DRAFT ENVIRONMENTAL IMPACT STATEMENT

Volume 2

Thirty Meter Telescope Project

Island of Hawai‘i

Proposing Agency:
University of Hawai‘i at Hilo

This Environmental Document was Prepared Pursuant to Hawai‘i Revised Statutes, Chapter 343, Environmental Impact Statement Law and Chapter 200 of Title 11, Hawai‘i Administrative Rules, Department of Health, Environmental Impact Statement Rules

May 23, 2009

APPENDIX D

INITIAL DRAFT
CULTURAL IMPACT ASSESSMENT

Thirty Meter Telescope Project

Mauna Kea Science Reserve and Hale Pōhaku,
Ka‘ohe Ahupua‘a, Hāmākua District, Hawai‘i Island

TMK: [3] 4-4-015:001 por.; 009 por., 012 por.

May 2009

Summary

Introduction

The Project requires compliance with the State of Hawai‘i environmental review process [Hawai‘i Revised Statutes (HRS) Chapter 343], which requires consideration of a proposed project's effect on cultural practices and resources. At the request of Parsons Brinckerhoff, Cultural Surveys Hawai‘i (CSH) has conducted research of the existing literature documents and performed initial cultural consultation efforts, as part of the CIA process. The CIA process is intended to support the Project's environmental review and may also serve to support the Project's historic preservation review under HRS Chapter 6E-8 and Hawai‘i Administrative Rules (HAR) Chapter 13-275. The CIA process is ongoing, and the following is a summary of the initial findings thus far.

Project Location

The proposed TMT Observatory Project area is located within Area E of the Astronomy Precinct of the Mauna Kea Science Reserve. Approximately 3.5 miles south of the proposed TMT Observatory Project site, are the Hale Pōhaku Mid-Level Support Facilities, two discret parcels located in the Hale Pōhaku area, at approximately 2,800 m (9,200 ft.) elevation on the southern slope of Maunakea. The Project areas are depicted on the U.S. Geological Survey 7.5-Minute Series Topographic Map, Mauna Kea Quadrangle (1993) (Figure 1).

Land Jurisdiction

State of Hawai‘i

Agencies

State of Hawai‘i Department of Health, Office of Environmental Quality Control (DOH/OEQC), and State Historic Preservation Division (SHPD), Department of Land and Natural Resources (DLNR)

Project Description

The proposed TMT Observatory Project involves the construction of a thirty meter diameter telescope and associated infrastructure on an approximately 5-acre site within Area E of the Astronomy Precinct. Minimally, land disturbing activities would include grading of the TMT Observatory Project site and access road and excavations associated with building construction and installation of subsurface utilities. The proposed Mid-Level Support Facilities include construction staging areas and development of housing for TMT Observatory Project staff and contractors. The proposed Project also involves upgrades to the existing Hawai‘i Electric Light Company (HELCO) power substation at Hale Pōhaku. Minimally, land disturbing activities would include grading of the construction staging areas, and excavations associated with construction of workers dormitories and associated structures, installation of subsurface utilities, and substation upgrades.

Project Acreage

The footprint of the proposed TMT Observatory Project ground disturbance measures approximately 5 acres. The footprint of the proposed Mid-Level Support Facilities measures approximately 3.2 acres.

Area of Potential Effect (APE)

The APE for the TMT Observatory Project considered in the initial research and consultations includes the entire approximately 36-acre Area E of the Astronomy Precinct, even though the TMT Observatory site encompasses 5-acre area. The APE for the TMT Mid-Level Support Facilities includes the entire approximately 3.2 acres. The APE also includes the rest of the island of Hawaiʻi and other Hawaiian Islands and places in Polynesia (e.g., Kahiki, or Tahiti), associated with Maunakea in the larger context of Hawaiian beliefs (e.g., moʻolelo or legends, oral histories and wahi pana or storied places), resources and practices.

Consultation Effort

Hawaiian organizations, agencies and community members were contacted by CSH to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the Project area and the vicinity. The agencies consulted include the State Historic Preservation Division (SHPD), the Office of Hawaiian Affairs (OHA), and the Hawaiʻi Island Burial Council (HIBC), in addition to community groups such as Mauna Kea Anaina Hou, Royal Order of Kamehameha ʻE kahi, Mamalahoa, Hilo Chapter and Hale o Lono. This effort is ongoing and is being made by letter, e-mail, telephone, and in person contact. In the majority of cases, letters are mailed along with a map and an aerial photograph of the Project area.

Note on Spelling of Maunakea

For this preliminary CIA, both spelling variations of the name Maunakea are used. The two word format - Mauna Kea - is used to address official entities such as the "Mauna Kea Science Reserve" and when quoting content from other sources such as books or past published interviews that include the name of the mountain as two words. All other uses of the mountain will be written as one word, Maunakea. See Section 3.2 on Place Names for further details on the spelling of Maunakea.

Results of Background Research

Background research conducted for this Project yields the following results:

1. Maunakea is a sacred cultural landscape; symbolic of Wākea (the 'Sky Father' to all Hawaiians), home of Poliʻahu, the goddess of snow and foe of Pele (the fire goddess), and of many other resident deities and supernatural entities (e.g., Līlīnoe, Kūkahauʻula and Moʻoinanea) and the piko (umbilical cord) of the island-child, Hawaiʻi which

connects the land to the heavens (Maly and Maly 2005:v); home of Waiau, the highest permanent lake in the Hawaiian Islands; location of the highest and most extensive basalt quarry in all of Polynesia and perhaps the entire world; and numerous trails, ahu (stone markers), religious shrines and cinder cone puʻu (hills), based on extensive historical and oral-historical documentation.

2. Maunakea is rich in moʻolelo, mele (chants, songs), and ʻōlelo noʻeau (proverbs, poetical sayings) associated with akua (God, male and female deities, spirits) and storied places (wahi pana). Poliʻahu, the snow goddess and Pele, the volcano goddess engaged in legendary battles to control Maunakea. Pele also had legendary battles with the pig demi-god Kamapuaʻa on the summit of Maunakea. Numerous stories of Wākea and Papa, Poliʻahu, Līlīnoe, Kūkahauʻula and Moʻoinanea, to name a few, are written into the landscape.

3. The TMT Observatory Project area is located below the summit cone, Puʻu Kūkahauʻula, at approximately 13,700 feet elevation. The Hale Pōhaku Project area is located at approximately 9,160 feet in elevation. Maunakea, the tallest mountain in the Hawaiian Islands at 13,796 feet elevation, is also the tallest mountain on earth as measured from the ocean floor to the summit, a distance of some 29,500 feet (thus, exceeding by approximately 1,000 feet the non-volcanic Mount Everest).

4. Vegetation is almost non-existent in the summit region of Maunakea; the tree-line is located nearly a mile in elevation below the summit (at approximately 9,000 feet elevation); the highest major vegetation zone, known as the Alpine Scrub Zone, generally ends at approximately 11,300 feet elevation. Plants in the so-called Alpine Stone Desert Zone of the summit region are mostly limited to small lichens and mosses. More plant life is present in the Hale Pōhaku Project area characterized by scrub vegetation including a number of natives such as mamane (*Sophora chrysophylla*), pukiawe (*Leptecophylla tameiameiae*) and the endangered endemic, ahinahina, also known as Maunakea silversword (Argyroxiphium sandwicense) as well as introduced exotics such as mullein (*Verbascum thapsus*) and various grasses.

5. Maunakea translates literally as white (kea) mountain (mauna), so named for its breathtaking snow-capped summit. However, according to Nā Maka o ka ʻĀina (2008) and according to other authorities on Hawaiian culture (e.g., Kepā Maly, Pualani Kanahele), Maunakea has numerous other meanings and translations. It is a short version of Mauna a Wākea, a name that connects it to the sky father, Wākea; this would be one of its kaona (hidden or more subtle meanings).

6. Hale Pōhaku literally "stone house," refers to the two stone cabins constructed by the Civilian Conservation Corps in 1936 and 1939 at an elevation of 9,220 feet on the southern slope of Maunakea. L.W. Bryan, who served as the Territorial Forestry Office and oversaw the construction of the "stone houses," also named them Hale Pōhaku.

7. Puʻu Poliʻahu is named for Poliʻahu, "the woman who wears the snow mantle of Mauna Kea"; Poliʻahu, which is also the name of a land division on Maunakea, is translated as "garment [for the] bosom (referring to the snow)" by Pukui et al. (1974) and as "Snow goddess of Mauna Kea. Lit. Bosom goddess" by Pukui and Elbert (1986). Maly & Maly include a citation by W.D. Alexander regarding the naming of Puʻu Poliʻahu. As the peak

was nameless, Alexander called it “Poliahu” since it had “a poetical name, being that of the demigoddess with snow mantle who haunts Mauna Kea” (Maly and Maly 2005:200).

8. Waiau, the permanent lake located within Puʻu Waiau near the summit of Maunakea at approximately 13,020 feet elevation, translates as “swirling water,” and is associated with the snow goddess Poliʻahu and is guarded by the supernatural water spirit (moʻo) known as Moʻoinanea. Queen Emma went to the top of Maunakea to bathe in the waters of Waiau. The ceremony was to cleanse in Lake Waiau at the piko (navel or center) of the island. The water caught at Lake Waiau is considered pure water of the gods much like the water caught in the piko of the kalo (taro) leaf and is thought of as being pure, therefore it is used medicinally (Nā Maka o ka ʻĀina 2008).
9. The Mauna Kea Adze Quarry, also known as Ke-ana-kākoʻi, “the adze-making cave” (Pukui et al 1974:103), is located on the southern slopes of the mountain, at elevations up to 12,400 feet. The site was listed on the National Register of Historic Places in 1969, and the Hawaiʻi State Register of Historic Places in 1981.
10. The ahupuaʻa of Kaʻohe was government land on which four native claims were made following the Māhele in 1848. Only one kuleana claim was awarded in the entire ahupuaʻa. The single awarded claim indicates coffee, arrowroot, banana, and taro were all cultivated in the lands of Kaʻohe. Kaʻohe was also known as a habitat for uwaʻu, or ʻuaʻu (dark-rumped petrel) seabirds that reside in rocky, dry, elevated areas (Foster 1893).
11. While historic accounts and moʻolelo tell of the presence of burials on Maunakea (Maly and Maly 2005), archaeological evidence until recently, was relatively limited concerning confirmed human burials in the summit region. Prior to 2005, archaeological authorities on Maunakea, including Pat McCoy, had documented only one confirmed burial site (with multiple burials) and four possible burial sites in the summit region (McCoy 1991). All of these sites are located on Puʻu Mākanaka to the northeast of the subject Project area. In progress work by McCoy and Nees however, has documented 28 sites designated as burials and possible burials (McCoy et al 2008).
12. Several extensive cultural studies have been previously carried out for Maunakea (McEldowney 1982; Kanahele and Kanahele 1997; Maly 1998; Langlas et al. 1999; Maly 1999; PHRI 1999; Maly and Maly 2005). The most comprehensive study by Maly and Maly (2005) builds on archival and oral-historical research conducted by the authors beginning in 1996 (to 2005) and presents a wide range of information on natural and cultural beliefs, resources and practices associated with Maunakea. Among the many critical findings of Maly and Maly’s (2005) cumulative research is the emphasis on Maunakea as a sacred landscape and native lore associated with traditional knowledge of the heavens - documenting 270 Hawaiian names for stars.
13. Past studies identify Traditional Cultural Properties (TCP) on Maunakea. Three places that have been identified by SHPD as TCPs and documented in a study done by PHRI (1999) are: (1) Kūkahauʻula, the summit (Site 21438), (2) Līlīnoe (Site 21439) and (3) Lake Waiau (Site 21440). Other traditional places may also qualify (Figure 6). Maly (1998:29) has suggested the entire Maunakea summit region down to the 6,000 foot elevation contour be designated a Traditional Cultural Property (Figure 16).

14. Archival and oral-historical evidence confirms that Maunakea has long been, and continues to be, a place where significant cultural practices are carried out: where, the piko of newborn children is taken to Puʻu Kūkahauʻula and Lake Waiau to ensure long life and safety; the remains of individuals with generational ties to Maunakea are taken to puʻu and the summit plateau for interment (Maly and Maly 2005:vi); shrines and stone markers are erected and; ceremonial and other activities related to birth, death, healing, navigation and more, occur.

Results of Initial Community Consultations

CSH attempted to contact 58 community members (government agency or community organization representatives, or individuals such as residents, cultural and lineal descendants, and cultural practitioners) for the purposes of this preliminary CIA. Out of the contacted community members 30 people responded via written comments or verbally over the phone. Of the 30 persons who responded, 13 kūpuna (elders) and/or kamaʻāina (native born) agreed to be interviewed for more in-depth contributions to the CIA process. Community consultation with a few respondents is ongoing. The results of these initial cultural consultations indicate that there are major concerns (and several ancillary ones) regarding potential adverse impacts on cultural and natural resources and associated beliefs and practices as a result of the proposed development of the Thirty Meter Telescope, construction of the staging area for the TMT Observatory Project and the HELCO electrical transformer needed to supply electrical power to the TMT Observatory Project:

1. All of the community consultants interviewed for this study stress that Maunakea is a sacred landscape and that any future development activities on the mountain proceed with greater awareness of, and the utmost respect for Hawaiian culture, Hawaiians' spiritual connection to the mountain, and the sanctity of Maunakea.
2. Nine of the community elders interviewed, and three of the respondents who provided brief commentary, explicitly stated their opposition to the proposed actions on Maunakea which is traditionally, and continues to be, one of the most sacred locations in all of Polynesia, not to mention Hawaiʻi Nei. These participants voiced sadness, frustration or negative feelings about the cumulative impacts of past and present developments on Maunakea. In the words of one participant, referring to the telescopes on the summit of Maunakea, "When is enough, enough?" Specific manaʻo (thoughts, ideas), concerns and recommendations from those that oppose the proposed TMT Observatory Project and Hale Pōhaku Mid-Level Support Facilities Project are:
    a. Three participants called for astronomy facilities to be removed and Maunakea be repaired to its original condition. Two of these participants recommended that the proponents of the TMT Observatory Project make an effort to better reach out to the community about the findings of the Mauna Kea Science Reserve and scientific intent of the proposed TMT Obervatory Project through public education events.
    b. One participant stated that there should be no further development until issues are rectified with the Hawaiian people.
    c. One participant called for the proposed TMT Observatory Project to be installed in Chile rather than in Hawaiʻi.

d. A number of these participants stressed the importance of astronomy to Hawaiians, particularly discussing voyaging traditions.

e. Several interview participants and respondents expressed concern about the disturbance of burials and associated cultural artifacts, markers and shrines (ahu) and in puʻu as result of construction of the proposed TMT Observatory Project and support facilities.

f. Five participants discussed environmental concerns, particularly about Lake Waiau and the mountain aquifer, as well as other impacts to environmental services. These participants assert that Maunakea - the principal aquifier and watershed for Hawaiʻi Island - is being contaminated by human use (i.e., sewage and toxic chemicals leaching from astronomy facilities). Participants also mention the threatened endemic Maunakea Wekiu Bug (*Nysius wekiuicola*) and cleaning up trash left by visitors to Maunakea.

g. One participant noted that the entire Mauna Kea Science Reserve has been identified by SHPD as an historic district; suggesting that a Cultural Reserve be created and that the following landscape features qualify as TCPs: the Mauna Kea Adze Quarry Complex; the cluster of 3 puʻu of Kūkahauʻula that make up the summit region of Maunakea; Lake Waiau; and Līlīnoe, referring to the puʻu southeast of the summit and within the Science Reserve

h. Three participants questioned legal aspects of the lease agreement between the University of Hawaiʻi and the state and legitimacy of the Mauna Kea Science Reserve to operate on ceded and/or occupied lands.

i. Two participants questioned the benefits to the local economy and education promised by past and proposed telescope projects on Maunakea.

3. Three participants interviewed and one respondent who provided brief commentary, are in favor of the development of the TMT Observatory Project and its associated facilities on Maunakea. These participants recommend Project proponents proceed with care and respect to the sacredness of Maunakea and advised mitigation measures and/or alternatives to the current proposed design and location of the TMT Observatory Project and support facilities. In the words of one participant, "The future of Maunakea…can serve as an educational center and a place for man to view the stars and the universe but it has to remain a sacred and holy place. It's like stepping into a sanctuary, a very sacred place of peace, a place that one can learn the things beyond what man knows now." Manaʻo, concerns and recommendations from these participants are:

   a. One participant believes the TMT Observatory Project should be built on a recycled site. He states that if an outdated telescope site on Maunakea is identified, the site should be recycled for TMT Observatory Project usage to avoid unnecessary intrusions that detracts from the beauty and majesty of Maunakea.

   b. One participant calls for a process to be put in place that respects community and allows projects such as TMT Observatory Project telescope to continue.

   c. One participant recommends the removal of all other telescopes and that only one telescope be utilized and shared by interested parties.

   d. All three of these participants state that if the TMT Observatory Project proceeds, it should be developed to blend in with the natural setting and not detract from the natural beauty and sacredness of Maunakea.

4. Interviewees discussed salient features of the cultural landscape, resources and associated uses of Maunakea including, moʻolelo about Wākea and Papa, Poliʻahu, Līlīnoe, Kūkahauʻula and Moʻoinanea; the summit as an area where families take the piko of their babies to bury, and where the bones or ashes of deceased family members are placed, burials and burial complexes; shrines and stone markers; navigation traditions and astronomy; the adze quarry, ancient and historic trails; the healing and purifying waters of Lake Waiau and snow and ice collected for medicinal and ceremonial purposes; bird hunting; and other past and present cultural practices (see Sections 7 and 8).

5. SHPD, responding in a memo sent on May 4, 2009, states that, "As you may have discerned from the most recent Mauna Kea Comprehensive Management Plan (MCMP) for the UH Management Area (January 2009) and the public hearings for that plan that Mauna Kea is a very sensitive subject that truly needs and deserves more time to consider all the cultural impacts to this iconic symbol of all cultural connections including but not limited to the genealogical connections, and the spiritual connections to all of the deities in the Hawaiian cosmos and to the kanaka maoli world view." Additionally, SHPD recognizes Maunakea's place in Hawaiian navigation as "the first sighting for voyaging canoes to arrive safely to our islands in the middle of the Pacific [and] a significant part of the Pacific Rim mythological connections to all the Pacific Rim." SHPD recommends:
   a. An assessment of buildings no longer functional be done before building new structures or "perhaps no more development on this sacred mountain";
   b. access for cultural practitioners be clearly addressed and defined;
   c. the entire summit of Maunakea be treated as one traditional cultural landscape and not as a piecemeal analysis of just the Science Reserve; and that
   d. more community outreach occur for all cultural impacts on the summit and the proposed area to properly assessed - see list of contacts in the MCMP.

6. OHA, responding in a letter dated January 9, 2009 (Appendix B), acknowledges the different perspectives on Maunakea as a spiritual, sacred place, home to "wao akua" (dwelling, place of the gods) and the place where the presence of numerous ahu and iwi kūpuna provide silent testimony that generations of Hawaiians have worshipped and buried loved ones "at the highest point possible to rest in peace." The "life sustaining waters known as Kanekawaiola…contribute to a healthy natural environment, which in turn allow man to thrive." The letter describes the 40-year debate surrounding the development of Maunakea and recommends that the current proposed TMT Observatory Project study be viewed in context of this long history to "consider the overall impacts of development on Mauna Kea." OHA suggests several parties for consultation and is currently reviewing the Hale Pōhaku Mid-Level Support Facilities Project area information to determine whether they will provide additional comments.

Ongoing Community Consultations

The consultations, including additional interviews with the community members will continue to be on-going in soliciting input representative of the community. The initial consultations resulted in a limited number of only 13 interviews with kūpuna and/or kamaʻāina. Thus, and also as indicated by some respondents during the initial consultations, outreach to other parties will continue in the on-going consultations and interviews conducted, in order to gather input representative of the community. The results of these consultations and interviews, and recommendations reflecting community input, will be documented in a final CIA report and the Final EIS.

Attachment: Draft Initial CIA report prepared by CSH

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Section 1 Introduction

1.1 Project Background

Cultural Survey Hawaiʻi, Inc. (CSH) conducted this Cultural Impact Assessment (CIA) for the proposed construction and operation of the Thirty Meter Telescope Observatory Project (TMT), an optical-infrared telescope on an estimated 5 acres of presently undeveloped land of the 525-acre Astronomy Precinct of the Science Reserve near the top of Maunakea. Approximately 3.5 miles south of the proposed TMT Observatory Project site, are the Hale Pōhaku Mid-Level Support Facilities, two discreet parcels located in the Hale Pōhaku area, at approximately 2,800 m (9,200 ft.) elevation on the southern slope of Maunakea. The Project would be located in Kaʻohe Ahupuaʻa, Hāmākua District, on the island of Hawaiʻi, on a portion of TMK: (3) 4-4-015: 009 and 012 (Figures 1 through 3).

The proposed TMT Observatory Project would be located within the western portion of the area known as the northern plateau within the Astronomy Precinct. More specifically, the area being considered is the general vicinity of the 36-acre area designed Area E in the Mauna Kea Science Reserve Master Plan (UH 2000). Area E ranges in elevation from 13,100 to 13,300 feet and is located approximately half a mile northwest of the nine existing optical-infrared telescopes located near the summit at elevations of 13,600 to 13,775 feet. The entire Mauna Kea Science Reserve is designated part of the State of Hawaiʻi Conservation District, resource subzone. Ancillary facilities include an access road from the end of the current access road near the summit to the new telescope site would need to be developed.

When the TMT Observatory Project's CIA consultation was initiated on November 24, 2008, communication with Project proponents indicated that the proposed Thirty Meter Telescope CIA consisted mainly of the actual construction of the TMT Observatory Project within the 36-acre area known as Area E in the Mauna Kea Science Reserve Master Plan. In February 2009, CSH was informed that the TMT Observatory Project will also include a construction staging area located at the 9,000 foot level Hale Pōhaku site, approximately 3.5 miles south of the proposed TMT Observatory Project site. Additionally, included in the proposed TMT Observatory Project description is a new electrical transformer to be installed at the Hawaiian Electric Light Company (HELCO) site located at the Hale Pōhaku site. For this reason, CSH sent out a second round of community consultation letters in February 2009 to include the additional information regarding the construction staging area and the electrical transformer in order to provide community consultants the opportunity to provide further comments and concerns.

The footprint of the proposed ground disturbance for the TMT Observatory Project measures approximately 5 acres. However, the precise 5-acre Project area is not yet determined, so the entire approximately 36-acre Area E of the Astronomy Precinct is included in the Project area. The Area of Potential Effect (APE) for this TMT Observatory includes the 36-acre area of the possible construction footprint as well as the approximately 6-acre footprint of the proposed Mid-Level Support Facilities. For the purposes of this CIA, the APE considers the Project area/s within the larger cultural context of the the *ahupuaʻa* of Kaʻohe; Hawaiʻi Island and, other islands of Hawaiʻi and Polynesia—lands, or *wahi pana* (legendary or storied places) culturally associated with Maunakea through legends, oral history accounts (*moʻolelo*) chants, songs (*mele*) and poetical sayings, proverbs (*ʻōlelo noʻeau*). This assessment further includes consideration of the *cumulative* effects of the proposed Project on traditional Hawaiian practices and resources in and around the Project area.

On May 11, 2009, an updated map of the Hale Pōhaku Mid-Level Support Facilities was provided by project proponents for this assessment and has been inserted in Appendix E. It is important to note that this updated map of the Hale Pōhaku Mid-Level Support Facilities was not used in the community consultation efforts for this assessment.

1.2 Document Purpose

The Project requires compliance with the State of Hawaiʻi environmental review process [Hawaiʻi Revised Statutes (HRS) Chapter 343], which requires consideration of a proposed Project's effect on cultural practices. CSH is conducting this CIA at the request of PB, Inc. Through document research and ongoing cultural consultation efforts this *preliminary* draft report provides information pertinent to the assessment of the proposed Project's impacts to cultural practices and resources (per the *Office of Environmental Quality Control's Guidelines for Assessing Cultural Impacts*) as well as consideration of eligibility for inclusion on the State Register of Historic Places, including Traditional Cultural Properties (TCPs) of ongoing cultural significance, according to Hawaiʻi State Historic Preservation Statute (Chapter 6E) guidelines for significance criteria (HAR §13-275-6) under Criterion E which states to be significant an historic property shall:

> Have an important value to the Native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity.

The document is intended to support the Project's environmental review and may also serve to support the Project's historic preservation review under HRS Chapter 6E-8 and Hawaiʻi Administrative Rules Chapter 13-275.

1.3 Scope of Work

The scope of work for this CIA includes:

1. Examination of cultural and historical resources, including Land Commission documents, historic maps, and previous research reports, with the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal, and other resources as may be indicated in the historic record.
2. A review of previous archaeological work at and near the subject parcel that may be relevant to reconstructions of traditional land use activities; and to the identification and description of cultural resources, practices, and beliefs associated with the parcel.

3. Consultation and interviews with knowledgeable parties regarding traditional cultural practices at or near the parcel; present uses of the parcel; and/or other (non-Hawaiian) practices, uses, or traditions associated with the parcel.
4. Preparation of a report summarizing the results of these research activities.

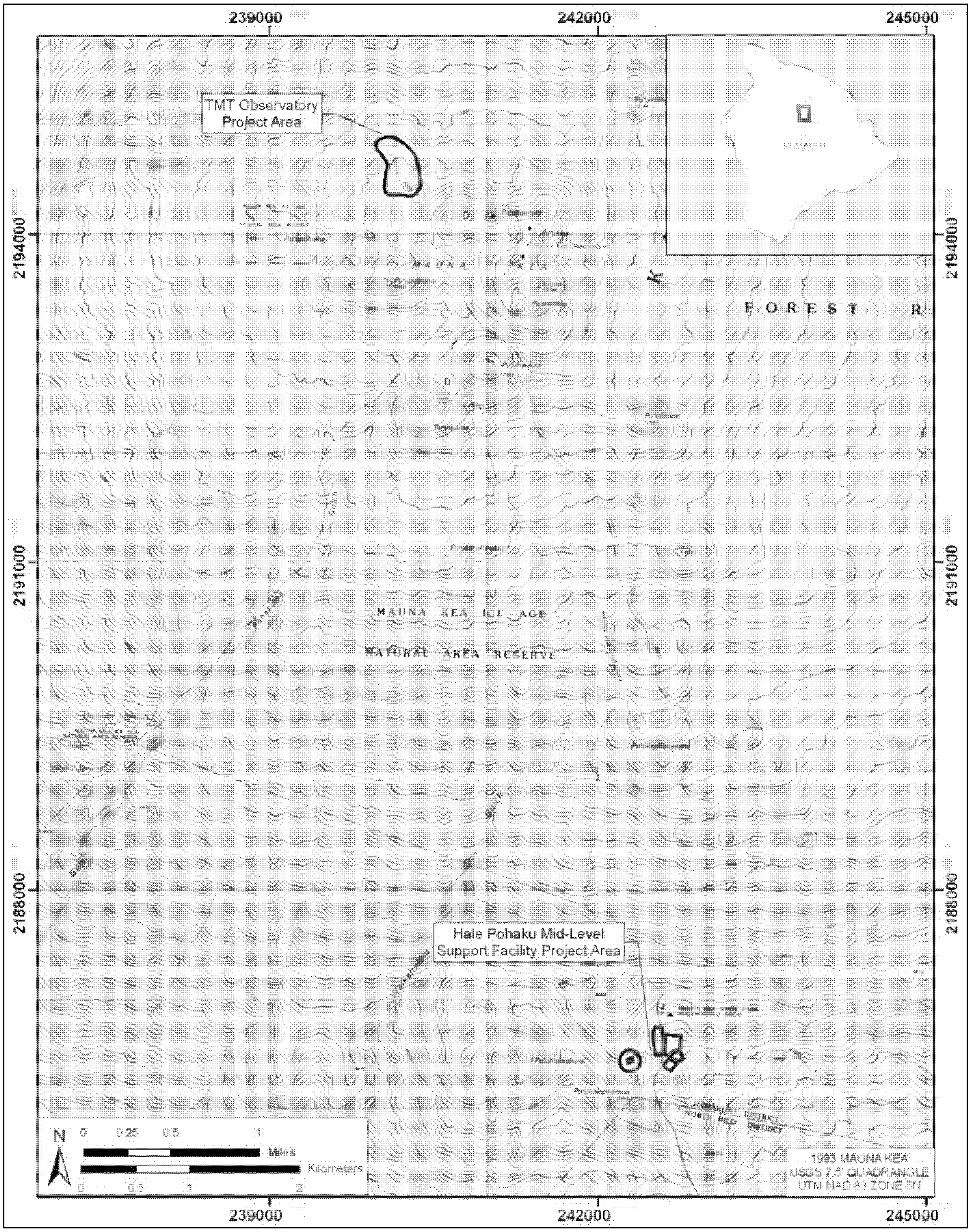

Figure 1. U.S. Geological Survey 7.5-Minute Series Topographic Map, Mauna Kea Quadrangle (1993), showing the location of the Project areas

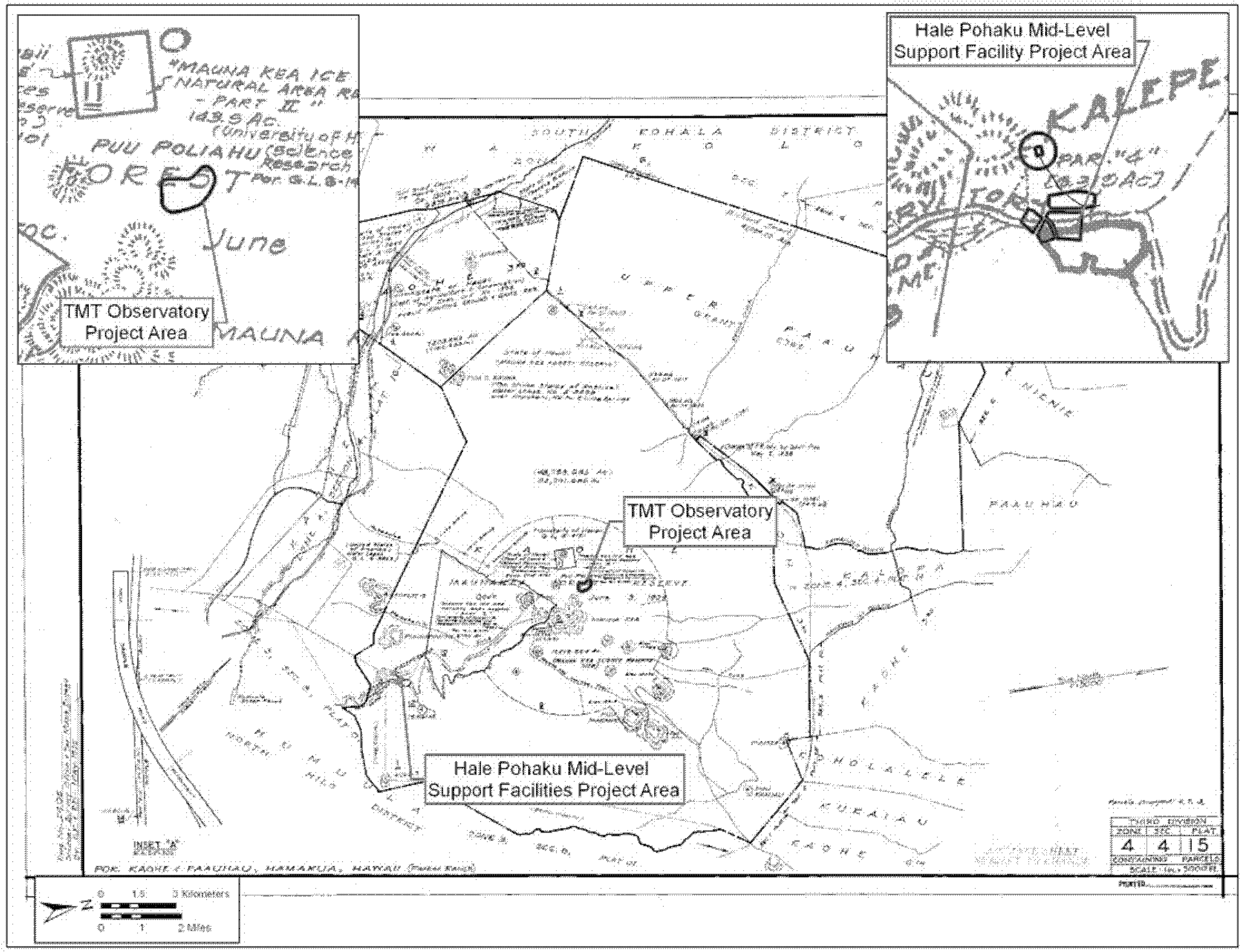

Figure 2. Portion of Tax Map Key (TMK) 4-4-015, showing the location of the Project areas

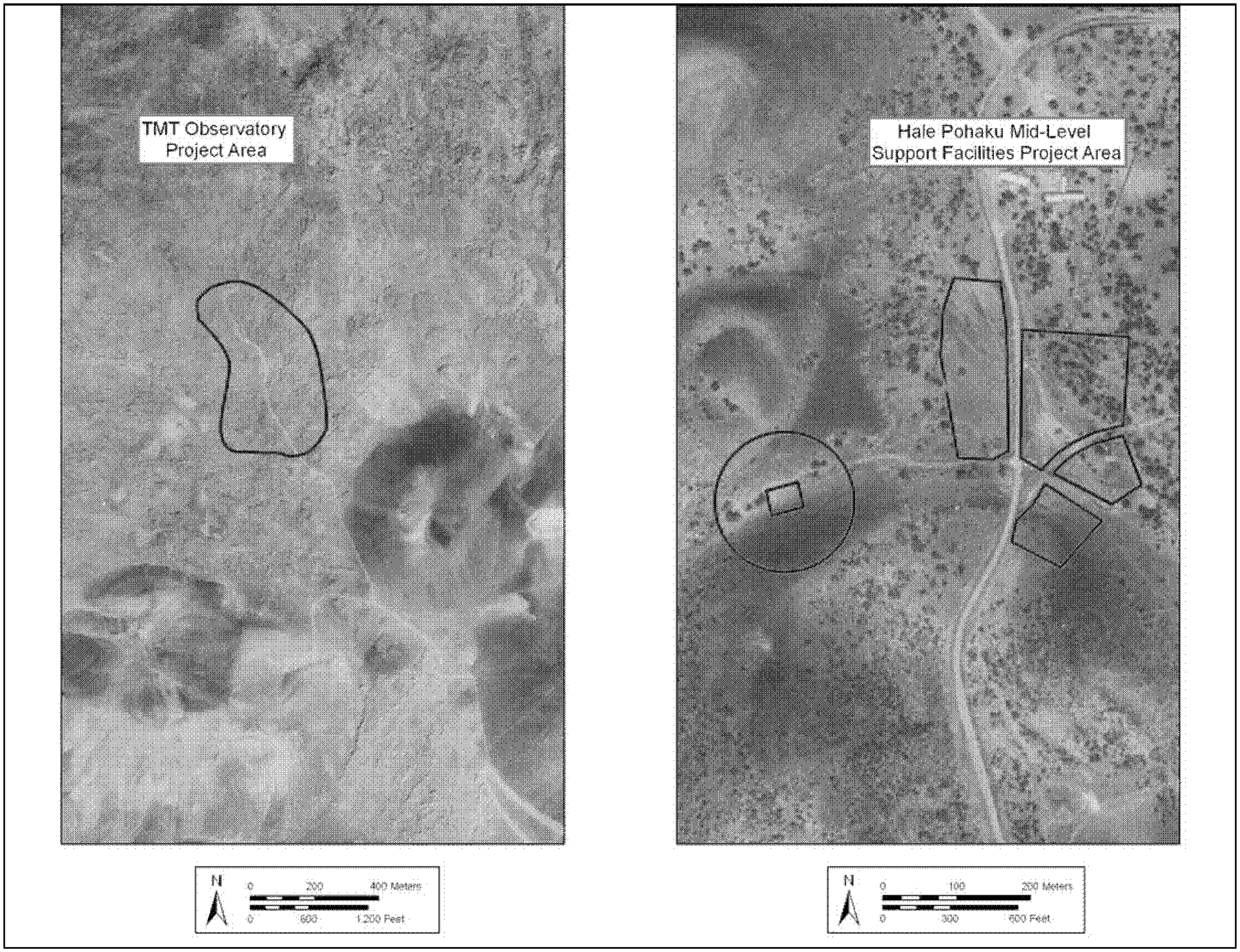

Figure 3. Aerial photograph (source: U.S.D.A. 2000), showing the location of the Project areas

1.4 Environmental Setting for the TMT Observatory Project Area

1.4.1 Natural Environment

The information in this subsection is based on the following primary sources: Macdonald et al. (1983), Juvik and Juvik (1998) and Ziegler (2002).

The TMT Observatory Project area is located on a ridge line north of the summit cone, Pu‘u Kūkahau‘ula, at approximately 13,700 feet elevation. Maunakea, the tallest mountain in the Hawaiian Islands at 13,796 feet elevation, is also the tallest mountain on earth as measured from the ocean floor to the summit, a distance of some 29,500 feet (thus, exceeding by approximately 1,000 feet the non-volcanic Mount Everest). This massive “shield volcano,” one of five making up the island of Hawai‘i (the others are Maunaloa, Kīlauea, Kohala and Hualālai), has formed through the action of the Pacific Plate moving over a more or less stable “hot spot” located deep within the earth that generates magma (molten rock). The oldest exposed basalts (cooled magma) from Maunakea have been dated to approximately 250,000 years ago, and the mountain is in its dormant Postshield Stage (highly unlikely to erupt but possible). No historic (i.e., prior to the late 1700s) eruptions have been reported for Maunakea, which last erupted approximately 4,500 years ago.

Unlike mountain-top regions in other parts of Hawai‘i Island and the rest of the Hawaiian Islands, the summit of Maunakea is actually very arid, receiving less than 15 inches of rainfall, and appropriately classified as an “alpine desert.” Most of precipitation is in the form of freezing fog and snow. This aridity is due to a meteorological phenomenon known as the “inversion layer,” in which a layer of relatively warm air between approximately 5,000 and 7,000 feet elevation impedes the upward rising of relatively cooler, moisten-laden air.

Light snows are common in the “winter months” at the summit, and frost is a nightly occurrence year-round. The monthly average temperature ranges from 25 to 60 degrees Fahrenheit with winter storms often depositing up to several feet of snow in the higher elevations. Maunakea was glaciated (i.e., covered with snow and ice-pack that did not melt during the summer) in the Late Pleistocene, and the primary geological activity shaping the summit terrain is glaciation. Several main glacial features present on the summit region include glacial striations on bedrock outcrop, the sculpted configuration of cinder cones, and the formation of Lake Waiau and Pōhakuloa Gulch as a result of glacial melt-water. The summit region’s ground surface is generally characterized by rubbly ground moraine deposits and Hawaiite ‘a‘ā flows of Late Pleistocene origin (Figure 4), partially mantled by cinder, coarse ash, and spindle bombs (McCoy 1982: A-29). The lowest temperature ever recorded in historic times in the Hawaiian Islands (9°F) was atop Maunakea. Permafrost is still present a few meters below the present ground surface in the summit region.

Vegetation is almost non-existent in the summit region of Maunakea; the tree-line is located nearly a mile in elevation below the summit (at approximately 9,000 feet elevation); the highest major vegetation zone, known as the Alpine Scrub Zone, generally ends at approximately 11,300 feet elevation. Plants in the so-called Alpine Stone Desert Zone of the summit region are mostly limited to small lichens and mosses. However, due to daily convection currents (warm winds moving upslope), the summit experiences a special type of local ecosystem known as the High-

Altitude Aeolian Ecosystem in which insects and other small arthropods (and sometimes small birds) are driven up to the summit, whose low temperatures immediately kill or immobilize them. The endemic Maunakea Wēkiu Bug (*Nysius wekiuicola*), which has lost the ability to fly, has developed a remarkable specialization (extremely low body temperature that withstands below-freezing conditions) that allows it to feed on immobilized or dead insects and arthropods driven up by the wind. According to Ziegler (2002:209), there are other similar creatures in this most forbidding environment, including a non-described species of black rock centipede only 1 cm long.

As discussed in more detail below, it is important to understand that Native Hawaiians were utilizing this Alpine Stone Desert Zone in pre-Contact times, as evidenced by the extraordinary (State and National Register of Historic Places site) Mauna Kea Adze Quarry, one of the largest traditional adze quarries in the world, located up to 12,400 feet elevation, a little over two miles south of the TMT Observatory Project area; and as indicated by many dozens of shrines at or above 13,000 feet elevation. The basalt available between approximately 11,000 and 12,400 feet elevation on Maunakea is generally perceived by expert stone workers to be the highest quality material available in the Hawaiian Islands. Several old trails exist in and around the TMT Observatory Project area that testify to the long-term utilization of the Alpine Stone Desert by the Native Hawaiians.

1.4.2 Built Environment

The TMT Observatory Project area is located at the end of an existing 4-wheel-drive road that was originally built in the 1960s to develop the general summit area for a number of astronomical observatories. Today, there are 13 main observatories and associated facilities located in the general vicinity of the TMT Observatory Project area.

1.5 Environmental Setting for Hale Pōhaku Mid-Level Support Facilities

1.5.1 Natural Environment

The environmental setting of the Hale Pōhaku area has been well described by McCoy (1990:237-92; 1991:4-9) and the reader is referred to his work for a thorough study and references. A brief overview is presented in this study, based on Dr. McCoy's work. The current Hale Pōhaku Mid-Level Support Facilities Project area is located on a gently sloping saddle area surrounded by prominent cinder cones, including Puʻu Kalepeamoa, Puʻu Haʻiwahine, and Kilohana. Puʻu Kalepeamoa is understood as an older hawaii-ite cone which contains a large number of cored bombs many of which are formed of angular mafic blocks with dunnite and gabbro inclusions (McCoy 1991:6). Puʻu Kalepeamoa is understood as the likely source for much of the raw material worked at the Puʻu Kalepeamoa site complex (see Section 5.3 and Table 4). The surrounding geology includes cinder cones, lava flows and air fall deposits termed Laupahoehoe Volcanics understood as probably less than 40,000 years old.

Elevations within the Hale Pōhaku Mid-Level Support Facilities Project area range from approximately 2,780-2,805 m (9,120-9,200 ft.) above mean sea level. The Hale Pōhaku Mid-Level Support Facilities Project area receives an average of approximately 650 mm (26 in.) of annual rainfall (Giambelluca et al. 1986). Sediments within the Hale Pōhaku Mid-Level Support Facilities Project area are listed as Huikau Extremely Stony Loamy Sand (rHLD) and Cinder Land (rCL) (Figure 4). Soils of the Huikau Series are described as "somewhat excessively drained loamy sands that formed in volcanic ash, pumice, and cinders" (Sato et al. 1973). Cinder Land is described as "bedded cinders, pumice, and ash…The particles have jagged edges and a glassy appearance and show little or no evidence of soil development" (Sato et al. 1973).

The Hale Pōhaku Mid-Level Support Facilities Project area lies close to the timberline and the vegetation is generally a subalpine xerophytic scrub of both native and non-native, introduced plants such as *pūkiawe* (*Styphelia tameiameiae*), *noho-anu* (*Geranium cuneatum*), *ʻōhelo* (*Vaccinium reticulatum*), *naʻenaʻe* (*Raillardia ciliolata*), *kalamoho* fern (*Pellaea ternifolia*), *ʻāheahea* (*Chenopodium oahuensis*), *pilo* (*Coprosma montana*), *māmane* (*Sophora chrysophylla*) and the endangered endemic, *ahinahina*, also known as Maunakea silversword (*Argyroxiphium sandwicense*), as well as introduced exotics such as mullein (*Verbascum thapsus*) and a variety of native and exotic grasses. It seems probable that prior to human utilization of this area, and the presence of feral goats and sheep, that the *māmane* vegetation was more extensive and diverse (McCoy 1990:91). The work of McCoy (1990) has also emphasized the "non-subsistence" nature of this alpine environment, and it is understood that virtually all food to support temporary habitation in the area would have been imported from lower elevations.

1.5.2 Built Environment

The eastern portion of the Hale Pōhaku Mid-Level Support Facilities Project area is adjacent to the Mauna Kea Access Road and includes components of the Hale Pōhaku Mid-Level Astronomy Facilities. Development in the Hale Pōhaku area includes the Onizuka Center for International Astronomy, the Visitor Information Station (a.k.a. Ranger Station), and construction laborer residences. The construction laborer residences are located within the current Hale Pōhaku Mid-Level Support Facilities Project area and include two dormitory structures and four cabins. The western portion of the Hale Pōhaku Mid-Level Support Facilities Project area consists of the existing HELCO power substation within a fenced enclosure. The vicinity of the Hale Pōhaku Mid-Level Support Facilities Project area is generally undeveloped, with the exception of jeep roads.

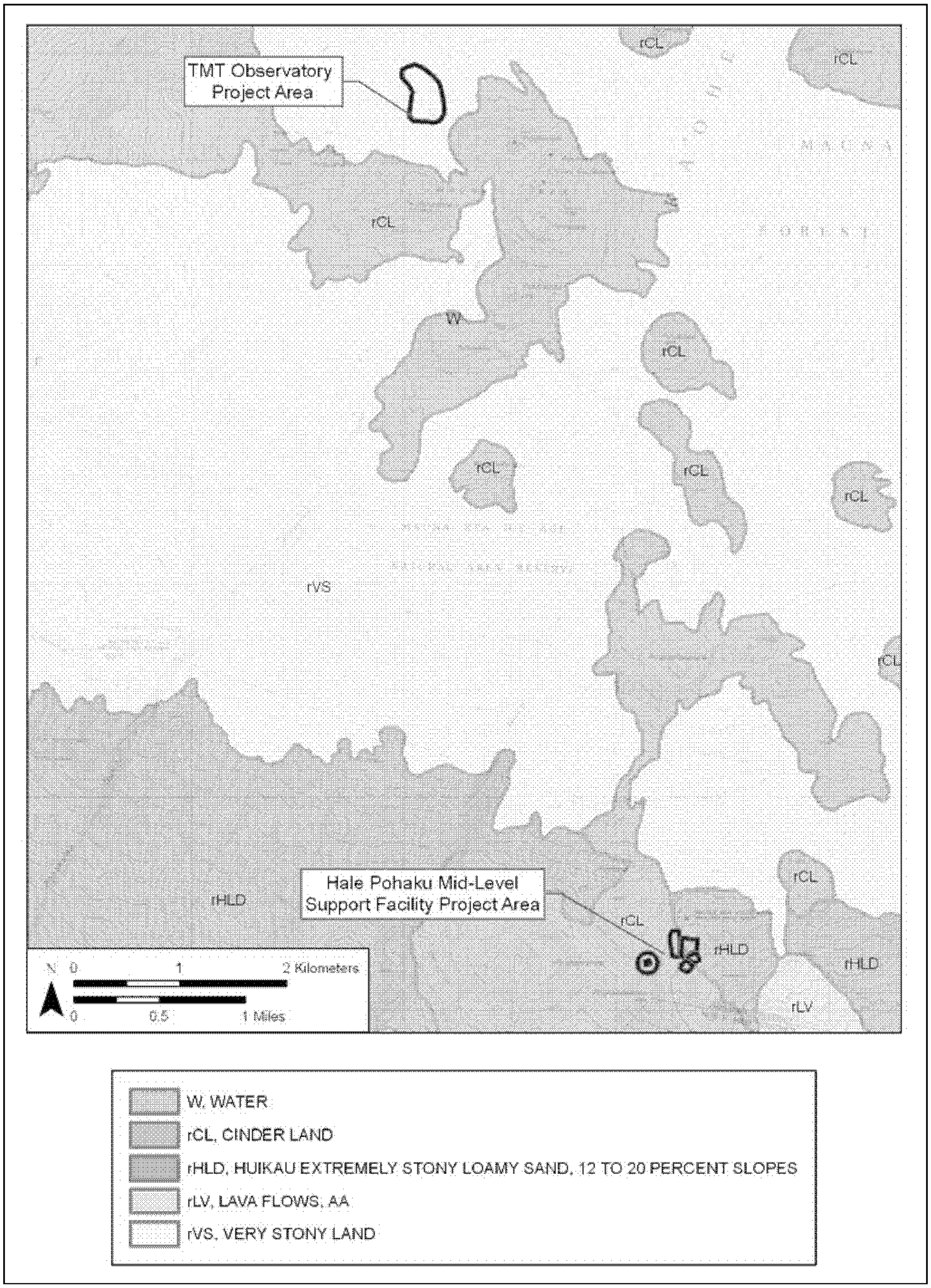

Figure 4. U.S. Geological Survey Topographic Map, Mauna Kea Quadrangle (1993) with overlay of the Soil Survey of the Island of Hawaiʻi (Sato et al. 1972), showing sediment types within the Project areas

Section 2 Methods

Historical documents, maps and existing archaeological information pertaining to the sites in the vicinity of this Project were researched at the CSH library. Information on Land Commission Awards was accessed through Waihona ʻĀina Corporation's Māhele Data Base (www.waihona.com). The State Historic Preservation Division, Office of Hawaiian Affairs, Hawaiʻi Island Burial Council, and community and cultural organizations in Hawaiʻi were contacted in order to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the Project area and the surrounding vicinity. The names of potential community contacts were also provided by colleagues at CSH and from the authors' familiarity with people who live in or around the Project area. The cultural specialists conducting research on this assessment employed snowball sampling methods, an informed consent process and semi-structured interviews according to standard ethnographic methods (as suggested by Bernard 2005). Some of the prospective community contacts were not available to be interviewed as part of this Project (see Section 6.1.1). A discussion of the consultation process can be found in Section 6 on Community Consultations. Please refer to Table 6, Section 6 for a complete list of individuals and organizations contacted.

Section 3 Traditional Background

3.1 Overview

This section focuses on the traditional background of Maunakea. For the purposes of this background section, the subject Project area is defined as the entire summit area of the mountain, including its many culturally-significant landscape features and natural resources (Figure 5). Because Maunakea is such a prominent landform, and because Hawaiian traditions recognize its connections with many other places, more distant associations with other parts of Hawaiʻi Island and with other islands are also documented and assessed.

This section includes important examples and excerpts from previous studies of the cultural significance of Maunakea to Hawaiians including Kanahele and Kanahele (1997) and Maly (1997, 1999, 2005); numerous examples and observations are also included from an excellent website maintained by Nā Maka o ka ʻĀina (2008).

Maunakea is a sacred cultural landscape to Native Hawaiians. It is symbolic of Wākea (the ʻSky Father' to Hawaiians), home of Poliʻahu, the goddess of snow and foe of Pele (the fire goddess), and of many other resident deities and supernatural entities (e.g., Līlīnoe, Kūkahauʻula and Moʻoinanea); home of Waiau, the highest permanent lake in the Hawaiian Islands; location of the highest and most extensive basalt quarry in all of Polynesia and perhaps the entire world; and numerous trails, *ahu* (stone markers), religious shrines and cinder-cone *puʻu* (hills) (Figure 6).

Figure 5. The summit region of Maunakea showing some of its main cinder-cone *puʻu* and an astronomical observatory, top center of the image (source: Ziegler 2002)

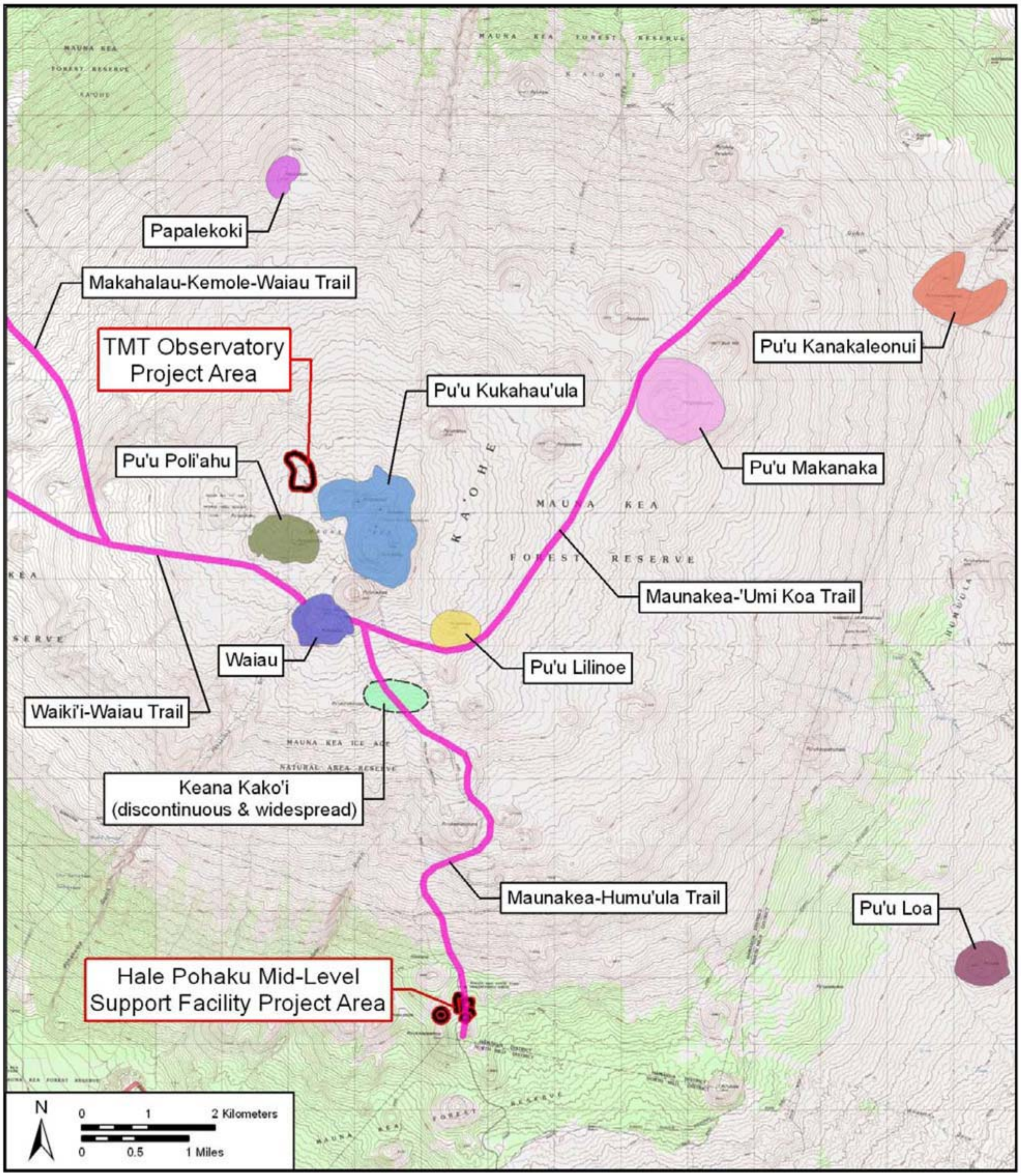

Figure 6. Culturally significant landscape sites and features in the vicinity of the Project area

3.2 Place Names

Translations presented without attribution in this subsection are from Pukui et al. (1974). Spelling and diacriticals also follow Pukui et al.’s (1974) usage.

