issue that calls for nuanced policy-making.

WEKIU BUG

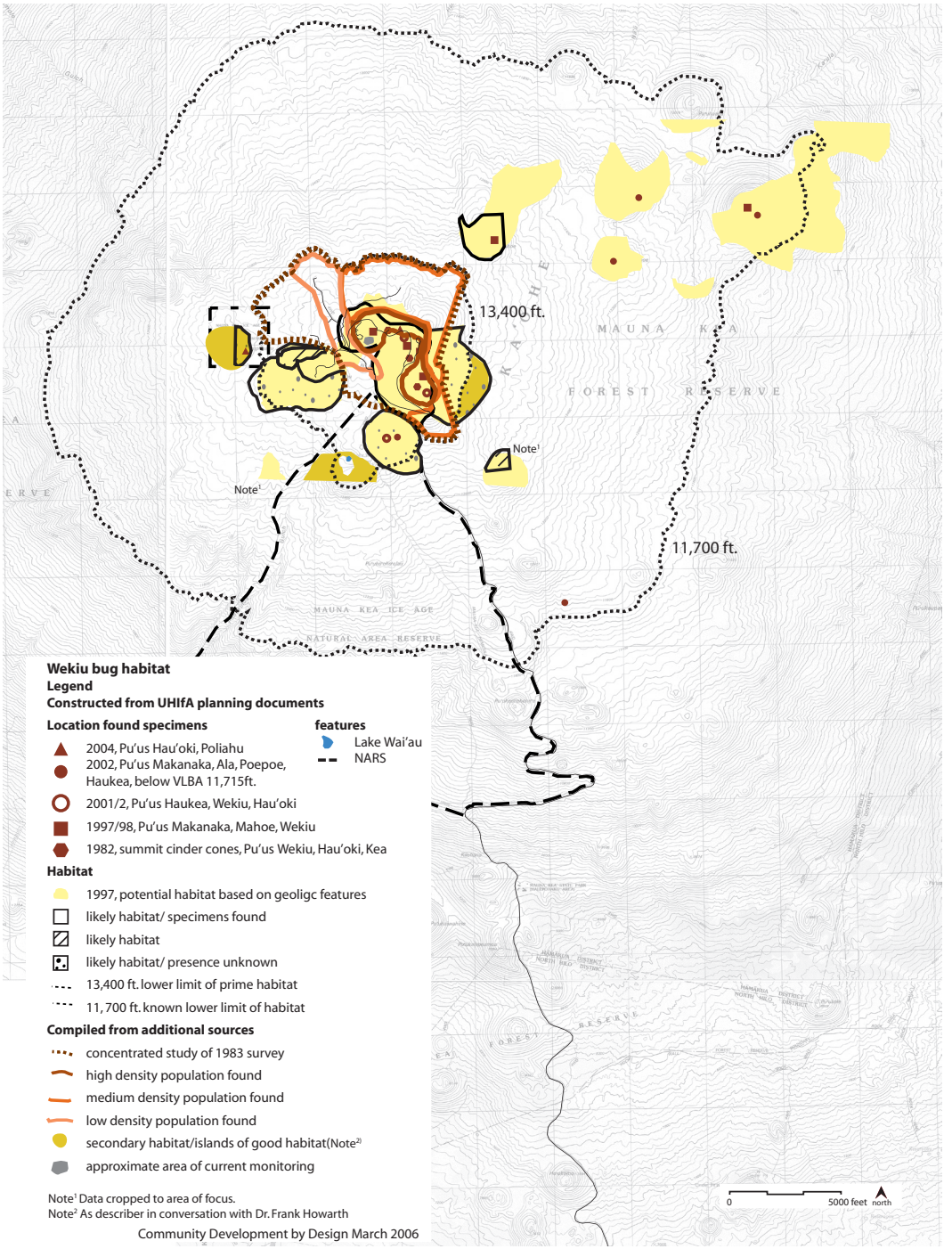


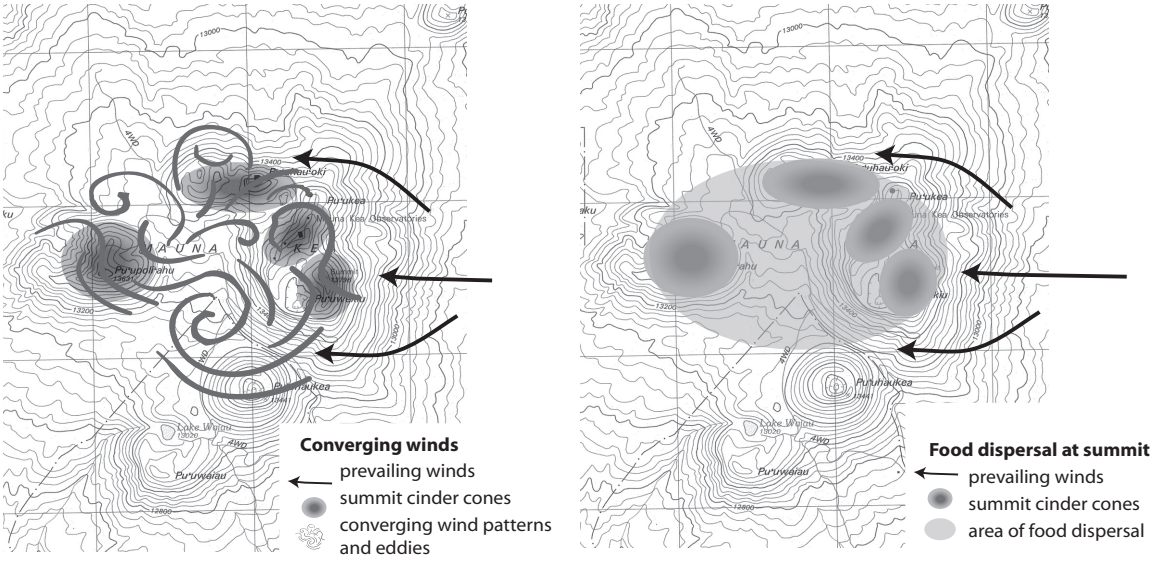
In the harsh climate of the summit of Mauna Kea, which appears to be devoid of life, there is an abundant arthropod community. It includes spiders, moths, mites, springtails, centipedes, booklice, bark lice, mealy bug, and true bugs; in total there are 11 known indigenous and 5 non-native species. The arthropod of most immediate concern is the wekiu bug (Nysius wekiuicola) discovered in 1979.

The wekiu is a long-legged, nearly wingless true bug, .14 to .20 inches long and .039 to .07 inches wide. It is rare, highly specialized and uniquely adapted to survive in harsh conditions. A glycol-like substance in its blood allows the wekiu to withstand temperatures as low as – 10° C. It is primarily found above 12,800 feet but the known lower limit is 11,700 feet. The wekiu is a diurnal predator/scavenger that feeds on wind-carried insects deposited at the summit. As winds converge on the multiple-peak summit of Mauna Kea and eddy patterns are formed, the insects, unused to the cold, drop to the ground and become prey for the wekiu. The wekiu is especially drawn to snow melts where it can feed on the frozen insects.

When it is hot and dry, cold or night-time, the wekiu needs a place to hide. They appear to prefer the voids between unconsolidated, baseball-sized, sharp-textured cinders in the surface layer of cinder cones for thermal cover, passageways, and hiding. According to 1982 studies, prime habitat for the wekiu was characterized by steep, deep cinder slopes close to the top on the inside and outside of the cinder cone with no ash layer - the bugs were low in number in areas with an ash layer. Recent contrary testimony from less credible sources describes wekiu habitat as shallower (12-18 inches) over an ash layer. This discrepancy is illustrative of the inconsistent assessment of the wekiu.

Although preserving the undisturbed core habitat that provides both refuge and foraging is considered essential to the survival of the wekiu bug, extinction may just as well be triggered by loss of secondary stepping stone habitat previously considered unimportant. Wekiu populations likely concentrate in habitat that provides both foraging and refuge. However, they may travel into more ashy areas that provide foraging grounds, act

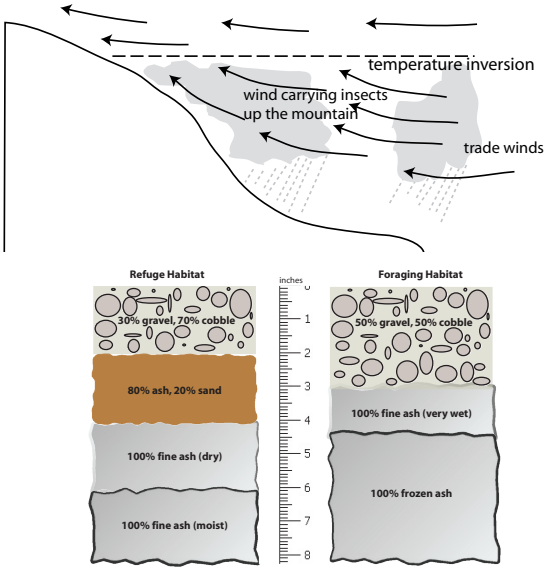

13,400 ft.
11,700 ft.
MAUNA KEA
FOREST RESERVE
Note1
Note1
MAUNA KEA ICE AGE
NATURAL AREA RESERVE
Wekiu bug habitat
Legend
Constructed from UHIfA planning documents
Location found specimens
2004, Pu'us Hau'oki, Poliahu
2002, Pu'us Makanaka, Ala, Poepoe, Haukea, below VLBA 11,715ft.
2001/2, Pu'us Haukea, Wekiu, Hau'oki
1997/98, Pu'us Makanaka, Mahoe, Wekiu
1982, summit cinder cones, Pu'us Wekiu, Hau'oki, Kea
features
Lake Wai'au
NARS
Habitat
1997, potential habitat based on geoligc features
likely habitat/ specimens found
likely habitat
likely habitat/ presence unknown
13,400 ft. lower limit of prime habitat
11,700 ft. known lower limit of habitat
Compiled from additional sources
concentrated study of 1983 survey
high density population found
medium density population found
low density population found
secondary habitat/islands of good habitat(Note2)
approximate area of current monitoring
Note1 Data cropped to area of focus.
Note2 As describer in conversation with Dr. Frank Howarth
Community Development by Design March 2006
0
5000 feet
north

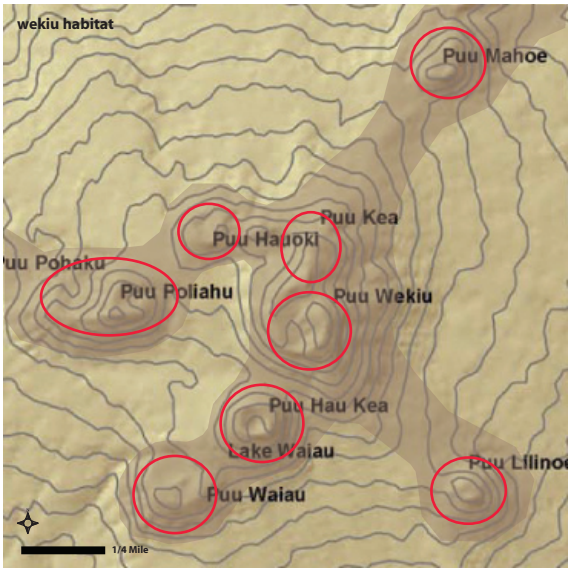


as stepping stones between prime habitats, provide for inter-population mating, and help to ensure genetic diversity between meta populations. None of these behaviors have been studied to date.