3.2.1 Mauna Kea or Maunakea: Why is Maunakea spelled as one word?

In Pukui’s (1974) “Place Names of Hawaii” Mauna Kea is listed as two words “Mauna” and “Kea” and is literally translated as “white mountain (often the mountain is snowcapped)” (Pukui et al 1974:148). A recent 2008 article in the Office of Hawaiian Affairs newspaper “Ka Wai Ola” presents a good argument for spelling Mauna Kea as one word—Maunakea. The article is presented in full below:

> By Larry Kimura
>
> Hawaiian names, both personal and place names, are usually made up of several root words combined together to represent the person or place. Hawaiian tradition is to write these root words together as a single word, for example, Kamehameha not Ka Mehameha, Kalākaua not Ka Lā Kaua, Waikīkī not Wai Kīkī, Keauhou not Ke Au Hou. The Hawaiian tradition is different from the English one, as in English the parts of a place name are sometimes written separately, e.g., Mount Vernon, New York, Red River Valley. It is also common in English to write “native” names as separate words: Sitting Bull, Crazy Horse, Red Cloud.
>
> The Hawaiian tradition is based in the Hawaiian grammar of the oral language that marks separate words differently from names. In the case of the two mountains on Hawai‘i Island that scientist from outside Hawai‘i have come to dominate, Maunakea and Maunaloa, American English spelling traditions have been imposed on earlier Hawaiian spelling traditions. The earlier Hawaiian spelling traditions can be seen in places with the same name where American scientist have not had as much of an influence, e.g., Maunaloa on Moloka‘i, Maunakea Street in Honolulu, and the Maunakea family name. Older Hawaiian writings also include examples of Maunakea and Maunaloa written as one word when referring to the mountains on Hawai‘i.
>
> *Larry Kimura is an assistant professor at Ka Haka ‘Ula O Ke‘elikōlani College of Hawaiian Language, University of Hawai‘I at Hilo.* (Vol. 25, No. 11, November 2008:16)

For this CIA, both spelling variations will be used. The two word format—Mauna Kea—will be used to address official entities such as the Mauna Kea Science Reserve and when citing content from other sources such as books or past, published interviews. For all other uses in the text, the name of the mountain will be written as one word—Maunakea.

Maunakea translates literally as white (*kea)* mountain (*mauna*), so named for its breathtaking snow-capped summit. However, according to Nā Maka o ka ‘Āina (2008) and other authorities on Hawaiian culture (e.g., Kepā Maly, Pualani Kanahele), Maunakea has numerous other meanings and translations. It is a short version of Mauna a Wākea, a name that refers to the sky father, Wākea; this would be one of its *kaona* (hidden or more subtle meanings). An excerpt from Maly's testimony to the Hawai'i Island Burial Council in 2000 (reproduced by Nā Maka o ka 'Āina 2008) effectively illustrates this point:

> When I spoke with *kupuna* about Mauna Kea, some of them believed that the name shouldn't be translated literally "white mountain."
>
> Mauna Kea, not just simply the "white mountain" because it's periodically snow-covered. But that it is Mauna Akea, Ka Piko a Wakea. The summit, the *piko* that ties this earth to Wakea, the God father who is the sky.
>
> They see it as the *piko kaulana o ka 'aina*, the famous peak, summit of the land. But that peak, or *piko*, is also what we would call navel or belly button. It's that which connects you back to the generations preceding you.
>
> *'Aha ho'owili mo'o*, this line, this cord that connects the Hawaiian people from these lands, from these islands, which were the children of the gods or creative forces of nature, back to their cosmic origins.
>
> Not just "white mountain." The mountain of Wakea, the progenitor of the Hawaiian race.

Waiau, the permanent lake located within Pu'u Waiau near the summit of Maunakea at approximately 13,020 feet elevation, translates as "swirling water," and is associated with the snow goddess Poli'ahu.

Pu'u Kūkahau'ula, which is the highest of several cinder-cones peaks around the summit of Maunakea, is located less than one mile southeast of the Project area. According to Nā Maka o ka 'Āina (2008), Kūkahau'ula translates as "[the peak of] Kū of the red-tinted snow," in reference to the light effects of the rising sun on this, the highest of peaks of Maunakea.

Pu'u Poli'ahu is named for Poli'ahu, "the woman who wears the snow mantle of Mauna Kea"; Poli'ahu, which is also the name of a land division on Maunakea, is translated as "garment [for the] bosom (referring to the snow)" by Pukui et al. (1974) and as "Snow goddess of Mauna Kea. *Lit.* Bosom goddess" by Pukui and Elbert (1986).

Maly and Maly (2005:200) include a citation by W.D. Alexander regarding the naming of Pu'u Poli'ahu. As the peak was nameless, Alexander called it "Poliahu" because he believed it to be "a poetical name, being that of the demigoddess with snow mantle who haunts Mauna Kea" (Maly and Maly 2005:200). This assignation of names to various places and peaks of Maunakea by non-Hawaiians was not an uncommon occurrence (Maly and Maly 2005).

Pu'u Līlīnoe, also known simply as Līlīnoe, is one of the major peaks (approximately 12,956 feet elevation) near the summit of Maunakea; Līlīnoe translates as "mists," and is associated with a goddess of mists by the same name, sister of Poli'ahu.

Other main *pu'u* in the summit area include **Pu'u Kanakaleonui**, which translates as "loud-voiced man"; **Pu'u Mākanaka**, which translates as "hill crowded with people (*mā-* is short for *maka*)"; and **Pu'u Loa**, or the "long hill." It is worth stating that there are many places named *puʻu loa* in the Hawaiian Islands, since it is a fairly generic descriptor. Another *puʻu* is **Papalekōkī** , which Pukui et al. (1974) do not define.

Keanakākoʻi (or **Ke-ana-kākoʻi**), literally "the adze-making cave" (Pukui et al 1974:103), is named for an ancient and most famous basalt quarry complex extending up to 12,400 feet in elevation on the southern slope of Maunakea. It is important to note that this place name is also fairly common in the Hawaiian Islands, and refers more generally to places at which excellent basalt for tool-making can be obtained. This particular Keanakākoʻi on Maunakea, however, is the finest such source in the islands (see discussion below).

Hale Pōhaku, literally "stone house," refers to the two stone cabins constructed by the Civilian Conservation Corps in 1936 and 1939 at an elevation of 9,220 feet on the southern slope of Maunakea. L.W. Bryan, who served as the Territorial Forestry Office and oversaw the construction of the "stone houses," also named them Hale Pōhaku.

3.3 Moʻolelo Associated with Specific Place Names

3.3.1 Maunakea

There are several references to associations between Maunakea and other islands, including an overlook and *pali* (cliff) at Haleakalā Crater on Maui:

> *Hahai ʻo Kahaʻi me Haui iā Pele i ka ʻāina o Maui,*
> *hakakā lākou i ke alo o Kamohoaliʻi.*
> *Pūʻāʻā ka iwi o Pele,*
> *mākole ka maka o Kānemilohai i ka uahi.*
> *Hoaka ke koʻiʻula o Pele i luna o ʻAlenuihāhā,*
> *kūhaka lunalilo ʻo Mauna Kea i ka ʻihiʻawaʻawa.*
>
> Kahaʻi and Haui pursued Pele to the land of Maui
> where they battled in Kamohoaliʻi's presence,
> Pele's bones scattered in the crater of ʻAlenuihāhā,
> where Kānemilohai's eyes are inflamed by smoke.
> The red cloud of Pele flames above ʻAlenuihāhā
> where Mauna Kea rises abovethe storm. (Landgraf 2003)

Pukui provides two relevant *ʻōlelo noʻeau* (proverbs or poetical sayings) dealing with Maunakea: 1) Mauna Kea, kuahiwi ku haʻo i ka mālie (Mauna Kea, standing alone in the calm) and 2) Poliʻahu, ka wahine kapa hau anu o Mauna Kea (Poliʻahu, the woman who wears the snow mantle of Mauna Kea) (Pukui 1983:234, 294). These sayings reflect a number of important Hawaiian beliefs and values about Maunakea, including her unique status as the unparalleled "top of the world," her calm and reassuring presence, and her gifts of *hau* (snow).

A common reference to Maunakea is as the most visible landmark of the islands. Hence, the Maunakea summit has become symbolic for the Hawaiian Islands. In Fornander's "The Legend of Kila (*He Kaʻao no Kila*)," the ruling chief of Kauaʻi, Mōʻīkeha commands his son Kila to set sail in a double canoe for the Society Islands. As they leave the relative safety of the waters of the Hawaiian Islands they have their first strife with malevolent monster demi-gods of the deep when "they sailed on until the islands of Hawaiʻi here were blotted out of sight and the land disappeared and all that could be seen was the top of Maunakea…(*Holo aku la lākou a nahā nā moku o Hawaiʻi nei, a nalowale ka ʻāina, koe o Mauna Kea, ʻaʻole i nalowale*)" (Fornander 1919: Volume IV:160-161).

In Fornander's "Story of ʻUmi: One of the Most Noted of Hawaiian Kings (*He Moʻolelo no ʻUmi: Kekāhi Aliʻi Kaulana o ko Hawaiʻi Nei Paeʻāina*)," the ruling chief ʻUmi-a-Liloa leads a war party out of Waipiʻo, Hāmākua, to attack Hilo:

> Up through the mountains of Mauna Kea and right back of Kaūmana, running towards Hilo, was a short cut over the mountains to the trail of Poliʻahu and the well of Poliʻahu at the top of Mauna Kea, the trail leading down to Hilo. It was an old trail for those of Hāmākua, of Kohala and of Waimea to take when going to Hilo. Therefore, preparations were made and the army ascended the Mauna Kea mountain and descended on the upper side of Hilo…
>
> *Aia ma ke kuahiwi a ma ka mauna o Mauna Kea, a mauka pono o Kaūmana iho i kai o Hilo, he alanui pōkole ma ke kuahiwi, o ke alanui o Poliʻahu a me ka punawai o Poliʻahu, iluna pono o Mauna Kea, a iho ma ka ʻaoʻao ma Hilo. He alanui kahiko ia, no ko Hāmākua, no ko Kohala, a me ko Waimea, ke hele ma Hilo. Nolaila, hoʻomakaukau iho la ka piʻi o ka huakaʻi kaua ma Mauna Kea, a iho ma ka ʻaoʻao maluna o Hilo*…(Fornander 1919: Volume IV:224-225)

As Fornander (1919) documents in "Legend of Kūapākaʻa (*He Kaʻao no Kūapākaʻa*)," the hero, Kūapākaʻa, is sailing in a double canoe with the ruling chief Keawenuiaʻumi past Kauaʻi for Kaula Rock. When the ruling chief and his men fall asleep, Kūapākaʻa turns the canoe around and sails straight for the Big Island and: "…when they saw the top of Mauna Kea above the mist, passing and repassing in the distance like a pointed cloud. At this the men all woke up at the call 'There is Hawaii' (… ʻ*ike aku la lākou i ka piko o Mauna Kea i loko o ka ʻohu, e māʻalo ana me he ʻōpua la. O nā kānaka a pau o luna o ka waʻa, aia ʻae la lākou, ʻaia o Hawaiʻi'*)" (Fornander 1919: Volume V:124-125). This is another account of Maunakea as a significant landmark for long-distance voyagers in Polynesia.

Fornander also recounts "Tradition of Kamapuaʻa (*Kaʻao no Kamapuaʻa*)," the pig deity sees the fires of Pele, the goddess of volcanoes, and begins to chant:

The fire by Lonomakua	*O ke ahi a Lonomakua la,*
Of the woman Pele	*A ka wahine a Pele,*
It is burning in the uplands of Puna	*Ke a ala i uka o Puna,*
By the white snow of Mauna Kea	*I ka hau aʻiaʻi o Mauna Kea*
The smoke darkens the heaven	*I ka uwahi pō i ka lani*

(Fornander 1919: Volume V:340-341)

Here, the brilliant whiteness of the snows (*hau aʻiaʻi*) of Maunakea provide poetic contrast with the darkening smoke (*uwahi pō*) of Pele.

In Fornander's "Legend of Pūpūkea (*Kaʻao no Pūpūkea*)," is an account of several columns of Hawaiʻi Island warriors rushing to repel an attack by the Maui ruling chief Kamalalawalu with the forces converging in the vicinity of Hōkūʻula Hill in Waimea. Some 112,000 (*ehiku lau mano kānaka*) defenders from Kaʻū District are related to have approached "from ʻŌhaikea between Mauna Kea and Hualālai (*Ma 'Ōhaikea mai, mawaena o Mauna Kea a me Hualālai*)" (Fornander 1919: Volume V:436-451).

Fornander (1919) provides an account of "Famous Men of Early Days (*Po'e Kaulana o ka Wā i Hala*)" he tells a story of Uma of Pūehuehu, Kohala, who lived in the time of Kamehameha I and was of very small stature (*'u'uku loa*). He was an expert in the art of bone-breaking (*akamai loa ia i ka lua*). Uma has a number of adventures dispatching brigands and muggers as he proceeds from Pu'uhue in southern Kohala to Kapia at Waimea, looking toward Maunakea (*e nānā ala ia Mauna Kea kuahiwi*), proceeding on to Manauea Stream and on to Pu'u o Moeawa at Mahiki between Waimea and Hāmākua, and then on to Kaupakuea in upper Hilo. The passing reference to Maunakea appears to serve as a geographic reference to Kapia. Kapia may be the first place from which Maunakea can be seen as one traverses the mid-slope of the west side of the Kohala Range arcing around to the southeast. The account notes that at the time "there was much robbery amongst the people in lonely places (*he nui loa ka pōwā ana o nā kanāka 'oia wā ma nā wahi mehameha*)," and certainly suggests that the trails around the north slope of Maunakea were among such lonely places (Fornander 1919: Volume V:500-501).

Fornander also tells of "The Flood in Hawaii in the Olden Times (*No Ke Kaiakahinali'i Ma Hawaii Nei*)" is an odd account of the goddess Pele bringing "the sea of Kahinali'i" to Hawai'i at a time when "here in Hawaii in the earliest times there was no sea (*ma Hawaii nei mamua loa, 'a'ole he kai*…)" (Fornander 1919: Volume V:524-525). Pele poured out the sea from her head submerging almost all of the land except for the highest peaks including Maunakea (*…ua koe iki 'ae kekāhi wahi, 'oia no o luna o Haleakalā, a me Mauna Kea a me Mauna loa, 'a'ole i nalowale loa…)* and then caused the sea to recede to what it is today.

In Thrum's (1907) *Hawaiian Folk Tales, A Collection of Native Legends*, a chapter on "Pele and the Deluge" appears to have been borrowed from the preceding Fornander account or shares a common source, and relates effectively the same story.

Kalākaua's *Legends and Myths of Hawaii* details an account of "Umi, the Peasant Prince of Hawai'i" which includes a number of passing references to Maunakea (such as comparing the color of an old priest's hair to the snows of Maunakea) but one account merits particular mention (Kalākaua 1888:249-315). In a side bar story about the fabulous conch shell trumpet known as the Kiha-pū is the following vignette:

> In obedience to the revelation of a *kaula* [seer] of great sanctity, he [Kiha] had secretly deposited it [the Kiha-pu] in a cave near the summit of Mauna Kea and retired to a valley below. Near the middle of the following night a sound unearthly and terrible came echoing down the mountain-side, followed by a hurricane which uprooted trees and tore great rocks from their fastenings and hurled them into the gorges below. The earth trembled as if a volcano was about to burst forth, and a ruddy light hung about the summit. The sound ceased, the wind fell to a whisper, and Kiha rose to his feet in the darkness and said: "It is well. The great [deity] Lono has kept faith. He has blown the sacred trumpet, and henceforth it will have the voice of a god!" The next morning he repaired to the cave, and found the shell, not where he had left it, but on the top of a huge rock with which the entrance had been forever closed. He raised the trumpet to his lips and such sound as his heart desired came forth at the bidding of his breath. He

> breathed a simple call to his subjects, and it was heard the distance of a day's journey. He gave a battle-blast, and his ears were stunned with the mingled cries and groans of conflict. He ventured an appeal to the unseen, and to a weird music around him rose gnomes, fairies and grinning monsters. He returned elated to the palace, and more and more, as its strange voices were heard, did the Kiha-pu become an object of awe and wonder. (Kalākaua 1888:254)

Thus the summit region of Maunakea is associated with the actions of deities, transformation of the Kiha-pū, and the imparting of qualities of awe and wonder.

Also in Kalākaua's *Legends and Myths of Hawaii* regarding Lono and Kaikilani is an account of the prowess of the ruling chief Lonoikamakahiki: "He outran the fleetest…as in bringing a ball of snow from the top of Mauna Kea" (Kalākaua 1888:322). Thrum's *Hawaiian Folk Tales* also has a chapter on Lono and Kaikilani that describes Lono as the deity Lono whom we encounter "reclining on the bosom of a cloud that rested over Mauna Kea" (Thrum 1923:108-116).

Kalākaua's account of: "Kahavari, Chief of Puna" is a brief sidebar discussion of the demi-god "Kana" who had the capacity to elongate himself so as to walk between the islands of the Hawaiian chain (Kalākaua 1888:501-507). It is asserted that when Kana waded back from the southern lands of Kahiki "he hung his mantle to dry on Mauna Kea, which was then an active volcano" (Kalākaua 1888:503). The tale seems to play on the height of the mountain and appears to provide an alternate explanation for whose cape explains the summit mantle of snow.

In Thrum's (1907) *Hawaiian Folk Tales* is a chapter on Hawaiian "Legends Resembling Old Testament History." Thrum relates the following:

> In the Hawaiian group there are several legends of the Flood. One legend relates that in the time of Nuʻu, or Nana-nuʻu (also pronounced *lana*, that is floating), the flood, kaiakahinaliʻi, came upon the earth and destroyed all living beings; that Nuʻu, by command of his god, built a large vessel with a house on top of it, which was called and is referred to in chants as "*He waʻa hālau Aliʻi o ka Moku*," the royal vessel, in which he and his family, consisting of his wife Lilinoe, his three sons and their wives, were saved. When the flood subsided, Kāne, Kū, and Lono entered the *waʻa hālau* of Nuʻu, and told him to go out. He did so, and found himself on the top of Mauna Kea (the highest mountain on the island of Hawaiʻi). He called a cave there after the name of his wife, and the cave remains there to this day – as the legend says in testimony of the fact. (Thrum 1907:20)

3.3.2 Hāloa and Kalo on Maunakea

Hawaiian genealogy reveals the importance of *kalo* (taro) and the reasons Hawaiians have such a sacred connection to this plant and to Maunakea. According to Hawaiian mythology, the first man was born from the taro plant. Wākea, the sky father, and Papahanaumoku, the earth mother, on the summit of Maunakea, birthed a child who was premature.

> The first-born son of Wākea was of premature birth (*keiki alualu*) and was given the name of Haloa-naka. The little thing died, however, and its body was buried in the ground at one end of the house. After a while, from the child's body, shot up a

taro plant, the leaf of which was named *lau-kapa-lili*, quivering leaf; but the stem was given the name Haloa.

After that, another child was born to them whom they called Haloa, from the stalk of the taro. He is the progenitor of all the peoples of the earth. (Malo 1951:244)

Hāloa is therefore both plant and man. "Wākea's stillborn son is reborn as a taro plant which produces his second son, a human child Hāloa" (Kanahele 1995:18). Taro therefore becomes a metaphor for life, because both need to be rooted in good soil and nourished with waters of Kāne. The kalo stalks and Hawaiians both grow towards the sun, striving to be nearer to the heavenly spirit, and as every plant must die, so too will every human. What remains of the plant lives on for the next generations. Because of this close interconnection between life and *kalo*, *kalo* and *poi* (pounded taro thinned with water) thereby became the main staples of the Hawaiian diet (Kanahele 1995:18).

For nutritional and spiritual significance *lo'i kalo* became vital for Hawaiian way of life. The work was for men and required marshland, a large supply of *kalo* cuttings, and advanced irrigation systems (Kanahele 1995:19-22).

3.3.3 Kūkahau'ula

Kūkahau'ula, or Kū of the red-tinted snow, is Maunakea's highest *pu'u.* The following *mo'olelo* about the love affair between Kūkahau'ula and Poli'ahu (another nearby peak named for the goddess of snows) comes from the July, 1931, edition of the *Paradise of the Pacific*, and was recounted by Ahuena (source: website maintained by Nā Maka o ka 'Āina 2008):

The Betrothal of the Pink God and the Snow Goddess
The Pink Snow Is Always Seen Upon Mauna Kea
by Ahuena
(edited)

Tell me one of your many legends, Puna, some tale belonging to the Big Island of Hawaii …something different, something altogether apart from the lore of Pele, goddess of Volcanoes, creator of the Islands.

So spoke a tawny-skinned young girl to her indulgent old Hawaiian nurse whose bent form bespoke four score years and more.

Her devoted old nurse sat on the edge of the mat, facing her.

Let us finish this task first…while I tell you the legend of the betrothal of the Pink God and the Snow Goddess of Mauna Kea. The Pink God's devotion to the Snow Goddess of Mauna Kea is most wonderful to behold. He is known as the most constant lover on the island of Hawaii.

"How beautiful!" exclaimed the maiden. "What a pleasure it would be to see them in real life — but continue with the story, please."

Then the old nurse's voice floated out in a low tremulous chant, apparently chiding the young girl for her impatience —

The youths of Kohala never travel unprepared;
Their kapa togas are already on;
They heed not the rain nor the wind
for their shoulders are ever kept warm.
So worry not for thou shalt hear
The story of the Pink God of Mauna Kea
whose glowing beam is seen afar,
And she of the snow-white bosom
Whose heart melts at his caress.

"Listen," continued Puna, "the Pink Snow is always seen on Mauna Kea, the great white mountain that towers above and almost touches the blue heavens. Its summit of snow-clad peaks clings to the clouds that float near the sun, at Hikiana (the Beginning), where the rosy Kipuʻupuʻu (chilling) rain continually dwells and comes sweeping down to the district of Waimea and at Lanimamao, and away up on this great white mountain dwells a beautiful snow-white maiden whose name is Poliahu…who wears a wreath of the silvery, snow-white hina-hina blossoms that grow upon the mountain tops.

She is known as the Snow Goddess of Mauna Kea. She is the favorite daughter of the red-headed god, Ka-ne, Creator of Waters, and the Goddess of the Mist called Hina. Her nurse's name is Lihau (the Chilling Frost).

Ka-ne, her father, created a silvery swimming pool with beautiful clear water within it for Poliahu, upon the summit of Mauna Kea, reflecting the heavens, forming a basin behind the snow-clad peaks. And in this wonderful, cool basin of Wai-au…he placed a Merman there, as a sentinel, to guard over it and keep a loving watch over the Snow Goddess. The name of this favored sentinel was Moo-i-nanea. [note, this description of Moo-i-nanea as a male is almost certainly in error, as these supernatural water spirits, *moʻo*, were always female in Hawaiian traditions.] It was, and is, he that drives all admiring lovers from there, all who dare climb the mountain slopes and steep precipices to catch a glimpse of Poliahu and chant poems of love and admiration to her. Others he entrances until they become numb and fall asleep before they can behold the face of the beautiful Snow Goddess as she passes by on her way to the icy pool.

But there was a devoted lover whom he helped to cross the kapu pool, for he found this lover to be constant and true despite his trials and disappointment.

This lover was the handsomest and most daring man that he had ever seen. He was known as Ku-kahau-ula (The Pink Tinted Snow's Arrival), the Pink-Tinted Snow-God of Mauna Kea, who made daily pilgrimages to court the Snow Goddess at morn and in afternoon.

Throwing his pink kapa toga over his shoulders, and starting down on the first sun's ray, beyond Haehae, the Land of Desire at the eastern gateway of the sun at Kahiki (the Beyond), he tried to approach as near as possible the place where she dwelt upon the snow-capped mountain. He watched her each day as she played with the kini-akuas (fairies) amongst the silversword (hina-hina) near the pool, and, sometimes further down near the fern belt. But her faithful attendant, Lihau (the Chilling Frost), was always with her.

Each day he became more fascinated and made every effort to reach her abode and court her — win her for his bride — but Lili-noe, another sprite (the Fine Rain) drove him back, and at other times when he started, Pele's sister at the eastern gateway of the sun endeavored to entice him away, all striving to prevent him visiting Poliahu, at Mauna Kea.

Undaunted, he continued his pilgrimages, sending his beam towards Mauna Kea. One day when Poliahu had grown into womanhood, the handsome prince espied her, identifying her by her fine soft white kapa robe that Hina, her mother, had beaten out so beautifully from the bark of the Wauke plant with her magic kapa beater, until it resembled soft white clouds when finished. Her nurse, Lihau, wrapped it around her.

Poliahu was coming slowly down the mountainside almost to where plant life grew when he saw her, and immediately was enraptured with her beauty, beholding her from his place of vantage. Her sparkling face and divine form were radiantly beautiful, and it seemed to him that she even out-rivaled the silvery-white hina-hina blossoms. Throwing his pink kapa toga over his shoulder again, he hastened to greet her, but her nurse, Lihau (the Chilling Frost) and Kipuʻupuʻu (the Hail) came out and found her. It became so chilly he withdrew his beam.

However, that did not weaken his resolution to court her. The next day he departed earlier than usual on his love quest — for he planned all night how this feat of winning the Snow Goddess for his own could be accomplished, and when dawn arrived he departed bravely, but Lilinoe (the Fine Rain) chased him away again. Again and again he made the attempt at each new dawn of day and near sunset, approaching closer and closer, until one day Poliahu's mother, Hina (Goddess of Mist) discovered him just as he was nearing the Snow Goddess' abode. She immediately covered the mountain with mist and sent out Lilinoe (the Fine Rain), and then the biting, black, drizzling rains, Kua-uli and Kipuʻupuʻu to sweep across the forest, all in her anger and fear of losing her beautiful snow-white child.

So, the Snow Goddess was hidden from view, and he had to return alone to the Land of Paradise, disappointed.

Another dawn came and he started again, wearing his usual pink kapa robe, full of hope, and determined to win his heart's desire that day.

Hina, who was on guard, saw him and sent the biting black rain after him. He glided back and forth and waited until the rain had disappeared, when he departed again, his pink kapa so vivid as he traversed the heavens that its reflection caused a glorious rainbow to arch. When the sentinel Merman saw the rainbow caused by the radiant form of the Pink God reflected in the mist, he understood the omen of love and took pity on him, and blew his conch shell, calling out to him:

"Oh, Magnificent Pink Lord, come tomorrow at dawn and I will show you the way to meet Poliahu and conquer Hina; come with thy iridescent pink robe; part the Gray Veil of Night, and send thy red glow to fascinate her;

"I have watched thee daily as thou sailed the heavens in quest of thy loved one, at morn and in afternoons, and am convinced of your love; come to the swimming pool; be not afraid of Lihau's anger; you can overcome her coldness."

Ku-kahau-ula did as he was told, and as he started down in all his radiant beauty, he saw Moo-i-nanea beckoning and he came a little nearer to the topmost peak with his pink kapa cloth outspread prepared to throw one end of it over the shoulder of the Snow Goddess.

Poliahu, seeing him at that moment, called out to her mother in ecstasy and delight.

"Oh, Hina! Behold the handsome one as he stands at the very edge of the sun's ray — all ray himself — and his rosy form is sending a warmth to my bosom. He is wearing a pink helmet and is swathed in a pink cape. Look, mother Hina! Call to him to come nearer that I may chant a message of aloha to him."

Hina was beside herself with fear and grief at the possibility of losing her daughter, for she saw that his beauty had attracted Poliahu, and again, she sent the biting, driving rain and the cold, white mist over the land until the Pink Snow God was lost in the fog and it took him some time to find his home. He became discouraged, and he chanted to the sentinel of the pool, appealing to him to come to his assistance, for he was burning with an unquenchable love for Poliahu.

"Lead me over the swimming pool, to my beloved; to the gods Ka-ne and Hina that they may know of my devotion."

"'Then,' the sentinel called to him, 'come, brave one of the sky, but you must first conceal your beautiful pink kapa robe from view until you arrive at the pool; then take it out and wear it that you may go forward and snare the goddess with it. But you must come humbly, steadily and stealthily, spreading your radiant pink kapa well out as you approach the Goddess of the Treasure Bosom, Queen of the Snow.'

"Ku-kahau-ula followed the instructions minutely. The sun's ray glided over the swimming pool causing a rainbow to arch, turning the silvery waters to a shimmering pink. As the god approached the spot where the snow-white goddess was reclining upon a couch of snow and hina-hina blossoms, clad in her soft white kapa robe, her faithful nurse was watching over her in the sacred stillness of the mountains.

"He advanced slowly, his pink robe outspread, radiantly gilding the brow of Mauna Kea with its glorious hue, until it was almost noon, chanting softly to her of his love, in the stillness of god's acres until he was close enough to throw his brilliant pink toga over her shoulder. Drawing her within his arms, he wrapped the robe entirely around her until they both were concealed within its folds.

"The Merman, Moo-i-nanea, blew the conch-shell that the world would know of the betrothal, and chanted these words:

Ku-kahau-ula and Poliahu, Oh!
These two were betrothed in the Chilling Frost
In the cold region of Mauna Kea;
They are the residents of the uplands,
The children of the thicket of wild-woods
The thicket that radiates their love
From the summit of Mauna Kea
Is most beautiful to behold;
'Tis there the pink Sun's beam
Embraces and kisses the snow.

"And, from these early days, when the gods were betrothed on the heights of Mauna Kea we have followed the tradition of their marriage ceremony, the chieftain men, folding the feather cape of kapa around the chosen maiden, just as the sun's ray is reflected on the snow mountain and turns it pink at morn and noon and the treasure-heart of the goddess melts and overflows with love and feeds the mountain streams with her refreshing gift for man and nature to thrive upon.

"You have heard of the waters of Poliahu that our ancient and noble chieftains of that great island preferred to any other, to quench their thirst with, and how each day, starting at early dawn, carrying their water gourds all the way up the steep slopes of Mauna Kea, to a place called Pohaku-loa to fetch the drinking water from the melted snow accumulated there, bestowed by the goddess, for their feudal lords.

"Well, child, that is the aloha of Ku-kahau-ula and Poli-ahu who were betrothed in the cold region."

Then, as the story ended, and a chant floated out upon the air and faded away, the young girl sighed, and said, dreamily:

"Thank you, Puna," and smilingly gazed out toward the glinting blue sea of Waikiki and whispered,

"I, too, shall watch for the arrival of the glorious sunbeam that brings happiness and plenty, called the Pink God (Ku-kahau-ula) of Mauna Kea."

3.3.4 Poli‘ahu

Poli‘ahu lives within Lake Waiau atop Maunakea, from which she emerges each winter and to which she returns with the summer sun. She and her sisters are closely associated with Maunakea and are sometimes referred to as the "Four Sisters." At other times, Poli‘ahu's sisters are referred to as her maidens (Beckwith 1976:222). The four sisters were born as fully grown women who had great talents and wisdom. Waiau is the guardian of the lake that bears her name. The lake provides drinking and bathing water where Waiau bathes Poli‘ahu. Waiau sometimes assumes a bird form to fly to sources of sweet water to fill her drinking gourd. Līlīnoe is the goddess of the mists of the mountain. She maintains Poli‘ahu's hair so that it will float like a cloud at the summit. The fourth sister, Kahoupokane is the goddess of Hualālai. Known as a master kapa maker, the sound of thunder is said to be Kahoupokane beating her kappa while during heavy rains, Kahoupokane is tossing water on her kapa while she beats it (Ka‘ahele Hawa‘i 1999).

There are many *mo‘olelo* regarding Poli‘ahu, usually in association with her sisters, and also with other major gods and goddesses such as Hina (‘Moon Goddess’), Wākea, Kāne, Kū, and others that date from very ancient Hawaiian cosmological times. Westervelt (1915), for example, translated and published a lengthy story entitled “Ke Au Mele Mele, The Maid of the Golden Cloud,” a brief portion of which is reproduced below. This small part of the legend ties the natural phenomenon of snow atop Maunakea to Poli‘ahu’s mischievous nature:

> [Referring to a high chief of the Hilo area] The chief looked up Mauna Kea and there saw the mountain women, who lived in the white land above the trees. Poliahu stood above the precipices in her kupua-ano (wizard character), revealing herself as a very beautiful woman wearing a white mantle.
>
> When the chief and his friends came near the cold place where she was sitting, she invited them to her home, inland and mountainward. The chief asked his friends to go with him to the mountain house of the beauty of Mauna Kea.
>
> They were well entertained. Poliahu called her sisters, Lilinoe and Ka-lau-a-kolea, beautiful girls, and gave them sweet-sounding shells to blow. All through the night they made music and chanted the stirring songs of the grand mountains, The chief delighted in Poliahu and lived many months on the mountain.
>
> One morning Paliula in her home above Hilo awoke from a dream in which she saw Poliahu and the chief together, so she told Wakea, asking if the dream were true. Wakea, by her magic power [note, in many other legends and *mo‘olelo,* Wakea is a male form], looked over the island and saw the three young men living with the three maidens of the snow mantle. She called with a penetrating voice for the chief to return to his own home. She went in the form of a great bird and brought him back.
>
> But Poliahu followed, met the chief secretly and took him up to Mauna Kea again, covering the mountain with snow so that Wakea could not go find them.
>
> (Westervelt 1915)

McDonald and Weissich (2003), citing Westervelt’s classic *Hawaiian Legends of Volcanoes* (1991), discuss a special *lei* (Lei Pāpahi) dedicated to Poli‘ahu:

> *Lei-o-Poli‘ahu* is a striking *lei,* a composition primarily of silver and white to commemorate the snow goddess Poli‘ahu. Hawaiian mythology features several snow maidens with white mantles, all of exceptional beauty, wit, and wisdom. They were adventuresome and were enemies of Pele, the volcano goddess. Poli‘ahu, the best known of the snow goddesses, is clearly visible each year as her dazzling mantle of white turns the great mountain Mauna Kea into a “white mountain.”
>
> *‘O Poli‘ahu ke kua wahine o ka mauna nui*
> *‘O kona mau punuhele*

ʻO ka ʻaʻahu hau ma Mauna Kea
ʻO ka hau poʻi ma Waiau
ʻO ka noe lana wale ma Lilinoe
A ka nohoanu lahilahi
Ka pua keʻokeʻo a lū ka poni
A ka lau hinahina
He ʻālana pono na ke akua

Poliʻahu, the goddess of the great mountain
Whose favorites are
The mantle of snow on Mauna Kea
The icy shroud on Waiau
The drifting mist on Lilinoe
And the delicate *nohoanu*
That delicate flower with a touch of purple
And glistening silvery leaves
A prescribed offering for the goddess
(McDonald and Weissich 2003:70)

Lei-o-Poliʻahu is made of white plants and plant-parts such as the white flowers and silvery leaves of *nohoanu* (*Geranium cuneatum*), the white *liko* (newly opened colored leaves) and *muʻo* (leaf buds) of *ʻōhiʻa* (*Metrosideros* spp.), *paʻiniu* (*Astelia* spp.), *pūkiawe* and white *limu* (seaweeds, algae, lichens, mosses and liverworts), in this case a type of lichen typically collected from branches and tree trunks at high elevations—areas identified with Poliʻahu. These botanical components of the Lei-o-Poliʻahu can be found "along the eastern segment of the long trail in the saddle between Mauna Loa and Mauna Kea that connects Hilo and North Kona" (McDonald and Weissich 2003:72).

In his retelling of the Story of ʻUmi-a-Līloa (the 16th century ruler of Hawaiʻi), Kamakau describes the time when ʻUmi was mistreated by his in-laws at Hilo, and names a trail and a spring at the summit of Maunakea called "Poliʻahu":

> As soon as they were released in Hilo, ʻUmi and his companions returned to Hamakua and went down to Waipiʻo. There he conferred with his chiefs and his father's old war leaders. It was decided to make war on the chiefs of Hilo and to go without delay by way of Mauna Kea. From back of Kaʻumana they were to descend to Hilo. It was shorter to go by way of the mountain to the trail of Poliʻahu and Poliʻahu's spring at the top of Mauna Kea, and then down toward Hilo. It was an ancient trail used by those of Hamakua, Kohala, and Waimea to go to Hilo. (Kamakau 1992:16)

In Kalākaua's *Legends and Myths of Hawaii* (1888:455-480) account of: "Laie i ka Wai," a *kupua* (supernatural chief) of Wailua, Kauaʻi, named Aiwohikupua is sailing the seas of Hāmākua, Hawaiʻi, and "saw a woman of extraordinary beauty reclining on a cliff by the shore. She was graceful in every movement and wore a snow-white mantle. They landed and made her acquaintance. Her name was Poliʻahu of Mauna Kea" (Kalākaua 1888: 462). She relates that she is also supernatural ("*kupua*"). They promise to marry and exchange mantles. Eventually

Aiwohikupua returns in state to claim Poliʻahu. "The three mountains [understood as Mauna Kea, Mauna Loa and Hualālai] were covered with snow, which was the sign promised by Poliʻahu." Aiwohikupua and his party "were met by Poliʻahu, Lilinoe, Waiau and Kahoupokane, the three later being mountain goddesses. The men suffered from cold but on being apprised of the fact Poliʻahu and her friends removed their snow mantles, causing snow on the mountains to retire to its usual limits" (Kalākaua 1888: 467). The couple sailed to Kauaʻi but Poliʻahu soon learns of the fecklessness of Aiwohikupua: "Poliʻahu was enraged and returned to Mauna Kea." Poliʻahu repeated thwarts Aiwohikupua's love life by sending waves of cold or heat over the object of his affections: "Poliʻahu sent the chill of her snow mantle upon her rival, and she was benumbed with cold…" When Aiwohikupua met his new bride at noon the next day to consummate their marriage "Poliʻahu put on her sun mantle, and a scorching heat almost consumed her rival" (Kalākaua 1888: 468).

3.3.5 Poliʻahu and Pele

Poliʻahu, the snow goddess, and Pele, the volcano goddess, engaged in legendary battles to control Maunakea. The following legend is often told and relates how the outcome of an *hōlua* (sled) competition established control over portions of the mountain and formed the peninsula of Laupāhoehoe.

> Pele loved the holua-coasting—the race of sleds, long and narrow, down sloping, grassy hillsides. She usually appeared as a woman of wonderfully beautiful countenance and form-a stranger unknown to any of the different companies entering into the sport.…
>
> Poliahu and her friends had come down Mauna Kea to a sloping hillside south of Hamakua. Suddenly in their midst appeared a stranger of surpassing beauty. Poliahu welcomed her and the races were continued. Some of the legend-tellers think that Pele was angered by the superiority, real or fancied, of Poliahu. The ground began to grow warm and Poliahu knew her enemy.
>
> Pele threw off all disguise and called for the forces of fire to burst open the doors of the subterranean caverns of Mauna Kea. Up toward the mountain she marshaled her fire-fountains. Poliahu fled toward the summit. The snow-mantle was seized by the outbursting lava and began to burn up. Poliahu grasped the robe, dragging it away and carrying it with her. Soon she regained strength and threw the mantle over the mountain.
>
> There were earthquakes upon earthquakes, shaking the great island from sea to sea. The mountains trembled while the tossing waves of the conflict between fire and snow passed through and over them. Great rock precipices staggered and fell down the sides of the mountains. Clouds gathered over the mountain summit at the call of the snow-goddess. Each cloud was gray with frozen moisture and the snows fell deep and fast on the mountain. Farther and farther down the sides the snow-mantle unfolded until it dropped on the very fountains of fire. The lava chilled and hardened and choked the flowing, burning rivers.

> Pele's servants became her enemies. The lava, becoming stone, filled up the holes out of which the red melted mass was trying to force itself. Checked and chilled, the lava streams were beaten back into the depths of Mauna Loa and Kilauea. The fire-rivers, already rushing to the sea, were narrowed and driven downward so rapidly that they leaped out from the land, becoming immediately the prey of the remorseless ocean.
>
> Thus the ragged mass of Laupahoe-hoe formed, and the great ledge of the arch of Onomea, and the different sharp and torn lavas in the edge of the sea which mark the various eruptions of centuries past. (Westervelt 1916:60-62)

3.3.6 Līlīnoe

This peak of Maunakea, Līlīnoe, is associated with *mo'olelo* about a legendary "woman of the mountains" who was reportedly buried on Maunakea. Kamakau, whose description makes it evident that Līlīnoe was understood by post-Contact Hawaiians to have been of great antiquity, makes two related references to this legendary figure:

> It was on old custom to hide the bones of chiefs who were beloved, as 'Umi's bones were hidden by Koi, in order that they might not be made into arrows to shoot rats with, into fishhooks, needles for sewing tapa, or *kahili* handles, as is still done today. There is a story told about the bones of Pae which illustrates this custom. Pae was a kahuna and high chief in the time of 'Umi son of Liloa [i.e., early 16th century] and a descendant of Lilinoe, the woman of the mountains…(Kamakau 1992:215)
>
> The year 1828 is notable for the visit of Ka-'ahumanu to Hawaii to fulfill a vow that she made to attempt the recovery of the bones of Lilinoe on Mauna Kea where her body was said to have lain for more than a thousand years in a well-preserved condition, not even the hair having fallen out. Others deny this and say her body was too well-hidden ever to have been found. Her [Līlīnoe] offspring count from Hua-nui-i-ka-la'ila'i; she was the ancestress of ruling chiefs, and from her line was born 'Umi-ka-lani…It is said that Ka'ahumanu did not find the bones of Lilinoe, but only those of Liloa…[and others]. (Kamakau 1992:285)

3.3.7 Hale Pōhaku

L. W. Bryan, of the Territorial Forestry Office for the island of Hawai'i from 1922 to 1949, and from 1949 to 1961 the Territorial Forester, built the two stone houses at Hale Pōhaku with the Conservation Corps in 1936 and 1939 (Rosendahl 1999:C-6). He named Hale Pōhaku after a *heiau* (temple, place of worship) (Maly, personal communication 2009).

'Umi-a-Liloa, the renowned mid 1500s king, constructed *heiau* in honor of Halulu, the god who provided his power. The following excerpt from Maly and Maly (2005:28-29) tells of 'Umi's heiau:

> …He ('Umi) also built a *heiau* (temple) below Pohaku Hanalei, it is called the ahua o Hanalei (altar of Hanalei); and on the side of Mauna Kea, by where one

travels to Hilo, he built the third of his temples, at the place called Puukekee [also written Puu Keekee in historical texts]; and there at Mauna Halepohaku he built the fourth of his temples; there, it is said, Umi dwelt with his many people. It is said that Umi was a chief who dwelt upon the mountain, it was because of his love of his people, that he (‘Umi) returned and dwelt in the middle of the island [Ahu-a-Umi], that is where he dwelt with his beloved people. His commoners lived along the shores, and they brought food for them (in the uplands), from one side of the island to the other… [Ke Au Okoa; Mei 22, 1865; Maly, translator] (Maly and Maly 2005:28-29)

3.4 Cinder Cone Peaks

Numerous cinder cone *pu‘u* are located around the Maunakea summit area. The main peaks in the vicinity of the Project area include: Pu‘u Kūkahau‘ula, which is the highest of several cinder cones peaks around the summit of Maunakea, Pu‘u Līlīnoe, Pu‘u Kanakaleonui, Pu‘u Mākanaka, Pu‘u Papalekōkī, Pu‘u Kanakaleonui, Pu‘u Poli‘ahu and Pu‘u Waiau.

From a geological perspective, these cinder cones formed during the latest phase of shield-building of the volcano. The nearly symmetrical shape of these formations is a truly remarkable and beautiful sight; most of these *pu‘u* are *wahi pana* and all are associated with specific *mo‘olelo* that connect the landscape, genealogy and actual and/or legendary people, demi-gods and -goddesses and gods and goddesses.

Kealoha Pisciotta, in an interview reproduced by Nā Maka o ka ‘Āina (2008), has this to say about the many *pu‘u* of the Maunakea summit region:

> Another level of the desecration is the leveling of the *pu‘u*, or the cinder cones. The cinder cones are sacred in and of themselves because they make up some of the *kino lau*, or the divine bodily manifestations of the gods.
>
> For example, you can look up and see the image of Poli‘ahu laying down. She’s the woman of the mountain. That’s her place. And when it’s covered with snow, it appears as though she’s lying on a bed of clouds, a ring of clouds. And you can see her very clearly.
>
> Unfortunately though, Poli‘ahu’s image and bodily form is being destroyed. They are altering the images of our deities because the *pu‘u*[s] are being leveled and the telescopes are being built on top of her.

3.5 Lake Waiau

Lake Waiau, situated within Pu‘u Waiau, is the highest permanent lake in the Hawaiian Islands at 13,020 feet elevation, and one of the highest permanent lakes in the world. Its area extent varies throughout the year, but is typically on the order of a couple hundred feet in diameter and is full of algae and microscopic life. It is generally assumed that in this otherwise arid region, this lake is permanent, on account of the underlying substrate that consists of a permafrost zone only three meters below the ground surface. This permafrost zone blocks the downward seepage of water into the porous bedrock (Ziegler 2002).

Some Hawaiian perspectives on Waiau's remarkable qualities are provided by Nā Maka o ka ʻĀina (2008):

> That glacier formed Lake Waiau, and it gave birth, I believe, to a lot of the springs that we now have. Some of that water is very, very old. Waiau is another of the *kupua* [supernatural being]. Waiau is the *kupua* of Lake Waiau on Mauna Kea. So Waiau is the keeper of all these hidden waters. Under Mauna Kea, under the lake and all the way through that whole area are large streams of water. And Waiau as the *kupua*, is the keeper of all those springs and hidden reservoirs, the great water supply of that island (the words of Keawe Vredenburg)
>
> There's a mystery about the lake and that is that it doesn't seem to have enough water to actually maintain itself. People say, gee, it's not that deep of a lake and it should evaporate because in the higher altitude there's less moisture. It's very arid. However, they [scientists] think that there is an ice cap down through the lava tube. So it holds the water in the lake (the words of Kealoha Pisciotta).

Lake Waiau is home of the goddess of snow, Poliʻahu, and is guarded by the supernatural water spirit (*moʻo*) known as Moʻo-i-nanea, or "the matriarch of all *moʻo* gods and goddesses," according Nā Maka o Ka ʻĀina (2008). Waiau is located along the major Waikiʻi-Waiau Trail (see Figure 6).

Westervelt relates that Waiau was one of the "four maidens with white mantles" in Hawaiian legends (Westervelt 1916:56), but:

> …has been almost entirely forgotten. There is a beautiful lake glistening in one of the crater-cones on the summit of the mountain. This was sometimes called "The +Bottomless Lake," and was supposed to go down deep into the heart of the mountain. It is really forty feet in its greatest depth—deep enough for the bath of the goddess. The name Wai-au means water of sufficient depth to bathe.
>
> (Westervelt 1916:56)

According to Nā Maka o ka ʻĀina (2008),

> Water captured in the *piko* (the center) of a taro leaf, the nodes of bamboo or the coconut is considered pure and sacred water because it has not touched the ground. Similarly and even more so, the water of Lake Waiau, suspended high above in the realm of Wakea, is considered the most sacred.
>
> Hunters and other regular visitors to the mountain collect the water from Waiau and bring it back to the family to drink for good health.
>
> Water from Waiau continues to be used in rituals of dedication, such as the blessing of a new canoe.
>
> Waiau is also an area where families take the *piko*, or umbilical cords of their babies, to bury, and where the bones or ashes of deceased family members are placed.

Maly's (1999) research demonstrates that the waters of Waiau were considered to be highly sacred by Hawaiians in the 19th century:

> Mauna Kea falls in the senior line genealogy. During the 1880's, Emma Rooke, the wife of the late Alexander Liholiho Kamehameha, and David La'amea Kalakaua were in competition for the position of ruling chief for this kingdom of Hawai'i. Both of them needed to prove their connection to the senior line and connect back to a *wahi pana* [legendary or storied place].
>
> David La'amea Kalakaua went to Kanaloa-Kaho'olawe to bathe in the waters of the ocean god Kanaloa. Emma went to the top of Mauna Kea to bathe in the waters of Waiau. The ceremony was to cleanse in Lake Waiau at the *piko* [navel or center] of the island. The water caught at Lake Waiau was considered pure water of the gods much like the water caught in the *piko* of the *kalo* leaf is thought of as being pure therefore it was used medicinally. (Nā Maka o ka 'Āina 2008)

3.6 Mauna Kea Adze Quarry

This brief subsection is based primarily on Kirch's (1985) summary. The Mauna Kea Adze Quarry (State Inventory of Historic Properties [SIHP] No. 50-10-23-4136), also known as Ke-ana-kāko'i "the adze-making cave" (Pukui et al 1974:103)", is located on the southern slopes of the mountain, at elevations up to 12,400 feet. The site was listed on the National Register of Historic Places in 1969, and the Hawai'i State Register of Historic Places in 1981.

The quarry occupies an area of at least 4,800 acres and is the largest site of its kind in all of Polynesia; in fact, there are very few quarry sites of its kind and size in the entire world (7 and Figure 8). Kirch explains:

> The attraction that drew prehistoric Hawaiians to these inhospitable heights, inducing them to brave sudden and frequently severe winds and snowstorms, was a single flow of extremely hard and dense blue-black basalt, probably the best single source of adz rock in the archipelago. The flow had erupted at a time when the summit of Mauna Kea was capped with glacial ice, with the sudden cooling effect causing the extreme density of the basalt. (Kirch 1985:179-180)

Archaeological surveys of the quarry site have identified hundreds of features, including "extraction areas…workshops, open-air shelters, shrines, overhang shelters, and rockshelters" (Kirch 1985:180). Plant and animal food debris has also been recovered in excavation, which has yielded radiocarbon-dated hearth materials from as early as the fifteenth century. Other evidence suggests the quarry was likely used up until the time of European contact (i.e., late 18th century).

Abbott (1992), citing Allen (1981), notes that *pōpolo* (glossy nightshade, *Solanum americanum*) seeds have been recovered in excavations at the Mauna Kea Adze Quarry and dated to A.D. 1650.

Paul Cleghorn, who analyzed much of the Maunakea quarry material for his dissertation (1982) and has conducted extensive experiments with its properties and production techniques, characterized the makers of these tools as follows:

> …there was a tremendous amount of standardization at the Quarry—standardization in adze form, standardization in size proportions, and standardization in procedure. This high degree of standardization supports the contention that the adze makers were craft specialists.

> This study has also provided details on the development of behavior at the Quarry. It appears that expert craftsmen worked at the escarpment where there was abundant raw material. Novices or, perhaps more accurately, apprentices foraged for suitable raw material on the outwash plain, where they practiced their skills. (Cleghorn 1982:343)

3.7 Religious Shrines

As discussed in significant detail below (see Section 5), archaeologists have documented at least 79 religious shrines in the Maunakea summit region. Unlike traditional *heiau* in lower altitudes throughout the Hawaiian Islands—which were commonly constructed in the form of stone platforms, enclosures, walls, and other such features—the shrines atop Maunakea almost exclusively consist of large slabs of basalt that have been uprighted into vertical positions. Sometimes these upright slabs are balanced on small rock piles, *ahu,* or cairns, but frequently these slabs are situated directly atop exposed bedrock.

Some of these shrines are associated with informal stone-tool workshops and evidence of temporary site occupation (shelter areas). Archaeologist Pat McCoy, who has spent extensive time studying these sites, believes at least some of the sites were used as locations for performing traditional ceremonies related to "rites of passage" (McCoy 1999).