The total amount of both wekiu habitat and wekiu range has shrunk, largely due to construction damage. Bishop Museum scientist Frank Howarth believes that there has been an obvious decline in population since 1982. Since then an estimated 30 to 40% of the habitat that was surveyed has been destroyed during the construction of new telescopes. Much of the habitat found in 1982 and 1997 was on Pu'u Hau'oki, but 1/3 of that habitat was altered or lost during the construction of the Kecks and Subaru. The only undisturbed habitat left is a small area about 45 feet high and 60 feet wide at the base of the southwest facing slope. Although the slopes are recovering, size-sorting of surface rocks is not yet evident. Wekiu bugs may return to these slopes in time, but only if the population within the crater survives until the preferred habitat develops. Although creating new habitat may be possible, it has not been tested and is therefore not currently considered a viable option by most experts. Current mitigation and monitoring efforts are focused on 6,200 square feet of previously-damaged area on Pu'u Hau'oki. The measures being implemented are unproven and could harm the wekiu habitat and introduce alien species.

The total population of wekiu bugs is not known, and the methods used to study them report pit trap activity, not number of bugs. In 1982 bugs were found all over the mountain due to good weather, many traps, and a high snow year. Data collected in 1997-98 determined that the bugs had declined by 99.7% since 1982. In February 2002, quarterly wekiu bug monitoring began at Pu'u Hau'oki and Pu'u Wekiu. The 2005 population seems to be more consistent with 1982 numbers, but inconsistencies in data collection methods, weather, and other variables make it impossible to compare.





Several conditions on Mauna Kea jeopardize the survival of the wekiu bug and potentially the summit arthropod community. A comprehensive study of the wekiu's lifecycle and precise habitat needs is needed to guide protection measures. Two thirds of the wekiu's critical habitat is unprotected and is the primary area of astronomy development. The fragility of the tephra makes it vulnerable to human activities like excavation, grading, construction, vehicle traffic, and recreation. It can easily be crushed, creating silt and ash that is not only uninhabitable, but can also be washed into adjacent tephra where it degrades habitat by filling interstitial spaces. The lack of a habitat protection zone and a species recovery plan are additional causes for concern. Other threats to the wekiu include global warming, which would shrink its already limited habitat, and invasive species that either hunt it or compete with it for food.

Strategies laid out in a 1999 EIS to protect and preserve the wekiu included mitigation of construction activity, mitigation of visitor activity, habitat restoration, and a comprehensive, iterative monitoring program. None of these strategies have been implemented except on a piecemeal basis.

Although the wekiu has been a candidate to be listed as an endangered species since 1999 and petitioned in 2003, no designation of the bug or its critical habitat, which is all on state land, has been made. The criteria for being considered an endangered species include severe population decline and suspected potential threats. The wekiu bug meets both of these criteria, but the data showing the population decline is not robust enough to conclusively show population decline. Despite the uncertainty in the data, experts agree than if current use and construction practices continue the wekiu bug may not survive.

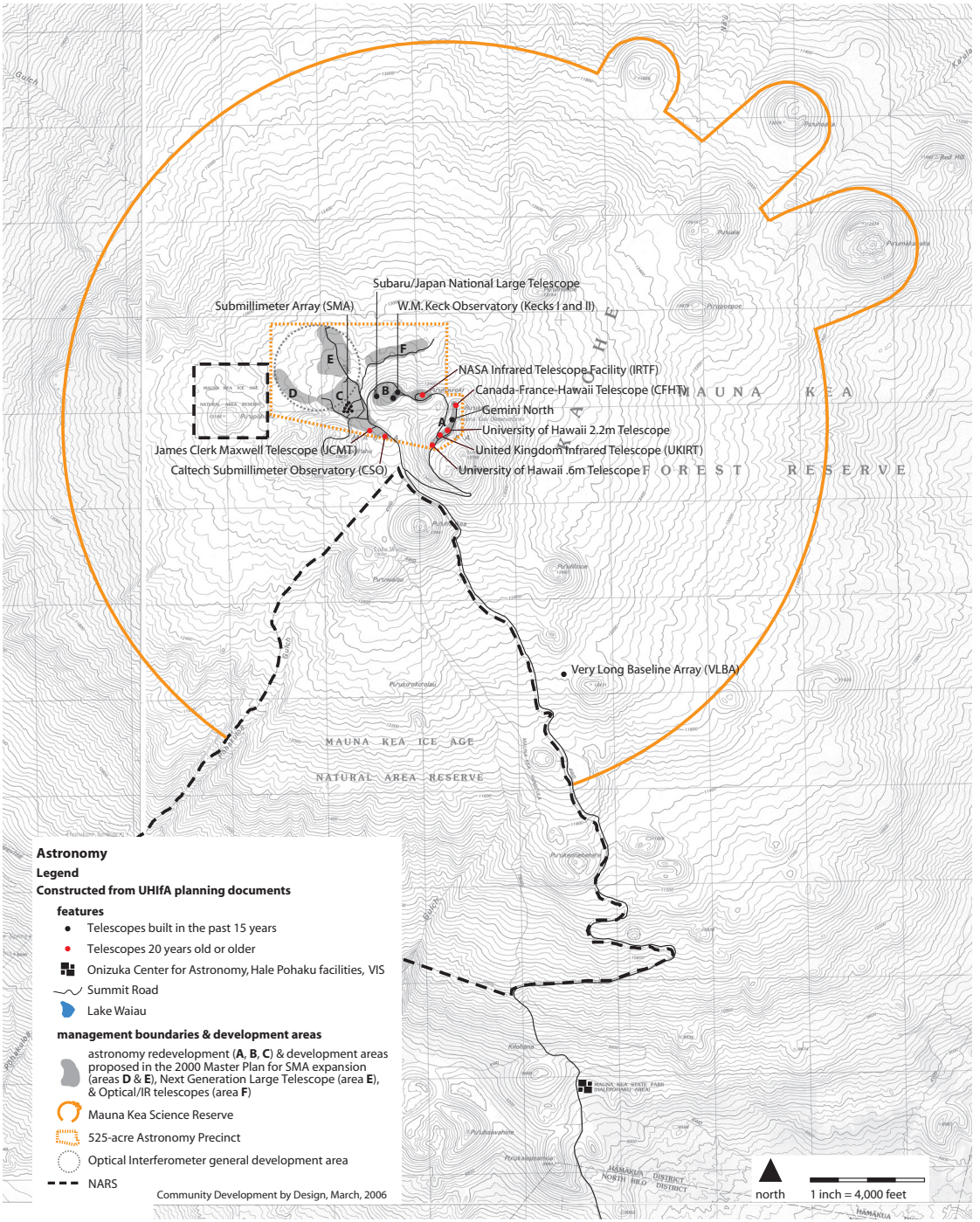
ASTRONOMY

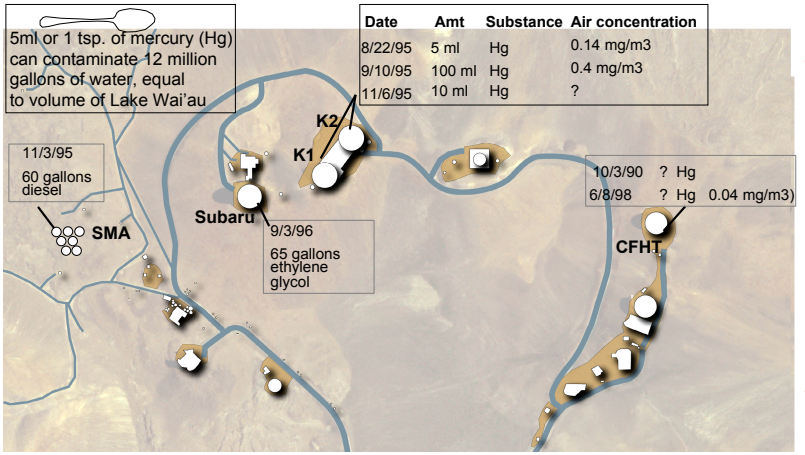
The summit of Mauna Kea is one of the best locations for ground-based astronomy in the world with about 300 clear nights per year, one of the world's highest records. Due to its location above the tropical inversion layer high on a Pacific island, the skies are generally cloud-free, dry, pollution-free, and undisturbed. An understanding of the work, goals, and spatial needs of the astronomy community is a critical piece to decide Mauna Kea's future.

In an effort to diversify the economy after tidal wave devastation in 1960, the Hawaii Island Chamber of Commerce approached U.S. and Japanese universities to develop astronomy facilities on Mauna Kea. After initial investigations in 1962, Mauna Kea was designated as a leading astronomy site. Shortly thereafter in 1967, the UH Institute for Astronomy (UHIFA) was founded and the construction of the UH2.2m telescope was funded and built by NASA. UHIFA was made responsible for the development and management of the newly-created 13,321-acre MKSR. Today it is 11,288 acres. The State-held land was and still is leased to UH by Hawaii's Department of Land and Natural Resources (DLNR) for $1.00 per year. By the1970s six new telescopes came to the mountain and international recognition of Mauna Kea as a premier astronomical site began to increase.

Almost all astronomical activity takes place on the summit in an unofficial 525-acre "astronomy precinct" within the MKSR. There are currently 13 telescopes (12 in the precinct and one outside), although the lease stipulated just one. They represent four basic types of telescopes: infrared, optical/infrared, submillimeter, and radio telescopes.

Astronomy has been touted by its proponents as a major economic engine on the islands. According to the Keck Observatory website, in 2004 research on the summit represented a capital investment of more than $1 billion as well as hundreds of jobs for residents. The Keck Observatory has an annual operating budget of $11 million and employs about 125 people full-time, two thirds of whom are from Hawaii. It is reported that some


Subaru/Japan National Large Telescope
Submillimeter Array (SMA)
W.M. Keck Observatory (Kecks I and II)
NASA Infrared Telescope Facility (IRTF)
Canada-France-Hawaii Telescope (CFHT)
Gemini North
University of Hawaii 2.2m Telescope
United Kingdom Infrared Telescope (UKIRT)
University of Hawaii .6m Telescope
James Clerk Maxwell Telescope (JCMT)
Caltech Submillimeter Observatory (CSO)
Very Long Baseline Array (VLBA)
MAUNA KEA
FOREST RESERVE
MAUNA KEA ICE AGE
NATURAL AREA RESERVE
A
B
C
D
E
F
Astronomy
Legend
Constructed from UHIfA planning documents
features
Telescopes built in the past 15 years
Telescopes 20 years old or older
Onizuka Center for Astronomy, Hale Pohaku facilities, VIS
Summit Road
Lake Waiau
management boundaries & development areas
astronomy redevelopment (A, B, C) & development areas proposed in the 2000 Master Plan for SMA expansion (areas D & E), Next Generation Large Telescope (area E), & Optical/IR telescopes (area F)
Mauna Kea Science Reserve
525-acre Astronomy Precinct
Optical Interferometer general development area
NARS
Community Development by Design, March, 2006
north
1 inch = 4,000 feet



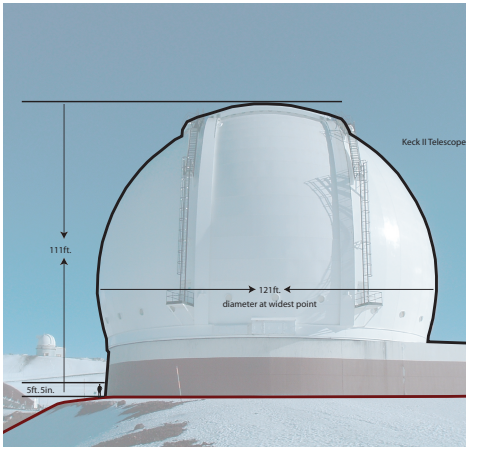
of the observatories rent time on the telescopes for upwards of $150,000 per day, but all revenues generated on Mauna Kea go to UH, not the State.

The astronomy community has also begun to emphasize commercial astronomy tours and increase public outreach through free stargazing and educational programs at Hale Pohaku and tours of selected summit facilities. Off-summit public astronomy facilities include the Keck Observatory Headquarters and Museum in Waimea and the recently opened 'Imiloa Astronomy Center. The $28 million facility aims to highlight the connections between Hawaiian culture and modern astronomy, but noticeably missing is an equal partnership with traditional Hawaiian navigators.

There are a number of costs associated with astronomy that are unrecognized. The extent of biological and ecological loss is not documented because initial telescope development was completed without environmental inventories. However, recent studies have revealed the serious negative impacts on endemic species. Additionally, the identification of the lack of data on toxic substances like mercury (Hg) have raised questions of impacts to the ecosystems. While many point out that the area of telescope development takes up less than 5% of the MKSR, this area is located in the heart of the most sacred part of the mountain. There are important energy costs as well. The present level of energy consumed by the astronomical industrial complex is unsustainable. It has been determined this complex produces more than 13,000 tons of CO2 annually; the equivalent of 2,259 cars. The observatories use more than 1.108 million kilowatts hours per month as compared to an average household use of 600. This is the equivalent of the energy use of 1846 homes and has an annual cost of $2.5 million.

While Mauna Kea is currently viewed as one of the premier locations for astronomy in the world, many of its facilities are aging. To retain international status into the future, UHIFA has put forward ambitious plans for expansion and upgrading of existing facilities and new development with cutting edge technologies.

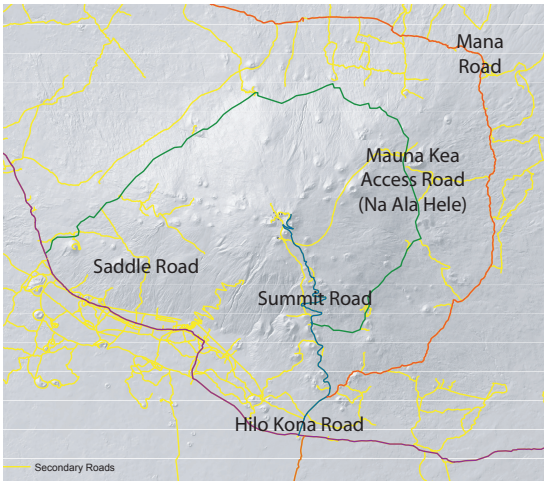
The most imminent threat of expansion was NASA's plan for the addition of four to six 1.8m Keck Outriggers. The proposed project was halted due to pulled NASA funding and the recent decision of the Third Circuit



Court, reversing BLNR's issuance of a CDUP for the project. The second proposed expansion is for the Submillimeter Array. Other new development on Mauna Kea consists of a proposal for the Next Generation Large Telescope (NGLT) on the slope of the northwest summit ridge. Although wekiu habitat would not be directly affected, lichen and moss endemic to Hawaii would be negatively impacted by the expansion. Additionally, an Optical/IR Interferometer Array is also being considered for this area, although the technology is not yet in place. It is expected that new development is likely to be proposed for the area on the plateau northwest of the summit ridge, which is both sacred and environmentally fragile.

The most critical issue surrounding astronomy on Mauna Kea is that the most sacred sites have already been occupied by telescopes. Making the assumption that the lease will be renewed, the astronomy community creates guidelines for future development that are more respectful of environmental and cultural resources, but siting criteria that state that no facilities will be placed on pu'us or obstruct historical, sacred, and presently important views are merely platitudes. The terms of the lease require the summit to be cleared of telescopes and the cultural and ecological systems restored by its expiration in 2033. Further, as development has continued, opposition has grown. In the early 1990s, when over 30 feet of Pu'u Hau'oki were leveled to build Keck I and II, a tipping point was reached and people began to say "no more".

INFRASTUCTURE



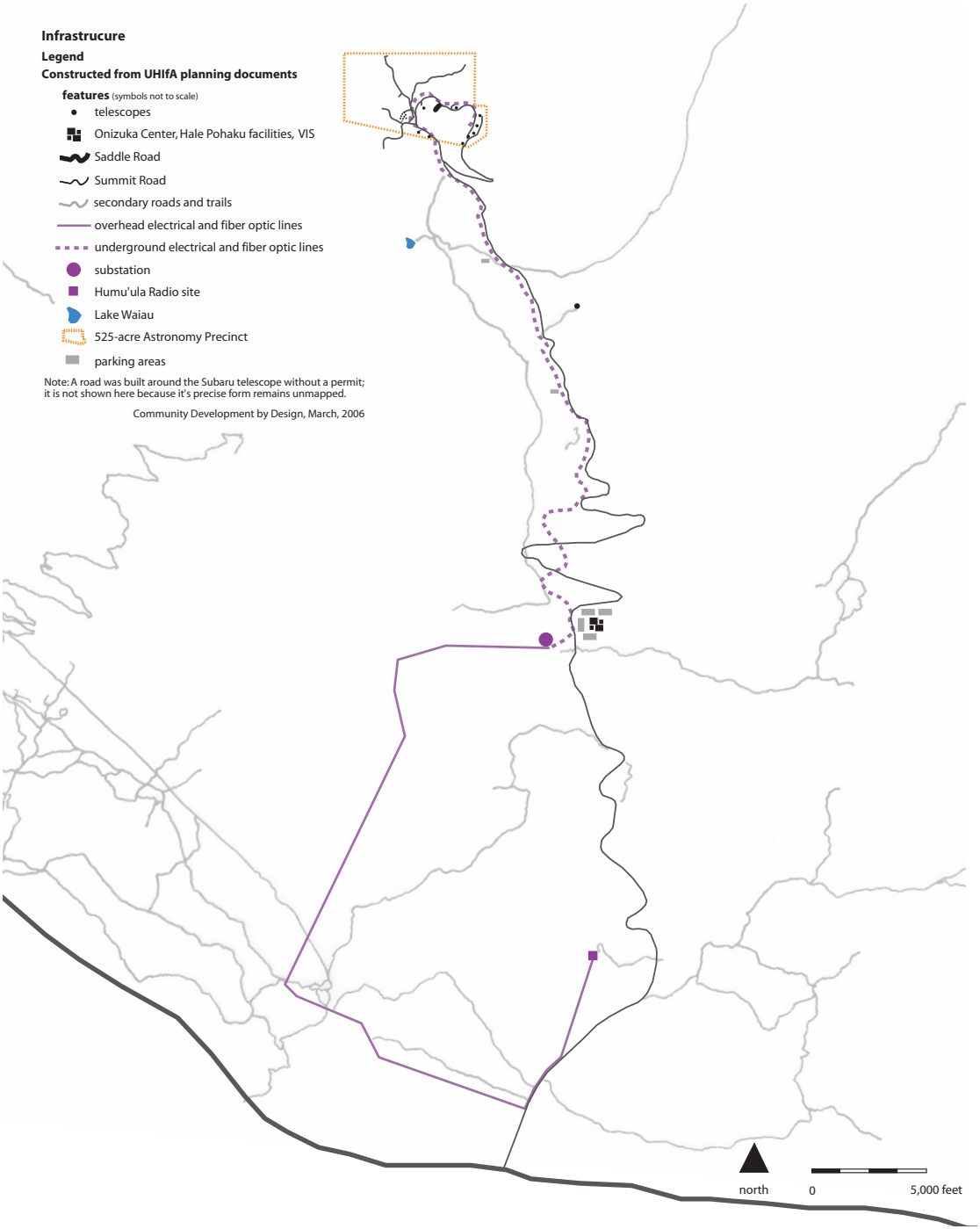
Infrastructure on Mauna Kea is linked to access and development capacity, two cornerstone issues in the struggle over Mauna Kea's future. Roads, power, water supply, and wastewater treatment have the potential to encourage or limit use and development on the Mauna Kea.

Summit Road has increased the volume and type of traffic to the summit dramatically. Traffic data from 2003 recorded 34,659 vehicles going to the summit. Despite the road, trails remain an important way to access Mauna Kea. On the south side of the mountain the Humu'ula Trail goes from the saddle to Lake Wai'au and then to the summit. Pilgrims and hikers also approach from Waimea and from Kona.

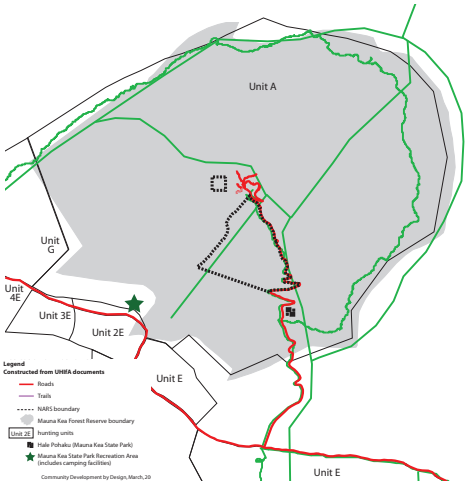
Water for the observatories is trucked to storage tanks at Hale Pohaku from Hilo. The primary source of wastewater on Mauna Kea is human waste. Wastewater treatment and disposal are handled by cesspools and septic tank/leaching fields. A 2005 NASA EIS states that water use and wastewater generation at summit facilities approximates domestic rates. These statements have been strongly questioned by opponents who estimate that it is much closer to commercial rates. The electrical and fiber optic systems for Mauna Kea can be readily expanded to accommodate three times the current demand, but some argue that just because these resources are available doesn't mean that they should seen as a blank check for development.

Infrastructure for astronomers and tourists has also increased. The Onizuka Center for International Astronomy includes the VIS and Hale Pohaku, which has sleeping units, a kitchen and dining area, offices, labs, and a library for astronomers working on the summit.

Issues around infrastructure on the mountain include damage done to the landscape during the building of power and fiber optic systems and roadways. The impact of vertical damage to Mauna Kea and its cultural implications is not discussed in the EISs. In addition, there have been instances where pu'us have been disturbed by illegal road extension.