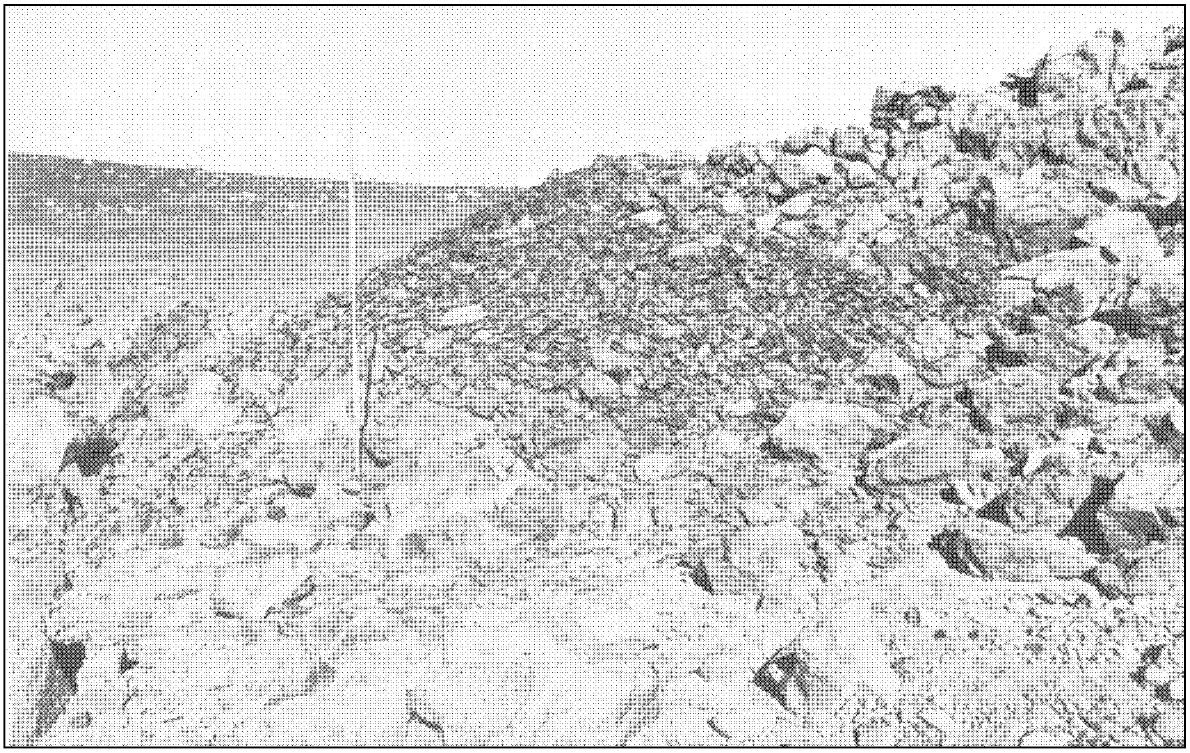

Figure 7. A representative large debris pile of discarded flakes and adze preforms at the Maunakea quarry site (source: Kirch 1985)

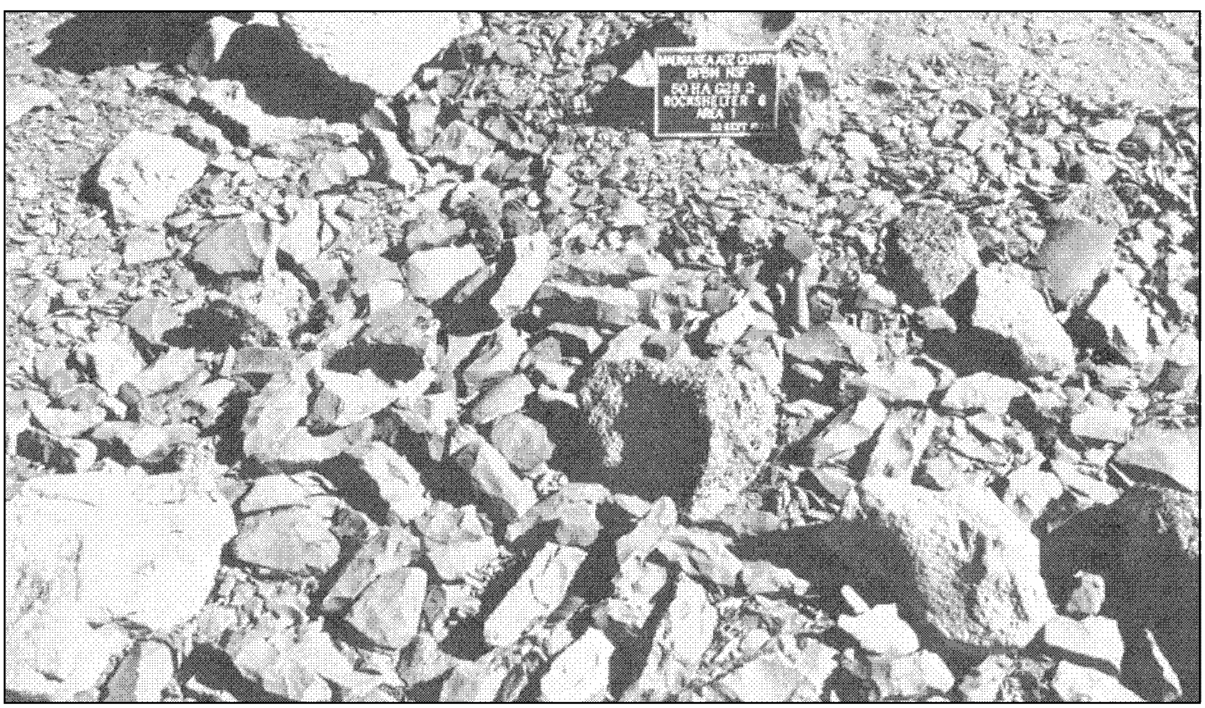

Figure 8. Detail of one of the rockshelter sites associated with the Mauna Kea Adze Quarry showing many preforms (source: Kirch 1985)

3.8 Burials

The subject of the presence of burials in the Maunakea summit region is a topic of considerable disagreement between the scientific, archaeological perspective, on one hand, and Native Hawaiian perspectives, on the other. The details are presented in full below (see Section 5.4.1). While historic accounts and *mo'olelo* tell of the presence burials on Maunakea (Maly and Maly 2005), archaeological evidence until recently, was relatively limited concerning confirmed human burials in the summit region. Prior to 2005, archaeological authorities on Maunakea, including Pat McCoy, had documented only one confirmed burial site (with multiple burials) and four possible burial sites in the summit region (McCoy 1991). All of these sites are located on Pu'u Mākanaka to the northeast of the subject Project area. However, McCoy (1999:28) also comments:

> There is good reason to expect that more burials are to be found in the Science Reserve on the tops of cinder cones, either in cairns or in a small rockshelter or overhang. The basis of this prediction is that all of the known and suspected burial sites on the summit plateau are located on the tops of cinder cones and, more particularly, on the southern and eastern sides. No burials have been found on the sides or at the base of a cone, or on a ridgetop amongst any of the shrines. There in fact appears to be a clear separation between burial locations and shrine locations.

His comments appear to be apt as current in progress work by McCoy and Nees has documented 28 sites designated as burials and possible burials (McCoy et al 2008).

There are widespread perceptions among many Kānaka Maoli (Native Hawaiians), some of which are backed by various types of documentary evidence, that the area holds or once held many more burials than archaeologists have been able to document. The following information regarding burials on Maunakea is from a website maintained by Nā Maka o ka 'Āina (2008); it has been reproduced here verbatim (except for formatting changes):

> The whole mountain throughout history was used as a burial ground of the highest born and most sacred ancestors. And like the kupuna say, so many generations that they have turned to dust. But their spirit remains. (Kealoha Pisciotta, Mauna Kea Anaina Hou, excerpt from Mauna Kea – Temple Under Siege)
>
> I am Hawaiian. Our people are up there. (Manu Aluli Meyer, Philosopher of Education, interview)
>
> There's many of our kupuna's and ali'i's buried on top that mountain, many more burial sites that have never been found. (Lloyd Case, Public meetings on Mauna Kea Science Reserve Master Plan, May, 1999)
>
> Our ancestors were buried there for generations. They don't bury only on the surface. They buried layers and layers and layers and layers, generations through generations, all the way to the top. You cannot cut, you cannot cut the mountain.

You must preserve and protect. (Hannah Reeves, Public meetings on Mauna Kea Science Reserve Master Plan, May, 1999)

In the olden time, it was a common practice of the natives in the surrounding region to carry up the bones of their deceased relatives to the summit plateau for burial. (W. D. Alexander, “The Ascent of Mauna Kea, Hawaii”, in the September 20, 1892 issue of the Hawaiian Gazette)

This high altitude area was also used as burial grounds. In particular, the cinder cones at and below the summit region…have been identified as burial areas. (Kepa Maly, From Mauna Kea – Kuahiwi Ku Ha‘o i ka Mālie, A Report on Archival and Historical Documentary Research Ahupua‘a of Humu‘ula, Ka‘ohe, districts of Hilo and Hamakua, Island of Hawai‘i, Kumu Pono Associates and Native Lands Institute, 1997)

Boundary Commission testimonies for ahupua‘a in Hamakua district include references to burials on cinder cones. (M. J. Tomonari-Tuggle. Bird Catchers and Bullock Hunters in The Upland Mauna Kea Forest; a cultural Resource Overview of the Hakalau Forest National Wildlife Refuge, Island of Hawai‘i, International Archaeological Research Institute, Inc., August 1996)

The accounts of late 19th and early 20th century visitors to the mountain in conjunction with native boundary testimony, establish the use of both the mountain’s upper slopes and the summit plateau as burial grounds.

Other observations of “graves” or “uncovered graves, eroded by high winds”…specifically locate burials within the summit plateau and suggest that interments in loose cinders were not necessarily marked by surface features or structures. (McEldowney 1982, McCoy 1982)

All of the known and suspected burials in the Science Reserve are located in cairns situated on the tops of cinder cones.

There are numerous references to human burials on the northern and eastern slopes of Mauna Kea, some at elevations that would fall within the boundaries of the Science Reserve. The practice of burying the dead in remote, high elevation areas may have been a common practice, based on the information collected by Thomas Thrum:

> The use of the craters within Haleakala as burial places, far removed from places of habitation, is quite in keeping with ancient Hawaiian practice. Distances and difficulties were no bar to faithful execution in carrying out the instruction of a dying relative or friend. (Thrum 1921)

There are four other sites in the surveyed areas of the Science Reserve that have been identified as possible burials.

There is good reason to expect that more burials are to be found in the Science Reserve on the tops of cinder cones, either in cairns or in a small rockshelter or overhang. The basis for this prediction is that all of the known and suspected burial sites on the summit plateau are located on the tops of cinder cones and, more particularly, on the southern and eastern sides. No burials have been found on the sides or at the base of a cone, or on a ridgetop amongst any of the shrines. There in fact appears to be a clear separation between burial locations and shrine locations. (McCoy 1999)

Eben Low’s obituary: Ebenezer P.K. Low, 89, a man who loved the Big Island ranch country died Sunday. He has asked that his body be cremated and the ashes strewn across the top of Mauna Kea. His daughter Clorinda Lucas, said that his request will be taken care of. Mrs. Annabelle Ruddle of Hilo, his eldest living daughter, flew to Honolulu for the private services. His full name was Ebenezer Parker Kahekawaioumaokauaamaluihi Low. (Maly 1999)

And in the olden days, when our grandparents, they die…then that’s when we take the people where they want to go. Like my grandparents, they came from Kalapana side so they like to be up Mauna Kea mountain facing towards Kalapana. In 1944, we took them up there.

And not only us. There’s lot of kupuna been buried up there on the mountain besides my kupuna. Lot of people take the bone up there.

But people come over here that don’t have aloha for our kupuna, they don’t care. Now the mountain get lot of building. We don’t know if the bones have been dug out or the bulldozer push them over the side.

And they’re still finding bones, people’s bones that coming out from Mauna Kea. And that’s what I don’t like. I like them leave alone. (Arthur “Aka” Mike‘ele Mahi, Interview, May 2005)

Hawaiians and observatory staff have mentioned over the years the rumors of burials being disturbed and destroyed. Has there been any attempt by UH/IFA to investigate persistent rumors that Hawaiian burials have been dug up during construction activities? (Sierra Club comments on Draft EIS, Mauna Kea Science Reserve Master Plan)

Archaeological surveys promised by IFA [Institute for Astronomy] in 1985 remain unfinished despite concerns from Native Hawaiians, archeologists and others that burials may be disturbed during continued telescope construction. These concerns arise from long-standing oral histories which say that the summit of Mauna Kea is the burial ground of the highest born and most sacred ancestors. Nineteenth Century archaeological surveys also confirm that Native Hawaiian burials were “commonplace” on the upper slopes of Mauna Kea. (Nelson Ho, “Astronomy director’s response disappointing”, Viewpoint, Hawai‘i Tribune Herald 7/11/96)

All of the current observatories and/or telescopes were built without the completion of archaeological surveys. So how can they know if they disturbed any sites or not?

Some of the pu‘u’s, the cinder cones, in order to accommodate the telescope foundations, were just leveled. They were leveled in some cases as much as 40 feet. It’s also important to us because the pu‘u’s are the burial places. And we don’t have any way of knowing if our burials were disturbed or not. (Kealoha Pisciotta, Mauna Kea Anaina Hou; interview, Mauna Kea – Temple Under Siege)

Would bulldozing cemeteries be allowed anywhere else in the world? (Carol Nervig, testimony before University of Hawai‘i Board of Regents, June 2000)

The bones, the ‘ohana up on the mountain. Walking on our ancestors, stepping on our ancestors. (Richard Kupihea Romero, Public meetings on Mauna Kea Science Reserve Master Plan, May, 1999)

And how dare you put an observatory on top there, on our graves, on the grave site of my ancestors. How dare you do that? (Reynolds Kamakawiwo‘ole, Public meetings on Mauna Kea Science Reserve Master Plan, May, 1999)

We cannot turn our back on our ancestors and say, “You know what, ancestors, can you just move your bones now?” No. We won’t do it. We will fight in every way possible we can.

If it was your church, I would expect you to do the same. If it was your graveyard or the graveyard of your mother or your father or your grandfather, I would expect you to do the same. (Ali‘i ‘Aimoku Ali‘i Sir Paul K. Neves, Royal Order of Kamehameha I, Moku o Mamalahoa, Heiau Helu Elua; testimony, NASA town meeting on Keck Outrigger Telescopes Project, October 2001)

The practice of removing burials for development has a long history in Hawai‘i. In the late 1980’s, when over one thousand bodies were removed for the construction of a beach resort on Maui, public opposition and outrage came to a head and forced the developers to move their site. Legislation was passed to establish burial councils on all islands to protect ancestral remains.

Today, laws call for Hawaiian families to be notified when potential development may impact the burial sites of their kupuna, or ancestors. But in the very act of protecting family burial sites, the burial councils are forced to reveal their locations.

And sorry, but I feel it personally. It hits me when somebody tell me my kupuna is buried there and I gotta prove ‘em. Our belief is that the secret places, where they stay and how they kept it, is supposed to remain secret. (Member of Hawai‘i Island Burial Council, Council meeting 3/30/2000)

Under burial law, where known or possible burials exist, a burial treatment plan must be created. We know that the pu‘u’s are the burial sites. We don’t know all

> the burials that are here. And, that's why we need to resolve the burial issues on Mauna Kea. (Kealoha Pisciotta, Mauna Kea Anaina Hou; interview)
>
> In the past, there may have been some misunderstanding or cases where people might have found bones and those bones were probably misplaced or whatever. And so, in order to avoid that kind of misunderstanding, what we're attempting to do is hire a cultural monitor and an archeologist who will be there at the time of the construction so that there would not be any misunderstanding and any mistrust, so that the Hawaiian community would feel that there is someone who is actually watching what the construction crew is doing.
>
> So this is the one step that NASA's taking to try to get someone like that on board. So we will not only have a cultural monitor who'll be there during construction, but we'll also have an archeologist who will also be available, who are trained to know what to look for. (John Lee, NASA; town meeting on Keck Outrigger Telescopes Project October 2001)

3.9 Trails

As depicted in Figure 6 (above), there are several trails traversing the Maunakea summit region including, from the west, the Waikiʻi-Waiau Trail leading up to Waiau; from the northwest, the Makahālua-Kemole-Waiau Trail also leading up to Waiau; from the northeast, the Maunakea-ʻUmi Koa Trail, leading to and from the Hamakua area; and, from the south and leading to the Mauna Kea Adze Quarry, the Mauna Kea-Humuʻula Trail.

3.10 Oli (Chants), Pule (Prayers) and Mele (Songs)

There are many different *oli* (chants), *pule* (prayers) and *mele* (songs) about Maunakea and its summit region. The following examples and brief accompanying comments are from the Nā Maka o ka ʻĀina website (2008). These examples date from different times periods: some are modern, some are post-Contact in age, and some are much older (e.g., excerpts from the Kumulipo or creation chant). These *oli, pule* and *mele* associate Maunakea with the original progenitors of life in Hawaiʻi, including Wākea and Papa, with the mountain's status as the *piko* (navel or center) of the *mokupuni* (island), and with various mountaintop deities:

> In some genealogical chants, Mauna Kea is referred to as "Ka Mauna o Kea" (Wakea's Mountain), and it is likened to the first-born of the island of Hawaiʻi (Pukui and Korn 1973). A *mele hanau* (birth chant) for Kauikeaouli (Kamehameha III) describes Mauna Kea in this genealogical context:
>
> O hanau ka mauna a Kea
> Born of Kea was the mountain
>
> ʻOpuʻu aʻe ka mauna a Kea
> The mountain of Kea budded forth
>
> ʻO Wakea ke kane, ʻo Papa
> Wakea was the husband, Papa

ʻO Walinuʻu ka wahine.
Walinuʻu was the wife

Hanau Hoʻohoku he wahine
Born was Hoʻohoku, a daughter

Hanau Haloa he aliʻi,
Born was Haloa, a chief

Hanau ka mauna,
Born was the mountain,

He keiki mauna na Kea...
a mountain-son of Kea

A Social Impact Assessment
Indigenous Hawaiian Cultural Values
of the Proposed Saddle Road Alignments
Kanahele, Pualani K. and Edward L.H. Kanahele 1997

Mauna Kea is the *piko* of the island and this is another reason this area is considered sacred. This piko is the initial provider of the land mass of Hawaiʻi *mokupuni*. Hawaiʻi was also the first child of Papa and Wakea as stated in "Mele a Pakuʻi":

ʻO Wakea Kahikoluamea ea
Wakea the son of Kahikoluamea

ʻO Papa, Papa-nui-hanau-moku ka wahine
Papa, Papa-nui-hanau-moku the wife

Hanau o Kahiki-ku, Kahiki-moe
Kahiki-ku and Kahiki-moe were born

Hanau ke ʻapapanuʻu
The upper stratum was born

Hanau ke ʻapapalani
The uppermost stratus was born

Hanau Hawaiʻi i ka moku makahiapo
Hawaiʻi was born, the first-born of the islands

Ke keiki makahiapo a laua
The first born child of the two

Wakea laua ʻo Kane
Of Wakea together with Kane

ʻO Papa Walinuʻu ka wahine
And Papa of Walinuʻu was the woman

In 1980, Tutu Kawena Pukui shared a mele (chant) she had composed for Mauna Kea with me.

O Poliʻahu i ke kualono o Mauna Kea
Poliʻahu is on the mountaintop of Mauna Kea

Noho ana i ka lau o ke kuahiwi
Dwelling on the expanse of the mountain.

Wahine noho anu o uka o Lihuʻe
Woman who dwells in the cold above Lihuʻe [on the Waimea plain]

E ku ana iluna o ke kiʻekiʻe
Standing atop the heights

Hoʻanoano wale ana i Pali-uli e...
Awe-inspiring [as seen from] Pali-uli...

Excerpts from Mauna Kea – Kuahiwi Ku Haʻo i ka Malie, A Report on Archival and Historical Documentary Research, Ahupuaʻa of Humuʻula, Kaʻohe, districts of Hilo and Hamakua, Island of Hawaiʻi, by Kepa Maly, ©1997 Kepa Maly, Kumu Pono Associates and Native Lands Institute

Maunakea
translation by Mary Kawena Pukui

E aha ʻia ana o Mauna Kea
What is doing with Mauna Kea?

Kuahiwi ʻalo pu me ka kehau
Mountain ever moist with dew

Alawa iho ʻoe ia Mauna Loa
Take a glance at Mauna Loa

Kohu moa uakea i ka malie
It is like a white cock standing in the calm

Ku aku au mahalo o ka nani
I stand and admire the beautiful scene

Ka haale a ka wai hui a ka manu
The rippling of the cold water of the birds

Kau aku ka manao a e ike lihi
Think constantly and to glimpse

Ka uwahi noe a o Kilauea
Of the gray, misty smoke of Kilauea

Ke hea mai nei Halemaumau
Halemaʻumaʻu is calling

ʻEnaʻena i ke ahi a ke wahine
She who is ever burning with the woman's fire

Ka wahine kui pua lehua o Olaa

The woman who strings the lehua blossoms of ʻOlaʻa

I hoa hoouipo no ka Malanai
Is the sweetheart of the Malanai wind

I ahona Puna i ka hone a ke kai
Relieving Puna in the sweetness by the sea

Ke ala o ka hinano kaʻu aloha
And the fragrance of the hinano I love so well

Aloha ia uka puanuanu
I love the chilly uplands

I ka hoopulu ia e ke kehau
in the wet and the snow

Haina ia mai ana ka puana
This is the end of my chant

Pulu elo i ka wai a ka Naulu.
Soaked, drenched in the water of the sudden shower.

Aia na kulu pakaua ko loku mau la ma na Kona i keia mau la.
There are dripping raindrops downpour unceasing days there at Kona to this day.

Ola aku la no hoi ia mau kini!
lived that return many.

Section 4 Historical Background

4.1 Overview

Historical documents about Maunakea focus on early observations by explorers, missionaries and others as well as on scientific expeditions to the summit area. This information often provides bits and pieces of Native Hawaiian perceptions and ideas about the mountain, although these are invariably intermixed with biased views of the natives, themselves, held by those who created the documents. These early observations also inform us about how climatic and natural-resource conditions have changed over the last 200 years.

More recently, starting in the 1960s, Maunakea has been home to numerous astronomical observatories, the construction of which is a direct result of the finest conditions for such scientific work on the planet. It is worth mentioning at this point that the initial construction of these observatories predated the Native Hawaiian renaissance of the 1970s that included a revival of the Hawaiian language and led directly to the contemporary Hawaiian sovereignty movement and other cultural revivals.

4.2 Early Post-Contact Period

The first recorded ascent of Maunakea was in 1823 by the missionary Joseph Goodrich (who lived 1794-1852). Like many missionaries, the Yale-educated Goodrich was also a naturalist and he published his observations on Hawai‘i Island volcanoes in the *American Journal of Science* in 1826 and 1829. According to records, the preacher hiked from Waimea to the Maunakea summit and back to Waimea in one 24-hour marathon. He approached via Kawaihae and Waimea. In the vicinity of Waimea he spent the night (at approximately 2,700 feet elevation). Leaving early, and approaching the summit from the north, he followed a steep ravine reaching the tree line at about 9,000 feet elevation approximately 15 miles from Waimea where he rested for a few hours recording the temperature at 43^{o} F at sunset. At 11:00 PM, he pushed on in bright moonlight encountering snow at 1:00 AM and recording a temperature of 27^{o} F. Goodrich attained the highest of several summits around 3:00 AM noting the presence of a pile of stones which he assumed had been constructed by Hawaiians. He roughly retraced his steps back to the vicinity of Waimea. Given that all of his time above 9,000 feet was in the dead of night and the distance he needed to cover, few details were recorded. Goodrich made a second trip up Maunakea in 1825 noting dead sheep on one of the cones at an estimated 13,612 feet elevation and speculating they had been driven there by wild dogs. For 150 years, the near perfect Pu‘u Hau Kea (elevation 13,441 feet), as it is presently known, was popularly known as the “Goodrich Cone” (see Kilmartin 1974:13; Macdonald et al. 1983:18, etc.) in his honor.

Hitchcock (1911) described several early scientific ascents of Maunakea (Figure 9 through Figure 13):

> Several of the party of the Blonde [i.e., the H.M.S. Blonde] ascended Mauna Kea in July, 1825, accompanied by a “missionary and botanist.” Rev. Mr. Goodrich of Hilo writes of an ascent made by him in August 27, 1825. He brought back specimens of the “granite” [i.e., basalt] from the summit, as well as the fine

grained basalt used for the manufacture of adzes. James Jackson Jarves climbed to the summit in 1840, bringing back specimens of "augite, hornblende and olivine." He looked into Mokuaweoweo and reported that there were no signs of activity, not even ascending vapors. In the early part of January, 1841, Dr. Charles Pickering of the Wilkes Exploring Expedition, made the ascent and noted the same features mentioned by his predecessors, such as the ice and several cones of volcanic origin. In a desolate and gravelly plain he found a few plants suggestive of a colder climate, probably the same that were brought back by Mr. Preston and named authoritatively, such as *Cystopteris fragilis, Trisetum glomeratum, Poa annua* and *Deschampsia australis.*

The English botanist David Douglas (for whom the common name of the Western American Douglas Fir [*Pseudotsuga menzies*] was named) carried out scientific ascents of Maunakea and Maunaloa and died of mysterious circumstances (at the age of 36) on the slopes of Maunakea in 1834 (Ziegler 2002).

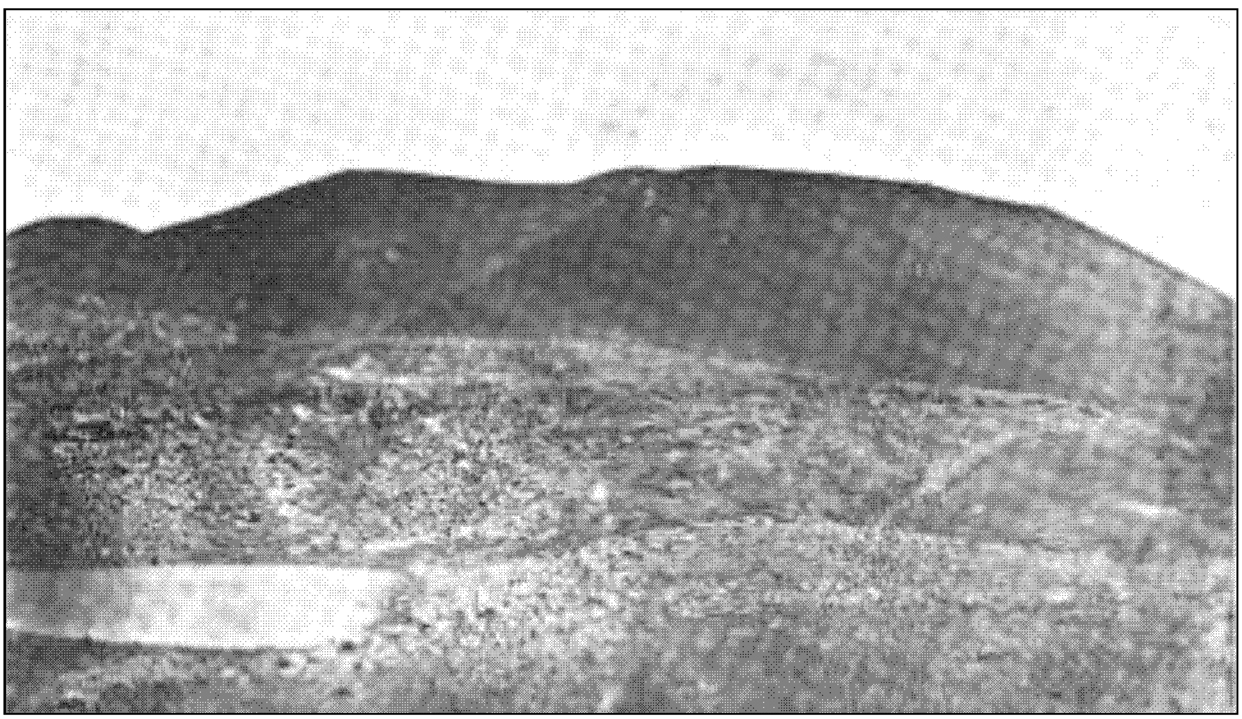

Figure 9. Photograph of cinder cones of Maunakea with Waiau (lower left) (Brigham 1909)

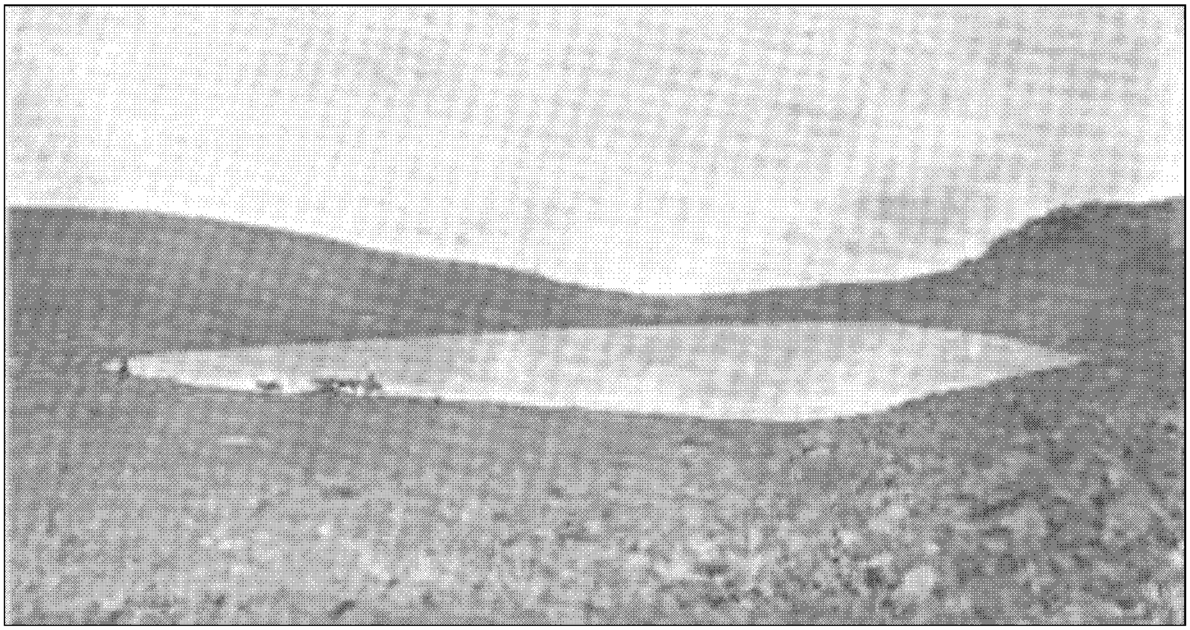

Figure 10. 1909 photograph of Lake Waiau from Brigham

Figure 11. Recent 2009 photograph of Lake Waiau (source: Brian Cruz)

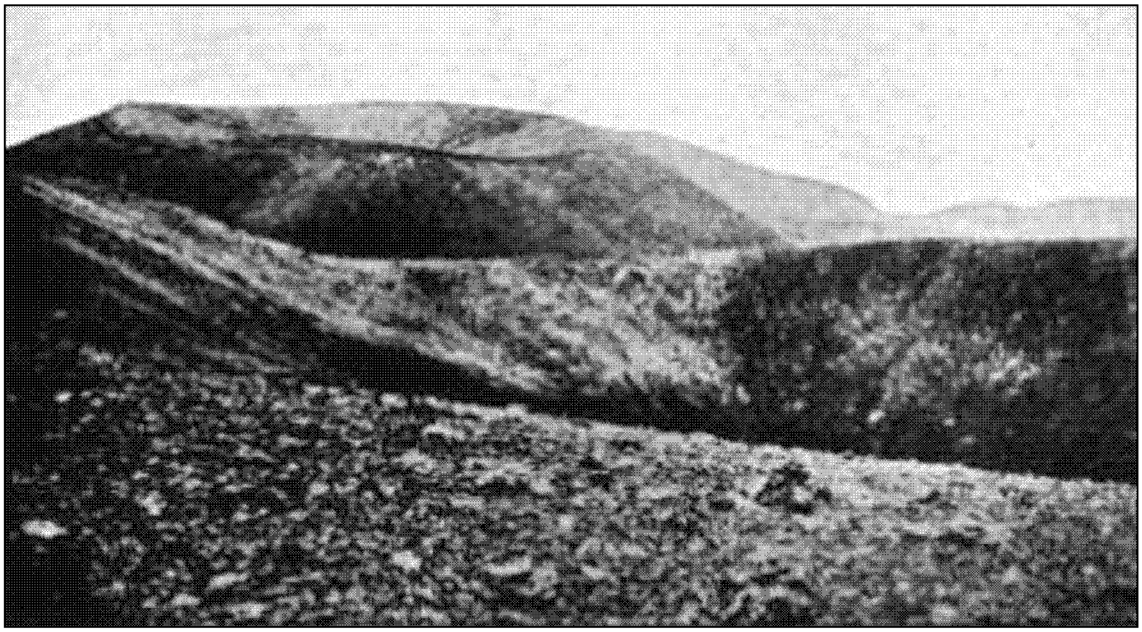

Figure 12. Photograph of cinder cones of Maunakea from Hitchcock (1911)

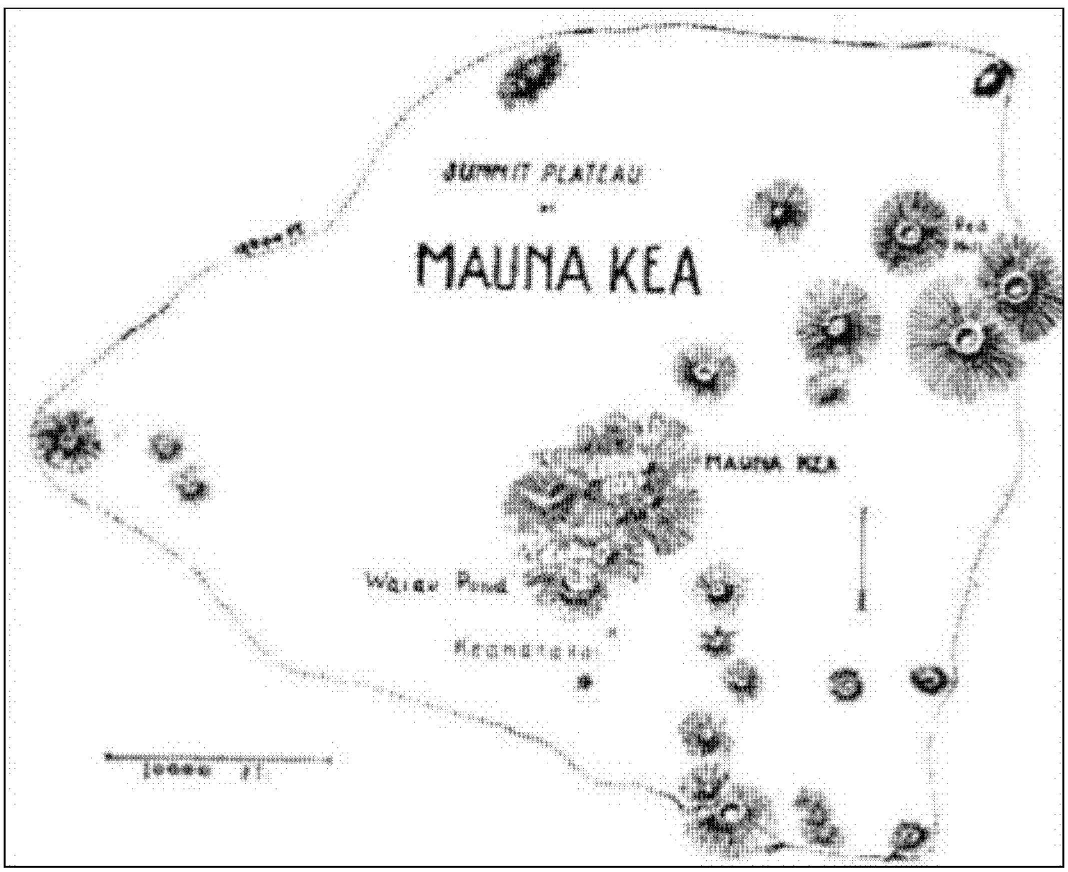

Figure 13. Hitchcock's copy of W.D. Alexander's 1892 map of the summit region

4.3 The Māhele

The Organic Acts of 1845 and 1846 initiated the process of the Māhele, the division of Hawaiian lands, which introduced private property into Hawaiian society. In 1848, the crown and the *aliʻi* received their land titles. The *ahupuaʻa* of Kaʻohe was designated as Crown land, and on January 27, 1848 was relinquished by Victoria Kamamalu to Kamehameha III (Buke Mahele, 1848:5–6). In March of the same year, Kamehameha III gave Kaʻohe to the Government Land inventory (Buke Mahele, 1848:191). These same records state that four native claims were registered in Kaʻohe Ahupuaʻa (Table 1) but only one was awarded.

Table 1. LCA claims in Kaʻohe Ahupuaʻa

LCA	Claimant	District	Ahupuaa	Ili	Award
08297	Kookooku	Hāmākua	Koholalele, Kaʻohe	Lipelau	Awarded 1 āpana in Koholalele
10180	Malao, Tatina	Hāmākua	Kemau 2, Kaohe	Kahaumake, Manele, Haleolono	Awarded 2 āpana in Kemau 2
03705B	Koolau	Hāmākua	Kaʻohe		Awarded 1 āpana in Kaʻohe
03722B	Keopohaku	Hāmākua	Kaʻohe		None

The following testimony was provided as Native Testimony in support of Koolau's claim on October 30th, 1848:

> Keopohaku, sworn, He has seen in Kaohu ahupuaa of Hamakua, Hawaii, 10 sections.
>
> Section 1: House site: All konohiki boundaries, 2 houses for Koolau, no fence.
>
> Section 2: All konohiki boundaries, 1 cultivated taro kihapai.
>
> Section 3: Mauka, Kohala, Makai also by konohikiHilo by Nuumalolo's land. 1 cultivated taro kihapai.
>
> Section 4: All konohiki boundaries, 1 cultivated potato kihapai.
>
> Section 5: Mauka & Kohala by konohiki. Makai by Moano's land. Hilo by konohiki. 1 cultivated banana and coffee kihapai.
>
> Section 6: Koholalele ahupuaa: All konohiki boundaries, 2 cultivated banana kihapai.
>
> Section 7: All konohiki boundaries, 1 cultivated coffee kihapai.
>
> Section 8: All konohiki boundaries, 1 cultivated arrowroot kihapai.
>
> Section 9: All konohiki boundaries, 1 cultivated arrowroot kihapai.

Section 10: All konohiki boundaries, 1 cultivated taro kihapai.

Land from Keopohaku in 1836; no one has objected to him.

(Native Testimony; 389v4)

Of the ten *āpana* that Koolau claimed, he was awarded only one 7-acre *āpana*. This was the sole *kuleana* award in Kaʻohe Ahupuaʻa. This single awarded kuleana claim indicates coffee, arrowroot, banana, and taro were all cultivated in the lands of Kaʻohe.

The 1862 S.C. Wiltse map of Humuʻula (Register Map 668/Figure 14) and the 1892 C.J. Lyons map of Kaʻohe, Hāmākua and Humuʻula (Register Map 1641/Figure 15) show the summit portion of the Project area. Questions related to the location of the eastern boundary of Kaʻohe and the western boundary of the *ahupuaʻa* of Humuʻula, led to an investigation by the Commissioner of Boundaries in the late 19th century. The 1892 map is likely related to that decision.

Testimonies regarding *ahupuaʻa* boundaries were initially heard in 1873, although the Kaʻohe and Humuʻula boundary was not completely documented. Additional testimonies were provided and a determination was made. In 1891 the boundary was determined to run along the Kaula Gulch (Foster 1893:455). This area supported the habitats of two native bird species:

> From the mass of evidence taken we find that in ancient time the main value of the land of Kaohe was the "uwaʻo," a sea-bird, whose habitat was the dry, rocky and elevated portion of the mountain. The habitat of the bird "oo," whose feathers were valuable, was in the mamane of Humuula. So the bird-catchers, retainers of the chief to whom Humuula was assigned, were limited to this area on which to take the "oo," and could not take the "uwaʻo," for those belonged to Kaohe. (Foster 1893:456)

The "uwaʻu" bird is also spelled *ʻuaʻu*; this is a dark-rumped petrel.

During a discussion of the testimony, court documents note that:

> The kamaainas of forty years ago [1851] were less likely then to be mistaken as to the correct boundaries of lands than those of these days. They lived on the lands, pursuing their occupations under the chiefs of gathering feathers, canoe making and getting articles of various kinds from the mountains. (Foster 1893:458)

McEldowney's (1982:A-10) ethno-historical summary of the Maunakea summit region provides Boundary Commission Testimony of a man named Haiki for the disputed boundary. He asserts that: "my parents told me Humuula went to Kaluakaakoi and Poliahu. We used to go there after adzes for Humuula people."

Maly's 1999 archival study included a reference in border testimony to burials within Kaʻohe Ahupuaʻa:

> [Puʻuokihi] it belongs to Kaohe and above that is where people were buried in old times, when people used to make fishhooks from the bones. [Testimony of Kahue, 1880, BCB, Hawaiʻi, B:444] (Maly 1999:D-4).

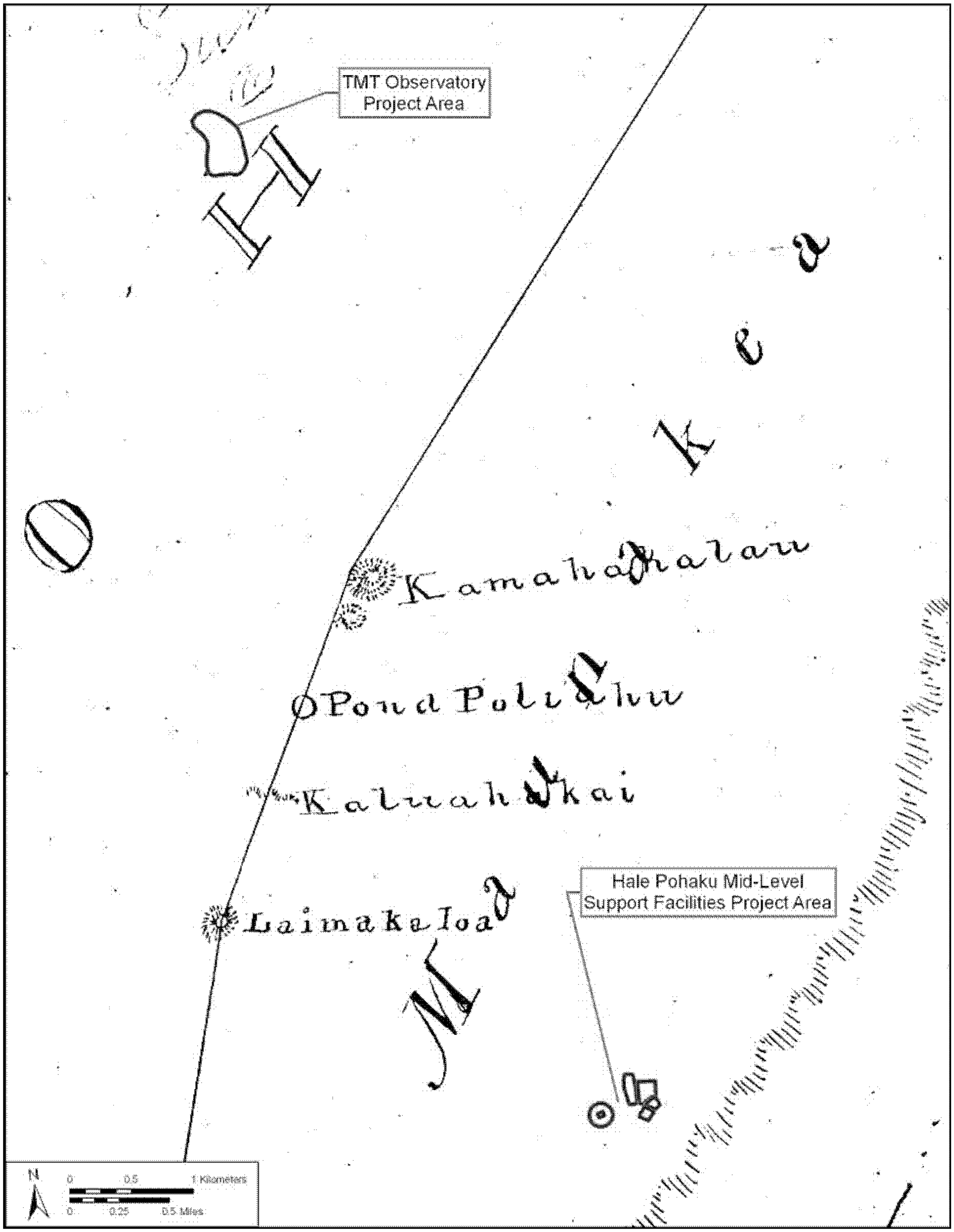

Figure 14. Portion of 1862 S.C. Wiltse map of Humu‘ula (R.M. 668) showing the location of the Project areas

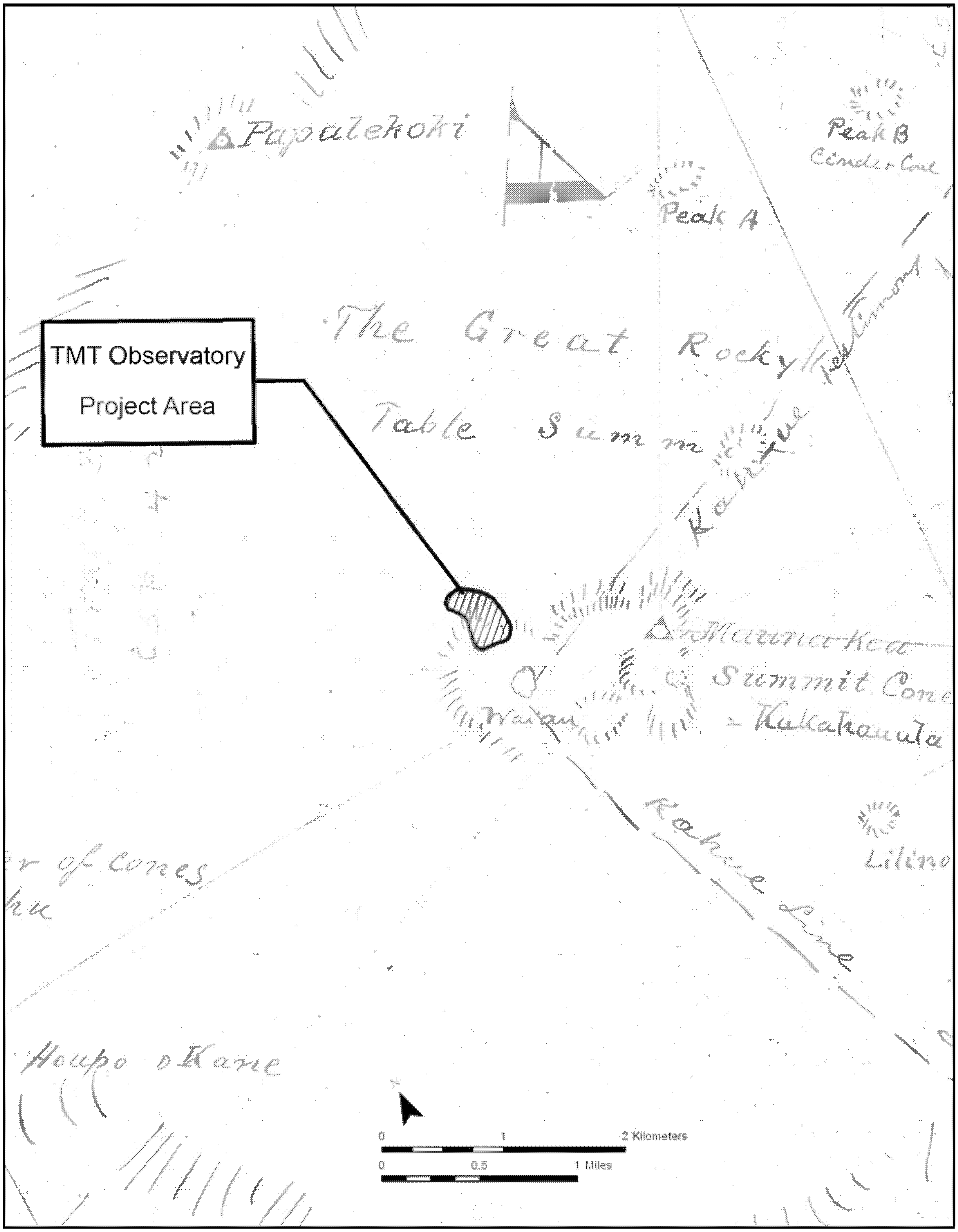

Figure 15. Portion of 1892 C.J. Lyons map (R.M. 1641) of Ka'ohe, Hamakua and Humu'ula showing the location of the TMT Observatory Project area

4.4 Middle 19th Century

Wilkes (1856) discusses a scientific ascent of Maunakea in 1841 by Drs. Pickering and Brackenridge. Many of the details describe the long journey of ascent beginning in Hilo, rather than describing the summit region, itself; however, some of the details provide important observations about the presence and distribution (especially elevation) of natural resources that differ from contemporary data. These mid-19th century observations, in conjunction with modern data, provide comparative information about long-term change on the mountain.

Wilkes' description of Pickering and Brackenridge's ascent begins near Hilo, and mentions the names of Native Hawaiian guides and their chief:

> They [Pickering and Brackenridge] were furnished with guides, among them Sandwich Jack, our bullock-driver, whose true name was Dawson, though he went by the sobriquet of Billy Lilly. They set out on the 8th of January, attended by natives from Hilo, belonging to [the chief] Kanuha, having agreed to pay each of them fifty cents a day. (Wilkes 1856:200)

After arriving for the night seven miles from Hilo at a dilapidated sawmill belonging to "Mr. Castle" and managed by a man named Simons, there was a disagreement or miscommunication regarding compensation between the Hawaiian guides and porters and their chief (Kanuha), which took a day to resolve. Traveling through a forest of "ohea (Callistemon)" and "koa (Acacia)," they encountered many unique fern species, including an edible one, and watched as one of the young men of the group tried (unsuccessfully) to capture a large bird. They also encountered many heads of cattle, thought to have been introduced by Vancouver in 1795, and Native Hawaiians hunting them. This was despite the fact that "[t]he cattle have been tabooed for five years, from the year 1840, in consequence of the slaughter that had been made among them" (Wilkes 1856:200).

At the location of these observations of feral cattle, described as no higher than 5,000 feet elevation, the expedition noted the presence of frost:

> From these natives [hunters of cattle] they procured some jerked beef, and were told that ice had formed there the night before. The effects of frost on the foliage was evident, and yet the elevation did not exceed five thousand feet. (Wilkes 1856:200-201)

Later, Wilkes states:

> On the 12th, they started at sunrise, and by eleven o'clock found they had cleared the forest. Their altitude was about six thousand feet…The ground was frozen, and the pools of water were covered with a thin ice. (Wilkes 1856:201)

It seems that during this time (1841), the mountain was a much colder place than it is now, when frost and ice do not extend down to the elevation of 5,000-6,000 feet. This may be at least partially explained by the fact that the 16th through the mid-19th century was the approximate time of three interspersed global cold periods collectively known as the "Little Ice Age."

Regarding the vegetation on Maunakea, Wilkes (1856) states that, unlike Maunaloa—where vegetation stops at around 7,000 feet elevation, vegetation on Maunakea "continued to twelve thousand, and a few scattered plants may even be found within a few hundred feet of the top of Mauna Kea." He also notes that *māmane* (*Sophora chrysophylla*) "occupies a belt eleven thousand feet high" on Maunakea, which suggests a significantly higher treeline than at present, where *māmane* occur no higher than above 9,000 feet elevation.

4.5 Late 19th century

Bryan (1915), describing Hitchcock's 1885 ascent of Maunakea, noted:

> When not covered with snow the surface of the plateau of Mauna Kea is described as a desolate gravelly plain on which occur five or six species of plants resembling those of the colder climates of high altitudes. As reported by Professor MacCaughey, the lake at the summit [Waiau], though very cold throughout the year, supports a luxuriant growth of green algae. (Bryan 1915:152)

W.D. Alexander, Surveyor General, ascended Maunakea along the Waimea-Waikiʻi trail in 1892. His description of the route is as follows:

> A wagon road made by the owners of the Humuula Sheep Ranch leads from Waimea around the western and southern sides of Mauna Kea. On the western side of the mountain it passes through a region which only needs more rainfall to make it a superb grazing country. The ancient forests here, as at Waimea have been nearly exterminated, but a fine grove of mamane trees still survives at the Auwaiakeakua Ranch. The manienie grass is gradually spreading and will in time add immensely to the value of the land. At the half-way station, called Waikii, water tanks and a rest house have been provided for teamsters.

4.5.1 Humuʻula Sheep Ranch

In 1897, 137,200 acres of Kaʻohe Ahupuaʻa were leased by the Humuʻula Sheep Station Company. The lease state was described as, "Subject to homestead reservation: term, 15 years" (Mitchell 1903:586).

The Humuʻula Sheep Station Company began as the Waimea Grazing & Agricultural Company, which by the mid 1860s, leased most of the upper elevations of Kaʻohe, as well as Waimea and Humuʻula. Frank Spencer, the owner, sold the leases.

One of these leases was sold to Parker Ranch. Parker Ranch held the lease to most of the Kaʻohe mountain lands until 1905 when leases were withdrawn on lands between the 7,500 and the 9,500-foot elevation to establish the Mauna Kea Forest Reserve (Maly and Maly 2005:522). Parker Ranch continues to utilize lower portions of Kaʻohe for grazing (Maly and Maly 2005:viii).

Parker Ranch continued to hold land in the Humuʻula lands and continued their ranching activities. Initially focusing on sheep ranching until 1964 when it ended it's sheep program, Parker Ranch carried out it's cattle operations until the end of their lease in August of 2002 (Maly and Maly 2005:vii).

4.6 Twentieth Century

In 1936 the Civilian Conservation Corps carried out improvements to the old Maunakea-Humu‘ula Trail from near the main base of the sheep station at Kalaieha to the summit (Bryan 1938). The first stone cabin at Hale Pōhaku was constructed at approximately the same time. The second stone cabin was built in 1939. L.W. Bryan, at that time the Acting Territorial Forester, wrote in a 1938 article that the original stone house measured 16 by 20 feet and was equipped with a 2,000 gallon water tank and a large stove. The summit road only extended to Hale Pōhaku in 1938 (Bryan 1938:38).

Starting in the early 1960s, Maunakea was promoted as a prime location for developing astronomical facilities by a group of business leaders on Hawai‘i led by Mr. Tetsuo Akiyama. A road was built to the summit in 1964, with the support of then Governor John A. Burns. After testing at the top of the mountain showed superb conditions for astronomical observations, two facilities were constructed by the University of Hawai‘i at the end of the decade. By the turn of the millennium, Maunakea was home to a total of 13 astronomical facilities, making it "the largest concentration of telescopes in the world" with facilities being operated by astronomers from ten countries (Juvik and Juvik 1998).

Some of the most important recent discoveries in the field of astronomy have taken place at observatories on Maunakea, and proponents and advocates of these facilities have stressed that this work in many ways represents a continuation of the long tradition of Polynesian celestial observation and navigation that was integral to the initial discovery and peopling of the Hawaiian Islands (Juvik and Juvik 1998). At the same time, many Kānaka Maoli (or Native Hawaiian) individuals and groups have become increasingly opposed to any additional development atop Maunakea; a sacred mountain which should not be subject to additional ground disturbance, vehicular traffic, trash and human wastes.

The Onizuka Center for International Astronomy Visitors Information Center was constructed in 1986 within the vicinity of Hale Pōhaku.

4.7 Previous CIA and Cultural Studies for Maunakea

Several extensive cultural studies and management plans have been previously carried out for Maunakea. This section summarizes these studies. Some of these studies, particularly Maly (1999) and Maly and Maly (2005), have provided details for the current study.

Management plans for Maunakea dating from 1977 to 2000 are listed on the Mauna Kea Comprehensive Management Plan website (http://www.mkcmp.com/about). Table 1 was taken from the website and summarizes the management plans written for Maunakea.

Table 2. Maunakea Management Plans

Year	Description of Management Plan	Approved by
1977	*Mauna Kea Plan*. Adopted by DLNR to serve as policy framework for the management of Mauna Kea. The plan divided Maunakea into five management areas and described acceptable uses and management controls for each area. (1998 audit report)	BLNR (Board of Land and Natural Resources)
1980	*Hale Pōhaku Master Plan*. Prepared by DLNR to address the mid-level facility at Hale Pōhaku. Served as a guide to UH in the design and construction of the astronomy mid-level facility. The plan incorporated the needs of the six telescopes in the operation at that time, allocated space for public restoration and set controls for future expansion. (1998 audit report).	
1982	*Research Development Plan (RDP) for the Mauna Kea Science Reserve and Related Facilities*. UH approved the RDP as its own research development plan for the Mauna Kea Science Reserve and Hale Pōhaku facilities. The RDP was to serve as a programmatic master plan for the continued development of the Mauna Kea Science Reserve.	UH Board of Regents
1983	*Mauna Kea Science Reserve Complex Development Plan*. UH developed this plan to facilitate the implementation of the specific research facilities identified in the plan. The plan consisted of two components. The first component was a complex development plan to provide the physical planning framework to implement the UH Research Development Plan. The objective of the document was to guide and control development in order to preserve the scientific, physical, and environmental integrity of the mountain. The second component was the environmental impact statement (EIS) to evaluate the general impact of implementing the actions proposed in the complex development plan and propose mitigating actions for potential negative impacts. (1998 audit report).	UH Board of Regents
1985	*University of Hawai'i Mauna Kea Management Plan*. Revised management plan to address concerns from DLNR and the public. BLNR retained management control over the commercial activities. (1998 audit report)	BLNR
1995	*Revised Management Plan for the UH Management Areas on Mauna Kea*. Adopted by UH and DLNR to improve control over commercial uses in the summit area. All management responsibilities, except those related directly to astronomical facilities or the summit road, are transferred back to DLNR. This plan replaced and superseded the 1985 Management Plan. (1998 audit report)	BLNR

Year	Description of Management Plan	Approved by
2000	UH Mauna Kea Science Reserve Master Plan. Adopted by the UH Board of Regents as the policy framework for the responsible stewardship and use of university managed lands on Maunakea. Master Plan created a new management structure, housed within the University of Hawai'i at Hilo, as the local management authority over Maunakea. UH also established the astronomy precinct, which confines astronomy development to 525 acres within the MKSR. (2000 audit report).	UH Board of Regents
2008	*Preliminary Draft Report: Cultural Resource Management Plan for the University of Hawai'i Management Areas on Mauna Kea, Ka'ohe Hamakua, Island of Hawai'i TMK (3) 4-4-012, 015*	Draft

This section reviews relevant previous cultural research in the Maunakea summit region (Table 3). Several CIA and cultural studies have been previously prepared since the 1980s for the Maunakea summit region.

Table 3. Cultural Studies in the Maunakea Summit Area

Reference	Comments
McEldowney 1982	First ethnographic study prepared and included in an EIS. No consultations were conducted.
Kanahele and Kanahele 1997	Cultural assessment for the proposed realignment of the Saddle Road, detailed discussion of cultural values, protocols and practices
Maly 1998	Archival and historical documentary research, including "limited" oral historical interviews not formally part of the study
Langlas et al. 1999	Archaeological Inventory Survey and cultural assessment along Saddle Road and Hawai'i Defense Access Road
Maly 1999	Oral history and consultation study including 22 interviews, and 3 interviews dating 1956-1967 translated by Maly
PHRI 1999	First Cultural Impact Assessment study prepared for the University of Hawai'i Mauna Kea Science Reserve Master Plan Project Area. Basis of the study was Maly (1999)
Maly and Maly 2005	The study's Executive Summary appears in Appendix A of this current document. Study includes extensive background research and oral histories and recommendations that have been ongoing since 1996

4.7.1 McEldowney (1982)

Holly McEldowney (1982), then of the B. P. Bishop Museum Department of Anthropology, produced an Ethnographic Background report for the Maunakea Summit Region for the Research

Corporation of the University of Hawaiʻi as part of an EIS for a Mauna Kea Science Reserve Master Plan. The data are presented in three sections addressing 1) myths and legends and "oral traditions," 2) land use practices and cultural activities and ,3) a study of place names.

McEldowney (1982:A-5) starts by relating a tradition of the goddess Poliʻahu from Haleole's (1863) story of Lāʻieikawai. While McEldowney relates this as a "Hawaiian tradition recorded by S. N. Haleole," Lāʻieikawai has increasingly been recognized as a "romance," a Cinderella-like story that undoubtedly utilized pre-Contact traditions and motifs but was self-consciously more in the nature of a fairy-tale or work of imagination than a recordation of traditional legends. Haleole's traditions of Poliʻahu, however, have almost nothing to do with Maunakea (although "Līlīnoe" is given as the name of one of Poliʻahu's companions). McEldowney then goes on to discuss Westervelt's accounts of Poliʻahu and opines that Westervelt "took the unwarranted license to assign each of the 'goddesses of the snow covered mountains' to specific localities" (McEldowney 1982:A-6). This appears to be the case as popular assignations of the names of deities to specific land-forms are modern appellations. McEldowney goes on to briefly discuss mentions of Maunakea, Poliʻahu, Līlīnoe in works by Fornander, Kamakau, Kalākaua and Thrum. She notes the common case (as exemplified in Haleole's Lāʻieikawai and Fornander's Hawaiʻi Loa legend) of characters and themes inserted into more recent versions of older myths and legends. McEldowney notes that "Otherwise Mauna Kea is mentioned only briefly and rarely as the backdrop to more compelling events, or to characterize the attributes of a figure or an event by analogy" (McEldowney 1982:A-7).

McEldowney points out that: "Several early accounts report that Hawaiians were reluctant to travel or serve as guides on inland journeys, or that they professed no knowledge of these areas, leading to the false impression that these regions constituted a wilderness unknown to the Hawaiian people" (McEldowney 1982:A-7, A-8). This generality is even more pronounced for the summit plateau of Maunakea, where almost all early post-Contact visitors made the final ascent to the summit without native guides. The only report of Hawaiians on Maunakea prior to the 1870s Boundary Commission accounts is Kamakau's reference to Kaʻahumanu's 1828 visit "to Hawaii to fulfill a vow that she had made to attempt the recovery of the bones of Lilinoe on Mauna Kea…" (Kamakau 1992:285). It is unclear whether Kaʻahumanu or her retainers actually ascended the mountain but: "It is said Kaʻahumanu did not find the bones of Lilinoe…." (Kamakau 1992:285).

McEldowney relates various western visitors' accounts of Hawaiians acquiring birds, hardwoods, fine-grained basalt, sandalwood and wild cattle in "this region" (McEldowney 1982:A-8, A-9). The first specific Hawaiian account of activities on the mountain discussed in the McEldowney study is in the Boundary Commission Testimony of a certain Haiki who asserts that: "my parents told me Humuula went to Kaluakaakoi and Poliahu. We used to go there after adzes for Humuula people" (McEldowney 1982:A-10). As McEldowney notes: "Haiki's overall testimony and placement of the boundary was rejected by the commission" (McEldowney 1982:A-10).

Similar to her study of legends, myths and early accounts of land use, McEldowney's accounts of place names also emphasizes the dearth of information, the lack of specificity of that information, and the suspicious nature of the paucity of early data. McEldowney points out that guides and informants were often familiar with land features but traveled from landmark to landmark rather than on trails. She notes that access to the mountain in the second half of the 1800s appeared to utilize ranching establishments (Humuula Sheep Station, Umikoa Ranch) and may not have related to pre-Contact approaches (McEldowney 1982). Many Hawaiian place names were noted to be modern.

4.7.2 Kanahele and Kanahele 1997

Kanahele and Kanahele are native cultural practitioners and authorities on Native Hawaiian customs, beliefs, and practices (Maly 1999:D-18). The cultural assessment was conducted for the proposed realignment of the Saddle Road (Hwy 200). The study discussed the broader cultural impacts addressing the cultural and natural landscape from the summit of Maunakea down to the ocean. This is evident in their following conclusions:

> The native Hawaiian was a creature of the land and his environment was his environment was his life line. He recognized and practice respect for hierarchy of *hiapo* for man and land alike. The mountain is sacred because it the sacred child of Wākea. It is also the nourishment source for our land. The mountains and the land were genealogically connected to him through the original ancestor, Wākea and Papa. The mountains or land, water and sky were a necessary part of life cycle.
>
> (Kanahele and Kanahele 1997 as cited in May 1999:D-21)

4.7.3 Maly 1998

Maly (1998) conducted archival and historical documentary research for Maunakea from August 1996 to March 1997 for the Native Lands Institute: Research and Policy Analysis. The study "reported on Native Hawaiian traditions, history culture, practices, and beliefs; and post contact history for the summit and mountain slopes of Mauna Kea" (Maly 1998:1). Maly also mentions that he conducted "limited oral historical interviews" that were not "part of a formal study of Mauna Kea" (Maly 1998:61). Individuals that were interviewed expressed a strong attachment to Maunakea's landscape and those interviewed "feel disheartened about the highly visible presence and impact of the telescopes and development on the summit" (Maly 1998:61).

4.7.4 Langlas et al 1999

Langlas conducted and archaeological inventory as well as cultural assessment for the proposed realignment of the Saddle Road (Hwy 200). As part of the cultural assessment, Langlas interview several area present and past residents. Information acquired in the interviews provided details on both pre- and post-Contact land uses, including trails, adze manufacture, bird catching, cattle hunting, and ritual sites.

4.7.5 Maly 1999

In 1999 Maly prepared an oral history and consultation study with archival literature research for an update of the Mauna Kea Science Reserve and Hale Pōhaku Complex development plan for Group 70 International. Since the author had previously researched and reported on the same Maunakea summit area from August 1996 to May 1998, this study "focused on oral history interviews, limited archival research, and development of an overview of several recent studies which provide important historical documentation of Mauna Kea" (Maly 1999:iii). During the study, 22 individuals were interviewed. Maly also spoke to over 100 people in the course of the study. The general consensus was that the construction of additional observatories was "inappropriate due to their deep respect for Mauna Kea"; two of the individuals hesitated to support additional development; and one individual stated the observatories "provided important knowledge to mankind" and the benefits outweighed the concerns (Maly 1999:25). The basis of the concerns is related to the "cultural attachment" of Native Hawaiians to Mauna Kea. Maly explains that cultural attachment:

> …embodies the tangible and intangible values of a culture. It is how a people identify with and personify the environment (both natural and manmade) around them. Cultural attachment is demonstrated in the intimate relationship (developed over generations of experiences) that people of a particular culture share with their landscape – for example, the geographic features, natural phenomena and resources, and traditional sites etc., that make up their surroundings. This attachment to environment bears direct relationship to beliefs, practices, cultural evolution, and identity of a people. In Hawai'i, cultural attachment is manifest in the very core of Hawaiian spirituality and attachment to landscape, the creative forces of nature which gave birth to the islands (e.g., Hawai'i), mountains (e.g., Mauna Kea) and all forms of nature, also gave birth to *na kanaka* (the people), thus in Hawaiian tradition, island and mankind share the same genealogy. (Maly 1999:27)

4.7.6 PHRI 1999

In 1999, Paul H. Rosendahl, Ph.D., Inc. (PHRI) prepared a Cultural Impact Assessment study for the University of Hawai'i Mauna Kea Science Reserve Master Plan Project Area. The basis of the study was "the oral history and consultation study carried out by Cultural Resources Specialist Kepa Maly" [Maly's 1999 study – see above] (PHRI 1999:ii). The document notes that a good faith effort was made to "identify the full range of Native Hawaiian cultural practices, features, and beliefs" associated specifically with the Science Reserve project area. PHRI recommended that "a comprehensive plan for both the short-term and long-term management of the Science Reserve Master Plan project area is vital for the protection and preservation of significant traditional cultural resources."

Three places that have been identified by SHPD as traditional cultural properties and documented in the PHRI study are: 1) Kūkahau'ula, the summit (Site 21438), 2) Līlīnoe (Site 21439), and 3) Lake Waiau (Site 21440). Other traditional places that may qualify include: 1) Pu'u Poli'ahu, 2) Pu'u Mākanaka and Kaupō, 3) Kūka'iau-'Umiko Trail, and 4) Mauna Kea-Humu'ula Trail (see Figure 6).

4.7.7 Maly and Maly (2005)

Maly and Maly (2005) prepared a study for the Office of Mauna Kea Management (OMKM) that:

> compiled a detailed collection of archival-historical records, and conducted oral history interview with *kūpuna* and elder *kama'āina*, pertaining to the *ahupua'a* (native land divisions) of Ka'ohe, Humu'ula and neighboring *'āina mauna* (mountain lands) of Mauna Kea, on the island of Hawai'i. (Maly and Maly 2005:v).

The document includes research and interviews that Maly and Maly have been conducting since 1996. Additional research, including translations of Hawaiian documents and oral history interviews were conducted for the study. Compiling historic documentation of the traditions and history of Mauna Kea into a single document was one of the study's primary goals (Maly and Maly 2005:v). The study's Executive Summary appears in Appendix A of this document.

In addition to the interviews, the study cited numerous sources among which are included native accounts translated from Hawaiian language sources, Kingdom and government records, post-Contact visitors' journals, ranching and lease records and narratives from the many scientific expeditions.

The study looked at not solely the summit of Maunakea but adapted a broader perspective encompassing the *ahupua'a* of Ka'ohe, Humu'ula and neighboring *'āina mauna* (mountain lands) as well and acknowledging Maunakea as a sacred landscape.

As Maly and Maly point out, an additional purpose of this study was to address the native lore associated with traditional knowledge of the heavens. Some of their conclusions in this regard are that:

> as is the case in all areas of Hawaiian life, the traditions, customs and practices associated with the *'oihana kilokilo* (astronomy) and *kilo hōkū* (observing and discerning the nature of the stars) were deeply tied to the spiritual beliefs of the Hawaiian people. The stars are physical manifestations of the gods who created the heavens, earth, and humankind, or are body-forms granted to select individuals or beings of nature (Maly and Maly 2005:vi)

Based upon their research, Maly and Maly were able to document 270 Hawaiian names for stars.

The study also discusses the land uses of Maunakea and the traditional knowledge and practices associated with it, including such places and activities as: Maunakea, Pu'u o Kūkahau'ula, Waiau, Pu'u Poli'ahu and Pu'u Līlīnoe, heiau and *ahu*, trails, resource collection sites, shelters, water collection, and bird hunting.

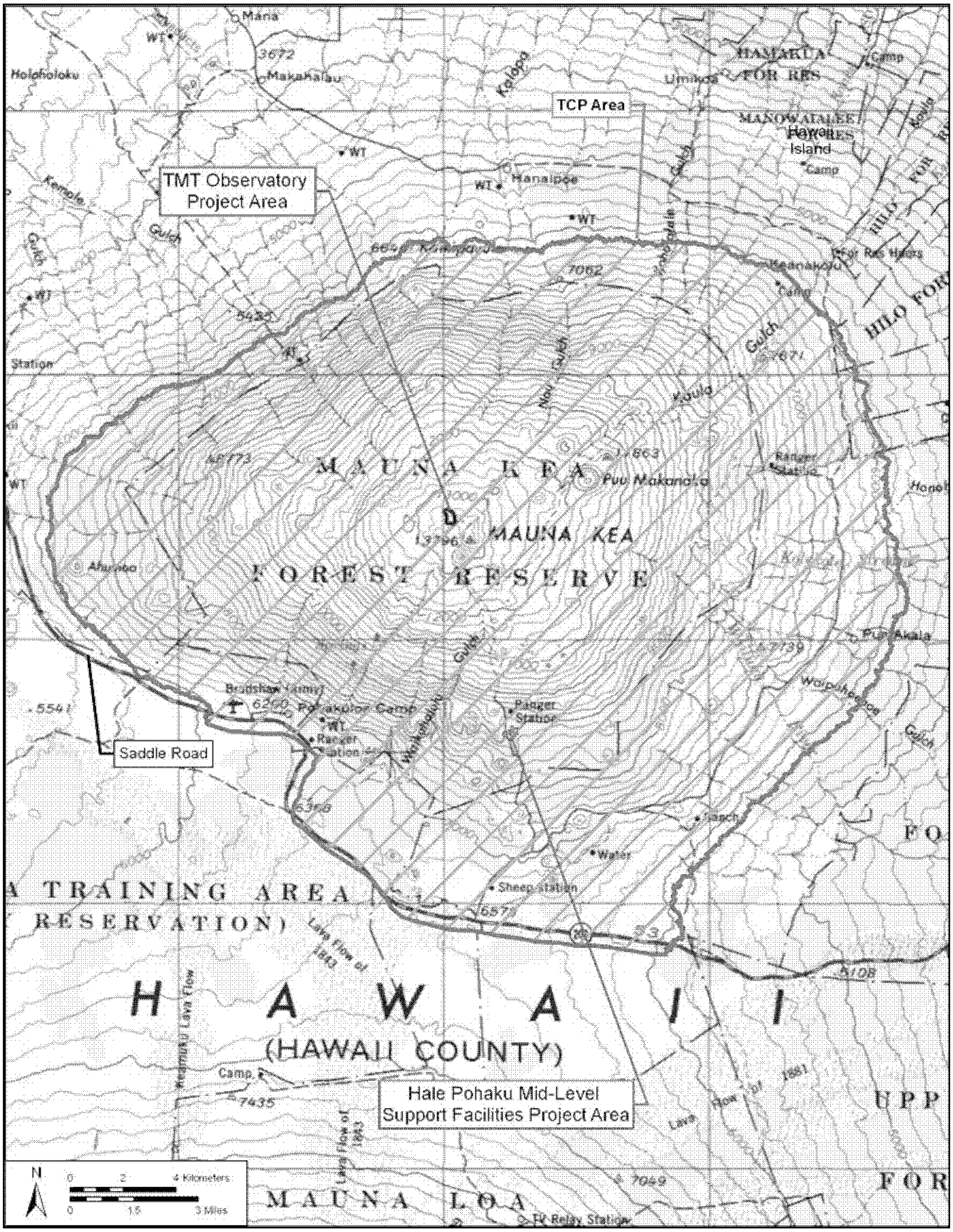

Figure 16. Map showing the proposed Tradition Cultural Property boundaries at the Maunakea summit region down to the 6,000 foot elevation contour based on Maly (1999)

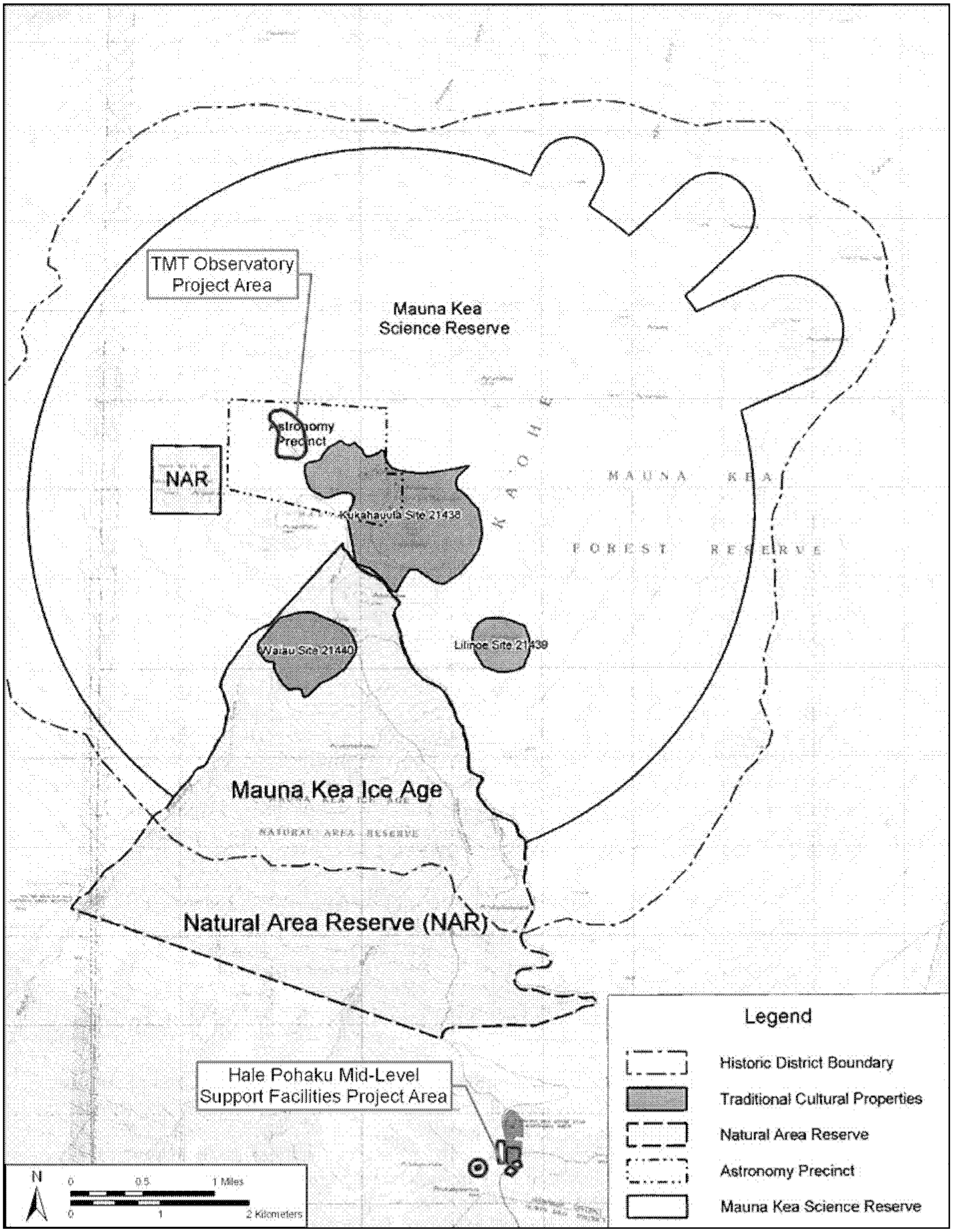

Figure 17. Map showing the three SHPD designated TCPs in the Maunakea summit region (adapted from McCoy et al 2008:2-25)

Section 5 Archaeological Research

5.1 Overview

This section reviews relevant previous archaeological research in the Maunakea summit region. The single most outstanding aspect of the archaeological record around the Project area is the high number of shrines to the virtual exclusion of all other types of sites. At least 79 shrine sites (three that are also lithic workshops) have been documented in the summit region, comprising approximately 83% of known sites in the region. Shrines typically consist of one or more large basalt slabs turned upright and arranged in different formations (Figure 17), sometimes associated with other foundation stones or rock piles (i.e., “cairns”). Several burials or possible burials have been documented in the summit region. A few stone markers and sites of unknown function have also been documented. Overall, the very high proportion of shrines near the summit is noteworthy and unique in comparison to most other places on Hawai‘i Island.

Numerous historic properties have been previously documented in the Maunakea summit region (Figure 19). There are also a large number of remains present that do not qualify as historic properties (Figure 20). These remains are referred to as “find spots” and are either clearly modern or their age and function is unable to be determined (McCoy et al 2008:2-1).

Five archaeological sites—all shrines—have been documented within approximately 1,000 feet of the TMT Observatory Project area: three of these (16171, 16172 and 21200) consist of single uprights; Site 16172, the closest site to the TMT Observatory Project area, is approximately 250 feet north of the northern boundary of the Project area. The other two sites are a pair of cairns with several uprights (16170) and a pair of uprights (16169). As discussed above (Section 3.9), several trails pass through the summit region; the closest to the Project area is about 1.5 miles to the west and south (see Figure 6).

Several historic properties have also been identified in the area surrounding the Hale Pōhaku Project area (Figure 21). These sites include primarily stone tool workshop locations and shrines.

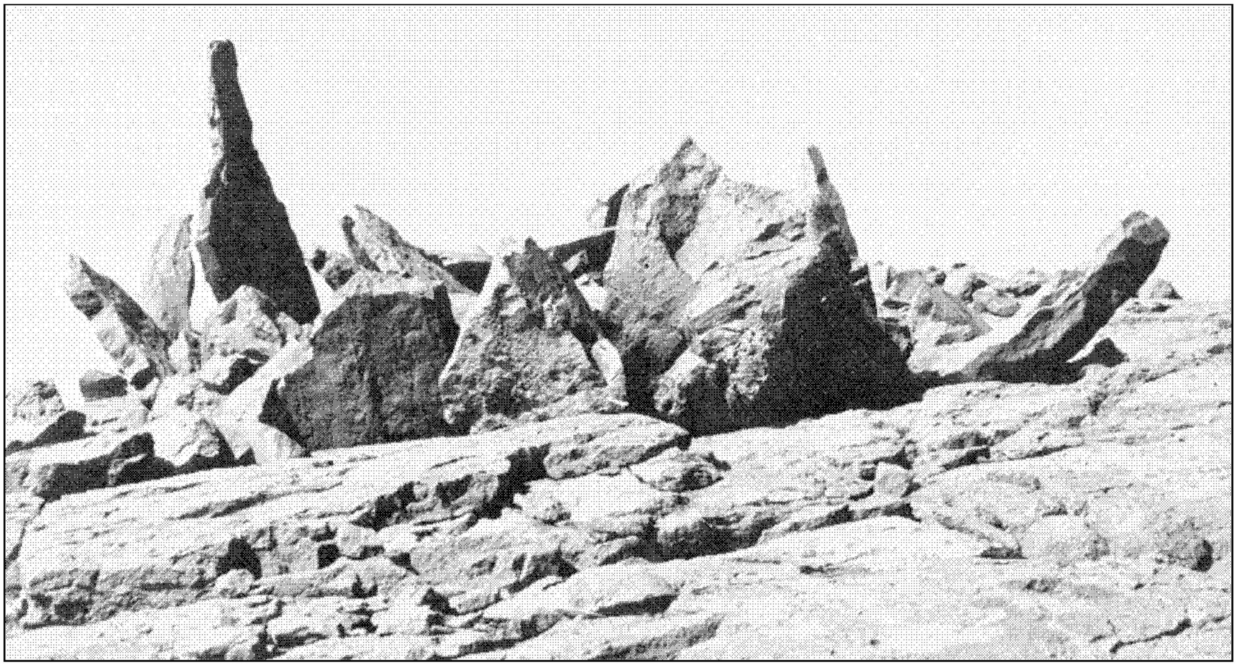

Figure 18. Traditional Hawaiian religious shrine at the Mauna Kea Adze Quarry (source: Kirch 1985)

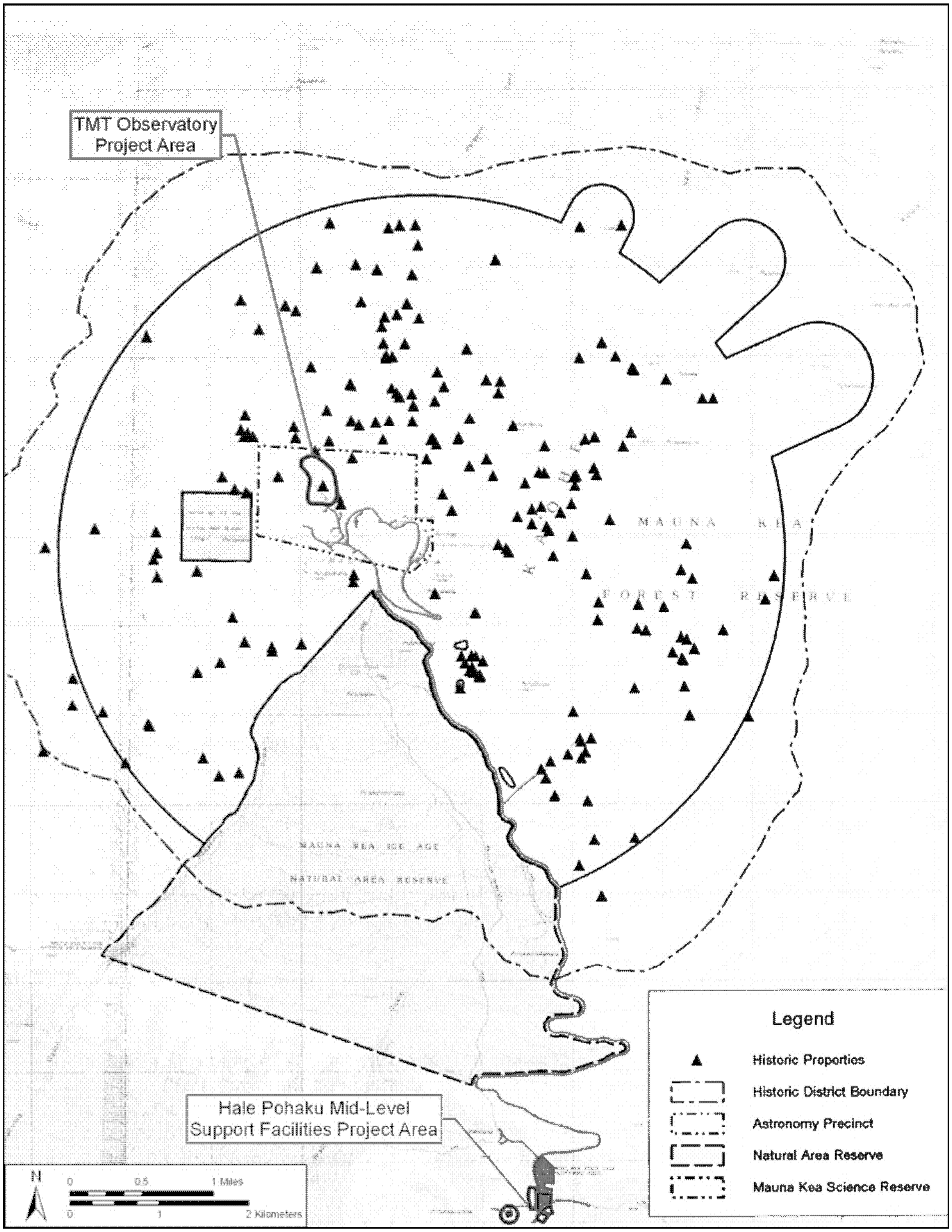

Figure 19. Map showing historic properties in the Maunakea summit region (adapted from McCoy et al 2008:2-16)

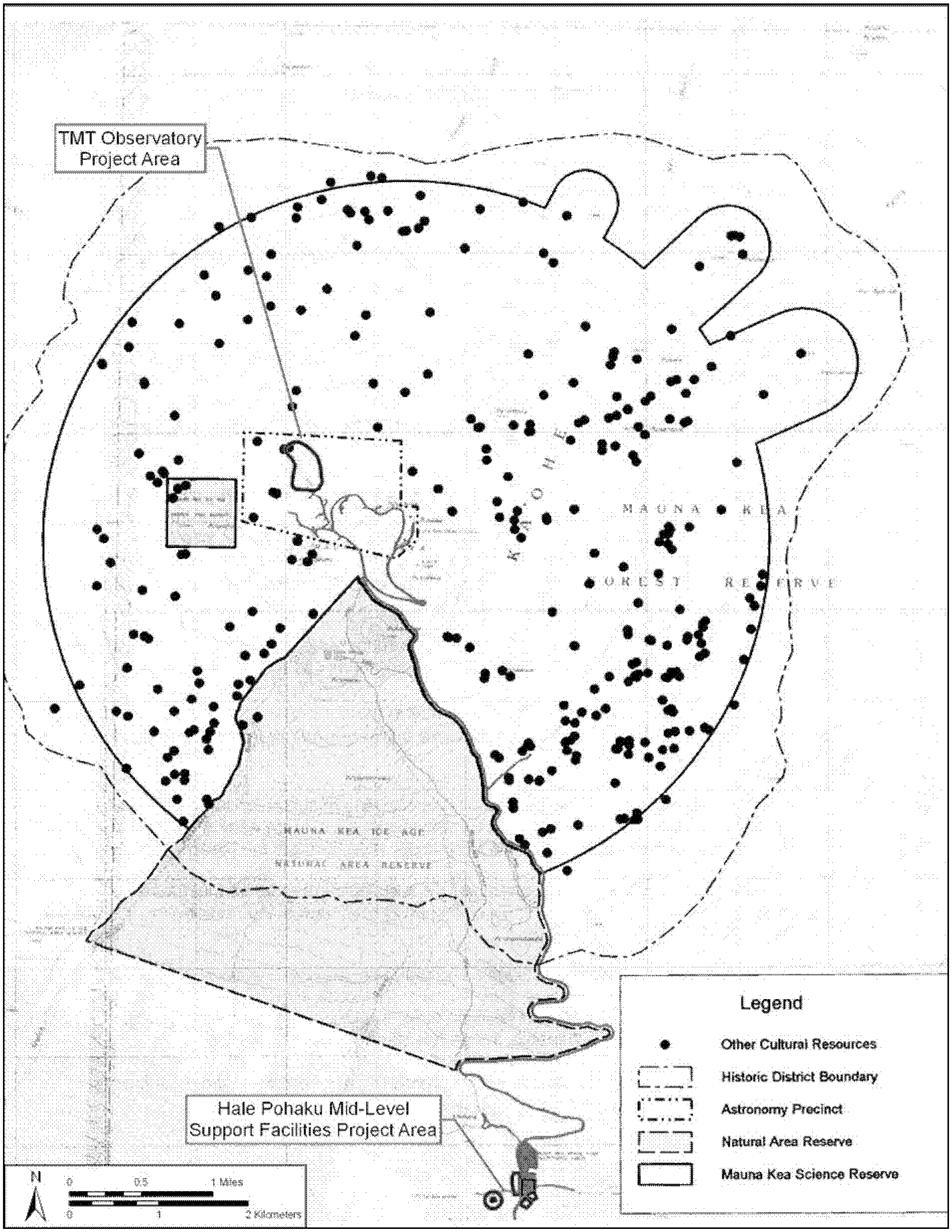

Figure 20. Map showing find spots in the Maunakea summit region (adapted from McCoy et al 2008:2-33)

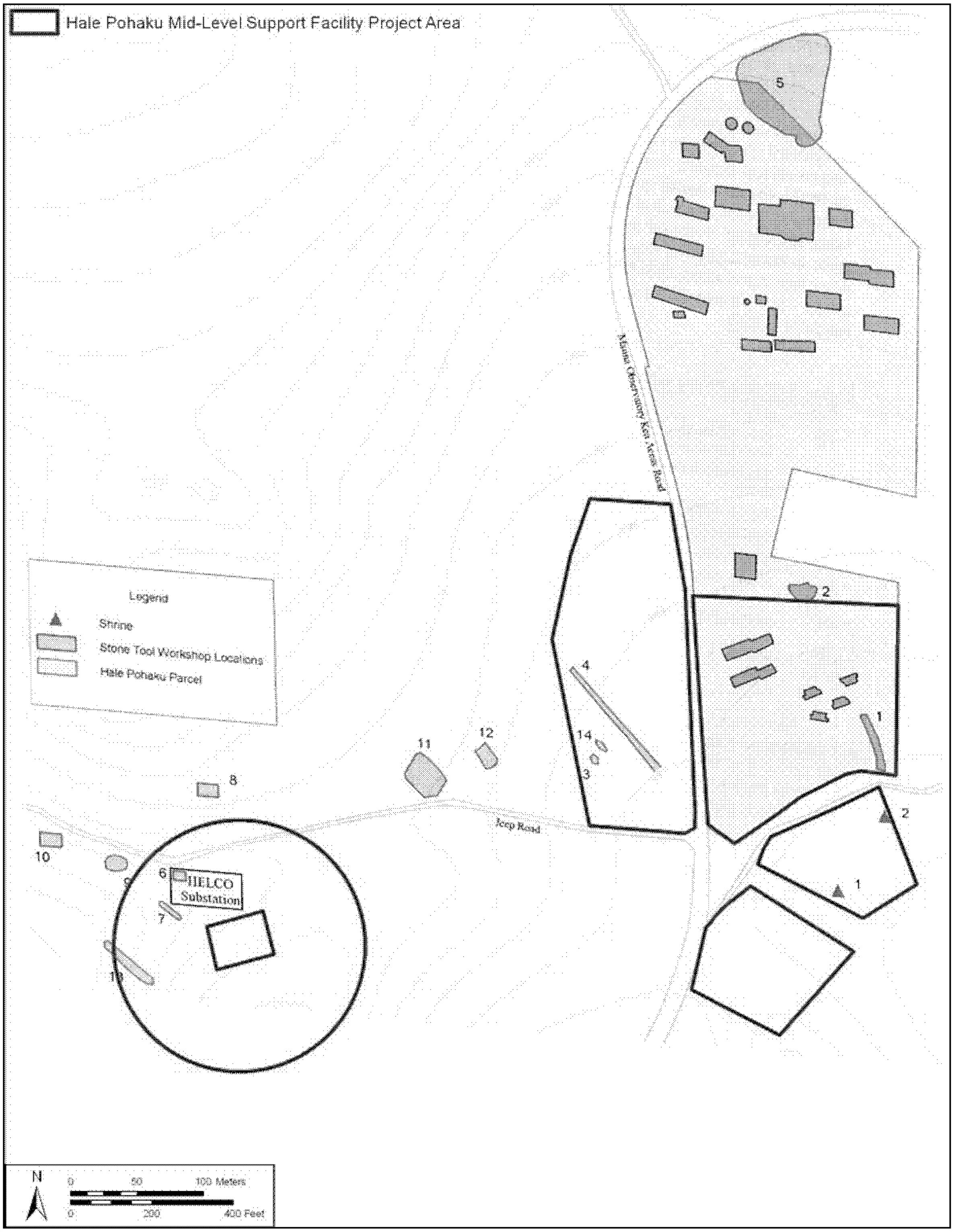

Figure 21. Map showing historic properties near the Hale Pōhaku Project area (adapted from McCoy et al 2008:2-21)

5.2 Early Observations

Early documentation of archaeological sites in the upper reaches of Maunakea was somewhat anecdotal and ad hoc. McEldowney's (1982:A-11) summary of the ethnographic background of the Maunakea summit region notes:

> Although most accounts speak in general terms, those that specifically locate the presence of human bones, "graves," "burial caves" or mortuary features indicate that burials are "not uncommon" between 7,800 ft and 13,000 ft elevation along the northern and eastern slopes of Mauna Kea (Alexander 1892; Preston 1895:601; Gregory 1921; Aitken 1935:48; Gregory and Wentworth 1937:1720; Kilmartin 1974:15; Bryan 1927:106; Hamakua Site Records, Dept. Anthro, B.P. Bishop Mus.).

On the first recorded ascent of Maunakea in 1823, Rev. Goodrich (see Section 4.2) noted the presence of a pile of stones which he assumed had been constructed by Hawaiians. Goodrich's time on the mountain, however, was extremely brief and his observations about archaeological matters, at least, were quite cursory.

William D. Alexander described a trip up Maunakea with a surveying party, and observed:

> That same afternoon [July 25, 1892] the surveyors occupied the summit of Lilinoe, a high rocky crater, a mile southeast of the central hills [the "summit"] and a little over 13,000 feet in elevation. Here, as at other places on the plateau, ancient graves are to be found. In olden times it was a common practice of the natives in the surrounding region to carry up the bones of their deceased relatives to the summit plateau for burial. (cited in McCoy 1999)

McCoy discusses a visit in 1975 to the summit of Līlīnoe in which he described two adjacent cairns on the eastern rim and comments that: "If the cairns that were recorded in 1975 were in fact the same graves [as described by William D. Alexander in 1892] the remains had been removed sometime prior because no human bone was visible at that time" (McCoy 1999:27). It is also possible that Alexander was in error in his assessment of the function of the cairns.

Jerome Kilmartin (1974) published a brief reminiscence reflecting on his involvement in a 1925 United States Geological Survey project to map the Lake Waiau topographic quadrangle. That 1925 work put him in the summit region for more than five months in 1925. He did not return again until 1971. Kilmartin's 1925 U.S. Geological Survey work was facilitated by the Umikoa Ranch based at approximately 3,500 foot elevation above Kūka'iau in Hāmākua. The team established a base camp at Pu'u Kihe (7,821 feet elevation), where water and forage were available, and a summit camp (Camp 3) of four tents at Lake Waiau.

Kilmartin reported little archaeological detail, but did note that at Pu'u Mākanaka (elevation 12,414 feet):

> On the rim I found a partially uncovered grave, eroded by high winds, with an incomplete human skeleton. This was unknown as far as I could discover, to anyone familiar with the area. The name Pu'u Makanaka means "Hill crowded with many people" and the grave must have been ancient. (Kilmartin 1974:15)

He also notes:

> Ancient stone piles, quarries, walls, platforms, and burial caves are sufficient evidence that early Hawaiians were familiar with Mauna Kea's highlands. Stone chips from adze manufacture are found near a cave at 12,360 feet. …(Kilmartin 1974:13)

It may also be noted in passing that the U.S. Geological Survey party created archaeological sites of their own (and perhaps many):

> …the wind was so strong I thought surely we would be blown away. However the *ahu* (stone pile) that we built did give a little protection after I had made a setup with the plane table only two feet above the ground. (Kilmartin 1974:15)

Kenneth Pike Emory was the first person to have described the distinctive shrine features of Maunakea in a brief, popular piece published in *Paradise of the Pacific* magazine (April 1938). Emory was struck by the "immense quantity of chipped stone" and posited that the piles of debitage were "the largest so far recorded anywhere in the world." He concluded that the evidence of "chips and rejects" was the result of skilled adze makers and that "they were able to create a stone-tool industry on a scale unequaled in the stone-age because of the superior social organization of the Hawaiian people." Emory noted similarities of the shrines to a shrine on Maunaloa photographed by the geologist Dr. T. A. Jaggar in 1919 and also to the shrines of Necker Island. Emory posited that in the shrines "each upright stone stood for a separate god" and referred to them as "*'eho*" ("a collection of stone gods")—a term used in the Tuamotus as well as Hawaii to designate an alignment of upright stones.

Wentworth and Powers (1943) carried out geological studies on Maunakea in 1939 that noted archaeological sites in the Hopukani and Liloe Springs area. They noted stone walls that they interpreted as a trap to impound wild cattle that frequented the springs and certain older sites:

> In the area to the east and up the slope from the springs are numerous small heaps of pre-European stone adz workings. Certain lava caves contain evidence of habitation, suggesting that the springs were frequented by adz workers. The latter not only secured adz material from lava flows in places but carried on a surprising amount of casual prospecting on dense basalt boulders included in the moraines and outwash strewn several thousand feet down the mountain. (Wentworth and Powers 1943:544)

Two tables are provided below detailing both previous archaeological studies of the summit region (Table 4) and documented archaeological sites within the summit region prior to the on-going McCoy and Nees study (Table 5).

Table 4. Archaeological Studies in the Maunakea Summit Area

Reference	Nature of Study	Area of Study	Comments
McCoy 1976	"The Mauna Kea Quarry Project: A First Analysis"	Mauna Kea Adze Quarry Complex	--
McCoy 1977a	"Archaeological Investigations at the, Hawaii: Preliminary Results of the 1975-76 Fieldwork"	Mauna Kea Adze Quarry Complex	--
McCoy 1977b	"A Summary of the 1975 Field Investigations"	Mauna Kea Adze Quarry Complex	--
McCoy 1978	Account of the "The B.P. Bishop Museum Mauna Kea Adz Quarry Project."	Mauna Kea Adze Quarry Complex	--
McCoy 1979	Reconnaissance survey	Hale Pōhaku	--
Allen 1981	Adze quarry analysis thesis	Mauna Kea Adze Quarry Complex	--
McCoy 1981	"Stones For the Gods: Ritualism in the Mauna Kea Adz Quarry Industry, Hawaii."	Mauna Kea Adze Quarry Complex	--
Cleghorn 1982	University of Hawai'i Ph.D. dissertation in Anthropology on Mauna Kea Adze Quarry lithics	Mauna Kea Adze Quarry complex in the vicinity of Pu'u Ko'oko'olau	Focuses on technological analysis and experimental tests. Some 534 archaeological site components of 38 designated sites are briefly summarized.
McCoy 1982	Reconnaissance survey	~1,000 acres of the summit and north slope (down to 13,000 ft. elevation)	Documents 22 sites including an open air shelter and 21 shrine sites.
Kam and Ota 1983	Reconnaissance survey	Mauna Kea Observatory Power Line	--
McCoy 1984a	Summary of the 1984 fieldwork	Mauna Kea Summit Region	--
McCoy 1984b	Archaeological reconnaissance	Hopukani, Waihu & Liloe Springs area, west side of Pōhakuloa Gulch between 8,640 and 10,400 ft. elevation	Documents six archaeological sites and a number of find spots (More thorough coverage is presented in McCoy 1986).
McCoy 1985	Reconnaissance survey	~40 acres extending on both sides of the Mauna Kea Observatory access road between 9,080 and 9,400 ft. elevation	Preliminary report for Pu'u Kalepeamoa Site documenting five lithic scatters and two shrines used for the manufacture of hammerstones and octopus lure sinkers. Ritual was an integral part of the manufacturing process

Reference	Nature of Study	Area of Study	Comments
Bonk 1986	Reconnaissance survey	HELCO transmission line and substation	--
McCoy 1986	Report on archaeological investigations	Hopukani and Liloe Springs area located on the west side of Pōhakuloa Gulch well southwest of the Mauna Kea summit region	Documents three sites initially discussed in McCoy (1984). Eight radiocarbon dates indicated use from A.D. 1000-1800; camps used for acclimatization and for procuring water, food (primarily birds) and fuel.
Sinoto 1987	Reconnaissance survey	HELCO transmission line and substation	--
Williams 1987	Reconnaissance survey	Mauna Kea Access Road	--
Hammatt and Borthwick 1988	Reconnaissance survey	Two locations: ~15-acre area between 11,560 & 11,840 ft. elevation, west side of present summit road; ~100-acre area, east side of summit road in a saddle between two cinder cones at 12,100-12,225 ft. elevation	4 sites: Sites 11,076 & 11,077 are probable pre-Contact shrines; Site 11,078 is a probable pre-Contact overhang shelter; Site 11,079 included a probable pre-Contact shrine and a probable pre-Contact *ahu* or cairn with basalt flakes and an adze preform.
Williams 1989	Inventory survey	Mauna Kea Adze Quarry Complex	--
Borthwick and Hammatt 1990	Reconnaissance survey	Two locations (total 2 acres) on summit of Mauna Kea.	No finds – the areas had been "fully graded" for existing telescope facilities.
McCoy 1990	Lithic analysis	Mauna Kea Adz Quarry Complex	--
Robins and Hammatt 1990	Reconnaissance survey	Two locations: 5.1-acre area on Pu'u Hau Oki cinder cone at summit and a 21-acre lot near Hale Pōhaku	No finds at JNLT summit project area which had been largely graded. In Hale Pōhaku area, three lithic scatters described in McCoy (1985) are discussed.
McCoy 1991	Survey and Test Excavations report	Pu'u Kalepeamoa Site	--
Borthwick and Hammatt 1993	Reconnaissance survey	Proposed Gemini Telescope location at ~13,700 ft. elevation on a ridge line north of the summit cone	The entire summit ridge on which the Project area was located had been graded for existing telescope facilities. No finds.
McCoy 1999	Analysis of a site complex (Site 50-10-23-16204) that he had described 24 years earlier	East side of Mauna Kea Access Road between 12,240-12,300 ft. elevation just south of Pu'u Līlīnoe	McCoy posits a ritual significance to the site specifically as a location for a rite of passage.
Hammatt and Shideler 2002	Data Recovery report for two lithic scatters	Sites 50-10-23-10,310 and -10,311 located in the Hale Pōhaku area between 9,080 and 9,160 ft. elevation	Documentation of data recovery of sites identified in McCoy (1985) and Robins and Hammatt (1990). Two radiocarbon dates (A.D. 1260-1410 and A.D. 1510-1950 at 95% probability) were both were thought to be problematic. Possible ritual associations with healing and the deity Kanaloa are explored.

Reference	Nature of Study	Area of Study	Comments
McCoy 2005	Monitoring	Septic tank excavations	--
McCoy et al 2005	Inventory survey	Mauna Kea Science Reserve	--
McCoy and Nees 2006	Inventory survey	Mauna Kea Science Reserve	--
Hammatt 2009a	Archaeological Assessment	Proposed Thirty-Meter-Telescope Observatory (TMT) Project on the northern plateau of the Mauna Kea summit area, within Area E of the Astronomy Precinct of the Mauna Kea Science Reserve	No findings
Hammatt 2009b	Archaeological Assessment	Hale Pōhaku area at approximately 2,800 m (9,200 ft.) elevation on the southern slope of Mauna Kea	No findings
McCoy and Nees (in progress)	Inventory survey	Mauna Kea summit region	In progress

Table 5. Documented Archaeological Sites in the Summit Region

SIHP #	Elevation	Description	Function
11077	12320	Single upright	Shrine
11079	12313	Lithic scatter of adze manufacturing byproducts and 2 associated cairns	"Workshop" and possible shrine
16163	12880	Platform/pavement with 14 uprights	Shrine
16164	13397	3 to 5 uprights on platform and 1 isolated upright	Shrine
16165	13362	Single row of 2 uprights	Shrine
16166	13422	2 rows of uprights, 8 to possibly 9 total	Shrine
16167	13395	Single row of 2 uprights	Shrine
16168	13098	Semi-enclosure with 21 to possibly 25 uprights	Shrine
16169	13210	Single row of 2 uprights	Shrine
16170	13139	2 cairns with 3 to possibly 4 uprights	Shrine
16171	13087	Single upright	Shrine
16172	13218	Single upright	Shrine
16173	13009	7 dispersed uprights	Shrine
16174	13075	Boulder with 1 to possibly 8 uprights on the side	Shrine
16175	NA	5 cairns with 1 upright each	Shrine
16176	13078	Single row of 3 uprights	Shrine

SIHP #	Elevation	Description	Function
16177	13118	Single row of 3 uprights	Shrine
16178	13236	Single upright	Shrine
16179	13122	Single row of 3 uprights	Shrine
16180	13086	Boulder with 3 uprights	Shrine
16181	13401	Single upright	Shrine
16182	13155	3 to 5 uprights	Shrine
16184	13072	Semi-enclosure with 24 uprights	Shrine
16185	13008	Single row of 3 uprights	Shrine
16186	13076	Single row of 2 and possibly 3 uprights	Shrine
16187	12775	Single row of 9 uprights	Shrine
16188	12857	Single upright	Shrine
16189	12902	Single row of 3 and possibly 4 uprights	Shrine
16190	12956	Single row of 10 and off-set uprights	Shrine
16191	12889	Single row of 4 uprights	Shrine
16192	12842	2 sets of uprights, 6 total	Shrine
16193	12843	Single upright	Shrine
16194	12673	Single row of 12 - 14 uprights	Shrine
16195	NA	2 cairns	Possible burial
16196	12953	Single row of 2 uprights	Shrine
16197	12953	Single upright	Shrine
16198	12930	2-tiered platform with 7 uprights	Shrine
16199	12991	1 and possibly 4 uprights	Shrine
16200	12975	Single row of 5 and possibly 6 uprights	Shrine
16201	12990	Single row of 3 uprights	Shrine
16202	13006	Single upright	Shrine
16203	13145	Single row of 2 and possibly 3 uprights and a lithic scatter of adze manufacturing byproducts	Adze "workshop" and shrine
16204	12332	5 shrines, 26 stone-walled enclosures and a lithic scatter of adze manufacturing byproducts	Adze "workshop" and shrine complex
16248	NA	Series of cairns	Burial
18682	12955	Single row of 3 uprights	Shrine
18683	13012	Single row of 2 uprights	Shrine
21197	13052	2 platforms with a total of 5 uprights	Shrine
21198	13043	Single upright	Shrine

SIHP #	Elevation	Description	Function
21199	12876	Single upright	Shrine
21200	13165	Single upright	Shrine
21201	13087	Single row of 2 uprights	Shrine
21202	13048	Single row of 6 to possibly 7 uprights	Shrine
21203	13034	Single row of 2 uprights	Shrine
21204	12925	3 areas of stacked rock	Unknown
21205	13484	Single upright	Shrine
21206	12754	Single upright	Shrine
21207	12787	Single upright	Shrine
21208	12799	1 to 2 uprights on a boulder	Shrine
21209	NA	Cairn on summit	Unknown
21210	12233	Single upright	Shrine
21211	12275	Single row of 2 uprights on a platform and a lithic scatter of adze manufacturing byproducts	Adze “workshop” and shrine
21212	12385	Single row of 2 uprights	Shrine
21213	12249	3 piles of rocks with 1 upright	Shrine
21214	12241	Single row of 5 and possibly 7 uprights	Shrine
21406	NA	Single upright	Shrine
21407	12952	Single row of 2 uprights	Shrine
21408	12913	Single upright	Shrine
21409	12984	Single upright	Shrine
21410	12801	Single row of 5 uprights	Shrine
21411	12815	Cairn	Marker
21412	NA	Cairn	Marker
21413	NA	Cairn	Possible burial
21414	NA	Cairn	Possible burial
21415	13130	Cairn on boulder	Unknown
21416	12792	Cairn	Possible burial
21417	12974	Cairn	Unknown
21418	12889	3 and possibly 4 uprights on top and to the side of a boulder	Shrine
21419	12495	Single upright	Shrine
21420	12152	Enclosure with 11 and possibly 12 uprights and a nearby stone platform	Shrine
21421	12731	2 cairns, one with a possible upright and an isolated upright	Shrine

SIHP #	Elevation	Description	Function
21422	12847	Single upright	Shrine
21423	NA	Stones on boulder	Marker
21424	12320	4 to 5 uprights on a platform and boulder	Shrine
21425	12523	Single upright	Shrine
21426	12568	Single row of 4 uprights	Shrine
21427	12635	Terrace with possible upright	Unknown
21428	12720	Single upright	Shrine
21429	12719	Single upright	Shrine
21430	13111	Single row of 3 uprights	Shrine
21431	12532	Semi-enclosure with 7 to 10 uprights	Shrine
21432	13044	Single row of 2 uprights	Shrine
21433	12579	Single upright	Shrine
21434	12551	8 stones on a boulder	Unknown
21435	12564	Cairn and boulder with 1 upright	Shrine

5.3 Formal Studies

This section presents additional descriptions of the most important findings of the works summarized in Table 4.

5.3.1 Cleghorn (1982)

Cleghorn (1982) produced his University of Hawai‘i Ph.D. dissertation in Anthropology on Mauna Kea Adze Quarry lithics focusing on technological analysis and experimental tests. Some 534 archaeological site components of 38 designated sites of the Mauna Kea Adze Quarry complex in the vicinity of Pu‘u Ko‘oko‘olau were briefly summarized (sites are referred to by Bishop Museum site nomenclature).

5.3.2 McCoy (1982)

Patrick McCoy (1982) documented reconnaissance-level surveying of approximately 1,000 acres of the summit and north slope (down to 13,000 ft). McCoy notes that:

> Few, if any, archaeological sites were predicted to occur within the boundaries of the Project area, given the high altitude location and presumed absence of exploitable resources, including adze-quality stone, which on present evidence is restricted to the south slope of the mountain. (McCoy 1982)

Thus, it was far beyond expectations when 22 sites were recorded including an open-air (i.e., non-cave and non-rockshelter) shelter and 21 shrine sites. McCoy was quite familiar with the “occupational shrines” near the adze quarries but concluded the function of these shrines located away from the main quarrying area was unknown. McCoy posits:

> …that these structures were erected by travelers, most probably in propitiation of mountain spirits. Such practices are universal in the high mountain regions of the world. (McCoy 1982:A-37)

McCoy does note, however, that the majority of the shrines were located in a narrow 200-foot contour interval band between 12,900-foot and 13,100-foot elevation. He theorizes that this clearly defined vertical zonation site pattern is the result of utilization of a break in slope at the edge of the summit plateau where: “when viewed from either the base of the steep inclined slope directly below, or from the base of the summit cones above, is a relatively flat horizon on which the shrine uprights are silhouetted and therefore visible from some distance” (McCoy 1982). McCoy associates these shrines with “the request for permission to pass over the summit” and notes that this indicates a preponderance of access from the northern, windward side of the islands consistent with the inclusion of the land within Hāmākua District. He further posits that the distribution of the shrines may relate to “the lower margins of snow fields” and possibly, by extension, to the goddess Poli‘ahu. McCoy notes that at least one of the more complex shrine sites, “The placement of offerings and whatever other ritual took place here appear to have been intentionally directed away from Mauna Kea. The possibility of astronomical concepts being operative is explored.” McCoy also suggests that smaller sites were built and utilized by one or a few individuals while more complex shrines were built and utilized by a larger kin group and that perhaps “each structure would represent a separate social unit that had exclusive use rights.” McCoy recommended intensive archaeological survey and avoidance of construction and related activities on or in proximity to known archaeological sites.