Infrastrucure
Legend
Constructed from UHIfA planning documents
features (symbols not to scale)
telescopes
Onizuka Center, Hale Pohaku facilities, VIS
Saddle Road
Summit Road
secondary roads and trails
overhead electrical and fiber optic lines
underground electrical and fiber optic lines
substation
Humu'ula Radio site
Lake Waiau
525-acre Astronomy Precinct
parking areas
Note: A road was built around the Subaru telescope without a permit; it is not shown here because it's precise form remains unmapped.
Community Development by Design, March, 2006
north
0
5,000 feet

RECREATION

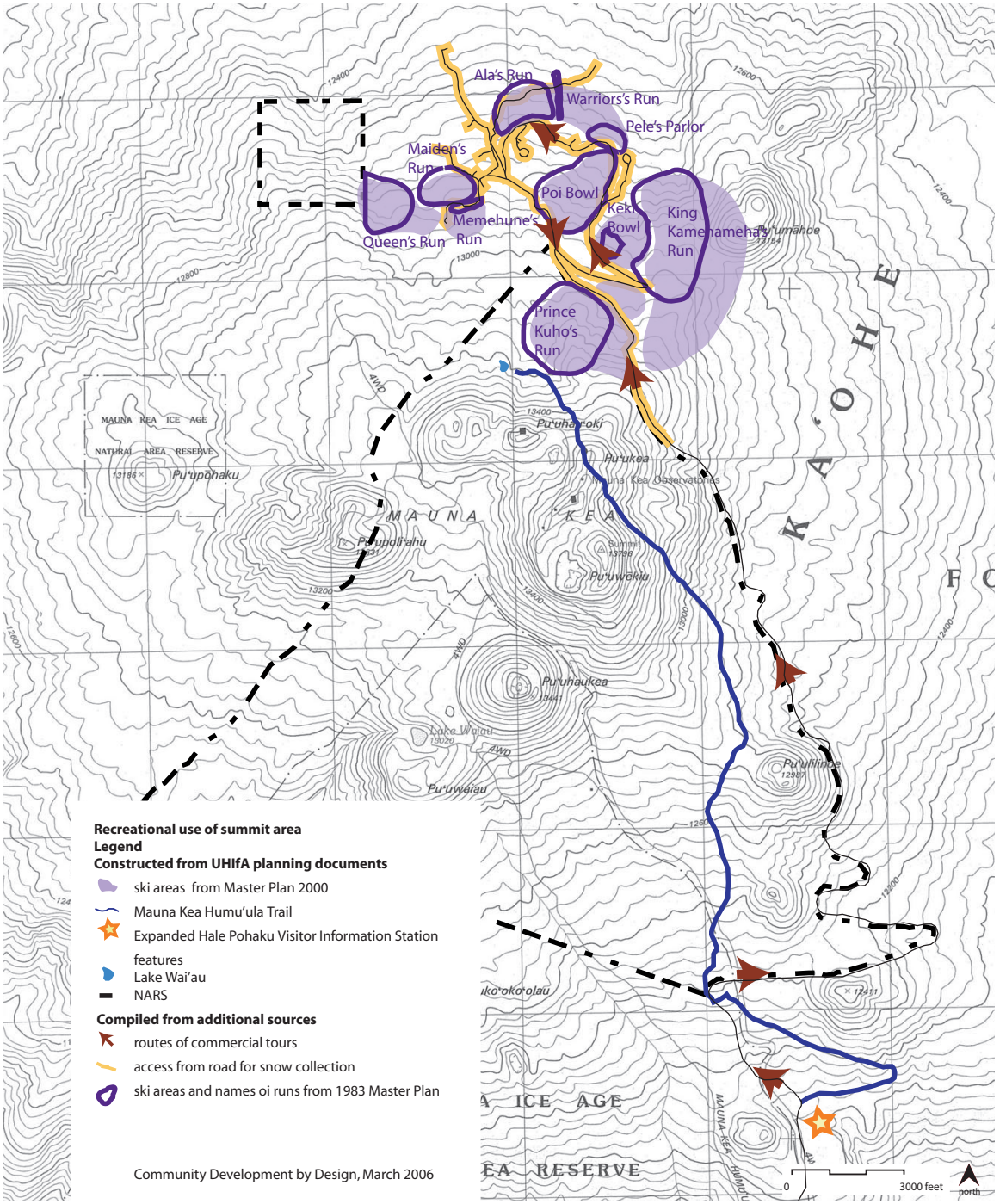


Recreation was and is unthinkable at the summit for many Native Hawaiians. Yet today Mauna Kea's beauty captivates hikers, snowboarders, skiers, snow collectors, hunters, and other outdoor enthusiasts. However, easy access has increased the risk to and damage of ecological and cultural resources. Rapidly expanding tourism and increased road traffic contributes to the introduction of non-native species and stresses the fragile ecosystem.

Prior to the first road built in 1964 there was no easy access and the use of the summit area was limited. The road along with 4-wheel drive vehicles and ATV's has made access easier, inviting casual recreation. The limited facilities on the summit for recreation consist of portable toilets and restrooms at the W.M. Keck Observatory. Increased facilities called for in the unadopted 2000 Master Plan include a shelter, restrooms, and an emergency phone at the base of Poi Bowl, a parking lot near the Lake Wai'au, and an expansion of the Visitor Center.

Use of the mountain is diverse given how relatively inaccessible it is. Astronomy sightseeing including stargazing activities at Hale Pohaku, commercial tours, and watching the sunset or sunrise from the summit appear to be the most popular activities. People also come to ski, snowboard, play in the snow, and gather snow to take down the mountain for others to experience. However, these unregulated activities have the potential to damage underlying habitat. Hiking is thought to be a popular activity, particularly on the well-defined Humu'ula-Mauna Kea Trail. In recent years cultural practitioners have also reestablished some ancient routes. Although hunting is a Hawaiian tradition, there are cultural discrepancies and ecological conflicts for this permitted activity. Hunting traditions in the Mauna Kea Forest Reserve, lead to the construction of the Hale Pohaku stone cabin in the 1930's which was also used as a camping facility. Camping and picnicking facilities have since been moved to Mauna Kea State Recreation Area.

The critical issues for recreation at the summit of Mauna Kea are managing access and educating users for the preservation of natural and cultural resources. Before this can be addressed a systematic accounting of recreational numbers, demands, and impacts must be available.


Ala's Run
Warriors's Run
Pele's Parlor
Maiden's Run
Poi Bowl
Keki Bowl
King Kamehameha's Run
Memehune's Run
Queen's Run
Prince Kuho's Run
Pu'umāhoe
MAUNA KEA ICE AGE NATURAL AREA RESERVE
Pu'upōhaku
Pu'uhau'oki
Pu'ukea
Mauna Kea Observatories
MAUNA KEA
Pu'upoli'ahu
Pu'uwākiu
Pu'uhauikea
Lake Waiau
Pu'uwaiau
Pu'ulilinoe
KA'OHE
4WD
Recreational use of summit area
Legend
Constructed from UHIfA planning documents
ski areas from Master Plan 2000
Mauna Kea Humu'ula Trail
Expanded Hale Pohaku Visitor Information Station
features
Lake Wai'au
NARS
Compiled from additional sources
routes of commercial tours
access from road for snow collection
ski areas and names oi runs from 1983 Master Plan
Community Development by Design, March 2006
0
3000 feet
north

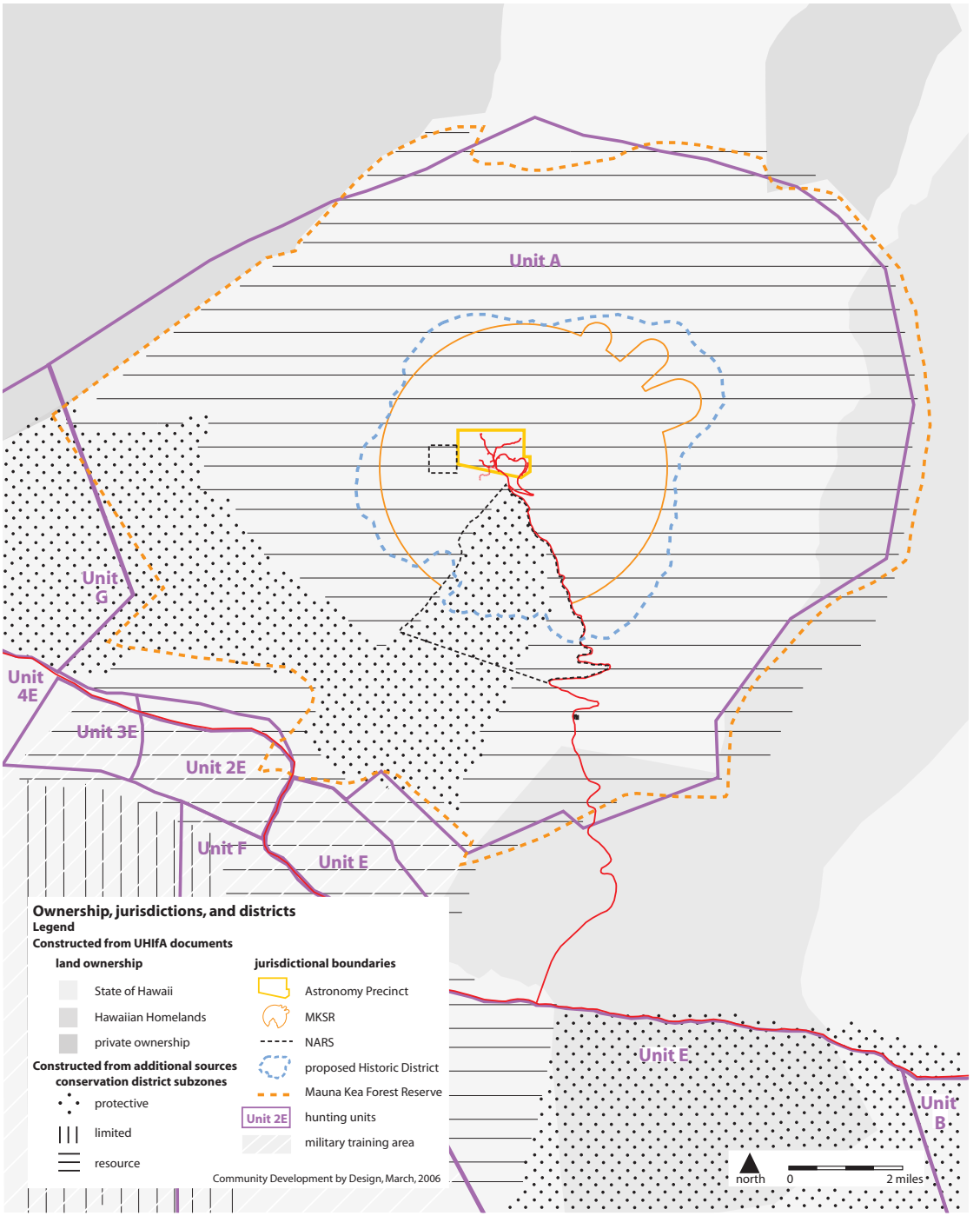
PLANNING AND MANAGEMENT

Looking up at Mauna Kea from Hilo Bay one gets a sense of the mountain as a whole; a massive, connected unit with ecological, geological, and cultural integrity. But the lines of ownership and authority fracture mountain management and undermine protection of this invaluable resource.

The 1983 Master Plan (amended in 1995) is the plan of record for the MKSR but is out-of-date. The 2000 Mauna Kea Science Reserve Master Plan, a highly contested attempt on the part of the University of Hawaii to expand its purview, was adopted by the Board of Regents, is used to guide current operations, but has not been approved by DLNR. The State has also failed to produce any plan for the Mauna Kea Natural Ice Age Reserve, a historic preservation and cultural management plan for the science reserve, or a mechanism for monitoring compliance by the astronomy facilities with conservation district use permit restrictions.