5.3.3 McCoy (1984)

McCoy’s (1984) archaeological reconnaissance report for the Hopukani, Waihu, and Liloe Springs area documents six archaeological sites and a number of find spots located on the west side of Pōhakuloa Gulch between 8,640 and 10,400 feet elevation. The work was associated with a Pōhakuloa Training Area (PTA) pipe line project. This preliminary report was elaborated upon in McCoy’s later (1986) study.

5.3.4 McCoy (1985)

McCoy’s (1985) preliminary report for the Pu‘u Kalepeamoa Site documents three archaeological surveys for a proposed new construction laborer camp at Hale Pōhaku located just above and below the Hawaii Institute for Astronomy’s Mid-Level Facility encompassing a total of approximately 40 acres. This project was located on both sides of the Mauna Kea Observatory access road between 9,080 and 9,400-foot elevation. Five lithic scatters and two shrines were recorded. These archaeological features were understood as functionally integrated components of a single activity system and one Bishop Museum site number was assigned (lithic scatters nos. 1 & 2 would subsequently be given SIHP Nos. 50-10-23-10,310 and -10,311, respectively). McCoy concluded that the primary activity at the site was the manufacture of hammerstones and octopus lure sinkers from the crystalline dunite and gabro deposits on the slopes of Pu‘u Kalepeamoa but he noted that ritual was an integral part of the manufacturing process. Further research was recommended. The lithic scatters would be subject to further documentation (Robins and Hammatt 1990) and data recovery work (Hammatt and Shideler 2002).

5.3.5 McCoy (1986)

McCoy's (1986) report on archaeological investigations for the Hopukani and Liloe Springs area documents three mid-level sites located on the west side of Pōhakuloa Gulch well southwest of the Maunakea summit region (that were initially discussed in McCoy 1984). These sites included a rock shelter at Hopukani Spring (10,400 foot elevation), the Hopukani Rockshelter (10,160 foot elevation) and an open camp site at Liloe Spring (8,921 foot elevation) Eight radiocarbon dates indicated use spanning A.D. 1000 to A.D. 1800. It was concluded that these camps were used for acclimatization and for procuring water, food (primarily birds) and fuel.

5.3.6 Hammatt and Borthwick (1988)

CSH (Hammatt and Borthwick 1988) carried out an Archaeological Reconnaissance Survey of two locations for proposed antennas for the National Radio Astronomy Observatory. An approximately 15-acre relatively level location between the 11,560 foot and 11,840 foot elevations on the southeastern slope of the summit region on the west side of the present summit road was examined but no archaeological sites were observed. Another approximately 100-acre location on the east side of the summit road in a saddle between two cinder cones at the 12,100 to 12,225 foot elevation was also examined and four archaeological sites were documented (none of which appear to have been previously recorded). Sites 11,076 and 11,077 are probable pre-Contact shrines; Site 11,078 is a probable pre-Contact overhang shelter with a stacked stone alignment; and Site 11,079 had two components: a probable pre-Contact shrine and a probable pre-Contact *ahu*, or cairn, with basalt flakes and an adze preform present. Preservation of the four sites was recommended but it was thought that the antenna project potentially would be compatible with such preservation of the four relatively small and discrete sites in the large acreage.

5.3.7 Borthwick and Hammatt (1990)

In 1990 CSH carried out an Archaeological Reconnaissance Survey of two locations for the proposed Galileo Telescope on the summit of Maunakea. The study was of an approximately 2-acre portion of the summit ridge that (at that time) included the UKRT, U.H. 2.2 m, U.H. 24-inch telescopes and Medical Support facilities. The study notes that previous work (McCoy 1982) had identified no sites in the summit region (above circa 13,330 foot elevation). Borthwick and Hammatt (1990) note that the entire summit ridge on which the project areas were located had been "fully graded" for existing telescope facilities and no archaeological features were observed; no further work was recommended.

5.3.8 Robins and Hammatt (1990)

CSH carried out another Archaeological Reconnaissance Survey in 1990 for the Japan National Large Telescope (JNLT) project at both the summit and the Hale Pōhaku area. The actual JNLT summit construction area was an approximately 5.1-acre area on Pu‘u Hauoki cinder cone in the northern portion of the Mauna Kea Science Reserve approximately 61 m (200 feet) west of the existing W. M. Keck Observatory and 304 m (800 feet) north of a paved "spur road" passing by the Submillimeter Telescope (CSO). The JNLT summit project area had been largely graded although certain undisturbed outcrop formations were present. No archaeological features were identified within the JNLT summit project area.

The Robins and Hammatt (1990) study also included several areas near the Mid-Level Facility Complex (OCIA) including a small dormitory construction area located approximately 134 m (440 feet) east of the Mauna Kea Observatory access road at 9,245 foot elevation (where no sites were observed). An approximately 21-acre lot surrounding the dormitory delineated on the west and north side by the Mauna Kea Observatory access road and to the south by an existing jeep road was also included in the study. Two archaeological features were newly described and three previously identified sites were recorded in the approximately 21-acre lot. The two newly-described features included a small oval enclosure and a roughly square enclosure that were both thought to be relatively recent constructions (no formal SIHP site numbers were assigned). The three previously-recorded (McCoy 1985) sites included three lithic scatters (lithic scatters nos. 1, 2 and 5) that McCoy had understood as being functionally-integrated components of a single site. Further work at the lithic scatters was recommended. CSH completed a later Data Recovery report (Hammatt and Shideler 2002) for lithic scatters nos. 1 and 2.

5.3.9 Borthwick and Hammatt (1993)

In 1993 CSH carried out an Archaeological Reconnaissance Survey for the proposed Gemini Telescope location at approximately 13,700 foot elevation on a ridge line north of the summit cone. The study notes that previous work (McCoy 1982) had identified no sites in the summit region above circa 13,330 foot elevation. The study notes that the entire summit ridge on which the project area was located had been graded for existing telescope facilities and no archaeological features were observed; no further work was recommended.

5.3.10 McCoy (1999)

McCoy (1999) wrote up an analysis of a site complex (SIHP No. 50-10-23-16204), that he had described 24 years earlier, located on the east side of the Mauna Kea Access Road between 12,240 and 12,300 foot elevation just south of Pu‘u Līlīnoe. The site included five shrines and three enclosure complexes. The complex was notably located 500 m from the nearest known source of worked raw lithic material and was perceived as “isolated.” McCoy noted that when viewed in terms of the natural environment and human productivity, “the location of this site appears to be irrational” (1999:14). Of particular interest were some 26 very small open-air enclosures (typical interior area approximately 1.6 m^2). This led McCoy to posit a ritual significance to the site, specifically as a location for rites of passage.

McCoy goes on to consider the form of the upright slabs of (typically unworked) basalt that were arranged into the many shrines of Maunakea and Site 16204, in particular. McCoy posits that pointed uprights symbolize gods and that flat-topped slabs symbolize goddesses (McCoy assumes that the Hawaiian goddesses Līlīnoe and Poli‘ahu were worshipped). Determining the affinities of the slabs is complicated by the presence of other forms (“angled,” “gabled,” “rounded” and “notched”) and the general difficulty of determining whether a particular stone was an upright at all.

McCoy argues that evidence supporting an unusual ritual function (rites of passage) includes:

- Unusual orientations of four of the five shrines,
- Lack of evidence of habitation,

- Unusual "lack of a cohesive structure" among the lithic byproducts present in the artifact assemblages – suggesting "symbolic manufacture and use,"
- The numerous (26) very small open-air enclosures that were "too small to accommodate a person and a fire hearth" of no obvious purpose and believed to relate to temporary day-time use.

McCoy concludes that the small enclosures "may symbolically represent both a womb and a grave" and that the site "was the locus of initiation rites" related to "formal initiation rites for groups of apprentices" (McCoy 1999).

5.3.11 Hammatt and Shideler (2002)

In 2002 CSH completed a Data Recovery report for two lithic scatters (SIHP Nos. 50-10-23-10,310 and -10,311) located in the Hale Pōhaku area between 9,080 and 9,160 foot elevation. These sites were first recorded by McCoy (1985:11-12) as Lithic Scatter No. 1 (SIHP No. 50-10-23-10,310) and Lithic Scatter No. 2 (SIHP No. 50-10-23-10,311) of the Pu'u Kalepeamoa Complex. Initially, the University of Hawai'i Institute of Astronomy planned to preserve the two lithic scatters; however, dormitory construction increased erosion in the vicinity and, in consultation with the State Historic Preservation Division, a data recovery program was developed. Data recovery fieldwork included mapping, surface collection and four 1 m^2 test units (two at each of the two sites). Two radiocarbon dates (A.D. 1260-1410 and A.D. 1510-1950 at 95% probability) were obtained but both were thought to be problematic. It was concluded that the sites were modest, out-lying, open, lithic workshop sites with octopus lure sinker manufacture of both "coffee-bean" and "bread-loaf" morphological types. It was concluded that the location of the sites was associated with a micro-climate of slightly greater moisture, slightly greater soil and slightly greater protection from the wind at the top of a natural drainage that favored *māmane* forest growth—which in turn provided greater protection from the elements, fuel and construction materials. It is suggested that the endeavor to produce octopus lures may have had other purposes than food procurement and the affinities with healing prayers (*pule he'e*) dedicated to the deity Kanaloa are explored.

5.3.12 Hammatt (2009a)

CSH conducted an Archaeological Inventory Survey for the Thirty Meter Telescope Observatory Project (TMT) in 2008. No historic properties were identified within the approximately 36-acre survey area. Previously identified historic properties in the vicinity of the survey area were found and confirmed to be outside of the survey area. CSH's effect recommendation for the proposed TMT Observatory Project is "no historic properties affected," therefore the final report was submitted as an Archaeological Assessment.

5.3.13 Hammatt (2009b)

CSH conducted an Archaeological Inventory Survey for construction staging areas and development of housing in the Hale Pōhaku area in 2009. The project is a component of the TMT Observatory Project and involves the construction of ancillary facilities. Previously identified historic properties in the vicinity of the survey area were found and confirmed to be outside of the survey area. CSH's effect recommendation for the proposed TMT Observatory

Project Ancillary Facilities is "no historic properties affected," therefore the final report was submitted to SHPD as an Archaeological Assessment.

5.3.14 McCoy et al. (2009 in progress)

5.3.15 McCoy and Nees (in progress)

As the Hammatt inventory surveys (2009a, 2009b) were being prepared, CSH archaeologists interacted with Dr. Patrick McCoy at the offices of Pacific Consulting Services, Inc. and also within the Project area. This study should greatly advance our knowledge of traditional Hawaiian use of the Maunakea summit region. Though drafts of this extensive survey project are not yet available, McCoy does detail some of the findings in the *Preliminary Draft Report: Cultural Resource Management Plan for the University of Hawai'i Management Areas on Mauna Kea, Ka'ohe Hamakua, Island of Hawai'i TMK (3) 4-4-012, 015* (McCoy et al 2008). As of the publishing of this draft CRMP, McCoy et al had documented 223 sites in the Mauna Kea Science Reserve, including 93 previously documented sites. These 223 site also include 28 sites which McCoy et al are designating as burials and possible burials (McCoy et al 2008:2-20, 2-23).

5.3.16 Traditional Cultural Properties

The State Historic Preservation Division has designated three prominent localities on Maunakea as Traditional Cultural Properties (TCP) due to their cultural significance to the Hawaiian people. Several additional prominent locations in the summit region are also considered culturally significant (see Figure 6). Additionally, a large area on the mountain's summit has been determined to be eligible for listing on the National Register of Historic Places as a historic district. Maly (Maly 1998:29) has suggested the entire Maunakea summit region down to the 6,000 foot elevation contour be designated a Traditional Cultural Property (see Figure 16).

5.4 Summary Observations

5.4.1 Burials and Possible Burials

McCoy (1999) presents a summary discussion of burials and possible burials on Maunakea noting that there are numerous traditions of burials at high elevations on Maunakea. He begins by presenting the account of Jerome Kilmartin (1974) who in 1925 personally observed human remains on Pu'u Mākanaka. McCoy relates that in 1991 he and others observed human bones within several cairns on the southern rim of Pu'u Mākanaka. He also notes that "several other spatially discrete groups of cairns, each comprised of two to three individual cairns, were found on the southern or eastern rim" (1999:26) [of Pu'u Mākanaka] – suggesting that these may also contain human skeletal remains.

Pu'u Mākanaka is the only documented place in the uplands of Maunakea in which human remains have been confirmed—although McCoy makes reference to "the well-known burial center at Kanakaleonui" and also to "a small group of cairns on the eastern rim of Pu'u Waiau that are also believed to be burials" (McCoy 1999).

McCoy (1999:26) then goes on to discuss four “possible burial sites” (16195, 21413, 21414 and 21416). Although no human remains were observed, these were thought to be burials due to the morphological similarity of these cairns to those on Puʻu Mākanaka and Kanakaleonui, their dissimilarity to other cairns (which are more cylindrical), and their presence on the eastern or southern rim of cinder cones.

McCoy clearly suggests that Site 16195, consisting of two adjacent cairns on the eastern rim of Puʻu Līlīnoe (recorded by McCoy in 1975), are “possible burials” (1999:27). This conclusion is based on William D. Alexander’s 1892 account of “ancient graves” on the summit of Puʻu Līlīnoe. McCoy comments that: “If the cairns that were recorded in 1975 were in fact the same graves [as described by William D. Alexander in 1892] the remains had been removed sometime prior because no human bone was visible at that time” (1999:27). It appears that by 1975 these features were no longer graves but may have functioned as graves previously.

McCoy (1999:27) then discusses three possible burial cairn sites (21413, 21414 and 21416) located on the southern and eastern rim of an unnamed cinder cone. This cinder cone is 12,840-foot high and located approximately 1 kilometer northwest of the Mauna Kea Ice Age Natural Area Reserve). McCoy’s discussion indicates that these may well be graves on the basis of form and location.

McCoy concludes:

> There is good reason to expect that more burials are to be found in the Science Reserve on the tops of cinder cones, either in cairns or in a small rockshelter or overhang. The basis of this prediction is that all of the known and suspected burial sites on the summit plateau are located on the tops of cinder cones and, more particularly, on the southern and eastern sides. No burials have been found on the sides or at the base of a cone, or on a ridgetop amongst any of the shrines. There in fact appears to be a clear separation between burial locations and shrine locations. (1999:28)

His comments have proven to be apt as current in progress work by McCoy and Nees has documented 28 sites designated as burials and possible burials (McCoy et al 2008).

In striking contrast to the earlier archaeological data is the belief of some contemporary Hawaiians that the summit region of Maunakea is something of a burial ground (“There’s lot of *kūpuna* been buried up there…” and several similar concerns at www.mauna-a-wakea.info/maunakea/F4_burials.html). Allied with this line of thinking are rumors of burials disturbed and destroyed by prior observatory developments (“Would bulldozing cemeteries be allowed anywhere else in the world?” www.mauna-a-wakea.info/maunakea/F4_burials.html).

5.4.2 Shrines

In McCoy’s analysis of a total of 93 sites identified in the Maunakea summit area Science Reserve some 76, or 81.7%, are classified as shrines (and an additional eight shrines are components of adze manufacturing workshop sites) (McCoy 1999:3). McCoy concludes that; “The vast majority of shrines are conspicuously sighted in the landscape, either on a ridgetop, or at a break in the slope, which generally seems to correspond to either a lava flow margin or a change in the slope of a glacial moraine” (1999:6). McCoy notes that “there are no shrines in the Science Reserve located on top of a cinder cone.”

As previously noted McCoy noted an unusually high density of shrines located in a narrow 200-foot contour interval band between 12,900 and 13,100-foot elevation on the north side of Mauna Kea that he attributes to a visually preferable location (1982:A-37).

5.4.3 Adze Quarries and Manufacturing Workshops

Based upon McCoy's 1999 summary analysis of site typology, the only quarries were in the extreme southern portion of the Maunakea summit area Science Reserve (the Mauna Kea Adze Quarry; SIHP No. 50-10-23-4136). McCoy does describe four adze manufacturing workshops (11079, 16203, 16204 and 21211) defined in part by their location in areas absent of naturally occurring stone-tool quality raw material. All four of these adze manufacturing workshops are on the south face of the mountain on the east side of the main Mauna Kea Observatory Access Road.

Section 6 Community Consultation

6.1 Community Consultation Effort

An effort is currently underway to contact and consult with Hawaiian cultural organizations, government agencies, and individuals who might have knowledge of and/or concerns about Hawaiian cultural practices, resources and beliefs related to Maunakea. This ongoing effort is being made by letter, e-mail, telephone, and in person. In most cases, letters with a detailed description of the proposed action and conceptual plan provided by Parsons Brinckerhoff, along with an aerial photograph and USGS map of the Project area and two figures depicting proposed TCPs: trails, sites and view corridors adapted from Maly 1999 (see Figures 6 and 16) are mailed to community consultants.

6.1.1 Community Respondents: A Note on Non-Participation

It is important to understand that community response to the proposed TMT and support facilities projects is represented not only by those who agreed to participate in this consultation, but also—and perhaps as importantly—by those who chose not to participate. A number of likely contributors to this cultural impact study by way of their cultural use, knowledge, attachment and generational ties to Maunakea (*'ohana* that have for generations brought family *piko* and *iwi kūpuna* to the summit), as well as those committed to community advocacy for the protection of Maunakea, declined to provide comment for this CIA. Their reasons for non-participation vary, but generally underscore decades of discontent with how developments on Maunakea (and attendant studies and management plans) have been undertaken. Many are fatigued by multiple cultural studies and public meetings that have similarly sought their *mana'o*; a subset of this group are frustrated by the continued construction of telescopes on Maunakea with what appears to be little to no attention to their earlier testimonies regarding cultural concerns and sometimes expressed opposition to further development on Maunakea. It is the perception of many community contacts—including those inclined to support the proposed actions—that past recommended mitigation measures have often been ignored (e.g., recycling telescope sites no longer in use, cultural education and protocols for scientist and visitors, access to cultural and natural resources). It is further assumed by these community contacts that the TMT Observatory and Hale Pōhaku Mid-Level Support Facilities Projects will similarly proceed without regard to community consultation outcomes. Instead of participating in this study, to express their disapproval for the proposed projects, a few organizations and individuals committed to protection of Maunakea and cultural activities and resources on the mountain prefer to pursue an independent, legal course of action and/or express their concerns at public forums. The words of one participant in this current cultural impact study (Ms. Ku'ulei Keakealani) summarize the general sentiment of many (participants and non-participants alike) that the voices of Hawaiian community members have not been heard:

> …there is a harsh reality for some reason that's on my heart that says, if this already has been stamped with a seal of approval that this is going through…if we are there at that point and that is the game we are in—again that is just a reference because I know by no means is this a game—then what are ways [to respond to this]…It's beyond having the Hawaiian people recognized or heard or they sit on

> the board. That's all wonderful and we need all these things, but then…how much have they listened to us? If the majority of the testimony is "No, don't put that TMT there," and it still goes in anyway, did it just not matter that we all said, "no, no"?

The results of the community consultation for this CIA, while elucidating many of the key cultural issues surrounding Maunakea, may not reflect the wealth of concerns possessed by many other members of the Native Hawaiian community who chose not to be interviewed for this study. As such, the findings of past and current cultural studies and management plans (see Section 4.7) provide necessary complementary information to this report. In particular, the oral-history interviews of many elders (some now deceased) included in Appendix A of Maly and Maly (2005) and found in Maly (1999) serve as important documentation of many facets of Hawaiian customary practices, understandings of the cultural landscape and ongoing attachment of Kānaka Maoli and *kamaʻāina* to Maunakea for further reference.

6.1.2 Community Outreach and Consultation Table

As described in Section 1.1., when the TMT Observatory Project's CIA consultation was initiated in November 2008, communication with Project proponents indicated that the proposed Thirty Meter Telescope CIA consisted mainly of the actual construction of the TMT Observatory Project within the 36-acre area known as Area E in the Mauna Kea Science Reserve Master Plan. In February 2009, CSH was informed that the TMT Observatory Project will also include a construction staging area located at the 9,000 foot level Hale Pōhaku site, approximately 3.5 miles south of the proposed TMT Observatory Project site. Also included in the proposed TMT Observatory Project description is a new electrical transformer to be installed at the Hawaiian Electric Light Company (HELCO) site also located at the Hale Pōhaku site. For this reason, CSH sent out a second round of community consultation letters in February 2009 to include the additional information regarding the construction staging area and the electrical transformer in order to provide community consultants the opportunity for additional comments and concerns.

Initial community outreach letters sent to community contacts in November 2008 along with an aerial image and a USGS map were mailed with the following text:

> Cultural Surveys Hawaiʻi (CSH) is conducting a Cultural Impact Assessment (CIA) for the proposed construction and operation of the Thirty Meter Telescope (TMT), an optical-infrared telescope on an estimated 4 acres of presently undeveloped land of the 525-acre Astronomy Precinct of the Science Reserve near the top of Mauna Kea. The project would be located in Kaʻohe Ahupuaʻa, Hāmākua District, on the island of Hawaiʻi, on a portion of TMK: (3) 4-4-015: 009 and 012. Please see the attached figures: USGS and aerial photographs of the proposed project area, maps of the Mauna Kea summit, considered a Traditional Cultural Property, and other TCPs, including trails, sites and view corridors adapted from Kepa Maly's 1999 Oral History and Consultation study for the Mauna Kea Science Reserve Master Plan (UH, 2000).
>
> The proposed telescope facility would be located within the western portion of the area known as the northern plateau within the Astronomy Precinct. More specifically, the area being considered is the general vicinity of the 36-acre area

designed Area E in the Mauna Kea Science Reserve Master Plan (UH, 2000). Area E ranges in elevation from 13,100 to 13,300 feet and is located approximately half a mile northwest of the nine existing optical-infrared telescopes located near the summit at elevations of 13,600 to 13,775 feet. The entire Mauna Kea Science Reserve is designated part of the State of Hawai'i Conservation District, resource subzone. Ancillary facilities include an access road from the end of the current access road near the summit to the new telescope site would need to be developed.

The purpose of this cultural study is to assess potential impacts to cultural practices, beliefs and resources as a result of the proposed TMT development on Mauna Kea. We are seeking your kōkua and guidance regarding on any of the following:

- **General history and present and past land use of the project area.**
- **Knowledge of cultural sites which may be impacted by future development of the project area - for example, historic sites, archaeological sites, and burials.**
- **Knowledge of traditional gathering practices in the project area, both past and ongoing.**
- **Cultural associations of the project area, such as legends and traditional uses.**
- **Referrals of *kūpuna* or elders and *kama'āina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua'a* lands.**
- **Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area.**

In February 2009, new letters which include the additional project information for the construction staging area and the electrical transformer were sent to community consultants with the following text:

Cultural Surveys Hawai'i (CSH) is conducting a Cultural Impact Assessment (CIA) for the proposed construction and operation of the Thirty Meter Telescope (TMT), an optical-infrared telescope on an estimated 4 acres of presently undeveloped land of the 525-acre Astronomy Precinct of the Science Reserve near the top of Mauna Kea. Previous outreach letters sent to our community consultants for the proposed Thirty Meter Telescope Project CIA did not include a project description for the Hawaiian Electric Light Company (HELCO) electrical transformer, which will supply power to the TMT, and a construction staging area, both of which are located approximately 3.5 miles south of the proposed TMT site. Information regarding the electrical transformer and the construction staging area was provided to CSH by project proponents on February 13, 2009 and are both included below with the original project description.

The project would be located in Ka'ohe Ahupua'a, Hāmākua District, on the island of Hawai'i, on a portion of TMK: (3) 4-4-015: 009 and 012. Please see the attached figures: USGS and aerial photographs of the proposed project area, maps of the Mauna Kea summit, considered a Traditional Cultural Property (TCP), and other TCPs, including trails, sites and view corridors adapted from Kepa Maly's 1999 Oral History and Consultation study for the Mauna Kea Science Reserve Master Plan (UH, 2000).

The proposed telescope facility would be located within the western portion of the area known as the northern plateau within the Astronomy Precinct. More specifically, the area being considered is the general vicinity of the 36-acre area designed Area E in the Mauna Kea Science Reserve Master Plan (UH, 2000). Area E ranges in elevation from 13,100 to 13,300 feet and is located approximately half a mile northwest of the nine existing optical-infrared telescopes located near the summit at elevations of 13,600 to 13,775 feet. The entire Mauna Kea Science Reserve is designated part of the State of Hawai'i Conservation District, resource subzone. Ancillary facilities include an access road from the end of the current access road near the summit to the new telescope site would need to be developed.

The proposed Thirty Meter Telescope construction staging area will include a temporary dormitory complete with restroom facilities, a cafeteria, and a parking area (Figure 5). The proposed staging areas, located both in and adjacent to the Hale Pōhaku site, will also be used to stage both construction equipment and materials needed for the construction of the TMT. A new transformer will be added to the existing HELCO site near Hale Pōhaku. The new transformer may require an expansion of the fenced-in area at the HELCO site. From there, new wires will be placed in existing underground conduit to provide power to the TMT Observatory.

The purpose of this cultural study is to assess potential impacts to cultural practices, beliefs and resources as a result of the proposed TMT development on Mauna Kea. We are seeking your kōkua and guidance regarding on any of the following:

- **General history and present and past land use of the project area.**
- **Knowledge of cultural sites which may be impacted by future development of the project area - for example, historic sites, archaeological sites, and burials.**
- **Knowledge of traditional gathering practices in the project area, both past and ongoing.**
- **Cultural associations of the project area, such as legends and traditional uses.**
- **Referrals of *kūpuna* or elders and *kama'āina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua'a* lands.**
- **Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area.**

Several (3-9) attempts were made to contact individuals, organizations, and agencies apposite to the CIA for the subject project. The results of all consultations are presented in Table 6; brief consultation responses and review letters from government agencies are included below Table 5. Excerpts from more extensive interviews and statements related to the proposed project and its environs are presented in Section 7 below.

Table 6. Community Contacts and Consultation Effort

Name	Affiliation, Background	Comments
Ailā, William	Hui Mālama I Na Kūpuna 'O Hawai'i Nei	CSH sent letter on December 5, 2008 and sent revised letter on April 2, 2009.
Akaka, Danny	Dir. of Cultural Affairs at Mauna Lani and Kahu.	See Section 7 below for full interview.
Ako, Val	Kohanaiki fisherman	CSH sent letter on November 29, 2008 and sent revised letter on February 25, 2009. Mr. Ako responded with the following statement on March 25, 2009: "That one I'm in opposition. Enough is enough, but they are not satisfied. They are just for money. There are Hawaiians who want to go ahead with that [TMT] telescope. I'd rather the mountain stay as it is. Enough telescopes already." In reply to the proposed changes, Mr. Ako stated: "Like I said, enough is enough already."
Alapai, Howard	Hawai'i Island *kupuna*	CSH sent letter on November 29, 2008 and sent revised letter on February 28, 2009. CSH called on March 26 and again on April 7, 2009. Mr. Alapai declined to comment.
Arakaki, Aric	Superintendent, National Park Service, Ala Kahakai National Historic Trail	CSH sent letter on November 29, 2008 and again on January 16, 2009. CSH sent revised letter on February 28, 2009. CSH emailed a follow-up letter and re-sent maps on April 1.

Name	Affiliation, Background	Comments
Ayau, Halealoha	Hui Mālama I Na Kūpuna 'O Hawai'i Nei	CSH sent letter on April 2, 2009. Mr. Ayau replied on April 3, 2009 with the following statement: Aloha no kakou, Our comments are as follows. As many have stated before us, Mauna Kea is kapu [restricted, prohibited]. It is the largest ahu in all of Hawai'i which contributes to it being a sacred place. There are already many intrusions into its kapu space and adding another such intrusion that serves no spiritual function further diminishes the mana of Mauna Kea. We wonder how Hawaiian spiritual practices would be affected by the building of the TMT Project, whether our akua, kini akua or 'aumakua would view the TMT has being there to honor their role in our lives or whether they would view it is our continued inability to maintain the kapu of these sacred places. The bottom line is that the TMT like the other telescopes on Mauna Kea lacks spiritual function for cultural practitioners. Mahalo for the opportunity to share our mana'o on this Project. Edward Halealoha Ayau Donna Kainaniokalihiwai Kahaunaele

Name	Affiliation, Background	Comments
Baybayan, Chad Kalepa	'Ahahui Kū Mauna	CSH sent letter on April 14, 2008. Letter was returned April 20, 2009 as undeliverable.
Boston, Richard	Kaloko-Honokōhau National Historic Park	CSH sent letter on Nov. 29, 2008. CSH called and left message on Jan. 20, 2009. CSH was contacted on Jan. 20 and told that Mr. Boston no longer works at Kaloko-Honokōhau National Historic Park.
Carpenter, Alan	Archeologist, Hawai'i State Parks Division	CSH sent letter on November 29, 2008 and again on January 16, 2009. CSH sent revised letter on February 28, 2009. CSH mailed letter and maps on April 2.
Cayan, Phyllis "Coochie"	State Historic Preservation Division, History and Cultural Branch Chief	CSH sent letter on November 29, 2008 and sent revised letter on April 2, 2009. CSH sent an email and left a phone message call on April 27, 2009. CSH is awaiting response to the revised letter. SHPD a memo via email in response to the initial letter pertaining specifically to the TMT Observatory Project area on May 4, 2009. The response is included below this table (Figure 22).
Chang, Clement	Trail and Access Specialist, Na Ala Hele Trail and Access Program, Department of Land and Natural Resources	CSH sent letter on November 29, 2008 and again on January 16, 2009. CSH sent revised letter on February 28, 2009. CSH again mailed letter and maps on April 2.

Name	Affiliation, Background	Comments
Ching, Clarence	Hawai‘i Island *kupuna*	CSH sent letter on February 28, 2009. Mr. Ching was interviewed on March 6, 2009; publication of his interview in this report was pending his review and approval. On May 6, 2009, Mr. Ching provided additional comments. CSH is updating his interview summary with new biographical information and commentary for Mr. Ching’s final review and approval. His interview will be included in the next draft report of this CIA.
Elarionoff, Leningrad	Kama‘āina and Hawai‘i Island Burial Council member	See Section 7 below for full interview.
Eoff, Karen	Community activist and president of Kohanaiki Ohana,	CSH sent letter on November 29, 2008 and again on January 16, 2009. CSH sent revised letter on March 5, 2009. CSH emailed letter and maps again on April 2.
Fergerstrom, Harry “Hank”	Hawai‘i Island *kama‘āina*	CSH sent letter on April 13 and again on April 20, 2009.
Flores, Kalani	Lecturer of Hawaiian History, University of Hawai‘i	CSH sent letter on November 29, 2008 and sent revised letter on April 13, 2009. Mr. Flores replied on April 17, 2009 saying he would provide a written statement for this Project.
Gmirkin, Rick	Archaeologist, Ala Kahakai Trail	CSH sent letter on November 29, 2008 and again on January 16, 2009. CSH sent revised letter on February 28, 2009. CSH called and left a message on April 8.
Greenwell, Kelly	Hawai‘i Island farmer	See Section 7 below for full interview.
Guiles, Peter	‘Imiloa Astronomy Center Executive Director	CSH sent letter on December 5, 2008 and sent revised letter on April 2, 2009.

Name	Affiliation, Background	Comments
Halemau, Karin	Hawai‘i Island *kupuna*	CSH sent letter on November 29, 2008 and again on January 16, 2009. CSH sent revised letter on February 28, 2009. Mr. Halemau replied by phone on March 11, 2009 with the following statement: My whole feeling is anything concerned with this generation and the next is good…if anything could educate the next generation, that would be good.
Harp, Isaac	Hawai‘i Island *kama‘āina*	See Section 7 below for full interview..
Hoke, Arthur	Kahu Kū Mauna	CSH sent letter on April 13, 2009. Letter was returned on April 17, 2009. CSH sent new letter on April 21, 2009 to a newer address. CSH sent the letter and figures April 21, 2009 via email.
Kakalia, Tiffnie	Kahu Kū Mauna	CSH sent letter on April 13, 2009. Letter was returned on April 17, 2009. CSH sent new letter on April 20, 2009 to a newer address.
Kalikokalehua, Kanaele	Hale o Lono	See Section 7 below for full interview.
Keakealani, Ku‘ulei	Ka‘upulehu Interpretive Center curator	See Section 7 below for full interview.
Keanaaina, Duane	Hawai‘i Island *kama‘āina*	CSH sent letter on November 29, 2008. CSH called on January 27 and on March 11. CSH showed revised Project changes on March 20. Mr. Keanaaina declined to comment.
Kimura, Kaiu	‘Imiloa Astronomy Center Associate Director	CSH sent letter on December 5, 2008.
Kwiatowski, P.F. “Ski”	Author on two books on Hawaiian Petroglyphs and Tattoos	See Section 7 below for full interview.

Name	Affiliation, Background	Comments
Lee, Reggie	State Department of Conservation and Resource Enforcement, DLNR	CSH sent letter on November 29, 2008 and again on January 16, 2009. CSH sent revised letter on March 5, 2009.
Lightner, Leina'ala	Hawai'i Island *kupuna*	CSH sent letter on November 29, 2008 and again on January 16, 2009. CSH sent revised letter and maps to Mrs. Lightner on February 19. Mrs. Lightner declined to comment.
Mahi, Arthur	Hawai'i Island *kupuna*	See Section 7 below for full interview.
Maigret, Mary Anne	Archaeologist, Division of State Parks, Hawai'i Island	CSH sent letter on November 29, 2008 and again on January 16, 2009. CSH sent revised letter on February 28, 2009. CSH emailed letter and maps on April 2.
Mallow, Antoinette Keahiolalo	Kahu Kū Mauna, Hawaiian Civic Club of Hilo, Na Pua No'eau	CSH sent letter on April 14, 2009 and sent second letter on April 20, 2009.
Mau, Lehua Lopez	Hawai'i Island Land Trust Executive Director	CSH sent letter on April 14, 2009 and sent second letter on April 20, 2009. However, the second letter was returned.
McDonald, Ruby	Community Resources Manager, Office of Hawaiian Affairs	CSH sent letter and maps on December 12, 2008. CSH emailed revised letter and maps on April 2, 2009. CSH mailed letter and maps on April 3.
McKenna, Dan	Palomar Observatory, Superintendent	CSH sent letter on November 29, 2008 and again on January 16, 2009. CSH sent revised letter on March 5, 2009. Mr. McKenna declined to comment.
Medeiros, Clarence	Hawai'i Island *kama'āina*	CSH sent letter on November 29, 2008. Mr. Medeiros replied December 6, 2008; referred CSH to contact E. Kalani Flores and Burt and Sheila Okin.
Meyer, Manu Aluli, Ed.D.	University of Hawai'i Hilo, professor of education	CSH sent letter on December 5, 2008. CSH sent revised letter on April 14, 2009 and an email on April 20, 2009.

Name	Affiliation, Background	Comments
Naleimaile, Sean	Kahu Kū Mauna	CSH sent letter on April 14, 2009 and sent second letter on April 20, 2009. On April 21, 2009, in a telephone call, Mr. Naleimaile declined to comment at this time.
Nāmu'o, Clyde	Administrator, Office of Hawaiian Affairs	CSH sent letter on November 29, 2008 and sent revised letter on April 2, 2009. Response to the initial letter pertaining specifically to the TMT Observatory Project area is included in Appendix B and is summarized below this table. OHA is currently reviewing the additional Project information and will comment at a later time.
Nazara, Cynthia	Member, Hawai'i Island Burial Council	CSH sent letter on November 29, 2008 and again on January 16, 2009. CSH sent revised letter on February 28, 2009. CSH called and left message on March 26.
Neves, Sir Paul K. Ali'i 'Aimoku	Royal Order of Kamehameha	CSH sent letter on December 5, 2008 and sent revised letter on April 14, 2009.
Nihoa, Moke and Lei	Hawai'i Island *kama'āina*	CSH sent letter on February 28, 2009. Mr. and Mrs. Nihoa expressed that they are against the proposed TMT Project because of the United States illegal occupation in Hawai'i.
Okin, Burt and Shiela	Hawai'i Island *kama'āina*	See Section 7 below for full interview.
Omphroy, Leilehua	Kahu Kū Mauna	CSH sent letter on April 14, 2009. CSH sent a second letter on April 20, 2009.
Ontai, Kalai	'Imiloa Astronomy Center	CSH sent letter on December 5, 2008 and sent revised letter on April 14, 2009. CSH sent follow-up letter on April 20, 2009.
Pihana, Kimo Keali'i	Hawai'i Island Park Ranger and *kupuna*	See Section 7 below for full interview.

Name	Affiliation, Background	Comments
Pisciotta, Kealoha	Mauna Kea Anaina Hou	See Section 7 below for full interview and Appendix C for written testimony.
Puhipau	Nā Maka o ka ʻĀina	CSH sent letter on December 5, 2008 and sent revised letter on April 2, 2009.
Soehren, Mr. Lloyd J.	Archaeologist, expert on place names	CSH sent letter and maps on November 29, 2008. Mr. Soehren contacted CSH on December 6, 2008 by email and stated that he does not have "particular knowledge of the project area." CSH did not send the revised Project description to Mr. Soehren.
Spielman, Elisabeth Tita	Resident of Waimea	CSH sent letter and maps on December 5, 2008. In December, in a phone conversation, Mrs. Spielman stated that she has, "said everything I had to say" for Kepa Maly's report.
Stevens, Ed	Kahu Kū Mauna	CSH sent letter and maps April 9, 2009. On April 15, 2009, in a telephone call, Mr. Stevens stated that Kahu Kū Mauna is meeting on April 22, 2009 and will decide then if they will provide a statement.
Sterling, Jo-Anne Kahanamoku	Hawaiʻi Island *kupuna*	CSH mailed letter and maps on January 27, 2009. Ms. Sterling called CSH on January 30 and declined to make a comment.
Tamanaha, Miwa	KAHEA: The Hawaiian Environmental Alliance	CSH sent letters and maps on December 5, 2008 and sent revised letter and figures through email on April 4, 2009.
Takamine, Vicky Holt	ʻIlioʻulaokalani Coalition, president	CSH sent letter on December 5, 2008 and sent revised letter on April 2, 2009.
Ursua, Larry	Hawaiʻi Island *kumu hula*	CSH sent letter and maps on November 29, 2008.
Van Gieson, George	Volcano Fire Station Fire Chief	See Section 7 below for full interview.

Name	Affiliation, Background	Comments
Young, Charles	Chair, Hawai‘i Island Burial Council	CSH sent letter on November 29, 2008. CSH left message on January 26, 2009 and again on February 12. CSH sent revised letter on February 28, 2009. CSH called and left message on March 23.

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
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BOARD OF LAND AND NATURAL RESOURCES
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May 4, 2009

LOG NO: 2009.1748
DOC. NO: 0905PC001

MEMORANDUM

TO: Mishalla Spearing, Cultural Researcher
Cultural Surveys Hawai'i, P.O. Box 1114, Kailua, Hawai'i 96734

Phyllis Coochie Cayan

FROM: Phyllis Coochie Cayan, History and Culture Branch Chief

Subject: MAUNAKEA 2: Cultural Impact Assessment (CIA) for the proposed construction and operation of the Thirty Meter Telescope (TMT), an optical-infrared telescope on an estimated 4 acres of presently undeveloped land of the 525-acre Astronomy Precinct of the Science Reserve near the top of Mauna Kea, Ka'ohe Ahupua'a, Hamakua District, Island of Hawaii.
TMK: [3] 4-4-015:009 and 012.

This memo is in response to your request to help assess potential cultural impacts to cultural practices as a result of the proposed construction and operation of the Thirty Meter Telescope (TMT) as described above.

As you may have discerned from the most recent Mauna Kea Comprehensive Management Plan (MCMP) for the UH Management Areas (January 2009) and the public hearings for that plan that Mauna Kea is a very sensitive subject that truly needs and deserves more time to consider all the cultural impacts to this iconic symbol of all cultural connections including but not limited to the genealogical connections, and the spiritual connections to all of the deities in the Hawaiian cosmos and to the kanaka maoli world view.

Some areas that should be addressed include but are not limited to the following mana'o:

1. Mauna Kea is the first sighting for voyaging canoes to arrive safely to our islands in the middle of the Pacific. Mauna Kea is a significant part of the Pacific Rim mythological connections to all the Pacific Rim. The significance of Mauna Kea is not limited to Hawaii only.
2. There is continued debate on the number of telescopes and buildings on the summit. There should be a deaccession of buildings no longer functional before building new structures or perhaps no more development on this sacred mountain.
3. Access for cultural practitioners need to be clearly addressed and defined.
4. The entire summit of Mauna Kea should be treated as one traditional cultural landscape and consider all the impacts to it – not a piecemeal analysis of just the Science Reserve.
5. More community outreach must occur for all cultural impacts on the summit and the proposed area. (Note: see list of contacts in the MCMP.)

This is a short list of the department's concerns. Any questions, please call me at 808-692-8015 or via email Phyllis.L.Cayan@hawaii.gov

C: Nancy McMahon, Deputy SHPO
Theresa Donham, Hawaii Island Archaeologist
Analu Josephides, Hawaii Island Cultural Historian

Figure 22. May 4, 2009 SHPD memo response

6.2 Office of Hawaiian Affairs

In its response letter dated January 9, 2009 (see Appendix B for full letter), OHA describes the ongoing debate surrounding the development on Maunakea and offers several recommendations.

OHA notes that Maunakea is a spiritual, sacred place, home to “wao akua” (dwelling, place of the gods) and where “Papa and Wakea meet in the physical world.” Maunakea stops “the rainclouds which provide pristine life sustaining water known as Kaneawaiola The “life sustaining waters known as Kanekawaiola” contributing to “a healthy natural environment, which in turn allow man to thrive.” It is the place where numerous “ahu and iwi kūpuna known to be situated in the summit area provide silent testimony that generation upon generation of Hawaiians” have worshipped and buried loved ones “at the highest point possible to rest in peace.”

At the same time, OHA recognizes the unique atmospheric conditions that make Maunakea an ideal place for observation of even the farthest galaxies and for this reason it hosts “the world’s largest astronomical observatory with telescopes operated by astronomers from eleven countries.”

OHA recommends that due to this forty-year-long debate surrounded the continued development of Maunakea which “has intensified and the divide between the above mentioned perspectives has not changed,” that the, “proposed TMT project should be viewed as one part of this long history.” The letter further states, “With this in mind, your assessment should…consider the overall impacts of development on Mauna Kea.”

OHA also refers CSH to the following individuals and organizations for consultation: Kealoha Pisciotta, Clarence Ching, Reynolds Kamakawiwo‘ole, Ke‘alakahi Meyers, the Royal Order of Kamehameha I, KAHEA, the Edith Kanaka‘ole Foundation, Kahu Kū Mauna and the ‘Imiloa Astronomy Center.

CSH later contacted OHA with the additional Hale Pōhaku Mid-Level Support Facilities Project Area description and figures on April 2, 2009. OHA is currently reviewing the additional Project area information and determining whether they will provide additional comments.

Section 7 Summaries of Kama‘āina “Talk Story” Interviews

Kama‘āina and *kūpuna* with knowledge of the proposed Projects and study area participated in “talk-story” sessions for this CIA. The approach of CSH to cultural impact studies affords community contacts an opportunity to review transcriptions and/or interview notes and to make any corrections, deletions or additions to the substance of their testimony. CSH employs snowball sampling, an informed consent process and semi-structured interviews (cf. Bernard 2005). CSH attempted to contact 58 individuals for this draft *preliminary* CIA (see Table 5, above); 30 responded; and 13 participated in talk story interviews. Efforts are still ongoing to solicit additional responses, which will be incorporated into subsequent drafts of this report. To assist in discussion of natural and cultural resources and any cultural beliefs and practices associated with the Project areas within the larger context of Maunakea, CSH initiated talk-story sessions with questions from the following broad categories: Gathering and Hunting, Ritual and Ceremonial Practices, Freshwater and Marine Resources, Burials, Trails and Cultural and Historic Properties. Presented below are brief backgrounds of participants’ “talk-story” sessions and their comments and concerns about the proposed Project area.

7.1 Acknowledgements

The authors and researchers of this Cultural Impact Assessment report extend our deep appreciation to *everyone* who took time to speak and share their mana‘o with CSH in talk story interviews and in brief phone, post or email consultations noted in Table 6; including contacts who opted not to contribute to the current CIA, but nevertheless spent time explaining their position on the proposed Projects. We request that if these interviews are used in future documents, the words of contributors are reproduced accurately and not in any way altered, and that report preparers obtain the express written consent of the interviewee/s.

7.2 Arthur Mahi

CSH interviewed Kupuna Arthur Mahi in his Hamanamana home on December 3, 2008. Born July 5, 1933 in Laupāhoehoe, North Hilo, Kupuna Mahi is a pureblood Native Hawaiian who was raised in the traditional Hawaiian way of life. His maternal great-great grandfather was Kuakahela, who was the *konohiki* (headman) of Ka‘ūpūlehu Ahupua‘a when Kuakini was the governor. As a baby, he was given in the *hānai* (adoptive) custom to his maternal grandfather, Keaua Kuakahela, who was born in 1870 and skilled in Hawaiian beliefs and practices. Kupuna Mahi was chosen by his grandfather to carry on the knowledge of Hawaiian culture.

A former *paniolo* (cowboy), he worked for Hu‘ehu‘e Ranch in the 1930s to 1946. In 1947, he was drafted in the army. Kupuna Mahi was stationed in Korea, Lebanon, Philippines and Vietnam, among other places, and was a member of the military police. Married to his wife Theresa for 55 years, Kupuna Mahi has 18 *hānai* children, including his own. He is knowledgeable about traditional fishing, trails, native plants and other Hawaiian cultural resources, beliefs and practices.

When CSH asked about Maunakea’s cultural resources and sites, Kupuna Mahi noted that Lake Waiau is a pristine alpine lake that was reserved for the *ali‘i* and is now being used by people who wrongly believe that it is for healing and cleansing. He stated the lake should be kept free from contamination as it is a source of pure drinking water:

> Cleansing is only for *aliʻi nui*, not for anybody cleansing. No healing the water will bring them. It only dirties the water. We know when people use the lake to clean themselves. It's not good because it's people's water. The water goes down to the ocean, and it is clean water. All the mountains water comes from up there.

Kupuna Mahi stated that it was obvious when visitors use the lake because of what they leave behind:

> People are there because of the green scum bucket they leave there. Lake Waiau is sacred for *aliʻi*…not for any Tom, Dick, and Harry. On top of that, they throw a lot of rubbish in there. People don't care…they come and do their thing and think it's theirs. But it belongs to people in Hawaiʻi. It isn't theirs unless the *kūpuna* (grandparents, ancestors) say so.

When CSH asked what he thinks about the proposed TMT Observatory Project, Kupuna Mahi emphasized the sacredness of Maunakea:

> The mountain is sacred, but people like UH is supposed to care for it. But they don't care for it. The mountain is our *kupuna* (grandparent, ancestor), it is a man mountain. We use the mountain as a guide for us, that's why we call it our *kupuna*. No do nothing. No add anymore. The hell with scientists…they *nīele* [inquisitive, nosy] somebody. They probe and look…see? We like no more nothing. As a *kupuna* of Kona, no like. I don't care what people say, put back the mountain like it was. Clean it up. Put [the] mountain like it was…I don't like observatory on top of the mountain. Leave the mountain alone.

Upon hearing the details of the proposed location of the TMT Observatory Project on the Maunakea Science Reserve area, Kupuna Mahi stated:

> There's no scientific area. I don't want to see anything on that mountain. Enough already! Tell scientists go somewhere else; go China, Russia, someplace else. Why here? We like our land free, free from junk. We like our land to be free, and leave our animals alone and stuff.

He suggested that the telescope could be put on the mainland and other countries. Kupuna Mahi also discussed how the *kūpuna* of Hawaiʻi did not give their permission for the other telescopes to be built, and whatever financial windfall the telescopes were promised to bring has never materialized:

> Put the dome in the mainland. People of Hawaiʻi didn't give permission. *Kūpuna* did not give permission. The young ones did it, and they didn't get paid. And now they get mad. They say Hawaiʻi gets money, but I stay here all my life and I didn't see any money. That's why I don't believe.

Kupuna Mahi noted the glaring obtrusiveness of the present buildings on Maunakea and again firmly stressed his opposition to the proposed Project and the role of the mountain as a guide for people:

> For me, I don't want any more telescopes. The ones on top ruin the mountain. Now Sierra Club is eradicating our animals. They are paid by the [former] President Bush. Send them back home. They are killing our sheep, our goats, whatever. They no care where we get our food. The mountain is no place for anybody to put anything on top. Stop making everything worse. We are guided by the mountain, when we are out in the ocean so we know where we are…the mountain is our *kupuna*.

CSH contacted Kupuna Mahi on March 11, 2009 regarding the changes in the Project description. Kupuna Mahi replied:

> No way Jose…the mountain is not their recreation. I pity the mountain. It doesn't benefit us; it's just the agony of defeat. Go take it someplace else. Leave mountain alone. Put it [telescope] someplace else or somewhere else, on the mainland, China, or Japan. Hawai'i is small. We don't need problems.

Regarding the presence of current telescopes on the mountain, Kupuna Mahi stated:

> When people come to Hawai'i, they come to see the real Hawai'i. We used to talk to the mountain. But now, there is a barnacle on the mountain.

7.3 Kalikokalehua Kanaele

Mr. Kalikokalehua Vernon Kanaele was born and raised in Hilo on July 28, 1949 to Ms. Verna 'Āina. Mr. Kanaele is a cultural practitioner and activist. Mr. Kanaele has been involved with many of the past issues concerning Maunakea and continues his traditional cultural practices throughout Hawai'i. CSH conducted an interview with Mr. Kanaele on February 13, 2009 in Pāhoa. When asked what Native Hawaiian Organization he belongs to and their association with Maunakea, Mr. Kanaele stated:

> The organization was called Kaulana Nā Pua, it was between 1977 after they killed George Helm. Aunty Edith Kanaka'ole changed our name to "Kīhāpai o Lono." From there we went into the Hale o Lono teaching which was *makahiki* [yearly]. Because of the set up of Kaho'olawe we decided to use Lono. Every other one if you make mistake, you get cracks. Lono going to give you couple slaps but get back on trail and do this, he is not going really give cracks. We are always approaching our issues that way. I would say we have been taking care the first part of our people like the *keiki* [children] and *kamali'i* [progeny, children or royal children] because we have 8 generations in our whole society, *keiki, kamali'i, 'ōpio* [youth], *mākua* [parents, uncles, aunts, etc.] , kūpuna, kua [generations back], *ka 'elemākua*, and *ka 'elemākule* [elder generations]. When you talk about the *maka'āinana* [commoners], it is *mākua* [parents] and *kua* that is the commoners. That is the PTA or Parents Teacher Association. They are going give you free. What is *mākua*? So you understand that in our society we not talking some feudal nation, we talking *'ohana* [family]. You confuse us by saying, "You feudal with the other guy, Kamehameha…" It is all kinds of separate jurisdictions within our societies. This is our main society which will take care of all that. So when we look at it that way, then we can understand

"civilization." Those five things that create "civilized nations"; clothing, shelter, health, food, and education—that's prevailing then.

In our family structure they set up their "*hale mua*" [man's eating house] up to their frozen food section and the teachings of our gods and goddesses and the separation of land to "*nā wao*" [the realms] systems. *Nā wao* hook us in where ahupua'a makes borders. *Nā wao* take us through the elevations to the spiral to the very top (referring to Maunakea) and come back down. And they make the wider spiral and finally going around the world. Like how we did in the beginning when you follow the stars and you want to see how everything just comes back to our creation story (Kumulipo).

What our real job in this whole thing is all about and the interruptions that has happened to our people and the other people which is our *'ohana* too. It took us that long, we had to go away from a whole teaching and then go to a Christian story to understand where we are standing right now and what our job is and who everybody is compared to how it was before. It went towards a different kind of creation story, you know, got to watch the movie cause she made us bite the apple and our older brother jealous of us and like kill us, all this kind things. That is not conducive to a paternal kind of teaching to a maternal kind of teaching. The guys only confuse and abuse, so when we look at all of this go back to what they are doing up there on that mountain. To that altar, ka mole, we tap one prayer what we are doing up there. Like try do them one by one down here, lean the heiau, no can because too much. You would need the whole *'ohana* for do that. Everybody who lives there got to understand what they have to do in their area. If you do the prayer from the top you can clean up from going down and this way come up. You clean them that way. When you do them that way, you do assort. Sometimes you have to use rainbow, I call it combined prayers of the four directions.

'Īo ka lani nui a maomao, 'Īlalo'ole [those that sit supreme in the heavens] those people up there are going to come and give us this *mana* [supernatural or divine power]. The peoples of our *'ohana* are going to come to us. When you come up there when they looked up they going see the rainbow. The culture committee OHA grumble with me taking up *nānā* [observations, attention]…Natives of their…Hawaiians is a political term, *kanaka* is our race. When they make our nationality our race that is where the brain wash is. You can circumvent our whole political system right now defining us as native Hawaiians. There are no such things, like Native Americans. Americans are a bit fiction with all these rules. What? You have to make us one fiction too in order to have jurisdiction of our minds. How they call it? Subject matter, jurisdiction. If you believe that to be true then it is, but if you question that you'll find it's not true.

Mr. Kanaele shared his *mana'o* (thoughts, beliefs, theories) about the early issues of Maunakea and how the native activist would react:

In the 60s, but everybody was behind that. Because it was not polluting and all of that kind of stuff. I can't say everybody was behind it. The *mana'o* of the activist at that time was it was a sacred mountain. We participated that time in questioning what everything was. In the 70s it is just building this whole mechanism.

I used to live on the University of Hawai'i. My father became custodian in 1955 so we moved up there and we stayed at the University from 1955 I think he retired in the 70s, but during that time they had many things happening. Astronomy was just beginning; you know they had their astronomers' right there by the Gym. They brought down the big telescopes and you set it up there and you look from right there. It was not up Maunakea. During the 60s I think that is when they planned all that [referring to present site of Maunakea]. In those days most of us were pretty well brainwashed. I could not see and understand what was happening around us. Nobody really questioned *aloha 'āina* [love of the land] things. Maybe a few people, like the Aunty Peggy and Aunty Emma, they were always watching at that time. I met them through the *hula* things. I used to dance for my Aunty in the earlier days.

Well, they couldn't at that time because you have to remember now, Christianity, we were just coming out of the Sunday thing. We could just buy liquor on Sunday. What we are talking about here, they probably talked soft kind inside the kitchen [whispering]. The kids could listen but who understood? And then we would come in and then they would speak Hawaiian.

So you know this movement has been going on a long time. Before we were born and back then what happened was only certain people whole them because we talk to loud, you could lose your business, your house could burn, if you had wooden house, you have to watch your house, until the Hawaiians make their own gangs control their own underground things and then started to nail these people back that they created law against that kind of things. Before you could do because never have law at that time.

Finally the *kūpuna* went to Statehood just because of the clinic things they had no control of the diseases that were brought here. So once we became state then we have this whole structure for watch out for our kids. Before never have nothing. But the deal from that day to now they never understand the price they had to pay for that. That our ocean [is] now from a healing ocean was turned into something that can kill you. Not because it gets rough because of the staph and mutated staph on top of everything that they went put there. By us not paying attention to *aloha 'āina*, oh we were too busy working for them that we never understand that! This stuff going come up out 20-40 years from now, they say, "I no care that happened 20-40 years ago." Who is going to be around to say, "Oh that was us." They never even care if it was their kid was the one who catch the staph and die. They never know it was going to be that way. The only guys who knew were the guys who

> made something like the EIS, which is why the EIS is good to have it now. They no can pull the wool over your eyes.
>
> They had no means, they had no *mana* [power] until they go over there and make those guys *mālama* [care for] the *kūpuna* bones then they get burial council. All of a sudden they had power. The never had power before. Why you think we had to do that? Because they had no power. Well, we finally blew up! It took us long time. To learn all these things and have our people out there to set up these things to bring us eleven guys over from Big Island for do this stuff. You know how much that cost? Lucky thing we on Kahoʻolawe so we can set up and get all the money and jump on the plane. We no care, main thing we show our people you can win that way. When they flew over Kahana Valley, they had enough *kūpuna* and *ʻōpio* [youth] and the *keiki* [children] over there to stand up and say something. Before they had to fly us around to do that kind of stuff.
>
> But this Maunakea issue is not like that. All our people say, "ENOUGH ALREADY." I don't know which part of enough they don't understand. Enough already! Do good now. Do good with what you get and then maybe later on ask the next generation and then be that good steward you would not have to worry about nothing of this. Questioning your integrity or your honor. We not supposed to do it. UH is supposed to be teaching that stuff. What is going on when it becomes like this? When Aliʻi O Nā Moku said, "Education to desecration isn't education at all." That is what we are talking about. Now you are going take them away all the way there to our people, that are not important enough. What is that? This plantation stuff we just finished that, Big Island just finished that going through that whole thing. Some people you going do that to, you going rub them wrong they going smile at you and stab you as soon as they can find one weak spot in you, your dead, and good for you, cause what you got to come see people like us for help heal you.

When asked about his involvement with the Royal Order of Kamehameha, Mr. Kanaele responded:

> I just finished doing Keaʻau and we was living up in Mountain View. Kealoha came over and at that time this *kahu* was living with me from New Zealand, Rotorangi Kaulua Porangi and she came to see him and talk to him about Maunakea and her experiences up there and what she has seen and her visitations and all kind of stuff she has experienced. She was asking us for help on what can we do about it. So finally, they look at me. The buck stops here, once we going do it there is no turning back. Once we start we cannot stop. The first thing we have to do is join the Royal Order of Kamehameha because up there is sacred. That belongs in the realms of the gods. The only guys I know that really go up there is you got to be chief, *kahuna* [priest, expert, specialist]. Rank your blood get in there and the only people that can rent is your blood is these people. Because from the Kingdom time if you look back there when number 5 put this in he put that deliberately, he not only made the commitments, he brought all the chiefs. Even

> the banished ones he brought back in under the order. So all the families now are back in under him, because his great was not through might, his great was through eight generations alive and kept him going until he died, then have the sicknesses. He had control over the sicknesses until he make. As soon as he make, everything just went broke. If you notice in history, the *kapu* was broken. You couldn't control them that way, but you could understand that this one comes from this area, and that one comes from that area. We are all *'ohana* we the Hawaiian race.

When asked about any ongoing Native Hawaiian traditional cultural practices on Maunakea, Mr. Kanaele mentioned:

> Ceremony and *kahuna* practices and whatever needs to be done now! In this time with whatever is left for us to use. Our ancestors' say, "They so happy to see us." They don't care how we come…just come!!!!! Come home. We your gods!!! It is not scary kind. We no need scare ourselves. This way we all family again, the *kānaka*. Our *kūpuna* had to doom their way in order to save our people from becoming cheating our friends. When we look at this whole thing we look at them as friends who stole from us. When we joined the Order they never know who we were. When I started to explain to them, he goes, "Ah, aaaa…" Then we brought some of the practices back. The Christian all get crazy. I explain no, look at it as a friendship kind of thing.

Mr. Kanaele shares his *mana'o* on the myths and legends associated with Maunakea:

> To the rest of our *'ohana* that is the only mountain. Everywhere or any place you go the highest hill is Maunakea. The second highest is Maunaloa and then you go around the world. That is our sacred mountain. It is a male mountain with many females. If you know already that is good teachings, creation and pro-creation. On the female mountain would have male gods on their mountain for the balance. The way I always look at our culture is as *'ohana*. We have to resist when they try to bring that other *mana'o* in like the feudal thing. We need to claim our lands and Maunakea all our mountains. Once I went into the Royal Order then I understood the different duties of each office, the *ali'i okana* [district], he creates the *konohiki* [Headman of an ahupuaʻa land division under the chief side], my office creates the security part this is because of my genealogy of Keʻeaumoku guys, I can actually right title.
>
> Who the god up there? Kāne, but coming up there Kū is around then Lono, and of course and out to the deep blue is Kanaloa. Where as you go up the place then going get *kanahelehele* [forests] to the *kini akua* [gods and spirits] and then on top of that is Kāne. The priesthood of Kāne and then the dog guys and then all these people. Why they call them dog guys? Because they wear dog skin, cause cold up there.

When asked about any concerns he may have on potential impacts to traditional cultural practices that may occur due to the proposed development, Mr. Kanaele stated:

Before I went up there, it always symbolized everything. When I left here to go to American and came back. That mountain was imprinted up there…*poʻo* [summit, head], when it got lonely or funny, it was there, mean. It brought me home. I could feel myself come home too. That is how heavy that place is. After I went up there then I understood what that experience was all about. Going up there, we went up there like shining nights in white armor we going save the mountain, all we could was go up there and cry and ask talents we never had. So we could understand to do in the correct manner and correct protocol to explain Maunakea. To explain any place we needed to focus on. Then we understood *aloha ʻāina.*

My concerns are in the last EIS, substantial and adverse impacts. You have to falsify some kind of documents in order to kill this. We are dealing with one aquifer and all the waste is going into that aquifer. The mountain itself is a great filtering system; inside of it has a hose that represents rivers underneath and on top. The melted ice and rain, all that seeps right into the aquifers and then down to the rest of the *ʻāina.* Maunakea is blue and Maunaloa is red. So you can see where the water goes. They are tampering with the main source of our water.

7.4 Kimo Kealiʻi Pihana

Mr. Kimo Kealiʻi Pihana was born in a small town of Wahiawā, central Oʻahu on October 22, 1942 to Mr. Eddie Fabian Pihana and Mrs. Kealiʻi Pihana. Mr. Pihana and his wife Leila Terouru Tarere Taina Pihana moved to Hilo 20 years ago. He is a retired OMKM (Office of Mauna Kea Management) Ranger and has retired from the United States Army. Mr. Pihana is a member of the Royal Order of Kamehameha ʻE kahi, Mamalahoa, Hilo Chapter, a voting member of the Office of Hawaiian Affairs, a member to the Ruling Chiefs of Hawaiʻi, Puʻu Kohola, and a member to the Kingdom of Hawaiʻi #10000138. CSH conducted an interview with Mr. Pihana on February 4, 2009.

When asked about his work as a cultural practitioner, Mr. Pihana commented:

As a cultural practitioner, my title was given to me by the Royal Order of Kamehameha ʻE kahi, Māmalahoa Hilo Chapter, as Kahuna Kuhikuhi Puʻuoni, caretaker to all of the shrines here in Hawaiʻi nei, not only on the Big Island but throughout most of the islands here in Hawaiʻi nei.

I have been able to work with all different Hawaiian Groups here like the Nā Aliʻi O Hawaiʻi Nei, the *wahine* group [a local chapter of Hawaiian women associated with the Aliʻi of Hawaiʻi] and the Kaʻahumanu Group [ʻAhahui Kaʻahumanu Hawaiian Civic Club]. I have participated in a lot of Hawaiian activities throughout the years, like Kamehameha Day, the *lei* draping ceremony of the new Statue we have here in Piʻopiʻo, sponsored by the Kamehameha Alumni Association. Other places throughout the island like ʻAhu ʻEna in Kona, the residence of Kamehameha and the place of his death is where we do a yearly retreat and workshops to bring awareness to the general public and to our people. We need to honor our ancestors and be part of a group that is still able to be proud of [who] they are and yet continue my education by going back to College today; learning who I am and my culture by going into areas like Waipiʻo Valley. Doing arts and crafts with our children and general public at Puʻu Koholā. I practice weaving with *ti* leaf [*Cordyline fruticosa*], *olonā* [*Touchardia latifolia*], and *lauhala* [*Pandanus tectorius*]. I learned different *lāʻau* [plants] at times throughout my life by people like Papa [Henry] ʻAuwai. I still have a lot more to learn and that is one of my reasons for going back to college.

My mentors on this island when I moved here, was ʻAnakē Pua Kanahele, ʻAnakala Aliʻi, Arthur Mahi of Kona, Aliʻi Ernest Akoni of Hilo, Papa Akau of Kawaihae, ʻAnakē Maile Akim Siu, and ʻAnakē Ahuna. Kupuna's here in the Hilo District. Also I have been working with many other elders, throughout Waimea, Puna, and the Kaʻū district.

Mr. Pihana shares his thoughts about his work and association with Maunakea:

Back in 1997 I was already a member of the Royal Order of Kamehameha. We were asked to resolve some of the issues that were being brought to our attention and we needed to find out how we can help as far as being able to bring awareness of protocol and respect to our people of Hawaiʻi and its culture. We needed someone that would take the initiative to help the University of Hawaiʻi understand that part of the problem of Maunakea was the cultural area was sort of put in the back seat. So, my first assignment was to of course to apply for a job and as an interpreter, a cultural interpreter. I applied and was hired in 2000 by RCUH Mānoa after about a year as a Nānā ʻĀina [one who oversees the land], they asked me how we can make it so that…because they didn't have any job position and stewardship So we came up with the idea of a program today known as their Rangers of Maunakea. It is not federal, it is State [run] by the University of Hawaiʻi. We are secondary enforcement for health and safety, which is a program I have built from the ground up. We created many new positions such as employment that would bring interest of our local people that are now in high school and college to look forward at something they might be able to get a job in to work up there—a job to work on the mountain. First of all we had to come up with ideas on how can we generate interest in our people because not everybody was happy with what was going on top of Maunakea.

The *kuaʻāina* are the people of the back land, the original inhabitance living on this island all of a sudden became hurt or you might say angry because they know that there was some restrictions to the mountain and they did not know how to approach the development and the University about the top of Maunakea. My position was to bring awareness to the University of Hawaiʻi, meet with the board of regions, Chancellor Rose Tang, and meet with newly created Office of Maunakea Management, Kahu Kū Mauna. They are cultural advisors to the University. We can then voice our concerns, because many time people were sort of reluctant because of it being a State position and citizenship. For myself, prior to getting a job on the mountain, one of the last questions was asked to me by the person who was interviewing me for the job was if I was an American citizen. The answer to that was and is no, I am Hawaiian citizen first and yes I am American citizen also because of the change from territory to statehood, I am in a position to say so. And we have excepted changes today, but we still need to know that our *kuleana* [responsibility] is to remember our ancestors, our genealogy, who we are, where we come from and things like this and how can help even the local people understand what responsibility they have when they go beyond the realm of *wao kanaka* [an inland region where people may live or occasionally frequent]. We need to understand *wao* Lono and also *wao akua* [a distant mountain region, believed inhabited only by spirits. gods]. Many of the scientist and people that I know today have a better understanding of the spiritual connection that everyone has, not only the Hawaiians, but many nations that come to Maunakea have a much deeper respect and learn a better responsibility of leaving their *ʻōpala* or rubbish all over the place, a program which keeps an eye on that. That was part of our creating of this new Ranger Program they have today and also help our visitors and local people so they don't get into trouble when they are up there and most of them understand protocol much better today.

We have created different stages of the mountain so people who cannot get to the top can give their respect to the mountain at Puʻu Huluhulu at Hale Pōhaku at the 9,000 foot level. I think by this way we have satisfied them at least at some part. The other part of my job and my responsibility was to bring the telescopes back down to the level of the people. In the year 2001 I asked a few of the people who had their own personal telescopes it they don't mind coming down and do a star gazing program at the yearly Makahiki festival we have here in Hilo. I had good cooperation from observers and astronomers from Gemini, Canada, France, Hawaiʻi, University of Hawaiʻi, and some people from the visitor's station and set them up in Keaukaha at Puhi Bay and we had quite a bit of people. That kind of brought about a new program into the University System of creating another position of people that would contribute their times and efforts doing outreach to the schools. It helps create the ʻImiloa Astronomy Center in Hilo. Today people who are not able to go to the top of Maunakea can enjoy the idea of science and culture right here at this level, here in Hilo at the University Park area, this way people don't feel being left out. We have been able to satisfy all nations not only the United States, Europe and Asia, Hawaiʻi has made its place in astronomy and science world doing work out there in space and the discovery of new planets and stars educating our people so that we can learn how to utilize our idea of science. Science doesn't really work unless you can apply it especially if you are going out into space and they want to colonize other planets such as Mars and *mahina* [moon], the moon.

So the future generations are very near of colonizing other areas outside of the planet earth. Preparation and engineering and education play a very important role. Today most of the observatories out there are at the edge of the universe utilizing their entire antenna, mirrors, and their data information on how to discover sounds and asteroids, which there are the possibilities that there may be another impact of an asteroid coming to this plant. If that problem occurs they should be prepared to divert an asteroid utilizing their science, skills, and scientist to divert it so we don't go through another big impact that would create devastation on this planet.

Human's can continue to survive on planet earth and maybe even colonize other planets. Luckily the Ranger Program was in place we were able secure and bring those people back in safely. Without that Stewardship Program in place a lot of people would have gotten injured—people getting hurt needing medical attention or medivac off the mountain. We had two people die out there. All rangers are required to become First Responders. You must attend several special classes on how to be good international interpreters not only local. Hard work and a lot of studies, a lot of care, keep yourself spiritually connected, mentally awake, and you have to be almost like being "Maui'" because you are protecting not only Papahānaumoku, but Wākea. You are looking at the heavens everyday and every night. You kind of get to know the real meaning of how it is to be up there. It gets lonely; it gets very close to the Gods and goddess that exist out there. It gave me time to reflect back because this is where the Kumulipo starts. Today I am retired, but I have all my Kumulipo intact. I am still doing more research. I carry one of the biggest charts on the genealogy throughout the islands. It help me grow a little bit better with the understanding on why I was asked to go up there and help the people and the University of Hawaiʻi understand much better on who we are. I help to create a DVD, "The First Life." I also help create the new "Mauna Kea Guide to Hawaiʻi's Sacred Mountain." I was asked to share my *manaʻo* (thoughts) in the forward of the guide. I was able to help create that book and the film by PBS and today it is one of the biggest selling items on the mountain.

I will share my *manaʻo* with you, the following comes from the forward from the Mauna Kea Guide to Hawaiʻi's Sacred Mountain:

Welcome to Hawaiʻi's sacred mountain, Mauna O Wākea. Visiting Maunakea is an adventure; one that allows us to step back in time in realm of the gods of the Hawaiian people. In the stars astronomers can trace the ancient history of the Universe, but we Hawaiians go to Maunakea in search of our mana or divine power in a quest to understand our ancient spiritual connections. On the mountain we can feel the close relationship between heaven and earth. People of many nations say that it is a sacred place for them where they experience awe and reverence as we do. As a Hawaiian cultural practitioner and care taker of the mountain I am often asked on how visitors should conduct themselves on Maunakea. I suggest that they say a silent prayer take a general moment for greeting the mountain and then walk with respect on our sacred place of worship. I share how we must *mālama* the *ʻāina* or take care of the land, take care of people and preserve the culture. We Hawaiians are fiercely proud of the accomplishments of our ancestors who navigated the vast Pacific Ocean by the stars, a thousand years before Galileo first pointed his telescope towards the heavens. Maunakea was a land mark for ancient navigators and is today a center for that revolving science of astronomy as we scope our place in the universe. As a Ranger on Maunakea I have enjoyed working with many astronomers who are generally people of goodwill and from whom I have learned much about the stars, but despite all of their accomplishments I do feel that much more needs to be done to bring awareness of and respect for Hawaiian culture on the mountain. Science does play an important role in people's lives, but it is not everything. A spiritual connection is just as important. This is symbolized for the modern Hawaiians by the humble stone and wooden *lele,* the altar at the summit. I welcome you to Maunakea also known as Mauna O Wākea, the mountain of the God Wākea from whom all things Hawaiian are descendant. Here you may experience and enjoy beautiful sunrises, sunsets, and evening star gazing under the northern and part of the southern sky. Here too are preserved many magical wonders of the Hawaiian Nation we all need to continue to perpetuate and protect this land as well as the legends and mythology passed down through the ages for our own and future generations. We must all continue to be good stewards of this sacred mountain.

When asked about the amount of telescopes now on the mountain, Mr. Pihana stated:

I am not a scientist, but from what I have gathered from all the years of working with all of the top scientist of the world, to include NASA and other exchanging of ideas from other scientist, the bigger the better, but when you look at it from a local Hawaiian perspective living here on this island, again we are going into the womb of what we consider sacred on Maunakea. My idea of no more development is no more development on the mountain period, is my *manaʻo*. I might get out-voted, that I know, but if I do at least I have made my testimony so that we cannot curve this idea of development because, one of the things they are saying is they are creating jobs. Not everyone will be able to work up there. You have to be very healthy and conscious with high education requirements.

We have many local people on Maunakea as of now, maintenance, custodians, cooks, security, and at the Visitor's Center we have many young Hawaiian people, and a mixed group of people, but we also have people in the observatories that are engineers, technicians, plumbers, observers, and controllers of the telescopes themselves; many operators that work at the lower levels in Hilo and Waimea. Some of the astronomers don't even go to the mountain. They work from their air-conditioned offices in the lower part of the land and also connected fiber optic to Maui. What it does is it keeps us abreast of what is really going on in space and the progress that is going on today as far as new discoveries of stars, planets, and finding out that Pluto is not a planet.

As a young person when I was growing up we always looked up in the heavens and see the twinkle of the stars, today I look at science and they took the twinkle

> out of the stars. They kind of took the romance away. Just imagine, colonizing the moon.
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> We have a connection to Wākea the heavens; many cultures have spiritual connections to their highest mountain and Maunakea is one of those places. What are we going to gain or what how is it going to help people that live on this planet—if there is something that we don’t know. If there is that they can come back and bring back from out there that could probably replace oil. We don’t know. Science has taken it many steps further and drawing water out of rocks. That is part of their project that they are working on right now.
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> Other programs are utilizing the use of minerals that could replace fossil fuel here on this planet. We don’t have all the answers yet, but then imagine colonizing another planet. It will not be an easy chore. Many people won’t be able to make that journey and some will fail and of course some will come back. We have already seen that happen in our time where we have lost quite a few of our astronauts.
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> Onizuka was a local born astronaut is one example. He dared to go out there and ready to lead and of course he did open up a lot of doors bringing awareness to the people of Hawai‘i. From a young boy growing up in Hawai‘i become one of the first astronauts to go out into space many times until that accident.

Mr. Pihana spoke about his cultural associations with Maunakea:

> My cultural association with Maunakea is when I first put together the Royal Order of Kamehameha to greet Princess Saiaku of Japan and their emperor to Maunakea. I had to go through the Japanese Embassy in Honolulu to assist her and to recognize her because of her diplomatic and very high position of government with Japan and Hawai‘i relationship. We put a group of people together especially the ruling chiefs and chiefs of Hawai‘i to be present when she arrived at the Visitor Center, at the nine thousand foot level. We were able to greet her and let the University of Hawai‘i witness that the people of Hawai‘i were interested on what is taking place on the mountain. There was a slight indifference on how we were going to do the right thing in protocol and respect to foreign visitors such as the Princess. We have also had visitors from the United Kingdom who visited. There were other dignitaries such as Prince Phillip and other countries that needed to make a presence on the mountain. The people and the chiefs of Hawai‘i are ready and willing to protect this mountain and to help our *kūpuna* understand that we have not forgotten about them [and] to teach our future generations as far as being able to understand. After all the development was already in place and now we needed to get to work and understand on how we work together much better than against each because it is very important that we be diplomatic and be the ambassadors to the people of Hawai‘i and for those who cannot go up there. I have had a lot of *kūpuna* that were afraid to go up there because they believe in the old system. That the mountain is under some kind of

kapu or restriction and they did not want to break that kapu. So, it took a lot of meetings, conferences, and work to finally get the word out to the people of Hawaiʻi that if you take certain ideas and learn the proper protocol to approach this high mountain not only of science, but of sacredness and the spiritual connection to our Kumulipo and to learn more about the significance of why it is important for us to help in the preservation of this area and leave it in tact and not build another city of some type on top of our sacred mountain. There have been many different articles in the newspaper that say, "There is too much on the mountain, too much rubbish, too much tourist on the mountain, and the foreigners are to blame for all the *pilikia* [trouble] out there." We are all involved in this; astronomy is nothing new to the Hawaiian people. We are navigators of Polynesian; we are on the ocean and on these islands prior to western contact and Captain Cook. So navigation on the ocean, the Polynesian navigators is still one of the best in the world today. This is another giant step if we become involved and become partners then we become of the work that is now available so that our children will become educated. We tell them to go to school get educated; after you get educated you are standing in the un-employment line. We want to make it available so it can reach out and touch many different people even those with disabilities.

I fortunate that I was able to finish up my time on Maunakea with honor. I have been there eight years and have retired from the University of Hawaiʻi Mānoa system. I received my retirement gathering by all my bosses and I collected all the different ideas of how we were able to come this close. Some of the comments I was given by Ed Stevens. When he first set eyes on me on Maunakea, he was scared. Others said I was very intimidating. That is the role I had to play to bring to the University some kind of awareness, that—hey, we are still alive, we are still here, we demand respect, and we need for you people to understand that we need a plan and better program to bring not only awareness and education, but bringing people from foreign lands to come and visit that the mountain is considered very sacred like all high mountains!

The development that is what there already, we need to understand whatever data collection and information they are getting from all the work being done up there happened a long time ago. Astronomy was introduced into the islands during the time of King David Kalākaua. He had one of the first observatories and telescopes set up for him in Honolulu by Dr. Forbes of the United Kingdom. So here we had another government at the early time, United Kingdom, Great Britain, today that is why our flag has part of the UK emblem on top of our flag. We were subjects to the United Kingdom at one time. Today of course there is a different government in place and we still respect the United Kingdom as part of our government in existence until today, but our citizenship today of course has been changed to the United States of America.

> I myself did my testimony for the thirty meter [telescope] development and I have also been accused many of times of being a traitor to the culture and I think I have proved many people wrong, because I lasted all the way to my retirement. I help to create many good jobs and brought awareness throughout the world. Not only in Hawai'i by working with and along side, not agreeing to everything they want to have done on the mountain, but how to better take care of our *'āina* and respect the culture so that we have people just trampling out there and removing some of the *pōhaku* [rocks] that you are not supposed to take off, but then we still do have people and work alongside archaeologist from Bishop Museum, Pat McCoy, and the State Archaeologist who have been working out there for about twenty or thirty years and have collected a lot of good information. We have protected the burial sites much better, we know where they are at and of course we don't want to see any more development up there. That is my *mana'o*. It must go through a process of muster.

When asked about his knowledge of burials and burial practices on Maunakea, Mr. Pihana mentioned:

> The burial grounds are much further out than that area, 13 North they call it, but even then it is too close to our *kūpuna* and early caretakers of the mountain have been put up there, some of our *ali'i* are buried up there. It would really be another hurt or you are going to put more salt on the wound so to speak and I don't think our people are going to accept that development. You are going to have a bigger protest than ever because of that, other things, because of conflict of interest out there. When it comes to who we are and employees to the employer that if we were to disagree it would be a conflict of interest, and many of local people of course, even like myself, were threatened with termination if we don't agree. For example, the removal of the *kuahu lele* that sits on Pu'u Wēkiu was a destroyed that didn't like to see that shrine up there at one point. I was responsible for helping and placing that shrine up there. The other part is that once found out, they were probably angry that were wasn't going to be accepting some of the changes out there, the only comment I had when I first comment when I first started working for the University that if they are going to renovate or they are going to improve that they stay within the imprint and footprint they have now and not go any further outside of that. I believe other project failed to come about and that was the Keck [Observatory] who wanted to put outriggers out there, which did not happen.
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> Early development where one of the observatories was on top of Pu'u Poli'ahu, prior to me working at the university that observatory was removed brought down and taken off Pu'u Poli'ahu I had brought the new established Office of Maunakea Management, Office of Hawaiian Affairs, Civic Clubs, and many other community leader, and other local community leaders to close the road to Poli'ahu. Today there is only a trail and the only way to get up there is by walking. No vehicles allowed on top of that mountain. No vehicles allowed at the Lake. No vehicles allowed into the area where we consider where our burial

> grounds are. Puʻu Māhoe and Puʻu Makanaka, those areas are off limits even to hikers.
>
> Yes, ashes are still being taken up there. I have a lot of people, non-Hawaiians also that have somehow got up there and distributed their family's ashes which is, at some time for me, it was hard that have left ashes. People bring all kinds; they even bring their ashes of their pets and animals up there. We can tell by doing the research and looking at the bone and teeth with some of the archaeologist and scientist out there. The biggest one I have seen brought up there by the Visitor's Center was a horse. It is on one of the Visitor's Centers, not the University area, the area that is under the control of Department of Land and Natural Resources. So there are some areas that DLNR has appreciates the fact that we are there and that the caretakers are on board and Stewardship Program is on and the Rangers suggesting they might take it someplace else. I had family members and people bring falling warriors from Iraq, Iran and Vietnam and even going back to Korea.
>
> Hawaiians bring their ashes up and distributing it in areas and holding their vigil. These are some of the things that are hard to control and stop. We don't want to see full body kind of ceremony and ashes goes back to dust. Once it is mixed in with the cinder, soil, the lepo up there we don't see. People today are also doing at point spreading of ashes in the ocean in different areas. So, as myself as a Hawaiian practitioner I kind of look at this that is not being desecration at all it is something that we cannot avoid sometimes and other times we can discourage, but other times we try to bring awareness that the soldier should have been taken to Punchbowl and place where they know, because they are not familiar with Maunakea or maybe a family plot. We have been able to see some of these ceremonies take place and once they are going on it is kind of rude to stop it. We also many nations and leave their prayers or their prayer sticks, their flags and other things and I feel for them.
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> I had a group come in from Tibet and talked with them. They were a group called a climb for Tibet. So other leaders from around the world have sent some of their people to distribute some of their ashes of their family on Maunakea. Sometimes it is after the fact, they tell us later on, because they don't want to let us know, they know we are going to stop them, but we warn them and caution them.

Mr. Pihana shared his concern about safety on Maunakea:

> We have had few people to go out there and get hurt and sick. Luckily the Ranger Program was in place we were able secure and bring those people back in safely. Without that Stewardship Program in place a lot of people would have gotten injured, people getting hurt needing medical attention or medivac off the mountain. We had two people die out there. All rangers are required to become First Responders. You must attend several special classes on how to be good international interpreters not only local. Hard work and a lot of studies, a lot of care, keep yourself spiritually connected, mentally awake, and you have to be

> almost like being "Maui," because you are protecting not only Papahānaumoku, but Wākea. You are looking at the heavens everyday and every night, you kind of get to know the real meaning of how it is to be up there. It gets lonely; it gets very close to the Gods and goddess that exist out there.

When asked about his knowledge of any ongoing Native Hawaiian traditional cultural practices on Maunakea, Mr. Pihana mentioned:

> Going back to the times of ʻUmi who had set up his shrines all over this island in celebration. By then the priest were concerned with studying the stars and navigation. Also the time of the year to celebrate the solstice and also the equinox. We were able to bring that practice up to the summit of Puʻu Wēkiu today. So that we can seek reverence towards the idea of our ancestors leaving behind information that we could go to higher places and do the same type of work they do below.
>
> Umi was navigating the stars. The star chart, the moon phase and also the directional between from here to Hawaiʻi. Today teachers, cultural practitioners visit the Lake Waiau, the place where Poliʻahu would go into her sacred lake and be protected by her *moʻo*. I was always thought he was a white *moʻo*, but he is red. I have been able to see that. The placing of the human piko or umbilical cord, an ancient and still a practice of today—the beginning point of our people. I was able to put my son's piko in Lake Waiau after I started working there and my son participated with me, he was turning seventeen at that time. I was just moved by being able by going out there and see the place clean not being desecrated, very serene. We consider this a tradition to the Hawaiians. It keeps it as a safe place for our future longevity of our family. There are many other families, generations that have done the same. Larry Kimura has his family up there; the Lindsey Family is up there. So those places need to be more and more protected and still witness in today in their life time that the practices of old still go on, do their *hula*, practices, and walk in the footsteps of their ancestors without getting overwhelmed by the development on the mountain.
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> We need to protect the environment up there, the animals, insects and all natural resources. We are conscious about that. The idea of being able to look up into the heaven and still be able to learn the old names of stars and constellations such as those we use in navigation. People like to go and practice at the night time too. They also need to learn to respect it more.
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> Practices we have established in the year 2000 until today is a yearly gathering of people to go up and pay tribute to the mountain first, by going through the proper protocol from the Naha Stone in Hilo from there we stop at the Kaūmana Caves and then we go to Puʻu Huluhulu area where we conducted the practices of setting up a *kuahu*, the center part to the island to rest and acclimate. They can leave *hoʻokupu* [tribute, gift or gratification], they can do practice there hula, and then we *kāhea* [call, greet, name, summon] from there and after that we mount up in

> vehicles today and drive up to the Hale Pōhaku where we set up another kuahu lele where the Silver Sword plants are located, so people again have another place to offer *ho‘okupu* and give prayer and reconnect themselves. They are going through the different realms as they come up to the summit.
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> People come to do their practices in the Pu‘u Līlīnoe area and other places. I have been able to work with other people who set up areas where they can go and pay their respects to Līlīnoe. In Pu‘u Līlīnoe there is no shrine, but we have seen others come and make shrine for today. Ed Steven, which is his favorite area to sit down and make himself ready to continue his way up the mountain.
>
> Then we head up to the top and from there they can see the rest of the *pu‘u* as they go up, Pu‘u Haukea, Pu‘u Kea, Pu‘u Hauoki, Pu‘u Pōhaku, Pu‘u Poli‘ahu, Pu‘u Wēkiu, Pu‘u Kūkahau‘ula. From there they prepare themselves to take their journey out to the top of the summit known as Pu‘u Wēkiu. They have protocol to approach the shrine; they have protocol to ask permission to be in reverence to the area. As they gradually climb to the top of the summit they are in full reverence in respect to the elders and the idea of being able to accomplish their quest. To go up there to see what our ancestors seen and the only obstruction is the people don’t like to look at the observatories so they look towards Maunaloa, Hilo, and Hualalai. They have to come back off, when we come off the summit area, we close with prayer, mahalo, forgiveness, and all the other things so that we don’t get overwhelmed and many do once they make that connection. It can be exhausting and at times we need to get oxygen to them. At one point, being overwhelmed and gathered we are just glad that some of the kūpuna that I met, Leinala‘ala was one that called herself Līlīnoe in some places and Poli‘ahu, the snow goddess and before she passed we had a short gathering together and she said, “You know if I pass, I would like to be on Maunakea, which is where Kealoha comes in and she put Aunty up there.

Mr. Pihana speaks on his knowledge of the reverence to the *pu‘u* and *akua* associated with Maunakea:

> I think it is idea to give reverence to all the *pu‘u* that is place names up there in recognition of their existence and their connection to the Kumulipo, because in the Kumulipo all of these areas on Maunakea are mentioned.
>
> As far as we can see today, most of it looking at Poli‘ahu, the snow goddess, she comes along almost daily even though you don’t see the snow, she is there, because of *hau*, the cold, the winds, *makani*. The senior of the male side are very powerful ones, other gods and goddess that reflect thunder and lighting, Kāne. Those ideas of recognition of acknowledgement. I have done many ceremony where out of the clear sky while doing our prayers and giving our thanks to Maunakea and all of the gods and goddess that reside in this area, that are the guardians of this mountain actually appear by snowing, hail, thunder which is to me an acknowledgement from a higher stratum.

> We assemble the gods. The god of lightening, Kahekili, Ku, the stratum is straight up, Kāne, Lono all the gods. They all come to an essential point of the mountain.
>
> Their idea of marriage and birth it is also being recognized because without marriage there wouldn't be any birth so have to continue understand that a little bit better on the creation part of man and the creation of the birth of the islands. Things like this is why cultural practitioners that go up there acknowledge all of this that was put forth before them, passed down from generation to generation, by the their ancestors. People even come from faraway places such as Borabora, Tahiti, Nuku Hiwa, Aotearoa, around the world, the Pacific Region center on the top of Maunakea. We have had other Polynesian Nations come and do their testimony, from Samoa, Tonga, and Fiji. Today we get out there coming up other Polynesians that have never been to the islands and they go up and give reverence and respect by hearing that some of these practitioners have brought down that it is okay to go up there and acknowledge your ancestors and share the mountain because of the highest temple today in the world. I am just glad that I was part of helping to create that program and bring it forward again. We are having visitors and astronomers to the mountain acknowledging what we have set up as proper protocol to come to this mountain.

When asked about what concerns he may have on potential impacts to ongoing traditional cultural practices on Maunakea, Mr. Pihana stated:

> I been in 13 North, this is the area that they have set up to put a portable station to collect data. I was one of the first practitioners to have that power to remove and close the road to the 13 North. The only reason I had closed the road was to make sure that public scrutiny and public quorums be held so that everybody's *mana'o* can get on the table that if we allow it we really have to think before we say, "Yes," to this development. We look across the island to Maui from the area and Maui and Kaho'olawe is looking back of what the people of Hawai'i is going to do and if they allow it to happen, the only thing I could say is, "Good luck and have the best of my respect and hope that you do a good job and that it would benefit the world." And you have show proof that you can do well by your words, "One up, two down." You cannot have it all. I think in the beginning of the Master Plan even though the 30 meter was already on the table that they had promised to remove some of their other telescopes because this is joint venture and I think the first one that would be removed is Canada, France, Hawai'i and the people there are going to lose their job. The other part is that you cannot replace what you already removed in that area. Another one that was said to be removed is property of University of Hawai'i 88, but then we got other plan that comes forward by the Air Force and probably even NASA, so the Government place a big role in decision making, "Put them up, money talks," everything else walks. Having the TMT up there will bring a bigger impact, the more visitors, and a major impact.

> My main concern is that it is going to hurt the Hawaiian people again. It will hurt their eyes and spirit. It hurts the eyes already. I have not been up there since I have retired. I need time, after giving my testimony at the 30 meter; I made a promise to myself that I really don't want to see the 30 meter developed up there. I told them in Canada, France, and Hawai'i, because it was like saying, "I re-nig I went back on my word as a Hawaiian." Not only the practitioner s, and if it does develop, like I said before sometimes we can come to agreement and sometimes we cannot satisfy everybody. I received a word from of my old uncles that live on Kaua'i, one of the high Chiefs, "It is okay to discipline." I took that statement seriously, but there are always disagreements in everything we do. I have been told many times and called many different names when I went up there and try to bring awareness, to all sides. It didn't stop them to overdevelop O'ahu or this island also. Population growth, jobs are very scarce and very demanding. Education is very demanding. What are we going to do with our people? If it is going to create good work for the majority of the people, as a whole, then you might say it is a good to build up here. There are other areas in the world that can use the jobs and the moneys, not necessarily Chile, countries like Mexico who need the jobs, but here we already have enough telescopes.

Mr. Pihana shares some knowledge of the myths and legends associated with Maunakea:

> Then the myths and legends will become very scarce; it will all focus on the observatories. They myths and legends I know about is the night marchers, and they are constantly at work. I had many visitors and employees that have had many spiritual experiences out there and unexplained happenings and have recorded it on film, because these guardians that are still on duty are showing themselves that they are asking, "Who are you? What are you doing up here? Where are you from? Go home, you don't belong here." I had a Japanese film crew and I was escorting them form 8 o'clock in the evening to 3 o'clock in the morning just to get a shot of the moon and the camera man and soundman noticed giants walking across the valley between Subaru and Cal-Tech. They stopped work and came down to ask me to escort them back down to Hale Pōhaku which I did. Their question was, "Are their giants on the mountain?" Yes, these are guardians to the mountain and area, they are known as the night Marchers, not only walking below lands, but up here too. They show themselves because they don't really want to be exposed. They want everything up there now to be left alone.

The myth of Poli'ahu lives and when she comes home everybody stops working because she closes the road.

7.5 Mr. & Mrs. Burt and Shiela Okin

CSH interviewed Mr. Okin via telephone on Jan. 23, 2009. He and his wife are residents of Waimea. Mrs. Okin is Native Hawaiian. She is a retired teacher. Mr. Okin is a retired air pollution meteorologist. Both are active volunteers in several community projects. When informed about the proposed Project changes involving a staging area and electrical transformer, Mr. and Mrs. Okin did not have any additional comments. When CSH asked if they wanted to share their *manaʻo* regarding cultural sites, resources and practices in the proposed Project area, Mr. Okin stated that they did not feel they had anything to add.

Regarding the proposed TMT Observatory Project itself, Mr. Okin noted the following:

> I am neutral about it. There is a cultural imperative that has to be acknowledged and respected. There is also scientific information that we need to gather in the long run that may aid us in how we look at the universe. We eventually may need to know what goes in our universe, because in the long run, who knows what information we need to understand the expanse of the universe, our place in it, and how it will affect our long-term survival.

Mr. Okin stressed that respect has to come from the two parties involved, those who are against and those who are for the Project. He stated that it is his hope that there will be some kind of process that can be put in place so that worthy projects can be done while respecting the Hawaiian cultural imperative.

> It has to be done with both sides. Nothing can be done with disrespect. We have to find some way before projects go forward, and we need to explore the culture with those who know it best.

In a follow-up email to CSH on Feb. 2, 2009, Mrs. Okin wrote the following:

> I have learned that several of the companies who have placed telescopes on Maunakea have not lived up to their agreements re: caring for the area on the mountain that they use. I don't think that there should be any further development until those issues are rectified to the satisfaction of Native Hawaiian groups who also care for the mountain. Every group using Maunakea needs to come together and take responsibility because you cannot act as an individual entity when it comes to caring for a sacred place or any place. Everyone is affected by what one group does.

7.6 P.F. "Ski" Kwiatkowski

CSH contacted Mr. P.F. Kwiatkowski regarding the proposed Project and he replied via email on March 6, 2009. Mr. Kwiatkowski is part Polish, Portuguese, and Hawaiian. An expert on Hawaiian petroglyphs and Hawaiian tattoos, he has written two books, *Na Kiʻi Pōhaku: A Hawaiian Petroglyph Primer* and *The Hawaiian Tattoo*. Mr. Kwiatkowski was raised in the Kapahulu area of Oʻahu. He has lived in Hawaiʻi Island for 30 years, and by his own estimate, he has walked and hiked about 80 percent of the island. Mr. Kwiatkowski is a supporter of astronomy, but he questions the way that Maunakea has been "managed" by the University of Hawaiʻi and the State of Hawaiʻi, as well as the proliferation of telescopes through the years.

> I will let you know a few things that have always been on my mind regarding Mauna Kea. Firstly, it is a very beautiful and inspiring mountain, not only to the Native Hawaiians of these islands, but to all who view her for the first time. To the Hawaiian, it is a place of awe, silence and reverence. A place filled with story

and myth and one of the greatest resources of quality adze material in the entire Polynesian triangle.

Now let's back up a few decades. When the State of Hawaiʻi (read: the people who run the government, not the people that actually comprise the State) decided that they would allow telescopes on the top of Mauna Kea, there was no cohesive Hawaiian group or organization to voice a Hawaiian opinion on whether or not there should be anything on the mountain but what nature put there. So, with no opposition, telescopes miraculously appeared at the summit.

When I first saw this, it was a fairly sad sight to see, as the unblemished view of Mauna Kea had suddenly sprouted a pimple, and then another and another and another. My lone voice would not have been sufficient to stop this from happening and many other Hawaiians and non-Hawaiians alike felt the same way. Opposing government was unpatriotic and likened to being a hippie protester.

Fast forward to just a few years ago....The University of Hawaiʻi, the entity that "manages" the mountain, now has the authority to do pretty much whatever it wants on the mountain, not taking into account that much of the land it "manages" is actually ceded lands from the Kingdom of Hawaiʻi. Whether or not that makes a difference is a moot point, as the will of the people is supposed to be manifested through the State Government, when, in actual fact, it is not.

I am an avid fan of astronomy, have been from the time I got my first plastic telescope at age 9 and saw the craters of the moon for the first time. I have a small 8-inch telescope that allows me to explore the universe from my front yard in the Kohala Mountains. I am not against astronomy or the wonderful results it produces in research. I cannot change the past; the telescopes were put there without any opposition. It is a sense, thought, that the State of Hawaiʻi and the University of Hawaiʻi will see additional telescopes up there, come hell or high water and "public" opinion be damned.

I do not care to see more of Mauna Kea turned over to PRIVATE use, and I use the word PRIVATE because no one of us is allowed into any of the facilities there unless there is an "open house" where they give people the dog-and-pony show to keep resentment of the existing facilities to a minimum, and even then, not many people take advantage of this once-a-year event. In the past, everyone was allowed access to the recreational winter aspect of Mauna Kea and to a degree that continues, although in a more whimsical way. I say whimsical as sometimes, for no apparent reason, there is a Mauna Kea ranger at the closed gate at Hale Pōhaku telling people that they cannot go up to enjoy the snow as it is not safe. And then, in the very next minute, the ranger allows a small caravan of vehicles (with no special equipment of any kind) to proceed through the gate and up to the summit. When questioned, the ranger responded that they were "scientists" as if to imply that they had some mystical power over the elements that we mere mortals did not have. That is like rubbing it in, that the University of Hawaiʻi can pick and choose who enters and that we can do nothing about it. Now it comes down to environmental and cultural impact statements and studies, and guess who is going to make those assessments? The fox that guards the henhouse, the University itself is going to make its own assessments!! The fix is in, how blatant can anyone entity be?

Anyway, I have ranted long enough, I have made my position known and I have but one post script. A few years ago some well meaning, but uninformed, Hawaiians erected an ahu, altar, at the summit of Pu'u Kahau'ula, the highest point, presently, on Mauna Kea. I researched why they would do such an inappropriate thing and the response I got was "To show the Haole that we were here first." That particular response showed me that they didn't realize they were doing the very thing they are against. Pu'u Kahau'ula is a sacred spot on a revered mountain. Didn't they realize that if the Hawaiians of long ago wanted to put something up there they would have? That site was left alone to leave it pure and unblemished, untouched by man, and then these uninformed people try to make a statement doing the very thing they are against, disturbing the sacredness of that high place. Auwe !!

7.7 Kealoha Pisciotta

Ms. Kealoha Pisciotta was born on the island of O'ahu. Her *mo'okū'auhau* or genealogical line comes from the island of Kaua'i. Her ancestral lineage is of the Oniha 'Ohana originally, but they were *lawe hānai* (traditional adoption practice) to the families of Ka'anape'a and Kamahukilani, Kaua'i lines. Ms. Pisciotta is the founder of the Native Hawaiian organization Anaina Hou, a group of Native Hawaiians and supporters who advocate for the protection of Maunakea. On March 14, 2009, Ms. Pisciotta provided written testimony for the proposed TMT Observatory Project on Maunakea. Her written testimony is included in Appendix C CSH conducted an interview with Mr. Pihana on January 19, 2009:

CSH: Let me start by asking you to share your past history and association with Maunakea?

KP: I worked for the British government for 12 years and I lived and worked on Maunakea for 12 years. My job title was telescope systems specialists, which is a name for the people who run the instrumentation and the observing for the visiting astronomers. The telescope I specifically worked for was James Clark Maxwell Sub millimeter Radio Telescope. It is jointly owned by the British Dutch and Canadian government, actually British Canadian, Dutch in that order and ran by the Royal Observatory of Edenborough. I also work for a little while for the Cal-Tech Sub-millimeter Observatory as a Technician. I have familiar genealogical ties to the mountain and some of the *iwi* [bones, remains] there, actually ancient and modern. I feel it is important to mention modern because that is still in ongoing cultural practice continuing today. Famous people of today have their '*ohana* there.

CSH: Okay, what about burials up there? How will they be impacted?

KP: Burials are in the *puʻu* and along important astronomical alignments. Burials are hard to talk about, on the one hand you need to speak to it to have them protected on the other hand culturally the different levels of *kapu* on speaking to it. One of our greatest concerns is that there has been no actual burial treatment plan. The one plan that the Hawaiʻi Island burial council basically said is the best treatment is no development, because the burials include not only important national figures, but also important spiritual figures. So, the question is what is the burial treatment for Līlīnoe? The problem has been is that there have been reports. Mr. Patrick McCoy and Holly McEldowney have done extensive work on the burials, but they never got to finish their work. Also Puʻu Makanaka, of course it is listed only as a burial, but really it is a burial complex, hence the name Makanaka. The problem is to not list it as one when it has many. The *kūpuna* have testified extensively in the past as eyewitness that on Puʻu Makanaka that there is so many *iwi* that you can see them through the cinder. So they immediately know better not go over there.

So destruction of the cinder cones and the landscape itself is the danger to *iwi*. They, University of Hawaiʻi, also mistakenly put a whole bunch of burial information on the web, which they realized was bad after the burial council complained about it, so I think one of the big concerns is the generalized disrespect for that fact that we have burial complexes that Maunakea is a burial ground and no one seems concerned about that. A good example on how it still continued is when the families brought the personal artifacts of their sons who were killed in the Iraq war. One of the father's is Hawaiian. Kupuna Clarence Ching helped to facilitate the bringing of them up there. Through protocol he placed all of these personal artifacts inside the *lele* on the summit. And now there was *ahu* that formed underneath it from years of people placing the *pōhaku*, and the burial artifacts were placed inside of it so their personal items were put inside. When that was desecrated the second time someone had used a hatched to hack down the legs of the *lele* and then just threw all of those *pōhaku* around and these boys artifacts came out and tourist found them. The state is supposed to protect these things.

At my own *ahu* site, it is hard for me to say is my own, it is where I go from time ago. Many people go there. The reason why I tell them to go there is because it is a place where they can go and [not] disturb historic sites. My Aunty Kamakahukilani, she asked to be placed in certain places and that was one of them. When the University personnel (tour guides and rangers) destroyed it, they destroyed her remains (ashes). That is more than desecration. It never ends. And you know how? We just went up to collect medicine in the big snow for water and it was gone again. That one was put up by Paul Neves of the Royal Order of Kamehameha, me and Keomailani. If we do it again we are going to file because initially when it was first taken by the University tour guide, Hugh Grossman in

1998, when it was discovered that he had taken the *'aumākua* stone of my family. He had taken it to the dump. Then I recovered it and I put it back. I tried to file a claim when he had taken it, but DOCARE [Division of Conservation and Resources Enforcement] actually investigated me instead of him. My family worship sight has been desecrated and destroyed seven times now this year is the eighth time.

CSH: What does the acronym stand for?

KP: Department of Conservation and Natural Resource Enforcement, I think. We have actually a good relationship and we would like to see them supported because they are the actual lawful enforcement arm of the state that is legally able to cite people for violations on historic properties. The DOCARE investigated me because they were told by someone at the University that I should be cited for having my *'aumākua* stone in the natural area reserve. So I went to find out if they had investigated the desecration and they said, "We found you innocent." Who actually helped me was Holly McEldowney as the SHPD at that point. She had Mark Smith write a letter on my behalf confirming that I had not destroyed or desecrated or impacted any historic sites within that area and kind of to affirm that I have a right to continue my practice. Nobody got cited in the end, but the University did force Mr. Hugh Grossman to apologize and the head of the Institute for Art wrote a letter saying, "It would never happen again." The problem is it has happened seven times. The fifth time the stone that was given to me to replace my *'aumākua* stone which was originally taken; I don't know where the original or the second *pōhaku* is they have never been found. Aunty Leina'ala Apiki McCcord gave me one of her family stone from her family of Aunty 'Iolani Luahine. She said, "You bring this until you can find another one from your family." So that was placed there and it is no longer there too. Both stones have been taken.

My controversy with that is two-fold. As a matter of fact, when I called the police to report it, I said, "This is probably going to sound really strange, but there is a man who has taken my family *pōhaku* and it is in his car and I need you to help to get it back." Because he was outright caught with it in his car, the brother, a Hawaiian police officer, said, "What! They take your *pōhaku*?" He then said, "Sister, you go and ask him first, politely, for it to be returned to you and if he does not return it, you call us back and we will come and assist you." I had to explain to him it is my *pōhaku*, but it is dedicated. I gave it as a gift because I am giving myself as a gift as part of my contribution to help *mālama* the mountain. So, yes it is of my family, but yes it is that I needed a place to go every day when I went to work. That is why it is there and nobody touched it for 12 years. Holly McEldowney also wrote on this—that our practice is a continuance of a traditional and cultural practice. I gave my *ho'okupu* because I work there and to ask permission.

The other thing is, when I spoke to the University about it they said, "Well it is modern and it doesn't belong on the mountain." I said, "Well, what is modern, how old is the *pōhaku*?" So I said, "Well, how are you determining what is modern and what is ancient? Who do you have that is qualified to determine that? Are you going to measure the age of the stone, well that won't help you? Are you going to measure the size, does the size matter here? What metric do you use to determine what is old and what is new?" Our *pōhaku* is old. How am I to know that they are not touching the ancient sites, because you believe they are modern? Who? The University is not the judges and jury of our practices. Neither are they politically appointed. They need to follow the law which is to protect our rights to continue our practice. It is not the UH's right to tell us what to do on our own *ʻāina* [land]. Sometimes the archaeologist would call me and ask me to look at a site because I have seen it [a] long time. So, they think that something was different with it and they would ask me, "Do you think was this a half circle or a complete circle site, Kealoha?" I would say, "I will go look." The other thing too is that sometimes there is clear evidence that a *pōhaku* is missing because of the rain shadow. Like if you look at many of the adz flakes, many of them have that shadow. So you can tell it is like a finger print left. I want to know who at made the University the authority to determine who is *pono* [proper, correct, moral] and who is not, who has a right to do something and who doesn't. It is not that I don't recognize we want to be careful; we don't want to interfere with the ancient sites in which we need to preserve them in their natural form.

CSH: What about the possibility of sites within the Project area?

KP: Yes, let us look. Oh, sure, that is part of the problem.

CSH: Are these sites, still cared after by our Native Hawaiian organizations, like yours?

KP: Yes, and many others too. Like Uncle Clarence Ching, individuals as well and families linked to Poliʻahu's Family.

CSH: Of the many issues on Maunakea, what about the past and present land use on Maunakea and that relationship to what is proposed for this Project?

KP: The State Land Division which is now the DLNR, it was called something different in 1968, but when they issued a lease for what is now known as the Science Reserve. I think it is everything above eleven thousand feet except for the pie shape of the Natural Area Reserve. The UH has no jurisdiction over the Natural Area Reserve. I don't know why there is no Cultural Reserve only a Science Reserve, because the mountains significance even way back then it is eligible. It is a national landmark the lake, then it is eligible for National Historic Register as a historic district, but all of those things were because of the geology, the archaeology, the cultural traditional properties and the fact that it is watershed a principal watershed for Hawaiʻi Island. So, we have this big area designated conservation, the natural area reserve is that big pie shape. The University was given the lease to build an observatory and so that what was the original lease was for.

CSH: Was that 1968?

KP: Yes, 1968.

CSH: For one observatory?

KP: Yes, and support structure, that is when they put in a diesel generator and stuff like that.

CSH: What observatory was that?

KP: I think it was the Air Force. That one is now down replaced by the Gemini Telescope which is substantially bigger than the little Air Force one. This [is a] breach of the lease, by the way.

CSH: So they have taken down and used those areas for new ones?

KP: Yes, the difference though the Air Force one is very small. The Air Force shared it with UH. So, they did take it down and then they erected the giant Gemini. So the footprint is still bigger. That is one of our problems is that the size keeps getting bigger. You can conceivably see that happening depending on the project.

After being given the lease to build this observatory people were already upset because they really didn't want to see the mountain changed. Many people, they are always saying, "Well, Hawaiians weren't objecting then." Well, Hawaiians didn't actually identify themselves as Hawaiian act then we couldn't speak our own language then, but the hunters were Hawaiian, along with other ethnicities. They were also environmental people and groups who supported like Mae Mall; she was a major player in that; fearful of the *ʻuaʻo* bird [an endangered seabird, *Pterodroma phaeopygia*, considered to by some as *ʻaumakua*]—she was a bird person. The other species those are unique, so unique that they are not found in anywhere else on the planet. In the 70s, they [built] several, let me say a number of telescopes, I think it is three or five, without permits which just aggravated the initial public concern. So, public outrage broke out and in the 70s people think we are the only ones who were upset, no. In the 70s they marched on the capitol and they carried signs that said, "Maunakea belongs to the people" principally because they were concerned that the astronomy community was taking over the mountain. Was not their concern real? So, what happened was this fact was brought forth that UH had built without permits illegally. The University had just been saying, "Yes, we can do what you want." So, the State had to intervene and it was actually Governor Ariyoshi at that time who ordered the BLNR to do a plan that would quell public concerns and protect Maunakea and its resources.

CSH: BLNR or DLNR

KP: Well, I think it was DLNR it became a board a little bit later (BLNR). It is the Land and Natural Resource Division. He ordered them because they are in charge of the conservation district and only those to do a plan that would help accommodate the multiple uses on the mountain. In that plan they established a legal limit on the number of telescopes that are allowed to be on Maunakea. That limit was thirteen including those six initial telescopes that had already been put up, so they didn't ask them to tear them down. They said, "You can't do that anymore." And now there is a limit. Now what is an agreeable reasonable number that the science community can live with and the people can live with? The people obviously didn't want to live with anymore. The science community said, "Okay, we will agree to 13." They actually integrated the science at the time, the biological science, and the cultural ethnographic studies. In the 1983-85 Plan they said, "Look, the caring capacity is thirteen," because that is a huge resource. Now the Smithsonian can build up to twenty four? So we are way beyond thirteen which means the UH continues to violate their lease. Not only was it in number, but it was a limited size and height. It is mostly the Institute for Astronomy; they are the arm of the University that is doing it. So, we now are beyond thirteen, not only is the number, but they size and height, only 125 feet max, height and diameter. That 13 limit is actually eleven major telescopes and two minor. So they included the Air Force and the NASA. So they removed the Air Force and put in the Gemini, which is significantly bigger. They put in Array, the Smithsonian Array [reference to the Submillimeter Array, funded by the Smithsonian Institution and the Academia Sinica] and that has as many as 24 pads covering I think an area of ½ mile in diameter. So that footprint is huge. They have all underground cable with no studies. They have this giant telescope mover that lifts the telescopes up off those pads and moves them around. It is a huge complex, a huge infrastructure going on there. So, then when NASA wanted to build the 4 to 6 more outriggers in a five acre area where the Keck I and Keck II are which would really increase that density it was too much. So the latest set of people came forward and argued, Native Hawaiians, Royal Order of Kamehameha, our group, Hank Fergerstrom, Ka Lāhui and many organizations came forward, KAHEA and Sierra Club, Life of the land. They said, "Wait a minute…." because they remember the legal limit was set to 13. There is no legal justification for building more. Here is the thing the University is not accepting as a reality for them, they are claiming, "Well, that plan only went to the year 2000. So that limit is over. We can exceed the limit now." And that is why they did that second plan, the 2000 plan we all had to testify for over and over again. We missed an important feature back then and that feature was the University is not the one who can do the plan. So the 2000 University Plan is not a legal document and that has been confirmed now in the courts. The Court said, "The UH 2000 MP has not been approved by BLNR and is not a legal plan." The Court said, "That is not a document that is legal." So we must fall back on the last legal plan. The last legal plan said, "13 only." It is still legal because it just said, "At least the 2000." It didn't say only to 2000. It is open, because the deal is what they were trying to say was, "In 2000 we should probably reassess the condition of the environment to see how much impact we can sustain?" All the data we have today came from 1982. Hydrology, bug studies, cultural studies, there is a couple new ones for the *wēkiu* [summit, peak] because they made it worse for the University, 99.7 percent reduction in population.