There are a number of public agencies and land units on the mountain, some of which have conflicting mandates. For example State hunting units are managed to protect sheep and pig populations while nearby Hakalau National Wildlife Refuge struggles to keep feral ungulates away from native vegetation. The management entity for the science reserve is as problematic. The Mauna Kea Management Board (an advisory board) and the Office of Mauna Kea Management (in charge of operations) are currently housed in the university, the reserve's lessee. This allows the resource user to be self-regulating which raises serious questions. Indeed, members of some of the advisory sub-committees have reported that they are expected to rubber stamp actions that further astronomy goals at the expense of the protection of the mountain's resources.

This large, continuous, and mostly publicly-owned mountain offers an opportunity for truly integrated management of public trust lands. The long-term ecological and spiritual health of Mauna Kea depends upon a more holistic approach, especially since many of today's most challenging management issues, such as the dynamic spread of invasive species, cross jurisdictional lines.


Unit A
Unit G
Unit 4E
Unit 3E
Unit 2E
Unit F
Unit E
Unit E
Unit B
Ownership, jurisdictions, and districts
Legend
Constructed from UHIfA documents
land ownership
State of Hawaii
Hawaiian Homelands
private ownership
jurisdictional boundaries
Astronomy Precinct
MKSR
NARS
proposed Historic District
Mauna Kea Forest Reserve
Unit 2E
hunting units
military training area
Constructed from additional sources
conservation district subzones
protective
limited
resource
Community Development by Design, March, 2006
north
0
2 miles

OVERLAY ANALYSIS

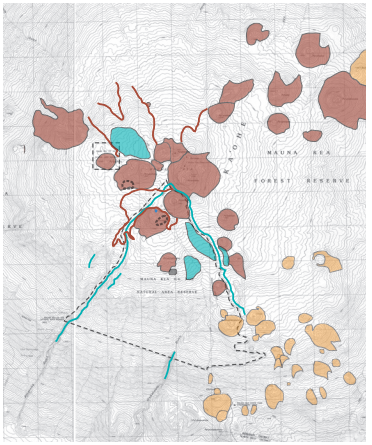
In order to manage the mountain well there must be complete data at all three scales: the summit region, the geological extent of Mauna Kea, and island-wide. However, it is essential that data characterizing the resources be layered to show concentrations and gaps in available information.

To that end two overlay maps using the information described in Section Two were created to assess the relationships between resources and uses in the summit region. The first series of maps show what is known to date about geology, hydrology, vegetation, cultural practice, and wekiu bug habitat, but the maps are as much about revealing what is unknown as they are about showing what is known. The final image on the opposite page is an overlay of critical factors, showing areas where resources are most concentrated and therefore should be protected. The spaces where fewer resources are shown indicate only where more studies are needed. Until the studies called for herein are completed, it is impossible to determine whether astronomy can be accommodated safely anywhere on Mauna Kea. But the initial pattern analysis suggests that the summit is not an acceptable location and that less resource-rich areas are acceptable only at great damage to ecosystems and cultural resources.

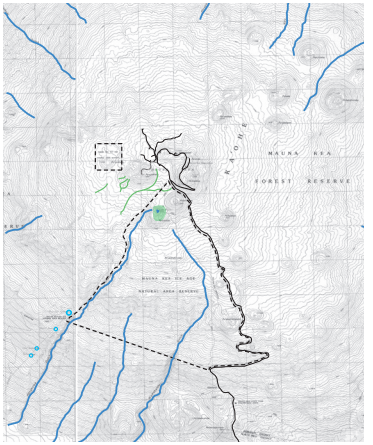
The second series of maps includes astronomy, infrastructure, and recreation. The fourth map is an overlay that shows that the highest intensity of use is located at the summit and that the road is critical for each user group.

Although more studies are needed, it is clear from the maps that the spatial concentration of use and Mauna Kea's critical resources occupy the same limited area of the summit region, delineating an area of intense conflict. Overlay mapping seldom shows such incompatibility between land uses as is revealed here. This demonstrates that natural and cultural resources cannot be adequately safeguarded as long as astronomy, roads, and other infrastructure occupy the same space as the most fragile resources. A similar analysis must be done at the scales of the mountain and the island. Unifying the data at all scales in this manner will allow for holistic assessment of resources to inform management and use.