When the University was doing this next plan, we looked at and realized it wasn't a Conservation Plan it was a Development Plan because they just want to build more. It is not a plan for conservation it is a plan for development. And we knew that, but we did submit to them, "If you must do this plan, you need to implement this structure, because it is not just that a plan needs to be done, but who does it?" We continuously told them, "You are not the agency, DLNR are the ones who controls conservation." The way we tried to explain it is to say, "If I am a police officer, then I am empowered by the State to be armed and use deadly force." I cannot take that gun and give to a civilian and say, "Shoot that criminal." Only I am empowered by the State to shoot the criminal as Police Officer. So we kept saying, "What is happening here is you are shifting the legal authority to the University claiming that you can do it. You may not do it because you are not BLNR. BLNR is the only ones that can do it." So eventually we had to challenge that in court. The problem with the Maunakea Management Board is that most were appointed by Senator Inouye and now they are just appointed by the University itself. That is not okay they are all political appointed that serve the community and not the people. That is one problem, the second problem is that they are not a legal body, well they are not a body who can tell people what to do that is for sure, because they were created in that 2000 Plan. It is not a plan contemplated by the rules of DLNR, so he threw it out. He also said, "The 1995 Plan that was approved by BLNR did not mention anymore development." So there is a limit.

CSH: Can we talk about your knowledge of cultural sites within the Project area and the mountain?

KP: Yes. [Looking at maps] Trails…there are *ahu* all over the mountain.

CSH: How has your past work helped you in your efforts to both understand the need of astronomy and the need to keep the mountain sacred?

KP: I think it is unfortunate and I have been coming out a little bit more on this now because I am tired of it. I feel that the astronomers are there to do astronomy and we don't object to astronomy. The astronomers are not there to hurt anybody; they are not there to offend the host culture, maybe there are a few who don't care, but most are good. They are not there to hurt the environment. Most astronomers want to be environmentally conscious. The problem is and this is what I am telling the astronomy community is, if you continue to listen to the University lawyers and only the University's side of the argument you are going to get in trouble, because you are going to come out and say things that already have been decided in a court of law. The difference between the political arguments and legal arguments is that in court you have to prove what you claim. In politics people say all kinds of things but they don't have to provide actual evidence, the University making arguments that they lost in court. That means that they cannot introduce evidence to contravene our evidence. Our evidence is 10 thousand documents of hazardous materials used on the mountain and no record of UH removing them. Our evidence is that hazardous waste can go directly in the ground because they have no proper waste containment. If the community's water becomes toxic, where do we go? On the other hand they can fix that. It is completely fixable problem, but the University continues to manipulate everyone involved. So we have come out to say, "Look, we are not going to let you keep saying that Hawaiians or the environmentalists are against astronomy." Because we have stated publicly and in written form that astronomy is a noble endeavor that should be support, however, not at the expense of everything else and good science should include environmental science, the geology, hydrology, the ethnographic studies, archaeology: all of it is science and our cultural tradition is science.

The lake is a significant site because it is like a *wai ea* [*Lit.*, aerated water, water used for purification], which was significant for marking time, seasons, even a mirror to the stars above. Many of the *ahu* around the lake are markers for directionals. So there are directionals not only of the primary four pillars, north, south, east, and west, but also the solstice, so you have the 8, the *heʻe* [octopus] *nanana* [spider], the *peʻa* [bat].

The Ahu-a-Umi is in between the three great *puʻu*. I have spoken with Aunty Kawena Rubillite Johnson because she has done significant work on the trigonometry of our *heiau*. I grew up with her youngest daughter Līlīnoe and so I have known her for years. Years ago she asked me to look for Ahu-a-Umi because I called her to say, "Aunty…." So I said, "Aunty I am working on Maunakea." The first thing she asked me if I could see Ahu-a-Umi. I said, "No….I am in the telescope." So she said, "Go outside and see if you can see it." And she directed me to look for it and what it looked like and everything. So I had never gotten to go until Uncle Clarence [Ching] made a *huakaʻi* [trip, voyage] and we went then. It took us two days to get in there. Amazing! So I called Aunty Kawena and I said, "What would you like me to do?" She said, "Go measure the alignments from Ahu- a-Umi to Maunakea. Especially look for the one relating to Venus." So I said, "Okay." Because I had measured the alignments from Maunakea and they just went to Ahu-a-Umi. So we have the alignments both ways on Maunakea. The *kupuna* told me to find the solstice equinox alignment because those are kind of critical for things. So I struggled with that. I couldn't make the initial alignments because I didn't know where they were standing. I struggled and struggled. The story I was being told was you need to know them because the alignments established on Maunakea become the baseline alignments at the other places and you'll see them if you can establish that. I had a dream and the dream kind of shook me up because it was an *iwi kupuna* . I was looking at the *kupuna*('s) back and he was pointing in this direction and he had this beautiful *hulu* [feather] cape on the bottom of it had a big black iridescent feather star. Where he was pointing I had no idea what that was meant for. Is there something going on I started to look around. I asked Aunty Kawena and went to see her about this dream. I had two significant dreams in a row. One the *iwi* grabbed my ankle when I was standing on a *puʻu* and it was a *puʻu* that Subaru and that is Puʻu Koholā the back of the *koholā* [whale] which is the alignment with Puʻu Koholā that was leveled in order accommodate Subaru. Aunty asked me, "So, you have this vision, where were you in the dream? Where you in the dream? Where outside of the dream looking in? And where was the *kupuna* in relation to you?" I said, "I was standing behind and he was pointing in this direction." And then I told her about the star pattern and she said, "How many points did the star have?" I said, "I cannot remember, Aunty." So she went from there and then she said, "Maybe you need to ask for clarification." So, I forgot about it for awhile about a month later it came. I saw it all clear. I called her up and said, "There is eight points. He's pointing north because he is standing on a ridge and I can tell is because I can feel the wind." I know the direction. She said, "That is very significant." Then she gave me that the number 8 is a magical number to the Hawaiian. So, I took the directional and I made the alignments based upon where the *kupuna* in my dream was standing, where I was. Then I drew the lines just for our summit area first. Then I said, "Okay, if this is correct, if this is establishing where I am supposed to look from." If this is correct then exactly on the solstice of December 21/22 I should see the sunlight and the crack of dawn hit this *puʻu.* So that is how I made my vision become scientific. And if that was true then these were correct because you cannot mess up after you get the first data point. So I waited that morning for sunrise it happened. Then I drew all eight lines out all the way to Poliʻahu Heiau on Kauaʻi. So that is a view plane. These solstices and equinoxes are of one view plane that must be protected.

I went to Kauaʻi to test my theory too. If in fact I was at Poliʻahu Heiau and I measured the alignments and they are completely aligned to the Maunakea alignments. When the navigators for our recent canoes came up to the mountain, some wanted to go to the lake, some wanted to go up to the summit to the *lele*, because the *lele* is aligned. We gave them snow water to take with them, but they needed to go to the lake to see the sky reflected in the lake. They are codifying the alignments in their mind's eye. That is how the *kūpuna* could see the pathway, see in the lake hold it in their minds and follow it on the sea. Some people say, "The navigation is all about the ocean." But it is really all about the sky. That is where the difficulty is on finding the *moʻolelo* on Maunakea. It isn't just under Maunakea it is under all the navigational lore. I remember Kepa Maly talking with me years ago, and I kept saying, “You know what you see on the ground Kepa is only the reflection of the heavens? This is our connection. When you are looking you have to look for those things over head.” Mrs. Johnson told me that too.

Our *kūpuna* could tell and some say that this is a modern myth that modern science taught us the idea of the procession the 26,000 year cycle. It is not true, the ancient Magi, the Egyptian Priest and the navigator chiefs of Polynesian all knew those things, and they made the alignments in accordance with that. Twenty six thousand years, we are basically being able to plot the motion of the heavens over a 26,000 year cycle. So that means that motion is really small, so small that in one humans life it would take them 70 years or so to detect it. They set up the *pōhaku* and they are watching the same star and that same star is moving slowly over time and they caught that the nautical sign. Then they knew that is found they found their seasons and that is how they led their lives. Again I called Aunty, I said, “We found this chant and this chant is saying that Canopus and Vega are the pole stars.” But that was 12 thousand years ago. So I am saying, “How can that be, 12, 000 years ago we aren’t recorded as being here.” She said, “There is any easy answer, perhaps it is proto-Polynesia.” That is a really exact measurement because we know when Canopus and Vega were there. Because of that movement of the 26,000 and where it comes in is in our *Kumulipo* because the number of wā [epoch, era, period of time] are broken down into the epoch periods. So, it is not just like everything just happened in days, it was here is and as we progressed in time. So, that our cultural things are antiquated and not science. [That] is not acceptable. Because our ancient knowledge is repeatable and it is measurable and that is what is required in science. Nainoa Thompson, before Papa Mau, they demonstrated that our ancient knowledge has relevance today, that by using the same ancient knowledge we can still go and find all of Polynesia. We populated 10 million square miles of islands, I mean if you are off by only a degree you are off by hundreds of miles on the earth. It was an acute observation. So our ancient *kahuna* had the same skills. I am not saying that we are better than the scientist today, I am saying give credit where it is due, and that we were able to circumnavigate the globe millennia before western science. So science would do well to recognize our star knowledge as science and stop calling it myth.

CSH: What are the cultural practices you have witnessed and participated in on Maunakea?

KP: Burials, contemporary and historic. Contemporary burials though I am not going to say that it is only limited to, but it tends to be more of the ashes, not all because people are still fighting the health department on the Hawaiian burial of bone. I have personally participated in a number of them. Other families have called me to help them and I have. This has involved their personal affects and belongings or things people would otherwise bury with their *iwi*. It is still done today. Sometimes people bury it or sometimes they leave it at the *ahu* or *lele*. In doing that they are placing it in the hands of the ancestors and for the benefit of those who have past and now to come.

CSH: You were talking about collection or gathering of ice, water, and snow?

KP: Yes, it is an old practice. There are reports of the *aliʻi*('s) travels to the mountain and bringing the ice down in big blocks on horseback, even contemporary times. They would use it for medicinal purposes, temple ceremonies, and other kind of cultural protocol. The water that is collected from Maunakea is water that is used for bringing life back or taking it. I only work on the side of bringing back life. We were blocked before at one point from gathering. For example sometimes we want to collect it while snow is falling and we were blocked, the road was blocked. Not because it was a safety hazard, I mean after working twelve years on the mountain I can tell the difference if it is a burial stone or not. Anyways the practice wouldn't live very long if all the practitioners died doing it. We were collecting it for Uncle Genesis for example, he had the lung cancer and then he drank all the water and it went into remission. For five years. So we still go and collect it for many people. A few years ago, Papa Auwai said, to his *haumāna* [students] who communicated it to me, because I often get for them and Aunty Margaret, they don't want to use the lake water anymore. So, that is what has caused us a lot of concern, we want to know is the lake clean? Is anything going in there? So why don't the authorities want to know if the sewage is hazardous material has contaminated the water or not?

Ceremony at the lake…there is a lot of that. All different kinds, Queen Emma went there to *hiʻu wai* [bathe for water purification] before her election and to demonstrate her worthiness and *moʻokūʻauhau* or genealogy. We found her *ahu* site. We have the GPS of it because we knew where it was. But they got the actual meets and bounds from *moʻolelo* that was found on the east coast and then Kepa brought it back and then him and Uncle Clarence guys did a *huakaʻi*. There [are] *pūnā wai* [springs] that you can collect from. There is the lake *puʻu*, Waiau, but there is another one, *pōhaku* I think. Uncle Clay is the one who knew all the names of all the *puʻu* from *paniolo* days. Pōhaku and Māhoe…they collect water. Perhaps it is because of the cinder cone it has ice plug. The other things is the fossil ice and the ice from the last ice age which still exist on the mountain maybe just 4 feet if you go below 2 to 4 feet you can hit that in certain spots. So, there is the collection of fossil snow and ice. The underground ice is important for some *lāʻau* [reference to lāʻau lapaʻau, or medical practitioners] people. There is actually water from Maunakea that is collected in the ocean.

CSH: What about the summer and winter solstices?

KP: Well you have the winter and summer solstice and then you have the equinoxes. They are conducted by the Royal Order of Kamehameha specifically can handle the temple kind. I know other people who go up at different times for doing different kind of ceremony. Then there is the navigational uses of lakes and other *pu‘u*, because of the *pu‘u* being markers. That is important because the landscape is the environment of our belief, so changes to the landscape alter the belief, they can take away or they can enhance it. Obviously placing the *lele*, Kaliko Kanaele was so clear about it. We need to re-center the focus. After I had done the alignments, we re-done some of those and then watched to verify that what I had seen was true. Once I re-did the alignments for the ceremony that I realized the *kua*, the backbone has been leveled. So if that would be the central place directly looking north where you would start it, but we cannot do it because there is the University telescope so we did it over here. So it has been changed. There is perfect demonstration of this. It is a beautiful picture taken by Richard Wainscot; it is a picture of facing the Southern Cross, which is significant for navigation because it is used for keeping time. The Southern Cross is used for keeping time at night on the sea. You can perfectly keep time of the 24 hour clock just using the southern cross at night time, so the rising and the setting of the southern cross. Before obviously you can see the view plain was clear, but when they built the Gemini they took that view plain out and that view plain, so when you are standing in the traditional setting you can no longer see the Southern Cross. The picture we have has the glow of the volcano on one side, and Gemini in the forefront, but Gemini did not put the whole dome on, so the southern cross is right in the middle of dome structure, so now with the dome on it the view of the Southern Cross is obstructed. Then you have the other type of ceremony which is for deity.

CSH: Who are the gods associated with Maunakea?

KP: There all the male pantheon gods, then the eight females. The story throughout Polynesia is the story of the god Kāne. For example in Aotearoa they speak about him bringing the three baskets of knowledge down. There are our own stories where they talk about Kāne not wanting to do it, told to me by my Aunty Kamaka. He was told that you have now go up to Maunakea and take care of your responsibility after the floods mentioned in the *Kumulipo*. He did not want to go, but the *kupuna* who used to go before could not go anymore. So the moral of the story is that Kāne had to go because of the *kupuna* told him too. It was his love for the kupuna is what made him willing to break through the limits of not wanting to do something or feeling that is not my *kuleana*. The main stories of Kāne are about the creation and also of him asking Poli‘ahu to care for the *kupua* children. The other story identifies Mo‘oinanea [legendary serpent goddess] as the one to do it, those stories are actually in the book called Moku‘ula on Maui. Maunakea is featured in this book through the Mo‘oinanea story. Because Mo‘oinanea has three principle places that she is always at; one is Pu‘uloa, Kaimanahila, and the lake. The other stories of Kāne and Kanaloa, they say Maunakea is where they meet. That is where the fresh water and salt water meet, that is also where the *pō* [darkness] meets. The deepest *pō* is the *pō* of the sea and the *pō* of the heavens, right there is the lake.

Papa and Wākea, Wākea as Orion is super significant for navigation because Orion's belt rises due east and sets due west, so you must know Orion and of course Orion comes winter and there was a time that I really got it because some say the sword is the *‘ule* [penis], so at certain angles you can see right over the summit how they are touching is loving embrace. Papa is clear when there is no snow and then is Poli‘ahu when there is snow. And those alignments are significant and major. There are different levels of each story as there are the levels of heavens. Papa and Wākea come to meet here in the *Kumulipo*. Bringing it all through their names will tell it all.

There is Līlīnoe, the sister of Poli‘ahu, her *iwi* are recorded to be there. Fornander also have some of those Kāne stories. I read this one that describes Poli‘ahu being able to see Poli‘ahu from Paliuli. Is it a state of mind that they are referring to or it is a place? and then one day I walked out and the snow had been perfect and there was a cloud bank, a typical cloud bank that always is on the mountain, and right there you could see her whole body, her face, her hair, her shoulder, and her arm, her *nene* [nipples of a woman's breast] and then of course the telescopes are right there by her *‘ōpū* [belly, stomach] and her *nene* and then you go down and then two *pu‘u* on the mountain that if you look from Hilo side, like looking from Moku‘ula is a good way to see, and then you can see her two feet. Then what happens is that she floats like a cloud of the tree line. So when I saw that it is a state of mind too because you have to be open to it. Because when I went out I was thinking about her and then all of a sudden I saw here, and once I saw, I could not see her anymore, so her *kino lau* [different forms taken by a supernatural body] is codified and to be seen especially during solstice, her *kino lau* manifested herself so that you can see her in the snow time. The legends tell of her adorning her *kīhei* [shawl, cape], or mantle. Yes, and the telescope levels the *pu‘u*, her image and *kino lau* on the top of Maunakea.

Let me just say something about the later stories of Pele and her sister Poli‘ahu. You hear it usually framed in a conflicting way, but this is what I think. That there were probably some battles between the *malihini akua* [foreign or non-native god, often referred to as Pele who traveled to Hawai‘i from Kahiki] and the older one, possible water and fire, *mo‘o*, fire, but in truth I think it is also a story that is telling us that you have to have both, because without them we cannot have those elements or the *wai*, which is Kāne *ka wai ola* [the life giving waters of Kāne]. The fires and ice make the water. In one of the things we submitted to the court also as to demonstrate the traditional use and the cultural *mo‘olelo* is as our *kūpuna* told. We had a satellite photograph from NASA in infrared and you can see Maunakea with no snow now is blue in color and Maunaloa is really a brilliant red. What it is showing because it is an infrared is that Maunaloa is hot even underground it can penetrate and you can see the heat coming through Maunaloa, but Maunakea doesn't have any heat. It is all brilliant blue and what that is showing is the fossil ice underneath. That fossil ice is perpetually re-circulated with the freeze and frost cycle of the mist, which is the deity Līlīnoe.

Everyone always talks about exactly watching the lunar arise and she shows herself in the evening and morning, those are the primary times to see her. She comes right over it looks like a waterfall made of mist because the changes in the temperature cause the mist to drop really fast, and I have watched her come around the telescopes of the summit. Where I worked was in the valley so I could watch it drop down like a big waterfall of mist coming down. Then Namakaokahaʻi comes on Pele's journey's here. Then she has to advocate for her sister who gotten herself in trouble and was frozen. I think it tells us the story that even the *malihini akua* have to abide by the *kānāwai* or 'law' of every *ʻāina* that may precede them. Every *ʻāina* has *kānāwai*. The significance of Maunakea is because the higher you go the farther back you go to the point of creation to ascend into. Below is the land root and heaven above, so it is principle spot that touches the two that brings the *lewa* [levels of heaven explained in next sentence] together. The *lewa* are the levels of the heavens. The Papa and Wākea come together there, they are significant in relationship to the mountain, for here is the *moʻolelo* of their relationship to or navigation. Our navigation is hinged upon our ability to understand what we now in modern terms as celestial equator. All that is means that our equator is expanded out so that we have an understanding of a dome of the sky.

The story of the connection between Papa and Wākea through the *aka* [shadow] that holds them together (the *piko*), when they separated when the gods and Kāne lifted up the pillars, the four directions of the heavens, they propped them up to give them space to live and flourish and for man to come into being. That is the *wao akua* [realm of the gods] and they were given the *wao kanaka* [realm of men]. When they separated they were connected by the by the *aka*, which is the *piko* and when they come together we see that. That also was the demonstration on how we drew our celestial equator, because once you have one direction if it is north, south or east or west, we have the southern cross in the south, so we got that one and then we Hokupaʻa [North Star or immovable star] in the north we need an east and west, and then that east and west is set by Wākea. Orion transverse east and west you always know where you are especially the three stars in the best is due east and west and never changes. So it records that as well so Maunakea sits in the middle and that is what the early kilo to see and assess. From that then they can set all along the whole archipelago the base line. Different heiau for different reasons but obviously the ones that have any kind of relationship to the deities related to Maunakea also their alignment.

CSH: What are the resources that may be impacted?

KP: Water. Let us talk about the lake in the context of cultural practices. As home of Moʻoinanea, the Royal Order of Kamehameha feels they have specific duty here is because Moʻoinanea, when you go back into the genealogies. It is pretty much a mystical realm, Moʻoinanea comes through and her first descendant is Kihawahine is the one who gives birth to the entire *moʻo* clans in Hawaiʻi. Their birth place being at Waikīkī and Pu‘uloa and that is why her *kino lau* is the mother of pearl shell. The story in the 1800s Pu‘uloa is raided along with the northwest Hawaiian Islands. Pearl and Hermes reef were pretty much fished out of all of our pearl shells, but about the same time a *mo‘olelo* came out where it is said that she was angry because a chief severely punished one of the *kama‘āina* for taking the pearl shell when it was *kapu*, but the *kama‘āina* was starving so Mo‘oinanea became angry and took the pearl shell to Tahiti, so if you see a pearl shell, right at the time that *mo‘olelo* is gone, and the pearl shell has gone to Tahiti and what today the pearl shell is flourishing there; which is beautiful so it connects of *kua mo‘o* [the back of the *mo‘o*] and it is all through Mo‘oinanea too. The navigator has her with the pearl shell I on their *wa‘a* [canoe]. She is significant because she is also is the caregiver of the *kupua* [demigod or supernatural being] and other *ali‘i* children. When the sacred chief Keopuolani is the bearer of the Kiha [supernatural lizard] and because of that Kamehameha had to marry her. Her lover was Wahilani. Kiha was her *kino lau*. I know that there are some people that go up to give ceremony for Mo‘oinanea, that is their primary deity. The ones I know that are of the *mo‘o* clan.

The resources up there are one of the earliest ones is the ‘*ua‘u*, the dark rump petrel, a bird. It is a high altitude bird that flies hundreds of miles out to sea to feed and then comes back to Maunakea to nest. They are always in the high altitude. One of them was making a noise one time and went out to look for it, but I could not find it, but I could hear it. I was looking and looking that is when I found one of the water caves with the water shooting down. So there is a lot of water flow up there. The ‘*ua‘u* was there before because during the times of the *ali‘i* there were a lot of remains, it is interesting question, what does that mean or lead, they must have been eating them. The *‘ua‘u* were reserved for the *ali‘i* to eat and there are many remains found of the *‘ua‘u*.

The *wēkiu* bug was not the first concern, because there is eleven other species of plants and animals that are also threatened. Some of them are lichen species, grass species, bugs, and tree species. Palila [native honey creeper *Loxioides bailleui*] is another. I have personally seen ‘*io* [the endemic Hawaiian hawk, *Buteo solitarius*], and *pueo* [Hawaiian owl, *Asio flammeus*] too. Why we saw them that high up is a question. I can understand the ‘*io*, but not the *pueo*. During the dedication of the Smithsonian there was an ‘*io* flying higher than normal. The tree line is very important because it is the home of our native bird species and realms, no more mosquitoes.

CSH: Let us close with what are your concerns about the potential impact to traditional cultural practices?

KP: First I think there has been enough built. This telescope is going to be so huge; the size of modern sports stadium, there is just no way won’t it impact some kind of resource or traditional cultural practice. We have compromised so much already. Our traditional ways, our customs and beliefs, customs never change tradition may evolve. We have to adapt, for example we have to put the *lele* over there because we cannot put it on the *kua*, because it is gone and a telescope is in the way. Don't forget the Kūkahauʻula riding the sunbeam to court Poliʻahu every morning—significant telling of the story. Ahu-a-Umi and the alignment with Venus. These are impacted with more construction and destruction of the landscape.

Our traditions are not antiquated, they are ancient, but that does not mean they are useless in the world today and their science. They are not just religious belief they have practical use to us every day. Many of the scientist learn about certain things because of the *moʻolelo* not because of the science. They would not have learned to look for unless someone communicated to them, "Well, did you look for this? Because this happens." We did not have any NASA satellite pictures of the two *mauna* but yet we know all the elements about them. We have a continuous base of knowledge that spans millennium and indigenous people is critical to the world because of the fact that it is continuous. It is unbroken knowledge and observation from generations, therefore modern science should actually learn to utilize it in a better way. Modern science is young compared to the ancient science. We don't want to eliminate native knowledge. The idea that astronomy is somehow superior to this knowledge because what astronomy does is good in which we support that, but it is not fulfilled. You cannot look one way and not the other. The fact is astronomy is flourishing on Maunakea and what is not flourishing is the practices being repeated because of the destruction of the landscape our ceremonies are impacted.

In the end good science is science that learns from the past and protects knowledge as well as collects new knowledge.

Mahalo no.

7.8 Leningrad Elarionoff

CSH interviewed Mr. Leningrad Elarionoff in Waimea, Hawaiʻi, on January 31, 2009. Mr. Elarionoff comes from a Hawaiian-Russian background. His father, Gregorio, left Russia with his family in 1910 when he was 10 years old. Mr. Elarionoff's grandfather had worked for Czar Nicholas II who was later assassinated along with his entire family in 1917. When his grandfather, Evan Elarionoff, realized that his allegiance to the Czar would probably get him sent to Siberia under the new administration, he fled the country with his family.

In San Francisco, the grandfather of Mr. Elarionoff learned that Parker Ranch was searching for employees to farm the lands of Waikiʻi, Hawaiʻi. A.W. Carter was the ranch manager at that time and he controlled the ranch with an iron fist. The grandfather settled in Waikiʻi with his son Gregorio and other Russian immigrants. At a young age, Gregorio was put in charge of the Parker Ranch farming operation at Waikiʻi. Eventually, he met and married Ms. Nancy Awaaʻa, a Hawaiian with a little bit of Irish and Chinese who was born in Kawaihae *uka* (uplands).

During this period of time, Parker Ranch maintained a huge population of sheep and regularly harvested the wool. Then with the introduction of synthetics in the 1930s, the market for wool diminished. Gregorio Elarionoff was assigned to reduce the sizable sheep population by getting rid of the sheep by the thousands. The method employed required channeling the sheep into a narrow, single file, with a chute on the edge of a ravine. As the sheep ran through the chute, men on each side would then stab the sheep with long bladed knives. As the knife was withdrawn, the sheep would run down the embankment and eventually die far away from the area without blocking the chute. Gregorio Elarionoff complained to the authorities about this Project in that it was cruel and they were prohibited from recovering some of the meat for home use. He was subsequently fired and relocated his family to Honuʻapo (*lit.*, "turtle back"), at the southeast side of Hawaiʻi, in Kaʻu. Gregorio was hired to work on the Honuʻapo Landing operating the crane that loaded sugar pallets onto boats called launches which ferried it out to large sugar ships which transported the raw sugar to refineries. Between sugar ships, Gregorio was assigned to the fishing detail that supplied fish for the community. It was during this time that Leningrad was born and raised along with his four brothers on property that they had bought in Kiolokaʻa, Kaʻu.

After attending Pahala High School (now Kaʻu High School), Mr. Elarionoff worked for the Hutchinson Sugar Plantation in Kaʻu, and the Satellite Tracking Station at South Point before attending college in California. Upon his return to Hawaiʻi, Mr. Elarionoff joined the Hawaii Police Department and retired as a Police Captain, District Commander in 1994 while residing in Waimea. At retirement, he became an active politician and was elected as a county council member. For the past four years, Mr. Elarionoff has been a Hawaiʻi Island Burial Council member. He currently is a volunteer on the Waimea Trails and Greenways committee working to establish a trail through the town and he also does volunteer work to maintain and enlarge the Waimea Nature Park. In his spare time, he grows *ʻōhiʻa* trees with a variety of *lehua* (flowers of the *ʻōhiʻa* tree) colors. He asked that this interview be considered his *manaʻo* as a private citizen, and not as an official burial council member.

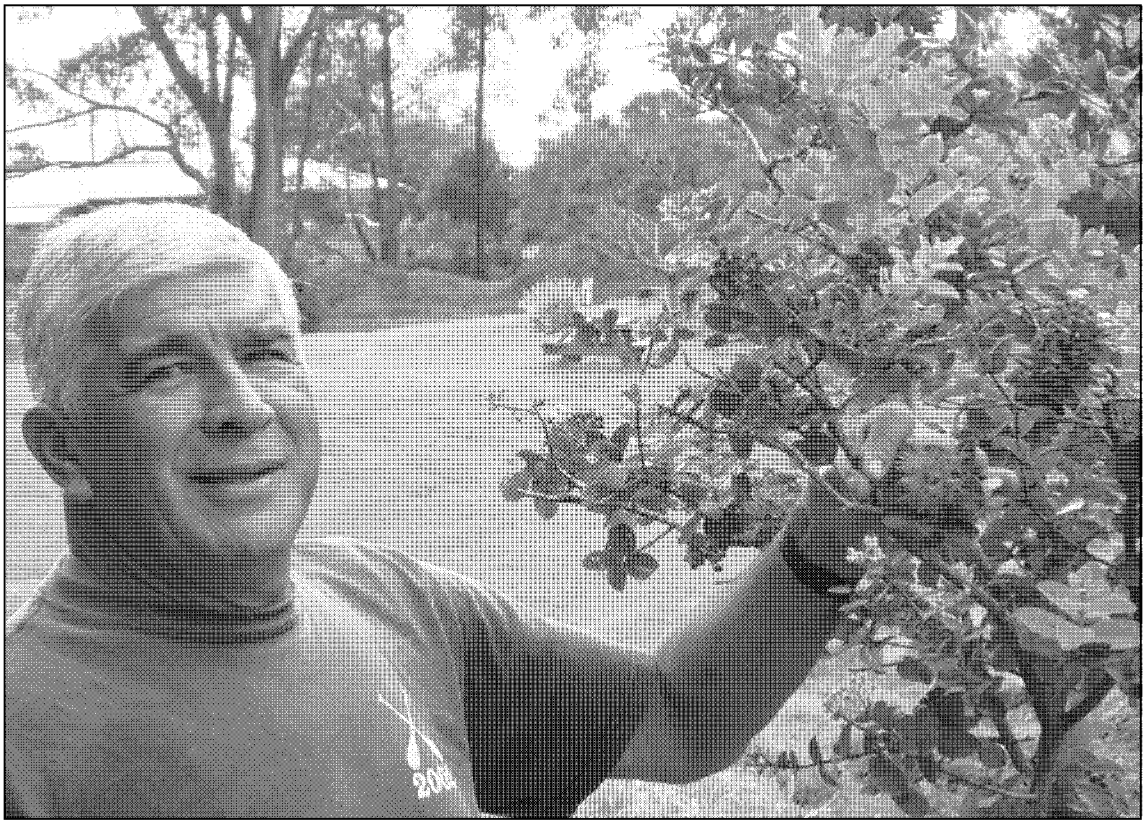

Figure 23. Leningrad Elarionoff shows the *lehua* from one of the *ʻōhiʻa* trees he has grown.

While giving CSH a tour around the nature park, Mr. Elarionoff told a *moʻolelo* about the meaning of the place name "Waikoloa." Pointing to the dry Waikoloa Stream bed that flows through the town of Waimea, he related that because the stream bed is covered with rocks of every shape and size; when the stream flows, it causes the rocks to tumble. The sound of the tumbling rocks is referred to as "koloa" (Hawaiian duck, *Anas wyvilliana*) in the Hawaiian language, and is similar to the sound a duck makes while filtering underwater in search for food. Mr. Elarionoff points out that the word for water in Hawaiian is "wai," and when combined with the word describing the sound of the tumbling rocks, the complete word would be "Waikoloa" which has been incorrectly interpreted by some to mean "duck water."

Figure 24. Salmon-colored *lehua* on an *ʻōhiʻa* tree tended by Mr. Elarionoff in Waimea Nature Park.

When CSH asked what he thinks about the proposed TMT Observatory Project, Mr. Elarionoff began with a story about his mother's family. He noted that his mother's maiden name was Awaʻa (*waʻa* means "canoe or boat"). According to Mr. Elarionoff, family history hints that his grandfather on his mother's side was related to skilled canoe travelers who came to Hawaiʻi from some distant land.

> Imagine traveling by canoe on an open ocean with no pre-knowledge of a destination. The only drive being the need to explore and the belief in a land destined to be called home, guided by fate for three thousand miles over uncharted waters with limited supplies of food and water. Their motivation is beyond understanding, their determination unwavering and their success a testimony to what a true explorer is capable of accomplishing. Their explorations were limited by their abilities but today, technology has expanded explorations to beyond our physical world. Given the opportunity, I believe that our ancestors would have explored outer space. Maunakea is a gift preserved for eons for just such a purpose.

The proposed TMT Observatory Project has his support, in part because of the history of Hawaiians as avid explorers of the world around them and beyond. Mr. Elarionoff stated:

> For me, Maunakea is the logical place to continue the explorations my ancestors began many years ago. Now that we have basically conquered the world,

> everything that is above the water anyway, where else is there to go? My cultural upbringing is full of respect for our ancestors who conquered the earth, understood and managed the resources available to them. They treated the island as a gift, not as a god. I feel that if my mother's side of the family had the opportunity to shoot off into space, they would jump at the chance. They would view Maunakea as a launching pad, a monument preserved for explorations beyond imagination. Until a few years ago, the mountain was uninhabitable, a very harsh environment. That harshness has preserved it for us today. It provides an opportunity so we, like our ancestors, can still explore. I think that our mountain is a fantastic gift. Whether it is God-given, nature-given, or whatever, it is still a gift. So let's make the best use of it. If we need to worship, let us worship the Giver, not the gift.

According to Mr. Elarionoff, the worshipping of the mountain is something that he likens to the Old Testament story where the Israelites were wandering in the desert and venomous snakes bit them. To heal them, God instructed Moses to make a bronze serpent and place it on a pole so whoever looked at it would be healed. As time passed, the bronze snake became the object of worship when in reality; it was just a piece of bronze.

> I take issue with the guys who talk about worshipping the mountain and wonder how they are able to associate worshiping of the mountain with the Hawaiian culture. I have never heard any old-timer or family member ever speak about stuff like that. They treated the mountain with great respect and honor and believed that it had *mana* [divine or supernatural power] but not to the point of being worthy of worship. It was always looked upon as something majestic, a Ku Paʻa [immoveable foundation], something that we could depend on. We may not know what is in it, we may not understand why it is there, but it is there.
>
> In my Christian upbringing…I'm thinking of my mother's side…we were taught that God is all powerful, you don't have to go up the mountain top to meet him. He comes down to you, and he meets you in your heart. So when I hear people talking about worshipping the mountain, it's really hard for me to comprehend why…
>
> To me it's going backwards. It's what God has given us to enhance island living, to provide direction as in *mauka*, the opposite of *makai*, but some chose to worship it instead…

As far as he is concerned, Maunakea is meant to be put to greater use.

> Maunakea is the anchor that secures our island to the ocean floor. It is a product of time during the formation of our islands. It didn't appear by some miracle---floating down through the mist and landing on the ocean. No, it came up from the middle of the ocean. It took eons and eons for the mountain to build up to what it is today. So as far as I'm concerned, the best use of the mountain would be for us to explore it and explore from it. I don't see it as being sacrilegious or anything close to that.

When CSH asked if he knew of cultural resources, sites and practices in Maunakea, Mr. Elarionoff described his first visit to the top of the mountain where he saw the famous large basalt adze quarries. The rock piles were up to 15 feet high, he estimated.

> It was many years ago, I don't remember who the first person is that took me up there...We explored the adze factories. It was fascinating, fascinating. You go up there, and you see these rocks. The rock piles are taller than these trees. There were five [of those piles] with hundreds of adzes in various stages of completion just lying around. It was obvious that to chip the rocks into rough finish implements, the craftsmen used other rocks, [as] they didn't have metal. The chips that were broken off fell to the ground and just piled up and piled up until it covered the side of the hill in a slope 30 to 50 feet long and who knows how deep. The amount of rock chips was amazing. If they brought the rocks down here to the warm area to work on it, it wouldn't chip. It couldn't. Basalt is hard and in the cold, it gets really brittle. So that's the most productive place to chip and rough shape it...when you get to the halfway finished product, you bring it down to the warm, comfortable climate and you finish it, sand it down then polish it on another rock to make it smooth and sharp.

Mr. Elarionoff finds the dedication and hardiness of ancient Hawaiians to be admirable and intriguing.

> To me it is fascinating...we sit here today and it is cold. Can you imagine what Maunakea was like? What did they wear to keep from freezing?—*ti* (*kī*, *Cordyline terminalis*) leaf? They couldn't walk from the warm area to the top of the mountain in one day's time and go back home after dark. They had to have slept up there and worked up there. In that harsh environment, some of them may have died and remain buried.

It is feasible that some of the burials that are present in Maunakea may be related to the adze makers, said Mr. Elarionoff.

> Because of their dedication to adze making and their craftsmanship, it is fitting that they be buried up there. The same honor afforded fisherman. A fisherman is buried in his canoe in a cave down by the ocean. The principle is the same. To have burials on the mountain is not a mystical thing like some strange god came down and got buried there. It's a normal thing. People die, and when they die, they rot. So what do you do? You bury them to hide the stench and protect the deceased from scavengers. The craftsman's life dedication to the culture was to make adze which earned him the right to be buried where he labored.

Another notable cultural feature that Mr. Elarionoff remembers about his trip to Maunakea is the presence of a rock slide where the millions of chips allow for a safe slide down to the bottom. "We used to go down there and slide down the chips…it's like a water slide only comprised of rock chips." He also discussed the ways Hawaiians in the past must have broken down big boulders into manageable-sized rocks, asking "How do you suppose they managed to break the rocks into manageable pieces for chipping?"

A family member explained to the young Elarionoff that Hawaiians probably found cracks in the boulder and used water to widen the cracks until it split. The tricky part was to keep the water within the crack until it froze and expanded. He noted that once thawed, the process would be repeated. “The process sounds very slow and time consuming but there is no other explanation and they had no means of cutting the rock,” Mr. Elarionoff admitted. “Fortunately, water was available.”

Mr. Elarionoff also described seeing Lake Waiau and its pristine, glacial waters. “It’s clear water, but [is] cold, cold, cold. It’s fresh water.” He stated that he drank from it at the time, but doesn’t know if it would be possible to drink from it now. As a young child, he grew up knowing that it was forbidden to step into the lake or swim in it. “We were prohibited...and found it prohibitive for two reasons; one, the water was too cold to be comfortable and two, out of respect for the lake and future explorers who utilize the lake as a resource for drinking water.”

Although he supports the proposed Project, Mr. Elarionoff emphasized that the dignity of the mountain should be respected and maintained.

> The thing that I wanted them to do, the thing that I’m not happy about, is that they have detracted from the majestic-ness of the mountain. By that I mean the road itself is a big scar caused created when the bulldozer came in and cut the road. They pushed the rocks off the side and left them there. They could have cut the road and then removed the excess material. It’s extra work and extra expense, but it would have allowed the mountain to maintain some of its dignity…If you just had a road without all of the extra rock-calling attention to the scar lying around, I think the mountain would look so much nicer. That is something that can and should have been done; it’s not impossible.

He also stressed that old telescope sites should be recycled, rather than constructing new ones on unsullied ground.

> I think we should recycle the sites. If an outdated structure is identified and there is a need to build another telescope on the mountain, tear down the old structure and build the new one on the same footprint. The Mountain is valuable and respected by us. Do not sacrifice our cultural monuments for expedience or budget concerns. Another structure can be another unnecessary intrusion that detracts from the beauty and majesty of Maunakea.

When CSH later contacted Mr. Elarionoff regarding the addition of a construction staging area and electrical transformer, he did not have any further comments to add.

7.9 Ku‘ulei Keakealani

CSH interviewed Ms. Ku‘ulei Keakealani on February 19, 2009 at the Ka‘upulehu Interpretive Center located in Kalaemano, where she is the curator. Ms. Keakealani has been a cultural activist and Hawaiian traditional practitioner for years, and has worked with cultural historian Kepa Maly on several projects including one regarding the *ahupua‘a* of Pu‘uwa‘awa‘a.

When asked about her thoughts on the proposed TMT Observatory Project, Ms. Keakealani stated the following:

> I think my first and foremost thoughts would be that it doesn't need to be done. Not because more research isn't needed or anything along those lines. The latest technology and research helps educate all of us, but at the same time, it's about the location…My question is when is enough, enough? I pose that question on many levels to many individuals. Looking at archaeology, when is enough data recovery enough? Do you have to, as an archaeologist, take everything that exists in a particular site to make the most accurate assumption, or prediction about what that particular site was? When is enough, enough?
>
> And so for me, for the summit of Mauna a Wākea, looking at what exists right now, that I do being a resident of Waimea see on a daily basis—open my eyes and it's there, close my eyes and it's still there—when is enough, enough? That would be my initial comment.

Ms. Keakealani emphasized that the stories of a place such as Mauna a Wākea are critical to understanding the place itself. Knowing the *moʻolelo wahi pana* of a certain area can often change the way one views the place:

> If we went to another layer…or dimension, for me, the stories of a place are something that I almost don't even have words to describe. Sometimes, all I need to know, all you need to know, is the story of a place that's hundreds and thousands of years old that can change my perspective or your perspective of a place.

As an example of how a *moʻolelo wahi pana* of a place can change one's perspective, Ms. Keakealani gave the story of a pond she once frequented as a teenager in Waimea. At that time, she knew the pond as "Anna's Pond" where teenage parties were held:

> Now years later, hearing this story about that place tells me there is a *moʻo wahine* who lives in this pond. This is her name, and here is the story that talks about this stream, this pond, this woman. It changes my perspective about that place. Had I known that—when I was 12, 13 and 16, if my friends and I, at that time the youth of Waimea—had we known and been told those stories, I know that we would have had a level of respect. Whether different ones of us deemed that a true story or not a true story, that wouldn't have been what was important. It would have been, we know this about this place, there is a *moʻo wahine* who lives here, her name is Manaua. I don't know that we would have carried coolers back there, and drank, and had all of this…raging teenage parties that are probably no way close to the raging teenage parties of today. But that changed my perspective. I now knew the name of the pond…it's actually called Kohākōhau. It's not Anna's Pond; Anna's Pond is just a nickname. A common name maybe, that everybody calls it. But its name is Kohākōhau. There is a *moʻo wahine* who guards this water, and her name is Manaua and she does come down into Waimea town; this is the rock that she loves to come and sunbathe and warm her body.

> And when she is done, she retreats back up to her home at Kohākōhau. So in that lake, and in sharing that story, a wonderful individual Kepa Maly and prior to Kepa, my grandfather, open this whole new world of stories for me. With Kepa, we find native accounts and native traditions of Maunakea, or Mauna a Wākea.

Ms. Keakealani shared her favorite Native Hawaiian traditional account, concerning Poliʻahu, the snow goddess. Whenever she tells it to children or adults, she stresses that it is her favorite *moʻolelo*:

> And so it says that Poliʻahu is going to be taken, reared and raised, in our language we say "hoʻokama"...raised by Kāne as if she was his own child. And he loves her so much. And it is because Poliʻahu was so beautiful that her father Kāne places a *kapu* on her. This *kapu* that Kāne places on Poliʻahu is this: she must live and dwell on the summit of Mauna a Wākea. Kāne knows that if any man were to see Poliʻahu, they would just be enraptured by her beauty. They would be so taken by her beauty that perhaps they would take Poliʻahu away as their wife. And Kāne, being the protective, loving father as he was, said, "I can't have that. So I placed this *kapu* on you, Poliʻahu, and this is where you will live."
>
> Kāne knows that Poliʻahu is going to need attendants, people who are going to care for her, and be with her, and be companions and attendants to her. So in this account, he is first and foremost giving her a nurse…Līhau will be Poliʻahu's nurse. Līhau will never ever leave Poliʻahu's side. Wherever Poliʻahu goes, Līhau will go. When we look at translating, or the elemental form of the word Līhau, she is the dew or the frost, first thing in the morning when it's still cold. So when you see that dew or that frost, that is what Līhau is. So a second attendant that is going to be given to Poliʻahu is going to bear the name of Līlīnoe. Līlīnoe…when you look at what her elemental form is, she is this fine misty rain, almost kind of like a fog form. That is Līlīnoe. So she is the second attendant that is given to Poliʻahu to live out her days on the summit of Mauna a Wākea. There's going to be a third attendant that is going to bear the name "Waiau."
>
> Kāne is going to dig for, and create for Poliʻahu her own swimming pool, her own bathing pool. Because yes in fact, Poliʻahu loves to swim in these cool and very chilling waters. So Kāne is going to dig for her, her own bathing pool which will bear the same name as her third attendant…Lake Waiau on top of Mauna a Wākea. So with her attendants in place, with her bathing pool, that's all Poliʻahu would need. Kāne as her father sees to it that she has all these things, the necessities…
>
> At this point, the *moʻolelo* is going to pull our story to a faraway place, never named. But there's going to be a man. And this man is going to dream and dream and dream; every night he dreams. He is going to see this area, this place, mountains. And it is what's called, *kupaianaha* [surprising, strange, extraordinary]…it has a weird notion to it, but it's also kind of intriguing. Because what in fact is this white stuff on these mountains. And so the man is

going to dream it and always sees the place…he sees various, a few mountains that are white-capped. And again it intrigues him…

So not only does he see these particular mountain ranges, he also sees a woman. The story will tell us that with this dream, his desires will grow. And it is going to propel him to come and search. And it says his *waʻa* is prepared and he is going to come. And lo and behold, yes, once his *waʻa* reaches the horizon, what his eyes will behold, he will have confirmation. So he sees potentially Haleakalā, Mauna a Wākea, Maunaloa, Hualālai—all snow-capped. He has confirmation. "This is the place that I have seen in my dreams." He knows that if he is to proceed forward, what else will he find but the woman? He will find her too.

One place name is given in the *moʻolelo*. It says Kawaihae. His canoe is landed. He is going to come to the second place named in the story which is Waimea. So he is going to be at Waimea and he will look to the expanse of Mauna a Wākea with just excitement. You could almost feel it. The excitement is going to overwhelm him because he knows he is going to find the woman, the woman of his dream. And so he will ascend. He climbs to the summit and what an incredible sight does he come across. There is Poliʻahu and she is bathing at Lake Waiau. He is just beside himself.

Well, her three attendants will rush out. They approach the stranger and they tell him, "What are you doing? Do you not know where you are at? What has overcome you to come here? You are at the sacred, the *hālau aliʻi o Poliʻahu*." And he is trying to tell them, "I have come from so far away, and I have seen this in my dream." And they are telling him, "You must leave."

The translation of the story actually says that they drive him away. He is going to descend. But it says he is not going to give up. He will return. A second attempt is going to be made. So this man from a faraway land is going to climb again, once again to the summit of Mauna a Wākea. And comes upon virtually the same scene. Poliʻahu engaged in her favorite past time, which is to lie at the waters of Lake Waiau. The three attendants rush out and they tell him, "You must leave." He again tries to plead his case. They tell him, "Listen, Kāne her father, has placed this *kapu* on Poliʻahu. We upkeep and we uphold this *kapu*. Listen, you must leave." And so it says he does.

Like we see very common in our culture, there are water guardians, half-women, half-lizard, if that's what your mind believes they are; they are called *moʻo wahine*. Well, Lake Waiau is no exception. There is a *moʻo wahine* and she is named in this story. It says Moʻoinanea has watched all of this happen and she is actually going to call to Kāne. She says to Kāne, "Come, we must talk." So Moʻoinanea will sit with Kāne and she is going to tell Kāne, "It is in the interest of your daughter, Poliʻahu, if you let her and this man love." Kāne is a little bit *pūʻiwa* [startled, surprised]. He is taken by the words of Moʻoinananea. And he's going to tell her, "Are you telling me that I should lift this *kapu* from my

> daughter?" And Moʻoinanea said, "No, no, no, no. I'm not asking you to lift the *kapu*. What I'm asking you to do is to allow them to love. Because Kāne, I have discerned the nature of this man, and you will not, cannot, find any man who is going to love your daughter like this man can."
>
> Kāne will then call his daughter and call this man before him and he's going to say to them, "Moʻoinanea has spoken. And what she says is that I should allow you two to love. And you, this man, this stranger, that only you can love my daughter like no other man can, well, what do you think about this?" So the man is actually going to tell Kāne, "Well, she was right. There is no other man who could love your daughter like me." And Kāne says, "Is that right?" He says, "Yes, I tell you the truth." So Kāne says, "Well, this is what I will allow: As Poliʻahu's father, I will allow love to happen two times, everyday, from *no na kau a kau*, forever and ever. You can love my daughter at sunrise when the sun first comes up. And the second time you love my daughter everyday is at sunset, when the sun goes down. This is what I allow. Let it be known."
>
> So for us, we bear witness to them, to this loving. Sunrise and sunset, Mauna a Wākea is going to turn colors. You'll watch certain time for a distinct amount of time, it's going to turn hues of pink and purple; some say red. But when you see Mauna a Wākea turn these colors, that is what we are watching. We are watching Kūkahauʻula, who is this man who has traveled afar and seen this dream and comes in search of this woman. So Kūkahauʻula is embracing and placing his love like no other man could, as he loves Poliʻahu two times, everyday, *no na kau a kau*, forever and ever.

Referring to the *moʻolelo* she narrated, Ms. Keakealani listed the reasons why she is opposed to the proposed Project:

> These are the sorts of things in all the identity molecules I have in my body, that identify me and my people. If we still have these stories but no longer have the places, I would definitely say that a large part of that *mana* [power] is gone. But how much more wonderful for us, for all people—it doesn't just have to be the Hawaiian people—that not only do we have these stories, but we have the places too, they still can remain in existence. The story says *no na kau a kau*, when you translate that, that means, forever and ever.
>
> And I just think that, that Thirty Meter Telescope and all of those observatories up there have just overstepped the bounds of going into what is a sacred realm. I don't know how many people can go to the summit of Mauna a Wākea and not acknowledge that you are in a different realm. That truly is the realm of the goddess Poliʻahu and of all these other incredibly stronger forces above and beyond us as humans. And you know, in one way or another, you are so aware that you are in a different realm up there.

> At the same time, I honor science. My grandfather, my mom’s dad…he was a guided missile creator. My grandfather actually made and created…he was one of the top engineers for the Johns Hopkins Space Center, and on contract with NASA and all of the top, leading people in missile making. He made guided missiles, I cannot even imagine that. So I totally honor…I honor that learning and that teaching and all of that information that we can get from there, from that study and that discipline. But to me, the summit of Mauna a Wākea is almost off limits, it is. I don’t even know a better word, because I think the word “sacred” is kind of used, overused nowadays. But you go there, and you know, you just know.
>
> And for me, sometimes, I don’t know if you have interviewed Uncle Ed Stevens, but he does have an extreme love for Mauna a Wākea, and he is a person who is really linked to the other side as well. For me, it jolts my heart when he says stuff like, “Poli‘ahu is so sad because she feels everybody has forgotten her. And Līlīnoe is sad and Kūkahau‘ula is sad.” If you look at any map, these are all the names of those top *pu‘u* up there, the summit of Mauna a Wākea. You have Pu‘u Līlīnoe, Pu‘u Kukahau‘ula, Pu‘u Poli‘ahu. To have an elder be telling us these things, and I know he has a direct communication line—for me. I go back and I say, “Uncle, I haven’t forgotten. And I will tell these stories as long as I can, and let their stories be heard and known.” Hopefully, at least some of the people that hear their stories will become the storytellers and they will speak it and carry it when I am gone. And that is something I hope will never stop. A hundred fifty years from now, those stories are still heard, and said, and told, and felt and known.

Ultimately, Ms. Keakealani urged for the TMT Observatory Project to be located in Chile instead of Hawai‘i.

> My bottom line recommendation is to not have it [TMT telescope]. At the same time, there is a harsh reality for some reason that’s on my heart that says, if this already has been stamped with a seal of approval that this is going through…if we are there at that point and that is the game we are in—again that is just a reference because I know by no means is this a game—then what are ways…It’s beyond having the Hawaiian people recognized or heard or they sit on the board, that’s all wonderful and we need all these things, but then how true have the people, how much have they listened to us? If the majority of the testimony is “No, don’t put that TMT there,” and it still goes in anyway, did it just not matter that we all said “no, no?” What about the other site, is it Chile, that there was another potential site for the TMT to go? As far as I know, the people wanted it there. And the people are okay with having it there. If I am wrong, I so stand to be corrected. But as far as I know, it was all good to go on that other site. I would like to revisit that. If there is another option on the table, try to look at Chile than here, than our mountain.

7.10 George Van Gieson

CSH interviewed Mr. George Van Gieson by telephone on February 11, 2009. Mr. Van Gieson's father is a community activist Hobie Van Gieson and as a young boy, he became active along with his father in helping preserve Hawaiian culture. He is half-Hawaiian and currently works as the Fire Captain of the Volcano Fire Station as well as being the coach for Kamehameha Schools' air rifle girls' team. In 1976, he was one of the members of the non-profit Hōlua Project Information whose mission was to record and safeguard *hōlua* throughout Hawai‘i.

Mr. Van Gieson is quite familiar with Maunakea. At 5 years old, he accompanied his uncle, an avid bird hunter, and his aunt to spend all day on top of the mountain. He still regularly visits the mountain to direct firefighters in containing bush fires set to eradicate the invasive gorsebush:

> As a kid, I spent a lot of time on the mountain. There were no four-wheel drive cars up there, just military jeeps. My uncle lived on O‘ahu but came over the winter months for the bird season. We caught ring-necked pheasants [*Phasianus colchicus*], chukars [*Alectoris chukar*], and Japanese [*Coturnix japonica*] and Chinese painted quail [button quail, *Coturnix Chinensis*]. It was beautiful; a whole different world with snow and frost…peaceful and quiet.

When Mr. Van Gieson grew older, he became a bird hunter as well and he would take his own sons, Jonathan, 27, and Jonah, 23, up the mountain along with their friends:

> These were real special outings; the kids loved it away from traffic and buildings, a very special place on the island. A lot of times you were above the clouds and you could look at Maunakea, and sometimes Haleakalā. When you go hunting, you go before sunrise. So you have a view of the sunrise, absolutely outstanding.