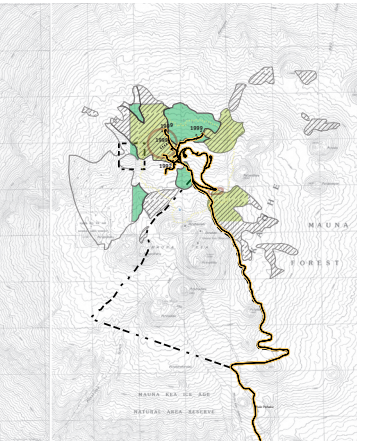
OVERLAY ANALYSIS OF CRITICAL RESOURCES IN THE SUMMIT AREA



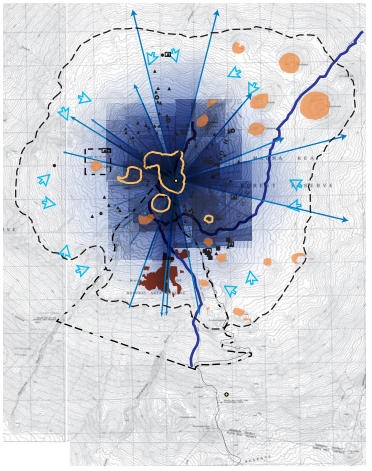
geology



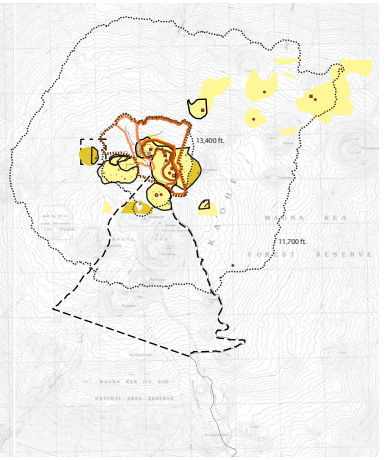
hydrology



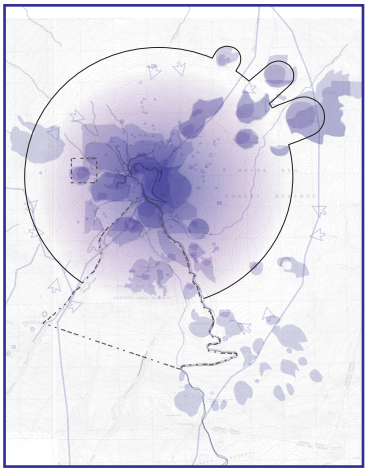
vegetation



traditional and customary practice



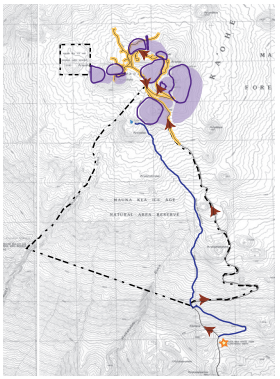
wekiu



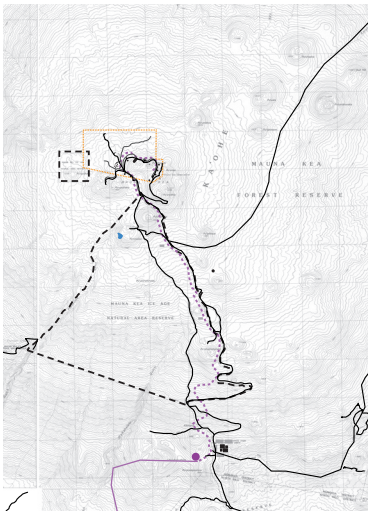
overlay analysis of critical resources

OVERLAY ANALYSIS OF USE COMPARED TO CRITICAL RESOURCES

astronomy

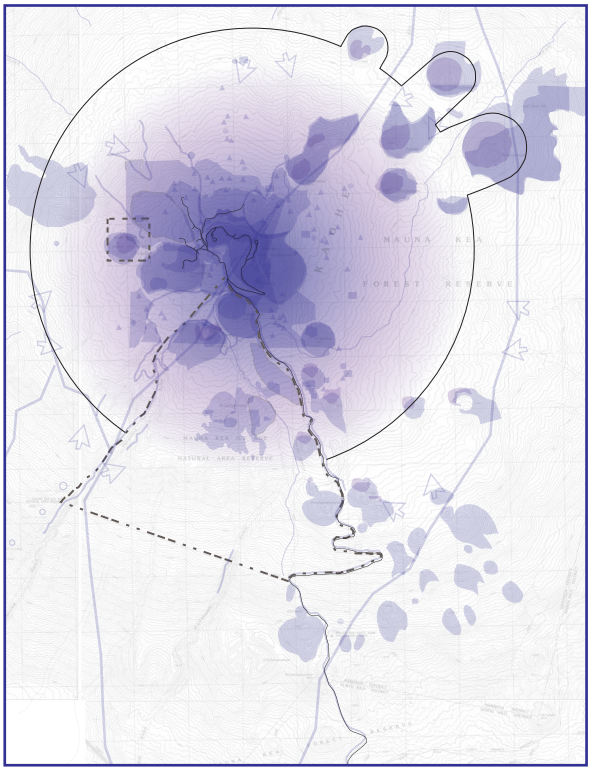


recreation



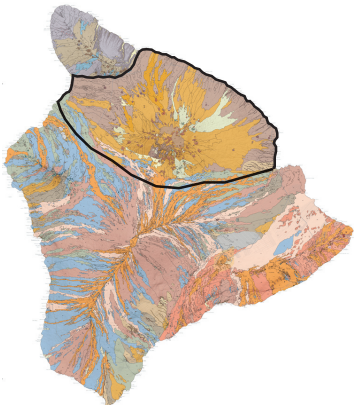
infrastructure

overlay anlaysis of use



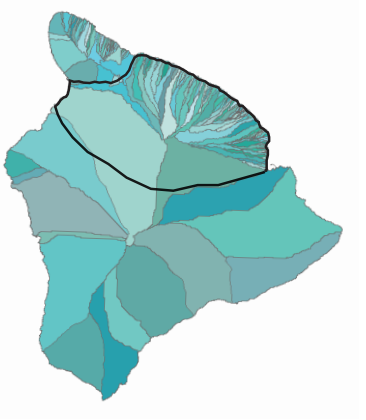
overlay analysis of critical resources

FACTORS FOR OVERLAY ANALYSIS OF THE ISLAND AND THE MOUNTAIN

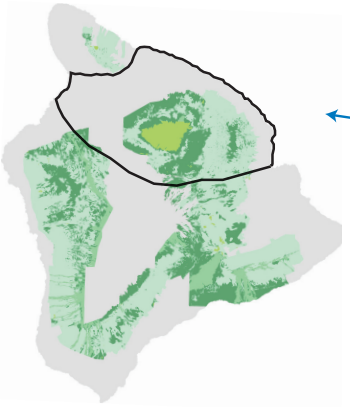


geology

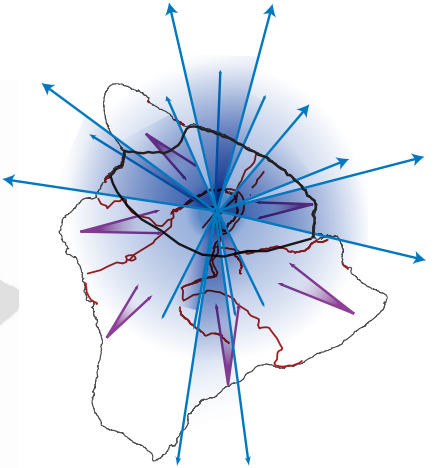
hydrology



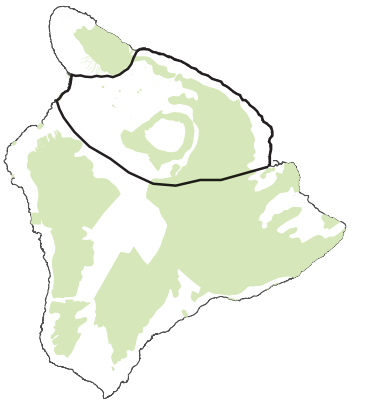
watersheds



vegetation



traditional and customary practice



habitat

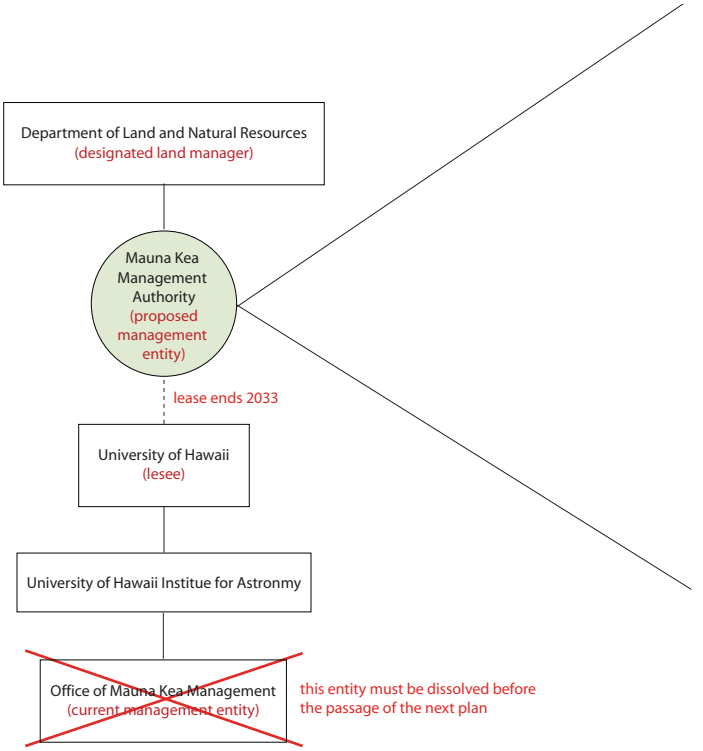
"Malama Mauna Kea, Malama Hawaii"

section three

What the Future Can Be

This section lays out a seven-part plan for the future of Mauna Kea based upon the available information about the mountain and those who use it. A new authority is proposed for the sound and fair management of the mountain. Baseline studies and monitoring are called for, along with programs to protect Mauna Kea's ecosystems from invasive species. Recommendations for compliance with the terms of the lease by its expiration in 2033 are described. A code of conduct appropriate to the significance of Mauna Kea is recommended. A plan to ensure that traditional and customary practices are continued into the future is outlined – protection of this sacred place and thorough inventories of its cultural elements are key parts of the plan. Ensuring that people have access to the mountain is also essential, and is tied to proposals for economic sustainability on the Big Island.

PLANNING FOR AND MANAGING THE MOUNTAIN

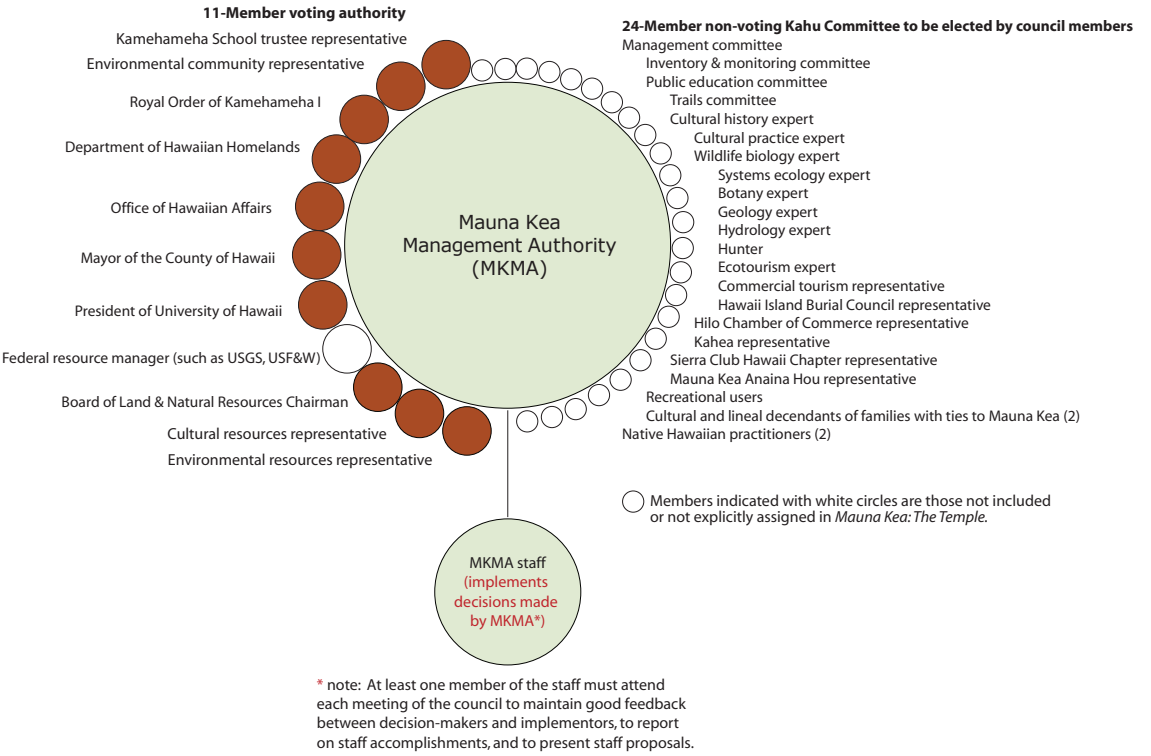


1. A functioning, holistic, community-based, and legal management structure that is separate from vested interests is urgently needed – the fox cannot guard the henhouse. Mauna Kea must be managed according to its designation as a conservation district, not according to any sub-uses that may occur within it. To that end a new entity to manage the mountain with broad representation of essential constituencies, including a majority of Native Hawaiians, should be created.

2. The management structure proposed in *Mauna Kea - the Temple: Protecting the Sacred Resource* provides a good foundation. This plan expands the ideas for the Mauna Kea Management Authority (the Authority). The new Authority would be housed in DLNR. It would be a three-part structure: the Mauna Kea Management Authority (comprised of eleven voting council members), the Kahu Committee (24 non-voting advisory members), and the staff (administrators, resource experts, rangers, etc). The Authority would be comprised of a majority of Native Hawaiians.

3. When a new management authority is established, a new budget authority must also be established to ensure the long-term viability and effectiveness of the management authority.

4. A process should be launched to discuss the future Mauna Kea. This process must be transparent, accessible, fair, fact-based, and actively engaging. We need to know each other's hearts; we must run the *aina* to collect

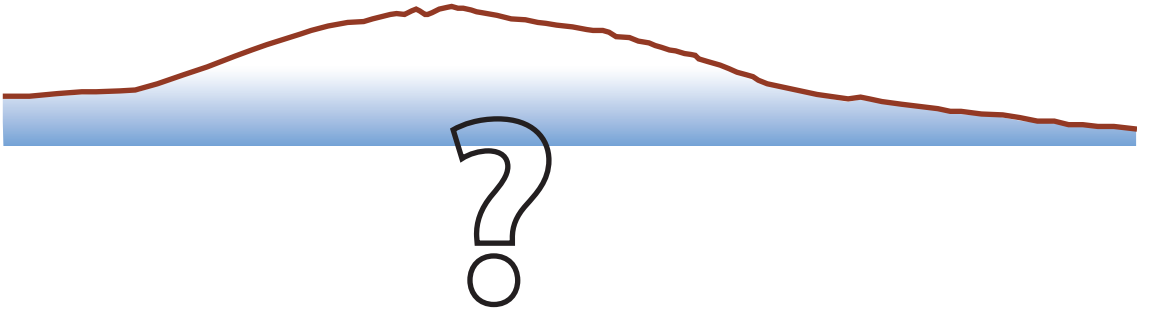


people's *mana'o.* This plan is a step in that direction, intended to ultimately lead to a plan for land use and long-term management of the mountain. The benefits of a new vision for the mountain must be made clear and tailored to Mauna Kea's different constituencies.

5. A new management plan should not be passed prior to the establishment of the new Authority.

6. Regardless of the Authority's spatial boundaries, it should manage the lands that it is responsible for in the context of the larger ecosystem and be mindful of the effects that each management decision will have on surrounding lands and the mountain as a whole. To that end each action should be evaluated to maximize all three scales put forward earlier in this document (science reserve, mountain, and island).

7. For the next quarter century, the lease allows for one observatory on the mountain, and astronomy will be one of the several permitted uses. To reduce further damage to fragile endemic resources, the new Authority should adopt a plan for interim re-use of limited sites for astronomy research, cooperative decommissioning, protocols for ecological remediation and safe guarding cultural practices, and financing of summit restoration.



1. Much of the natural science information that forms the public record of planning for Mauna Kea is outdated, fragmented, biased, and in many cases skewed to create a misleading story to support astronomy development. Few conservation districts anywhere in the world have been so industrialized with so little basic knowledge of the ecosystems. Before any legitimate plan can be done, these flaws must be undone. A legitimate plan requires comprehensive base information, not piecemeal studies. Cumulative impacts must be described and taken into account. As the basis of a management plan for Mauna Kea, a series of comprehensive, interconnected and cross-referenced, and peer-reviewed baseline studies by reputable scientists must be undertaken. These include but are not limited to the following:

• Surface and subsurface hydrology (this will likely require the Hawaiian congressional delegation to petition the United States Geologic Survey to undertake such a study).

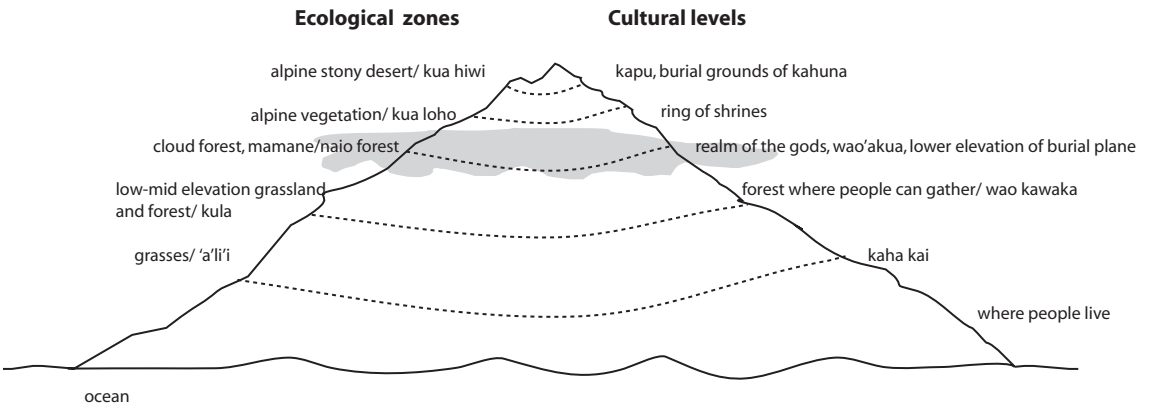
• The health of the unique sub-glacial eruption areas with particular attention to ones that have been disturbed by astronomical industrial development.

• Updated vegetation studies of the summit area and the relationship of the summit to lower elevation plant communities, their seasonal and temporal changes, their precise relationship to hydrology, and their function as habitat.

• Credible studies of the wekiu bug, its numbers, range, and full life-cycle habitat requirements and how the telescopes, roads, and other infrastructure have modified the Aeolian system upon which the bug is dependent; similar studies for other animal species at the summit and adjacent lower elevation ecosystems. This would include detailed studies of the dozen endemic arthropods and others that have not yet been identified.

• The cumulative impacts of astronomy and related infrastructure development on mountain ecosystems.

• Credible study of the extent of invasive and alien species introduced by astronomy industrialization, increased vehicular access and recreation; the impacts these species are having and are likely to have on the natural ecosystem which the Conservation District seeks to maintain; and the methods to eradicate and prevent further invasions.



• The impact of climate change in conjunction with astronomical industrial damage on surface and perched water, ice ecotones, permafrost, microclimates, vegetation, and the animal communities of Mauna Kea.

• Methods for clean up and remediation of damaged geological, hydrological, soils, plant, and animal systems; and an equitable plan for cost sharing by the lessee and sub-lessees.

• Accurate spatial and temporal mapping of all the above to reveal land use compatibilities and conflicts. In this way the amount and type of each land use can be precisely drawn and habitat remediation, expansion, and restoration can be operationalized as appropriate.

• The relationship of ecological systems to traditional and customary practices. These practices arose from the geologic and hydrologic features of Mauna Kea, which include 12 levels of sacredness, from sea to summit, which parallel elevation and vegetation zones. These relationships need to be studied in depth and articulated spatially in order to manage both.

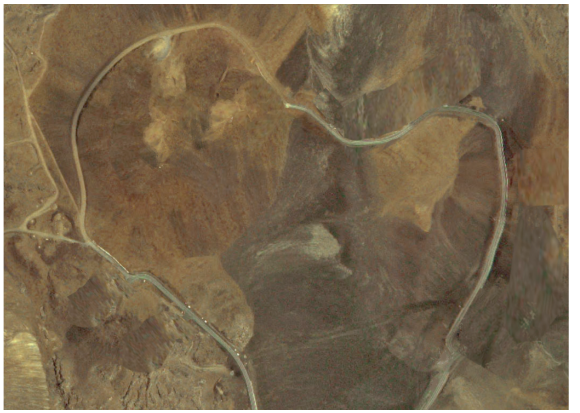
2. The State of Hawaii is asked to immediately implement procedures to stop introduction of invasive species occurring through current use. The cost of this effort should be borne by the lessee.

3. Once the above studies have been completed, a plan should be done that avoids any further damage to, preserves, and restores the ecosystems of endangered and/or endemic species. This can best be done by recognizing the interconnectedness of the ecosystem.

4. This endangered ecosystem should then be connected with others throughout the Big Island through the creation of an island-wide conservation district and walking trail system. Such a plan can be launched by creating a *wahi pana* zone that connects the summit to other public resource management units to the east, which largely reflect Mauna Kea's natural geologic extent. The *wahi pana* also are generally known to have the greatest biodiversity, in effect merging the sacred with ecology.

5. The science reserve should be maintained for the purpose of study of the ecosystem and on-going monitoring of ecological reources.

CONCLUDING THE LEASE



1. As part of developing this plan analysis was done to see how astronomical research as presently practiced via the use of telescopes could be retained on the mountain without negtively impacting the ecosystem, blocking traditional and customary practice, or disrupting views. It was impossible. Further, the absence of data on many of the natural systems and cultural resources, the need astronomy has for roads and other infrastructure, the introduction of invasive species and current threats to endangered species, and the likely pollution occurring made the continuation of telescopes on the mountain irreconcilable with the Conservation District mandate.

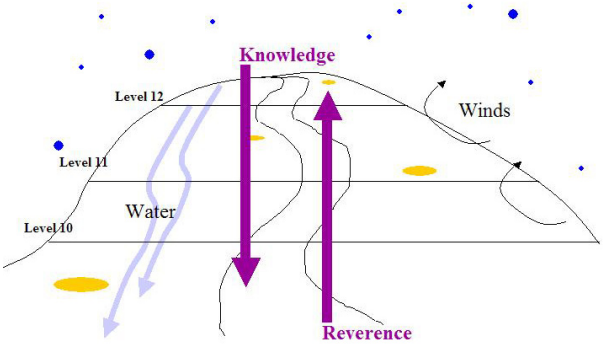
2. This plan calls for a halt to all actions that invite proposals and funding for new telescopes. No new scopes should be built on the mountain.

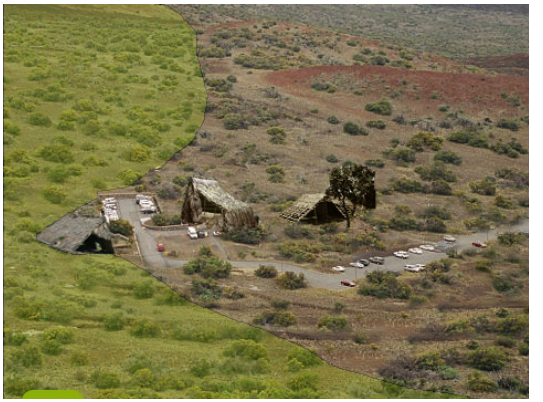
3. This plan calls for a phased removal of telescopes by age, obsolescence, and the functions the telescopes perform in order to "surrender and quietly deliver possession of the demised premises to the Lessor in good order and condition, reasonable wear and tear excepted" as called for in the lease. This removal should be completed by 2033.

4. A plan for remediation and restoration that would conclude on or before 2033 should be initiated. As part of the process of restoration, extraneous roads should be eliminated.

5. To redistribute the costs to society of telescope operation over the next 27 years, the existing telescopes should pay a 5-year, up-front energy fee. This fee should be collected and used to explore and develop new energy sources per the State's new energy bill (HB2848).

DEFINING MOUNTAIN USE AND CODE OF CONDUCT





1. Traditionally ascending Mauna Kea was an act of reverence. Descending occurred after knowledge was gained. This should be the guiding principle for people's use of the mountain.

2. Users of the mountain today, starting with astronomers, generally know little about the significance of Mauna Kea to Hawaiian culture and its role in creation. The Hawaiian way extends, respects, and protects the power of place, stewards the environment, and shares knowledge with others so that they may act accordingly. It is optimistic, not punitive. It conveys the significance of being given access to a place once only accessible to the alii by placing responsibility for the mountain in the hands of educated contemporary users. Access to the mountain should be through a Kahu Pass, obtained after completing an education session that teaches the mountain's ecology and culture and after being certified in proper behavior.

3. A respectful yet pleasurable protocol for use of the mountain should be determined collectively. A workshop should be held where participants are asked to look at traditional and customary use and discuss how to make it contemporary, with activities such as an *oli kähea* ritual, or a designated day of the year to study the mountain and evaluate its health and future. The *aloha* culture should be acknowledged as the rightful steward of Mauna Kea. To this end the *kahus* and *konohikis* should be given a lead role in the creation and implementation of this code and the plan for the Discovery Route. (see Becoming Economically Sustainable).

RENEWING TRADITIONAL AND CUSTOMARY PRACTICES

1. A holistic plan must be developed to inventory, preserve, restore, and monitor all ancient and contemporary cultural and religious sites on the mountain. This plan must guarantee access to and protection of those sites and the surrounding landscape necessary for traditional and customary practices. This should include protecting and restoring views of the sacred places, preserving settings and rituals on the mountain that celebrate and continue traditional Hawaiian culture locally, clearing the mountain above 9,000 feet of all evidence of the science reserve, and returning the summit to the *wahi pana*.

2. As part of this plan, a number of written descriptions, oral histories, and narratives about traditional and customary practices on the mountain have been translated into spatial geometries. These include the ambient open space and natural views necessary for Hawaiian rituals, specific routes, locations needed to perform ceremonies, and adze making activities. But much more remains to be done, including but not limited to the following:

• All available texts and records of traditional and customary practices should be spatialized to inform the plan.

• The State must complete the baseline studies underway by archeologist Patrick McCoy.

• The State must complete the historic and cultural preservation plan as called for in past audits and promised by the DLNR.

• There should be an inventory of all historic trails within the viewshed of Mauna Kea. From this the impacts on natural views and appropriate remediation can be determined, trails to be improved that historically provided access to the mountain can be prioritized, and other sites of traditional and customary importance around the mountain that should be connected can be identified.

• The State should establish the means to immediately protect from vandalism and construction the cultural and religious artifacts and traditional and customary practices ancient and present.

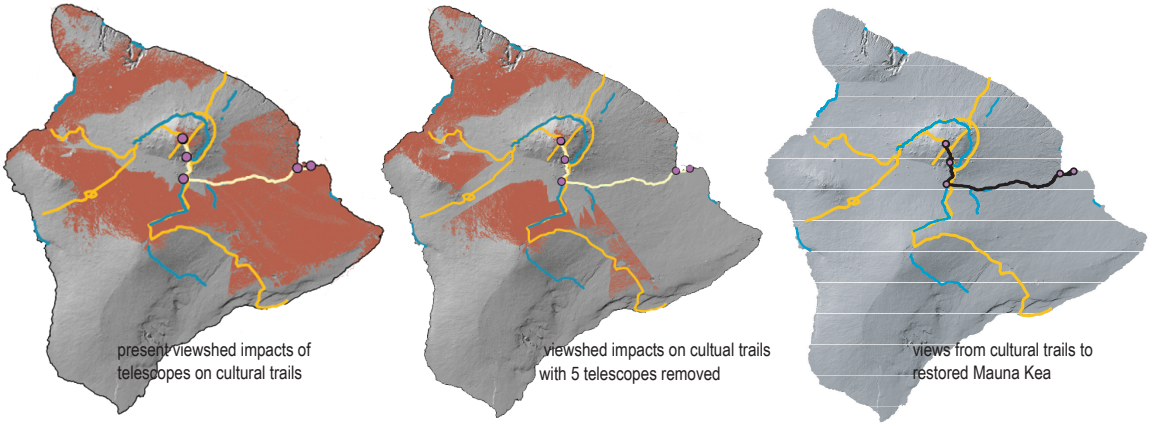
• The State should determine the best methods for restoring sacred land forms and rock arrangements that have been damaged during the astronomical industrial occupation.

• Some cultural practices such as adze making require special gathering rights in order to preserve them. The Authoirty should develop protocols to protect the resources and guarantee continuation of these practices.

3. This plan recommends that multiple venues and programs be created as part of the Discovery Route. These should be funded now and endowed for the future by proceeds from telescope leases and tour proceeds.

4. The curriculum to teach visitors mountain-proper behavior in a sacred zone should be developed and funded. This is key to the Discovery Route and Kahu Pass system and to respectful behavior on the mountain.

EXPERIENCING THE MOUNTAIN



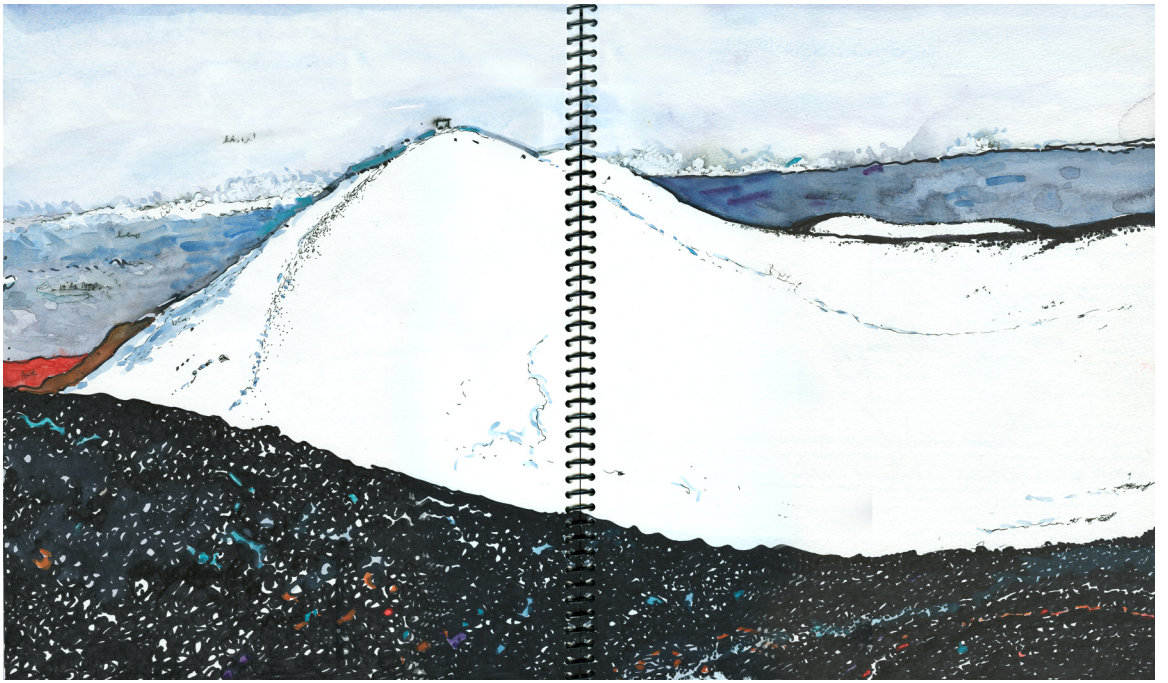
1. Access to the mountain for the people of Hawaii is fundamental. Similar access was fought for and upheld in the PASH case. Key access should be a system of trails based on historic routes that connect destinations of cultural and ecological importance on the mountain and to other parts of the Big Island.

2. This plan is based on three trail systems (sacred and historic routes of travel, trails the State recognizes, and those that facilitate the Mauna Kea Discovery Route). These should be fortified through maintenance, signage, and encouraging use. Opportunities should be sought to extend the system to the rest of the island to reinforce ecosystem and cultural connectivity.

3. There should be a program of cross-mountain *Huaka'i* treks like those led by *Huaka'i I Na 'Aina Mauna*.

4. An essential part of experiencing the mountain is the views– natural views from within the summit region and open views from the summit. Especially important views to the mountain are from inhabited areas on the island and from the trails described above. Views within the summit area from one sacred site to another and natural views surrounding sites of traditional and customary practice are presently diminished by the current industrial character of the summit. Likewise, views key to traditional and customary practices from the summit to sacred sites off the island and in the heavens are presently blocked by telescopes. The plan to decommission telescopes restore and improve these sacred views as shown in the the images above.

BECOMING ECONOMICALLY SUSTAINABLE



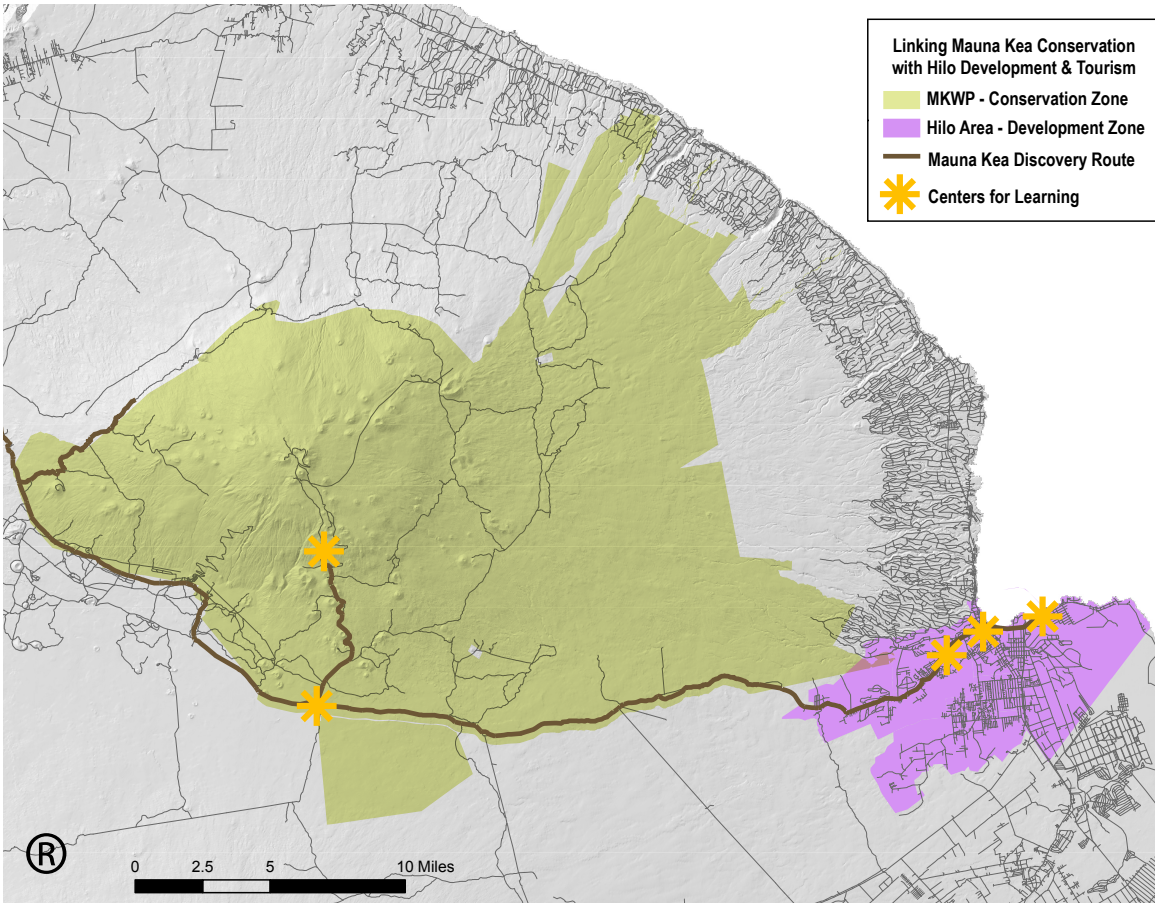
1. The decommissioning of telescopes must be done in tandem with implementation of new economic development. Further, stewardship of Mauna Kea must be financially sustainable so as to provide funds for the management entity and the above scientific, cultural, and ecological actions. The new economy should be independent, ecologically conscious, support local business, and engage the Big Island's work force.

2. A recycling and development zone should be established near the port with a goal of diverting at least 50% of the waste from the landfill. This would start with an island-wide clean up and continuous recycling of metal and other materials. Waste materials from the summit produced during decommissioning can be sold to eager markets where Hawaii has a competitive edge such as China (in California the recycling industry is responsible for 85,000 jobs, generated $4 billion per year in salary and benefits, and $10 billion per year in sales, the same as the state's movie and video industry).

3. An office of environmental clean up and ecosystem restoration should be established where local people can be trained to do this work, creating a new knowledge and economic base.

4. In order to complete this economic retrofit, Mauna Kea must become energy independent. The research and development of alternative energy should be funded by charging telescope operators a fee and by using existing resources that do not have an adverse effect (such as sugar cane fields to grow biofuel).

5. There are a number of other creative and low-impact ways to encourage economic activity tied to the mountain that do not rely on telescopes. This plan calls for a Discovery Route that extends from the port, to



downtown Hilo, to an educational center at the Imiloa Astronomy Center, a cultural village at Pu-u Huluhulu, and a Hale Pohaku Spiritual Wilderness Center. At the port short-term visitors would receive an ecological and cultural introduction to the Island of Hawaii and obtain a Kahu Pass. The second stop would be at a center in Hilo for performing arts, and sports, a film festival, and local crafts that build on the existing museums, markets, and festivals. The educational center would detail Hawaiian discovery voyages, explain the prayer closing story of when astronomy left the mountain, and archive astronomy's past. The cultural village would be a place to experience traditional and customary Hawaiian cultural practice, and would offer a place for visitors to stay overnight. At Hale Pohaku visitors would learn about the Mauna Kea *wahi pana*.

6. The Discovery Route is intended to provide increasingly first-hand experiences of the island's ecology and culture in keeping with ascending Mauna Kea with reverence and returning with knowledge. For those seeking the immersion in nature and culture, treks, academic homestays, and conservation restoration programs would be offered, all of which would employ local people.

Pursuing a positive future for Mauna Kea is essential for the mountain's ecological health, for the spiritual well-being of Hawaiians whose temple is embodied by it, and for the proper acknowledgement of the mana that resides in Mauna Kea. Rigorous baseline studies and monitoring at three planning scales will provide a deeper understanding of the mountain's unique ecosystems and cultural resources and will inform a new management structure that is rigorous and fair. Educating users of the mountain will help to ensure that everyone will ascend the slopes with reverence and descend with knowledge. Traditional and customary practices will be acknowledged, respected, and passed on to others into the future. Mauna Kea will not be managed as a resource to be exploited, but rather as a unique ecosystem, a sacred space, an embodiment of ancient and powerful gods, a place of transcendence, and a place held in trust for all the people of Hawaii.

Prepared for the Mauna Kea Hui by Community Development by Design: Randy Hester, Marcia McNally, Amy Dryden, and Sarah Minick.

Note: This plan is based in part on proposals made by the students in LA 205, a graduate studio class in the Department of Landscape Architecture and Environmental Planning. A number of the graphics and ideas are theirs. The work was supervised by Professors Randy Hester and Tim Duane. The students were: Randi Adair, Wenjing "Eva" Huang, Freyja Knapp, Anne Martin, Stephen Miller, Shiva Niazi, Brooke Ray Smith, Jane Wardani, Alex Westhoff, and Carmen Wong. Photos are credited to Community Development by Design with the exception of the following: Deborah Ward took the photographs on the cover and pages 2,7,12,14,16,18,26 ,32,34,36,40 and Florian Charreard took the photograph on page 48.