He is aware of the cultural resources, beliefs and practices regarding Maunakea and its environs, including the practice of putting the *piko* of infants into Lake Waiau:

> When I was researching the *hōlua* sledding, we went to the adze quarry to see where it was made and what materials it was from. We also went to the lake, which was smaller than I thought. People said it had healing powers, so they went and got water from the lake. And people put the *piko* of babies into the lake…
>
> It was very sacred. People spoke of the lake with great reverence and the mountain in its entirety. It was a religious site for a lot of old people.

Mr. Van Gieson also discussed the Kumulipo, the creation chant of Hawaiians. "The mountain was the birthplace of the Hawaiian people. That was my understanding." He feels strongly that the TMT Observatory Project should not be put on the mountain, as it would definitely be an act akin to desecrating the Egyptian pyramids:

> I think it would be like putting an escalator on the pyramids. It would take away from it [Maunakea]. I hope they take the…[other telescopes] down when they are done with it.

Regarding the lease agreement University of Hawai'i has with the Board of Land and Natural Resources (BNLR), Mr. Van Gieson said:

> This whole thing where the university leases the land for $1, I don't see the benefits of what they are accomplishing. It just destroys the mountain. If this telescope is as powerful as they say it is, they could put it anywhere. If it's 10,000 feet, they could put it in California for that matter.

He questions the foundation that is responsible for constructing the telescope, stating:

> Something is not right. They are funded by a non-profit foundation, but that foundation expects to profit from their investment. What are the objectives of this TMT group? They are saying they are a non-profit, working with a couple of universities, funded by a school and this foundation.
>
> Do they expect to profit from their investment? If they generate income, why is it not going to the state? Why is the university leasing for a dollar? It's not up to the university anyway, it's up to DNLR. I don't like them; I don't trust these people; I don't believe that what they're doing offsets the damage they are doing to the mountain.

Mr. Van Gieson believes that such projects as the TMT Observatory Project will benefit only a few, and not the majority of the population. He thinks that the proposed Project will lead to further commercialization and to larger and larger telescopes, with no end in sight:

> I believe these astronomical projects are largely projects of the wealthy and they do not benefit the general public. At this point in time, there are countries selling tours into space. And that bothers me. Is this where this is going to go? What's going to be next? Germany has a 100-meter telescope. The TMT telescope is 30 meters and will they want to move to a 100-meter and get bigger and bigger?
>
> I know some people say it's good for university kids, good for the economy. I don't think we should sell our mountains for a couple of jobs.

CSH again phoned Mr. Van Gieson on March 20 to inquire if he had additional comments on the changes and the proposed TMT Observatory Project. Mr. Van Gieson began by emphasizing that before any project is done, there must be a study of the cause and effect. Stating that he was a paramedic for 18 years in the fire department, he noted that the training taught him and fellow paramedics not to administer a medication that would require another medication to counteract it:

> You have to think things out, look at the cause and effect at what you're doing before you do them. A lot of people have pet projects that they would like to see personally done, and they haven't looked at the cause and effect…I wish I knew more about what's going on, and what the benefits are of having all these telescopes and continually putting more and more. You would think at this age that they could share their information and not need to each have their own telescopes. I'm just wondering what the motives [are] behind having to have their

> own separate telescopes…It bothers me they are saying that it is so much more powerful [the TMT telescope], so if it is that much more powerful, why do they have to put it on the mountaintop? Why couldn't they put it in the middle of a desert somewhere? The Mojave Desert is over there on the mainland.

Acknowledging that he has heard that Chile is the other potential site for the proposed TMT Observatory Project, Mr. Van Gieson further explained his opposition to the telescope being in Hawaiʻi:

> I guess it's cleaner air, but it's almost like they are looking at Hawaiʻi as a place where they can build it, use the place…and leave a mess behind. Historically, they have done that. The sugar plantations have done that. They've come in, they've had their sugar business and when they left, they left a whole bunch of trash and junk behind. The exit strategy has got to be in there too, and it has to be set on a timeline that if they put the thing [telescope] up, it's going to have to be dismantled and everything put back the way it was. The major funding behind it is a private foundation. Even though they say which funds are from a university in Canada, and I think University of Southern California is the other university but there's $200 million that's been put in as seed money by a private foundation in San Francisco.

Mr. Van Gieson noted that it would be better if the proponents of the TMT Observatory Project would make an effort to disclose and reach out to the community about the findings of the telescope, something that astronomer Carl Sagan did. Stated Mr. Van Gieson: "He [Sagan] did a bunch of shows and expos…showing everybody what he was doing, the pictures he was taking and what he was finding. I thought that was great."

When CSH asked if this meant he would be supportive of the proposed TMT Observatory Project if it would do something similar, Mr. Van Gieson said the following:

> It seems like they came in and they did the Canada one and the Keck. Nobody knew exactly what was going on. The next thing you know NASA has a telescope up there. All of a sudden there was a bunch of telescopes and nobody knew exactly what they were doing.

He challenged CSH to ask any three people on the street what is happening on top of Maunakea and if they could explain the benefits of the telescope:

> Most people don't know, they don't understand…That's where the first telescopes were lacking. They weren't giving information as to what they were doing up there. The military has a whole bunch of stuff in, and nobody really knew what they were doing. The sugar plantations put out a whole bunch of pesticides and chemicals that they were using, which transferred to the ocean. People weren't sure unless they were working hands on what was going on. Then the telescopes came in and they were doing things and for years, nobody really knew what they were exactly doing and how it benefited people here. UH received a dollar a year from these telescopes. How does it benefit anybody?

As for the proposed changes in the Project description which involves the installation of an electrical transformer and the construction of a staging area to house both equipment and materials needed for the construction of the TMT Observatory Project, Mr. Van Gieson said:

> I've got to see more benefit for the people than a dollar a year, and I've got to see an exit plan where they take everything with them. And a limited time for them to be there. I drive home every morning and I see six telescopes up there from my road. And I'm thinking why do they have to be there? What's going on and how is it benefiting us? How many of our kids are going into astronomy? What is the intent there?

Mr. Van Gieson compared the installation of the TMT Observatory Project on the mountain to other ventures, such as volcano monitoring, to underscore what he believes is the not-so-clear picture as to why such things are needed:

> A lot of the science thing now is very political. There's a $140 million in Obama's plan for volcano monitoring. What I hear from volcanologists is "there hasn't been a large eruption recently and we can't tell you when and we can't tell you where but there will be large eruption." For me, that's a real stupid thing to do, we all know that. You can apply that to hurricanes, tsunamis, and asteroids striking the earth. In terms of volcanologists, they're all crawling around on the field and taking extreme risks, and if and when they get into trouble, guess who has to get out and get them? Our fire dept. has to go and get them. I don't know what benefit they are getting from walking around active lava flows. A lot of college kids come in because they're all into volcanology and stuff and it's hard for me to see what they are learning out there. We know it's hot, we know it smells bad and they shouldn't be allowed near it. We can't tell when the next eruption is coming and we can't tell where it is going to come. So don't put our firefighters in danger by putting yourself out there where you may get into trouble and we have to go and get you…

According to Mr. Van Gieson, in the end, it is not clear how or what benefits the general public is receiving from such projects as the TMT Observatory Project. "The amount of effort and money invested…it seems to benefit the scientific community, but what do they do with all that?"

7.11 Mr. Isaac Harp

Mr. Isaac Harp was born 50 years ago in New Orleans. His father was of Native American Cherokee and Irish descent, who met his mother Agnes Puakalehua Nihi-Harp, a pure Hawaiian, in Honolulu while he was stationed in the Navy. In 1963, the young Harp arrived in Hawai'i. Mr. Harp was involved in commercial fishing from the mid-1980s to the mid-1990s, and he is knowledgeable about traditional fishing practices, thanks in part from knowledge shared by many of his relatives, including Uncle Val Ako. Mr. Harp married his wife Tammy on Kamehameha Day 21 years ago. He has five children: Isaac "Ikey" Chun, 36; stepson Chad Neizman, 30; Samson Harp, 27; Jacob Harp, 20; and Cherish Harp, 19. Mr. Harp remains active in the community and is a Hawaiian cultural practitioner. On January 17, 2009, Mr. Harp shared the following statement via email to CSH.

> In regards to your inquiry for consultation with Native Hawaiians on the proposed Thirty Meter Telescope, please see the attached Resolution from Na Kupuna O Moku O Keawe adopted November 15, 2008 (see Appendix D). The resolution reflects my sentiment as well as the sentiment of other members of Na Kupuna O Moku O Keawe, elder representatives of descendants of Hawaiian Kingdom nationals residing on the island of Hawai‘i.
>
> Under International Laws of Occupation, when a sovereign nation such as Hawai‘i is lawfully or unlawfully occupied by a foreign nation such as the United States, the occupying nation must apply the laws of the occupied nation rather than fabricating their own laws and applying their fabricated laws within the occupied nation.
>
> In relation to the statement above, under International Laws of Occupation, when the governing body of an occupied nation is absent, the elders of the citizenry of the occupied nation represent the lawful authority of governance.
>
> It is well-known and documented that the United States' Newlands Resolution approved by a simple majority of the United States Congress on July 4, 1898 and signed on July 7 by President of the United States William McKinley, purporting to annex Hawai‘i to the United States, was an illegitimate action having no basis in law beyond the borders of the United States.
>
> Additionally, it is well-documented that the large majority of the citizenry of the sovereign Hawaiian Kingdom opposed the United States' desire to annex Hawai‘i as witnessed in several anti-annexation petitions that were submitted to the United States Congress. The anti-annexation petitions clearly blocked any annexation attempt by the United States to annex Hawai‘i. Regardless of the fact, the United States Congress selected to ignore the will of the citizenry of the Hawaiian Kingdom by proceeding with their unlawful attempt to annex Hawai‘i with no Treaty of Annexation. Clearly, there was never a lawful United States annexation of Hawai‘i.
>
> Finally, in 1959 there was a pathetic and unlawful attempt by the United States Congress to establish Hawai‘i as the 50th state of the United States. The statehood ballot that was created for this charade was illegitimate at first because the only choice was statehood, and secondly because United States citizens living in Hawai‘i and United States military personnel stationed in Hawai‘i were allowed to participate in the 1959 vote, which thrice invalidates the statehood process.
>
> Therefore, lacking the support of the lawful governing body, Na Kupuna O Moku O Keawe, the proposal to construct a Thirty Meter Telescope on the Sacred Kanaka Maoli Temple known as Mauna Kea should be gracefully and

> quietly withdrawn. Na Kupuna O Moku O Keawe further suggests that telescope proponents read the attached resolution (See Appendix D) to gain an increased understanding of why Na Kupuna O Moku O Keawe has taken the position that is expressed in the resolution.

In response to the proposed changes in the Project description involving the electrical transformer and construction of the staging area, Mr. Harp provided the following statement to CSH via email on March 23, 2008:

> It appears that the proponents of the proposed Thirty Meter Telescope Observatory Project (TMT) had planned their release of information for their proposed TMT in segments rather than in its entirety in an attempt to minimize the appearance of the full impacts that would occur by their proposed project. All aspects of the TMT proposal, including supporting utilities, supporting areas, supporting structures, and supporting activities on our sacred mauna must be disclosed and viewed in its entirety from a cumulative perspective rather than from a fractionalized section-by-section viewpoint. This intentional practice of deception is nothing new to the people of Hawaiʻi when it comes to the University of Hawaiʻi, in particular their Institute for Astronomy and their astronomy partners. The people of Hawaiʻi have been lied to time and time again by the University of Hawaiʻi in their quest for world fame to attract prestige and funding from the international community.
>
> The greed of the University of Hawaiʻi is insatiable and this appetite is an ongoing threat for all of Hawaiʻi and its people regardless of race. Why would the Research Corporation of the University of Hawaiʻi voluntarily conduct research activities to enhance the killing power of the war machine of the United States government? What would drive what is supposedly an educational institution to conduct experiments on chemicals and biological agents of warfare? The answer is quite clear: the University of Hawaiʻi would do whatever it takes to boost their incoming funding regardless of the source, and boost themselves into the international spotlight regardless of the risks or consequences placed on Hawaiʻi and its people.
>
> The University of Hawaiʻi has supported and continues to support the unlimited desecration of more and more of our sacred and religious sites on Haleakala and Mauna Kea to quench their yearning for recognition by the international astronomy community. Astronomy interests from around the world have come to Hawaiʻi by invitation from the University of Hawaiʻi to forever destroy sacred and religious sites, and volcanic landscapes that can never be replaced. To allow and even support such destruction to quench a curiosity for knowledge about the universe is unforgivable.
>
> Hypocrites within the University of Hawaiʻi Institute for Astronomy have continually abused the host culture by ignoring expressed spiritual and religious concerns, then they selectively use the host culture to falsely portray themselves

as sensitive to the host culture as witnessed on their website http://www.ifa.hawaii.edu/haleakala/cultural/, which is related to the Haleakala observatories. Here they use parts of the maoli kumulipo and go so far as to include on their website:

"Hawaiian Protocol for Sacred Places:

E Ui No Ka Ae

Ask Permission,

E Mahalo Aku

Give Thanks,

E Komo Me ka Hoano

Enter With Reverence,

I Ka hele aku, e hoomaamau i ka wahi!

When you leave, return it as you found it!"

Hawaiʻi's sacred and religious sites that have been desecrated and destroyed in the name of astronomy can never be returned to how they were before the astronomy community took aim at them.

Who owns Haleakala and Mauna Kea? It is well-documented and widely recognized that the lands astronomy facilities in Hawaiʻi occupy are not owned by the State of Hawaiʻi, who are merely custodians of the land under the belligerent United States occupation of Hawaiʻi. As custodians of these lands, the State of Hawaiʻi is responsible for insuring that these lands are preserved unmolested for the eventual return to the rightful claimants, descendants of Hawaiʻi nationals regardless of race.

Although the State of Hawaiʻi and the Federal government of the United States pretend that these lands were ceded by the Republic of Hawaiʻi to the United States, who ceded these lands to the State of Hawaiʻi, the charade has been exposed as a farce. The self-proclaimed Republic of Hawaiʻi had no authority to cede anything to the United States; therefore, the United States had nothing to cede to the State of Hawaiʻi .

By this testimony, I hereby charge the State of Hawaiʻi, as custodians of these sacred and religious sites, with gross negligence and intentional mismanagement of these sites. By allowing the University of Hawaiʻi and their global astronomy partners to desecrate and destroy these sacred and religious sites to build their telescopes and supporting utilities and facilities, the State of Hawaiʻi is guilty of the acts of intentional desecration and destruction of sacred and religious sites of Hawaiʻi .

Therefore, I demand of the State of Hawaiʻi, the University of Hawaiʻi, and all nations

with astronomy facilities upon Hawaiʻi's sacred Haleakala and Mauna Kea to remove all evidence of your presence from our sacred sites, and to repair to the fullest extent possible the original condition of these sites as they were before "...you found it!"

There is also the matter of restitution to the many concerned who have worked hours, days, weeks, months, years, and in some cases, decades on efforts to prevent the desecration and destruction inflicted on our sacred mauna by astronomy interests. Perhaps the State of Hawaiʻi could acquire a few billion dollars from the congressionally approved economic stimulus package to provide restitution to these concerned individuals, groups, organizations, and cultural practitioners.

Finally, there is no restitution that can heal the decades of pain felt by thousands of Hawaiʻi ʻs people, pain that was caused by the actions of insensitive foreigners. The best remedial action that can be taken is for the offenders to clean up their messes, restore to the fullest extent possible the sites that have been desecrated or destroyed, and pack up and go home to their ancestral lands and do what they will there.

On April 3, 2009, Mr. Harp added the following cultural concerns via email:

Besides what I have already shared with you, my "cultural concerns" regarding Mauna Kea astronomy development includes fear of unintentional disturbance of kahiko burials on Mauna Kea, some of which are hundreds of years old or older. Many of these are burials of persons from the highest ranks of maoli society whose iwi (bones) were carried to Mauna Kea from all corners of Hawaii for interment on the summit, the realm of Wakea and Papa.

Were excavations for existing astronomy facilities, roads, utilities, etc. overseen by cultural monitors? If not, perhaps iwi, moe pu [*lit*., 'to put to sleep with', referring to artifacts placed with the dead], and cultural artifacts have already been disturbed by previous astronomy related development and gone unreported.

I am concerned that the many toxic chemicals used by and the sewage produced by the astronomy industry have the potential of polluting of the sacred healing wai (waters) of Waiau. My concern also extends to the health and safety of the wai from our aquifer that maoli and non-maoli alike depend on for life. Perhaps the wai has already been polluted. Was a baseline study of the wai of Waiau and of the aquifer been conducted prior to astronomy development?

> The wekiu is almost gone and further disturbance of their habitat could eliminate them altogether. Who is responsible for this, and what is the plan for wekiu population recovery?
>
> I am concerned that there may be further desecration of this sacred site from continued astronomy development. How does one go about stopping the destruction of one's place of worship? Would the astronomy industry build facilities on sites of religious importance to their culture?
>
> I am concerned that the astronomy industry is robbing maoli, and non-maoli who respect maoli culture, of their enjoyment of life. In what seems like a never ending cycle, we must put our lives aside to defend and protect our sacred mauna. When will it end...

7.12 Kelly Greenwell

CSH interviewed Mr. Kelly Greenwell on December 10, 2008. He belongs to the fourth generation of the Greenwell family who has been involved in agriculture and ranching since the 1840s. His great-grandfather was William Henry Greenwell, who was the father of Frank Greenwell, the founder and owner of Palani Ranch. Frank Greenwell's son Robert was also a well-known *paniolo* and the father of Kelly Greenwell.

Recently elected as a member of Hawaiʻi County Council, Mr. Greenwell has been active in the community for the last 30 years. Along with Louie Kahanamoku, Herb Kane, Stan Zurin, and Mary Jane Kahanamoku, Mr. Greenwell helped established the Keauhou Canoe club. He also co-founded several other parks, including the Old Airport Park with Mrs. Kunitake. He is a member of the Kona Young Farmers, a well-respected organization whose members are long-time residents and farmers of Kailua-Kona.

Mr. Greenwell considers the TMT Observatory Project as an important project that would bring back the cultural importance of consulting the heavens. He stated:

> If you were to look back 500 years, and if you were to look at the …lifestyle and beliefs of people who lived here then, and realize that it was tied in to what we call science today, tied to how you ran your life and how you ran your society, the most important element in their belief system is the heavens…They are able to find direction in something that is constant. Something constant is all important and the heavens are a constant. So they used it as a tool of discovery. It's not only [Hawaiians] that did this, almost all ancient people did it. If you were then able to have a tool that allowed you to see the heavens in a much more advantaged way, a telescope for instance, that can actually look at what you're looking at, see what you're looking at, it would be hugely embraced. It wouldn't be thought of as a bad thing; it would be thought of as a miracle almost…
>
> If you move forward today, what's happened to that whole cultural process is that it's been lost in the day-to-day way people ran their lives; it's no longer significant what the heavens are doing because we have other means of predicting

> the future. So the heavens have lost their import, so they're fading from the cultural processes. There's not the same degree of respect, there's not the same degree of wonder.

He noted that Hawaiians in the past would have supported a project such as a telescope which could provide a window to peer into the heavens.

> I think [Hawaiians] were a much more fluid people…Consequently; we have the same similarities in language all over the Pacific because they interacted with each other to a much greater degree. Therefore, from a navigational standpoint, the heavens were so important to them. They had to know what it was. If they had a tool that would make that more doable, it would be celebrated, rather than rejected.

Pointing to the flexible nature of Hawaiian culture, Mr. Greenwell cited the history of Hawaiʻi when Captain Vancouver showed up with guns and cannons that were integrated into Hawaiian culture, the same as when Christianity was introduced. He stressed that it is the fluid Hawaiian cultural process that needs to be preserved, not just the artifacts.

> If you go back and say we want to be culturally responsible at what we're doing in Maunakea, what you really want to revere, respect, preserve is the process, not the artifact. The artifact may give an indication of what went on, but it's not what went on. It's a tool, a guide.

In the example of Hōkūliʻa, a private residential development in Kona, stones that have been moved are being given undue attention, according to Mr. Greenwell. The focus must instead return to the Hawaiian cultural process, and what the culture can offer the world.

> Somebody picked up those stones and moved them. Yes, it is an artifact because it can demonstrate somebody was there and picked up the stuff. But is it meaningful and worth saving? Or is it an insult to the people that you're saying these people aspired to piling three stones on top of each other? What you want to do is to focus on who were these people and what it is they had that we need today to save the world. Hawaiian culture is so vitally important because it's different. It's different because of the fact that it's accepting, it's innovative, it's imaginative, and it accepts other things from other cultures and other happenstance. They take advantage of [it]…You couldn't survive if they didn't include into what they were doing, opportunity. And this telescope thing is an opportunity. It's an opportunity to see the heavens more clearly, more succinctly in a way so they can understand why the moon goes around one speed and why the stars go around another. You don't say, "Over here, we only use spears, we only use that kind of stuff." That's where we're going right now. That's very European, that's very American. "We have our way of doing this and we don't want to be disturbed." That's totally and completely opposite from what the Polynesian culture, Hawaiian culture was all about.

Mindful of the past issues and projects that have led some in the community to object against the treatment that Maunakea has been subjected to, Mr. Greenwell emphasized that the right attitude of respect needs to be present. There has to be a willingness to listen from both sides.

> If they went in there with a degree of respect and understanding for those issues…it's like building any temple, you have to bless the land that's its built on. You cannot violate the land that the temple is built on. These stargazers, if you will, are akin to a series of temples. And they have to be appreciated as such, and all that's involved in creating them has to be appreciated. But it's not an issue of "no, we're not going to do this." It's an issue of who we're doing it for, and why we are doing it. Who we're doing it for is very important…When it comes to actually sitting down, and deciding how we are going to build these structures on this mountain, the attitude has to be "we want to listen." And that is said from both parts. It's not just the people who are speaking who have a future up there…we're going to have to think for everybody. It's a big responsibility.

Mr. Greenwell believes that the Project's importance is not limited to the here and now, but it is eventually tied to the future of the planet.

> Why is it important to look at the stars? What are the opportunities that this presents to the future? What's the responsibility of the Hawaiian culture? Is it just going to become a list of artifacts, which is where it is headed right now? Artifacts are fine for museums, but the future is where the next generation of humanity is going to reside. And it's not just our kids and the Hawaiian kids, it's everybody's kids. What's the role of Hawaiiana going to be? What's its future? What's the future of this planet? I'm extremely strong believer that if the concepts of the Hawaiian culture are not re-activated, then this place is going to fall apart. I just don't mean Hawaiʻi, but the whole planet. There's too much antiquated religious thought that is dictating what is going on in the world today…

For Mr. Greenwell, what is needed is a process that will respect what the community wants but at the same time, enable the continuance of projects that are needed. He pointed to a current highway project as an example.

> We're having a problem now with the highway. We can't move a couple of graves so the highway has to go around it. And I don't know whose graves those are. I don't know if the circumstances of them being buried there are for, and I don't know if anybody does. But I do know that there is a distinct need that we have a highway system for the future. And there's also a distinct need to have a responsible process put in place for when this occurs, that's in compliance with everybody who is involved. Can this be done? And the answer is yes, it has to be. Otherwise, everything just stops. And that's where we are right now. We're at the place where everything is stopped.

As a young man who was born and raised in Kailua-Kona, Mr. Greenwell could remember the changes that occurred after World War II, and how life had to change.

> Hawai'i has to be part of the future rather than defending its position in the past. Things will change…I can remember going places and having to pack the mules. And then you got a hold of an old jeep and that was revolutionary. You can go up the mountain with a load of whatever, and you couldn't do that in the past. You'd have to go on horseback. You'd figure in Thomas Jefferson's time, the fastest thing at the time as 3½ miles per hour. That was a horse. Compare that with going to the moon, in a relatively short amount of time…We're thinking about building all of those new highways. I would venture to say that in 50 years, we won't be using any cars. The technology would have evolved, so that you could either get your body from place-to-place or at least get your message from place-to-place without having to go there. It's like we are going to spend $150 million dollars right now to build this West Hawai'i Civic government office. There isn't a thing that goes on in government that can't be done with a fax machine…and a computer.

Mr. Greenwell considers the government office building project as an unnecessary, expensive one because nothing physical is taking place except the distribution of license plates. His mission as a county council member is to look for sources of funding for community projects that are worthy of being funded.

> I'm right now looking at how we can get two to three billion dollars from the Federal fund monies. There's three hundred billion dollars allocated for things happening in the farm industry. Three hundred billion! That's a lot of money. But [it] is a lot of tools, a lot of enabling. You have to view money in a different way. Money is not a sign of wealth. It's a process of getting to wealth.

The building of the TMT Observatory Project is a worthy project than the building of a civic center, Mr. Greenwell stated. Instead of a civic center, it would make better sense to build a hospital.

> It's just a matter of priorities. Is the telescope center a matter of priority? I believe it's more than a priority; it's an essential element to establishing a cultural tie to who Hawaiians were 500 years ago. In a very real way, it's a living artifact.

He called for a process of constructing the telescope that would respect the aesthetics of the mountain. One way that could be done is to not paint it white and to bring it down to a lower level. Respect needs to be woven all throughout the process of building the telescope.

> I want to see it built…to see some respect for what is [being] built. I don't think it needs to impact the aesthetics of the mountain itself…To me…respect for nature is not to deface it. You can enhance it, but not deface it…When it comes to the bottom line, the only thing that really counts is that it is done in an appropriate manner, the alternative of that is inappropriate and this is not religious or any other than mechanical. What I have against windmills, they're ugly and I don't like them whirling about. It's the same as solar panels, if we can come up with a way that's not obtrusive, then I might warm up for it.

To get a clear understanding of how the community will respond to the TMT Observatory Project, Mr. Greenwell recommended that CSH speak to everyday, ordinary people. Also, he stressed the importance of making decisions with the future in mind.

> We're making decisions based on a very limited vision and it's most important to know what that vision is. We don't spend enough time researching answers for the future. I think that's our biggest problem.
>
> I like to think in terms of 1,000 to 10,000 years from now. We may not be physically here anymore, but there will be a planet here. It's so hard to let go of a little fingernail hold of what we think of as forever…Something like the telescope to broaden our view of the future rather than remembrance of the past cannot be set aside. We have to know as best as we can what's in the future. In the same way, why it's important to know what's in the past.

The grievances that people have about past projects and events on Maunakea do not have to be repeated with this new project, said Mr. Greenwell. He understands, however, why some people are against it.

> One of the things that we have to remember is that the mountain belonged to the old ancient Hawaiian culture. But now it belongs to the living, it belongs to the future. The mountain itself does not care who it belongs to. The concept is almost foreign to those claiming ownership. If the mountain does not belong to anybody, the mountain has a future just as much as it has a past. There's a way to build a relationship and it's going to come out of the culture of this place but has to be respected by people coming here. And that's what it boils down to. You are moving into an environment that's been fortified by a lot of grief, a grief that has come from theft. And this is an opportunity to show it doesn't have to be that way.

CSH sent revised Project changes on February 2, 2009. On March 25, Mr. Greenwell called CSH and stated the following regarding the Project changes:

> Frankly, I don't know if there is anything that we can do. We're going to have to have support facilities. I don't see a problem there, other than to say I'm hoping that whatever is envisioned is what we have already discussed.

7.13 Daniel Akaka, Jr.

CSH met with Mr. Akaka Jr. on Feb. 24, 2009. Mr. Akaka Jr. is the Director of Cultural Affairs at Mauna Lani. A *kahu* (minister, guardian) and historian, Mr. Akaka Jr. is also a Hawaiian cultural practitioner and active in the community. Born and raised in Nuʻuanu and Pauoa Valleys, Mr. Akaka Jr. is the son of U.S. Sen. Daniel Akaka. In 1995, he participated in Hōkūleʻa's voyage to the Pacific Northwest and in 1999; he traveled to Mangareva (French Polynesia) as the voyaging canoe's protocol officer. Last year, Mr. Akaka Jr. also traveled to

Japan on the Hōkūle‘a. He and his wife, Anna, have five children. They are Kaleihikina, Kahikina, Kapihenui, Kalā, and Keānuenueola‘akea.

Familiar with the cultural history of Maunakea, he related one of the most well-known *mo‘olelo* which pits Poli‘ahu, goddess of the snow, against Pele, goddess of fire:

> You know Maunakea is known for its snow. And the goddess of the snow is Poli‘ahu. And the most well-known of the stories of Poli‘ahu is a battle between two physical forces, fire and ice: Pele representing the fire, Poli‘ahu representing the ice and snow. In this *mo‘olelo*, this story, there was a chief from the island of Kaua‘i, ‘Aiwohikupua, who was betrothed to the legendary Lā‘ieikawai of this island. So he prepared his voyage, his journey to meet his fiancée on this island on Hawai‘i. But on this journey, he went to the island of Maui and he was enchanted by this very beautiful woman riding the surf. Because of this mutual interest, they both consented to having an affair while on Maui. Following this brief interlude, he left Maui to seek out Lā‘ieikawai here on the island of Hawai‘i.
>
> But as he approached the island of Hawai‘i and gazed at the beauty of Maunakea, he saw the beauty of Poli‘ahu in the mantle of white snow. And he fell in love with Poli‘ahu. They immediately connected with each other. And ‘Aiwohikupua took Poli‘ahu back to the island of Kaua‘i where he was from. He prepared for marriage and little did the chief ‘Aiwohikupua know that the surfer girl he had the affair with on Maui was none other than Pele in the guise of a beautiful woman. And so Pele, jealous [of] the relationship of ‘Aiwohikupua and Poli‘ahu, intervened and broke up their ceremony of betrothal on the island of Kaua‘i. The two forces of nature, Pele and Poli‘ahu, returned to the island of Hawai‘i to battle on the great mountain of Maunakea.
>
> It was a great battle. Pele would cause Maunakea to erupt, Poli‘ahu would release her snows and at one point in time, Pele seemed to be winning the battle as the snows would be melted by the fires. But then, Poli‘ahu with renewed strength caused a great snowfall that covered the mountain and covered the lava and solidified it. So Poli‘ahu won that battle. Pele took leave of Maunakea and the relationship that she had with the fickle young chief ‘Aiwohikupua, who left empty-handed. And because of that Poli‘ahu reigns over Maunakea. Maunakea’s never erupted since that battle, not until Pele tries to take over the mountain again. Pele moved over to Mauna Loa and Kilauea where she activates the mountains on occasion. That’s the story of these two eternal opposites of nature, Pele and Poli‘ahu.

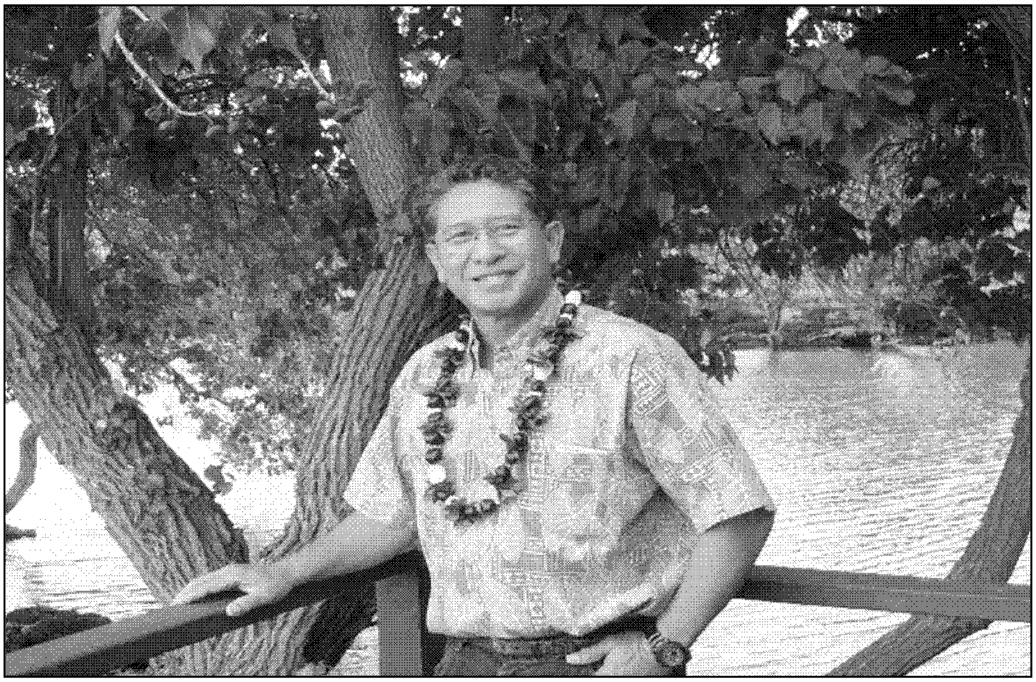

Figure 25. Mr. Danny Akaka Jr. stands in front of one of Mauna Lani's fishponds.

When asked about his *manaʻo* regarding the proposed TMT Observatory Project on Maunakea, he stated the following:

> I'd like to first of all say that education is primary to the future of not only Hawaiʻi and the Hawaiian people and the rest of the community, but to the nation and the world. Education comes in many forms. So we have to constantly educate ourselves, always knowing that we're not always educators, but many times…students. We get our education passed from what we've learned at home and at school. Things that were passed on from our *kūpuna* as a foundation of the things that we need to carry with us into the 21st century and beyond that even with the new technology knowing that modern technology can be very beneficial.
>
> We also need to be aware of the cultural foundation as well and to find a sense of balance and harmony in that. For our ancestors were very innovative, creative and resourceful, and if they had things like this, they would've used it. They were scientists in their own right. They looked at the night sky to use that knowledge to create star paths so they could travel to places where their ancestors came from. So they understood the world that surrounded them through their vast knowledge of the night sky, the many different stars, the moon and the sun. These things are all part of a great creation that was created by God, the Great Spirit who is known as ʻI or ʻIo. And then everything that surrounds man, all things of nature come through this Creator.
>
> So with that understanding, I always like to try to look through the eyes of the ancients to see what is best, what is best for our community, for our children, and

> the children of the future. Whatever we teach them, whatever we pass on to them will affect their decisions, which may affect the whole world and the universe.

In response to the question whether he has any concerns about cultural practices that may be affected by the proposed Project, Mr. Akaka Jr. said:

> It has to work in harmony with practitioners. That's the way it will work best. It is through the knowledge of the practitioner that can help the astronomers as far as how to do things up there, how to take care of the place, their understanding and connection with nature and that you have to become a part of the place. You can't just come up and feel that this is a place you can desecrate or trash out. It's a very sacred place. The mountain top is the highest physical point that a man can achieve. Maunakea is the highest mountain on earth. So, the Hawaiian at the summit of Maunakea reached his highest physical achievement for man. Beyond that is the spiritual aspect, the heavens.
>
> We need to instill that understanding to people who are going to be up there and who are going to work there. They need to have respect for this very sacred place. It's kind of like working on the grounds of a church, you don't want to be *kāpulu* [careless, slipshod, untidy, disgusting], you don't want to desecrate it. Maunakea is also a resting place for many of the ancients. So it's a very hallowed, very sacred place. So anything that is constructed up there not only has to fit into the nature of the mountain, but it has to be something that can also compliment Maunakea. One needs to understand that it's a place that at one time, not all Hawaiians were privileged to go to because it was the abode of the gods and a place that was greatly respected.
>
> The future of Maunakea is that yes, it can serve as an educational center and a place for man to view the stars and the universe but it has to remain a sacred and holy place. It's like stepping into a sanctuary, a very sacred place of peace, a place that one can learn the things beyond what man knows now. There are many secrets, some of which the ancients knew but was never all passed down. So it needs to be a blend of the ancient knowledge and modern knowledge and it needs to be treated as a church would be treated, as a sanctuary.

As for other concerns, Mr. Akaka Jr. stated:

> When you look at the mountain now, you see all these different observatories which kind of detract from the sacredness of the mountain. And if we truly feel this knowledge that we gain from learning about the universe, from the heavens will be one that's beneficial to the world, then all the nations need to work together, need to unite to have one observatory that will represent the world and one that everyone can use. And all of the other observatories should be removed. But it should be a united effort between all the nations. All nations should work together, not in separate facilities, but all in One [Mr. Akaka emphasized that the word "One" should be capitalized]. And maybe this is the theme that all nations should work together in harmony and unite as one.

Section 8 Cultural Landscape of Maunakea

8.1 Overview

Discussions of specific aspects of traditional Hawaiian culture as they may relate to the Project area are presented below. This section examines cultural resources and practices identified within or in proximity to the subject Project area in the broader context of the encompassing Kaʻohe Ahupuaʻa landscape and the summit of Maunakea. It also provides a sense of the cultural attachment that Native Hawaiians have for Mauna Kea. As defined above by Maly, "Cultural attachment is demonstrated in the intimate relationship (developed over generations of experiences) that people of a particular culture share with their landscape – for example, the geographic features, natural phenomena and resources, and traditional sites etc., that make up their surroundings. This attachment to environment bears direct relationship to beliefs, practices, cultural evolution, and identity of a people" (Maly 1999:27). Excerpts from talk story sessions from past and the present cultural studies are incorporated throughout this section where applicable. *Please note that parts of this section are still and draft form and will be revised for the final CIA report.*

8.1.1 Gathering and Hunting Practices

Maunakea's unique geographic features and relative isolation have combined to make it a place of special resources that have long attracted Native Hawaiians and other *kamaʻāina* seeking to partake of its abundance. For example, both traditional and archaeological evidence illustrate that there are numerous *ana* and *lua kā koʻi* (caves and quarries from which stone was harvested for making tools) (see Maly 2005) where Kānaka Maoli have gathered stone for their tools. Perhaps the most well-known is the Mauna Kea Adze Quarry, also known as Ke-ana-kākoʻi, "the adze-making cave" (Pukui et al 1974:103). Recognized on both the State and National Register of Historic Places, the basalt found between approximately 11,000 and 12,400 feet elevation on Maunakea is reputed to be among the finest. At 4,800 acres, the quarry itself is one of the largest of its kind in the world, certainly in Polynesia (also see Kirch 1985: 179-180; Langlas et al. 1999; McEldowney 1982: A8-A9).

Speaking about the adze quarry, community contact Mr. Leningrad Elarionoff noted:

> The rock piles are taller than these trees. There were five [of those piles] with hundreds of adzes in various stages of completion just lying around…The amount of rock chips was amazing. If they brought the rocks down here to the warm area to work on it, it wouldn't chip. It couldn't. Basalt is hard and in the cold, it gets really brittle. So that's the most productive place to chip and rough shape it...

Some rock shelters, including one at Hopukani Spring (10,400 foot elevation), the Hopukani Rockshelter (10,160 foot elevation) and an open camp site at Liloe Spring (8,921 foot elevation) bear witness to the traditional use of such camps for procuring water, food (primarily birds) and fuel, besides being used for acclimatization (see McCoy 1986). Bird walls or bird hunting blinds have been documented by Maly and Maly (2005) as existing "in the form of single, double or tri-sided stone walls" which are meant to keep the hunter hidden from the birds (also see McEldowney 1986 and Langlas et al 1999, for more accounts of bird hunting).

Mr. George Van Gieson, a participant in this CIA, confirmed the cultural practice of hunting birds on Maunakea. At 5 years old, he accompanied his uncle, an avid bird hunter, and his aunt to spend all day on top of the mountain. He still regularly visits the mountain to hunt for birds as well as to direct firefighters in containing bush fires set to eradicate the invasive gorsebush:

> As a kid, I spent a lot of time on the mountain. There were no four-wheel drive cars up there; just military jeeps. My uncle lived on O'ahu but came over the winter months for the bird season. We caught ring-necked pheasants (*Phasianus colchicus*), chukars (*Alectoris chukar*), and Japanese (*Coturnix japonica)* and Chinese painted quail (*button quail, Coturnix Chinensis*). It was beautiful; a whole different world with snow and frost…peaceful and quiet (see section 7 for full interview).

Another participant, Ms. Kealoha Piscotta, mentions the '*ua'u*, "the dark rump petrel, a bird. It is a high altitude bird that flies hundreds of miles out to sea to feed and then comes back to Maunakea to nest…The '*ua'u* were reserved for the *ali'i* to eat and there are many remains found of the '*ua'u*" (see section 7 for full interview). Birds were also caught for their feathers, in particular, the *o'o*, whose feathers were valuable (Foster 1893: 456). Historically, some cattle hunting and sheep hunting were also done, but at lower elevations such as 5,000 feet (Langlas et al. 1999).

Because the vegetation at the summit of Mauna Kea is almost non-existent with the exception of small lichens and moss, gathering of plants did not appear to be as prevalent as bird-hunting or the use of basalt for tools. The Alpine Scrub Zone which ends about 11,300 feet elevation is the highest major vegetation zone, with the tree line occurring at around 9,000 feet. Plant life is more abundant around the Hale Pōhaku Project area including endemic *māmane* (*Sophora chrysophylla*), *pūkiawe* (*Leptecophylla tameiameiae*) and the endangered endemic, *ahinahina*, also known as Maunakea silversword (*Argyroxiphium sandwicense*). The gathering of fuel on Maunakea (i.e *māmane*) was noted (McCoy 1986) as was the acquisition of hardwoods and sandalwood in the region (McEldowney 1982: A-8, A-9).

Ms. Piscotta stressed that the tree line is critical as it is home to native bird species, including the Hawaiian owl (*Asio flammeus*), the *palila* (native honey creeper, *Loxioides bailleui*) and the *'io* (endemic Hawiian hawk, *Buteo solitarius*)

8.1.2 Freshwater and Marine Resources

Maunakea is a major aquifer for Hawai'i Island. It represents the integrated system of Hawaiian culture where the surrounding environment is connected to people, as evidenced by the mountain's role in providing the life-giving waters known as "Kaneawaiola" due to its ability to stop the rainclouds (see OHA statement in section 6.2). Kāne and Kanaloa are said to meet in Maunakea, with water from Maunakea being collected in the ocean (see Kealoha Piscotta interview in section 7above).

Stated participant Mr. Kalikokalehua Vernon Kanaele: "The mountain is a great filtering system; inside of it has a hose that represents rivers underneath and on top. The melted ice and rain, all that seeps right into the aquifers and then down to the rest of the *'āina*" (see section 7 for interview). Other community participants such as Mr. Isaac Harp and Ms. Kealoha Piscotta also emphasized Maunakea's role as an aquifer.

The mountain is home to the highest permanent alpine lake, Lake Waiau, which contains melted glacial water. Community contact Arthur Mahi noted that Lake Waiau is a pristine alpine lake that was reserved for the *ali‘i* and is now being used by people who wrongly believe that it is for healing and cleansing. He stated the lake should be kept free from contamination as it is a source of pure drinking water:

> Cleansing is only for *ali‘i nui*, not for anybody cleansing. No healing the water will bring them. It only dirties the water. We know when people use the lake to clean themselves. It's not good because it's people's water. The water goes down to the ocean, and it is clean water. All the mountains water comes from up there (see section 7 for full interview).

The use of Lake Waiau for drinking water was discussed by CIA participant Mr. Leningrad Elarionoff, who recalled drinking its clear but "cold,cold, cold" fresh water as a young child (see section 7). He stressed that it was forbidden to step into the lake or swim in it, due to its cold temperature and "out of respect for the lake and future explorers who utilize the lake as a resource for drinking water."

Considered sacred by Hawaiians, Lake Waiau is reputed to hold special healing properties according to community contact Mr. Isaac Harp. Water from the lake is collected by visitors and hunters who bring it to their families to "drink for good health" (Nā Maka o ka ‘Āina 2008) as the water is believed to be the sacred water of Kāne or "*ka wai kapu o Kāne*" (Maly and Maly 2005 A-3). Ms. Piscotta noted that Queen Emma bathed in the lake to purify herself (*hi‘u wai)* "before her election and to demonstrate her worthiness and *mo‘okū‘auhau* or genealogy" (see section 7 Kealoha Piscotta interview; also see Nā Maka o ka ‘Āina 2008).

For Ms. Piscotta, Lake Waiau also marks time, seasons and the constellations which are reflected in its waters.

> The lake is a significant site because it is like a *wai ea* [*Lit.*, aerated water, water used for purification], which was significant for marking time, seasons, even a mirror to the stars above.

The waters of the lake also was also used to as a receptacle for the *piko* (umbilical cord) of newborns, as it assured "long life and safety" (Maly and Maly 2005: A-3). Cultural contacts Mr. Van Gieson and Mr. Kimo Keali‘i Pihana discussed the practice (also see Nā Maka o ka ‘Āina 2008). Said Mr. Pihana:

> The placing of the human piko or umbilical cord, an ancient and still a practice of today—the beginning point of our people. I was able to put my son's piko in Lake Waiau after I started working there and my son participated with me…We consider this a tradition to the Hawaiians. It keeps it as a safe place for our future longevity of our family. There are many other families, generations that have done the same.

Fresh water could also be gathered not just from the lake but in certain *pūnā wai* [springs], said Ms. Piscotta. There are *pōhaku* such as Māhoe that collect water, "perhaps it is because of the cinder cone it has ice plug." In addition to the water, fossilized ice or ice from the last ice age can be obtained by digging 2 to four feet. Collecting this underground ice and snow is essential for *lāʻau lapaʻau* (curing medicine). It is an ancient practice, according to Ms. Piscotta.

> There are reports of the *aliʻi*(ʼs) travels to the mountain and bringing the ice down in big blocks on horseback, even contemporary times. They would use it for medicinal purposes, temple ceremonies, and other kind of cultural protocol. The water that is collected from Maunakea is water that is used for bringing life back or taking it. I only work on the side of bringing back life.

Figure 26. Photograph of the snow-covered shoreline of Lake Waiau by CSH (2009)

8.1.3 Cultural and Historic Properties

Numerous cultural studies on Maunakea have documented a profusion of natural and cultural beliefs, practices, and resources associated with the mountain, resulting in one study calling for the entire Maunakea summit down to the 6,000 feet elevation to be classified as a Traditional Cultural Property or TCP (Maly 1998). To date, SHPD has named three places as TCPs, specifically the summit Kūkahauʻula made up of a cluster of cones (Site 21438), Puʻu Līlīnoe (Site 21439), and Site 21440 which refers to Lake Waiau (see PHRI 1999). In addition, the Mauna Kea Adze Quarry, known also as Ke-ana-kākoʻi "the adze-making cave" (Pukui et al

1974:103), was listed on the National Register of Historic Places in 1969, and the Hawaiʻi State Register of Historic Places in 1981. CIA participant Mr. Elarionoff described seeing the large basalt adze quarries, and he estimated the rock piles to be 15 feet high.

> ...It was fascinating, fascinating. You go up there, and you see these rocks….It was obvious that to chip the rocks into rough finish implements, the craftsmen used other rocks, [as] they didn't have metal. The chips that were broken off fell to the ground and just piled up and piled up until it covered the side of the hill in a slope 30 to 50 feet long and who knows how deep. The amount of rock chips was amazing (see section 7 for full interview).

Other places that qualify as traditional places include: Maunakea itself, which has several meanings, one being white (*kea)* mountain (*mauna*). It is also known as Mauna a Wākea, the eldest son of Wākea and Papa, ancestors of the Hawaiian race. It is the *piko* of Hawaiʻi Island, linking the heavens to the land (Maly and Maly 2005: A-3); Puʻu Poliʻahu, named for the snow goddess of Mauna Kea and literally translated as "Bosom goddess" (Pukui and Elbert 1986); Hale Pōhaku which refers to the two stone cabins constructed by the Civilian Conservation Corps in 1936 and 1939 at an elevation of 9,220 feet on the southern slope of Maunakea; various *heiau* and *ahu*; *ana* and *lua kā koʻi* (caves and quarries used for harvesting stones); *ilina* or burial features, trails, shelters and habitation caves, historical features from the mid-1800s such as walls, fence lines and pens, stone and wooden houses, water collection, storage facilities and other resource collection sites (see Maly and Maly 2005: A-2 to A-4).

Although a more recent tradition, the *lele* at Puʻu Kūkahauʻula which is the summit of Maunakea is a place of spiritual worship by Hawaiian cultural practitioners. Translating to "sacrificial altar or stand," the six-foot-*lele* (see Figure 27 below) was constructed by the Royal Order of Kamehameha in 1997, "as a place for spiritual ceremonies and as a monument for peace" (Ka Wai Ola, March 2006:6). CIA participant Mr. Pihana stressed the "spiritual connection" people feel for Maunakea, which for the Hawaiians of today is represented by "the humble stone and wooden *lele,* the altar at the summit" (see section 7 for full interview). For Ms. Piscotta, the *lele* at the summit is "aligned" with the sky and people have brought and buried their personal belongings inside or around it. She noted that there are other *lele* that have been built in different areas of the mountain such as at Hale Pōhaku where silver sword plants can be found," so people again have another place to offer hoʻokupu and give prayer and reconnect themselves" (see section 7 for full interview).

Ahu has been defined as "stone mounds as land markers" and like *heiau*, can also mean "ceremonial sites, shrines, and places where *mele* (chants and offerings were presented)" (Maly and Maly 2005: A-3). Community participant Halealoha Ayau described MaunaKea as "the largest ahu in all of Hawaiʻi which contributes to it being a sacred place" (see table 6). Ms. Piscotta, who has her own personal *ahu* on the mountain, also discussed the practice of leaving personal artifacts in numerous *ahu* on Maunakea. Ahu-a-Umi, located between the three great *puʻu*, is one of the important *ahu*, she said. In addition, Ms. Piscotta pointed out that *ahu* around Lake Waiau function as "markers for directionals."

> So there are directionals not only of the primary four pillars, north, south, east, and west, but also the solstice, so you have the 8, the *heʻe* [octopus] *nanana* [spider], the *peʻa* [bat] (see section 7 for full interview).

Besides *ahu*, there are shrine sites where the way offerings are placed or rituals held “appear to be intentionally directed away from Mauna Kea,” suggesting astronomical concepts at work (see McCoy 1982). The 22 sites including an open air shelter and 21 shrine sites were reported to be between 12,900 to 13,100 feet elevation, implying that these shrines “request for permission to pass over the summit” and their distribution may relate to “the lower margins of snow fields” which may well extend to the goddess Poli‘ahu (McCoy 1982: A-37). Other structures such as *heiau* have been also been confirmed by Ms. Piscotta to be navigational alignments, connecting Poli‘ahu Heiau on Kaua‘i to the summit of Maunakea, for example (see section 7 for full interview). *Heiau* have also been specifically built as places to honor deities, such as the four ‘Umi made in honor of Halulu, the god who gave him power (Maly and Maly 2005:28-29).

Figure 27. Lele at Pu‘u Kūkahau‘ula on the summit of Maunakea built in 1997 by the Royal Order of Kamehameha.

8.1.4 Burials

The subject of the presence of burials in the Maunakea summit region is a topic of considerable disagreement between the scientific, archaeological perspective, on one hand, and Native Hawaiian perspectives, on the other. In short—and the details are presented in full above (see Section 5.4.1), the archaeological evidence until recently, was relatively limited concerning confirmed human burials in the summit region. While historic accounts and *mo'olelo* tell of the presence burials on Maunakea (Maly and Maly 2005), archaeological evidence is relatively minimal concerning confirmed human burials in the summit region. Early documentation of archaeological sites in the upper reaches of Maunakea was somewhat anecdotal and ad hoc. McEldowney's (1982:A-11) summary of the ethnographic background of the Maunakea summit region notes:

> Although most accounts speak in general terms, those that specifically locate the presence of human bones, "graves," "burial caves" or mortuary features indicate that burials are "not uncommon" between 7,800 ft and 13,000 ft elevation along the northern and eastern slopes of Mauna Kea

William D. Alexander described a trip up Maunakea with a surveying party, and observed ancient graves:

> That same afternoon [July 25, 1892] the surveyors occupied the summit of Lilinoe, a high rocky crater, a mile southeast of the central hills [the "summit"] and a little over 13,000 feet in elevation. Here, as at other places on the plateau, ancient graves are to be found. In olden times it was a common practice of the natives in the surrounding region to carry up the bones of their deceased relatives to the summit plateau for burial. (cited in McCoy 1999)

Prior to 2005, archaeological authorities on Maunakea, including Pat McCoy, had documented only one confirmed burial site (with multiple burials) and four possible burial sites in the summit region (McCoy 1991). Pu'u Mākanaka, northeast of the subject project area, is the only documented place in the uplands of Maunakea in which human remains have been confirmed—although McCoy makes reference to "the well-known burial center at Kanakaleonui" and also to "a small group of cairns on the eastern rim of Pu'u Waiau that are also believed to be burials" (McCoy 1999).

However, McCoy (1999:28) also comments:

> There is good reason to expect that more burials are to be found in the Science Reserve on the tops of cinder cones, either in cairns or in a small rockshelter or overhang. The basis of this prediction is that all of the known and suspected burial sites on the summit plateau are located on the tops of cinder cones and, more particularly, on the southern and eastern sides. No burials have been found on the sides or at the base of a cone, or on a ridgetop amongst any of the shrines. There in fact appears to be a clear separation between burial locations and shrine locations.

His comments have proven apt as current in progress work by McCoy and Nees has documented 28 sites designated as burials and possible burials (McCoy et al 2008).

Past ethnographic studies about Maunakea have noted the presence of burials:

Maly’s 1999 archival study included a reference in border testimony to burials within Ka‘ohe Ahupua‘a:

> [Pu‘uokihi] it belongs to Kaohe and above that is where people were buried in old times, when people used to make fishhooks from the bones. [Testimony of Kahue, 1880, BCB, Hawai‘i, B:444] (Maly 1999:D-4).

The participants in this CIA also state that there are burials in the area. In a CSH interview with Kealoha Piscotta, she offered her concerns regarding burials located on Maunakea:

> Burials are in the *pu‘u* and along important astronomical alignments. Burials are hard to talk about, on the one hand you need to speak to it to have them protected on the other hand culturally the different levels of kapu on speaking to it. One of our greatest concerns is that there has been no actual burial treatment plan. The one plan that the Hawai‘i Island burial council basically said is the best treatment is no development, because the burials include not only important national figures, but also important spiritual figures. So, the question is what is the burial treatment for Līlīnoe? The problem has been is that there have been reports. Mr. Patrick McCoy and Holly McEldowney have done extensive work on the burials, but they never got to finish their work. Also Pu‘u Makanaka, of course it is listed only as a burial, but really it is a burial complex, hence the name Makanaka. The problem is - do not list it as one when it has many. The *kupuna* have testified extensively in the past as eyewitness that on Pu‘u Makanaka that there is so many *iwi* that you can see them through the cinder. So they immediately know better not go over there.

She also adds:

> I have familiar genealogical ties to the mountain and some of the *iwi* [bones, remains] there, actually ancient and modern. I feel it is important to mention modern because that is still in ongoing cultural practice continuing today. Famous people of today have their *‘ohana* there.

When asked about the cultural practices she has witnessed or participated in she says:

> Burials, contemporary and historic. Contemporary burials though I am not going to say that it is only limited to, but it tends to be more of the ashes, not all because people are still fighting the health department on the Hawaiian burial of bone. I have personally participated in a number of them.

It is feasible that some of the burials that are present in Maunakea may be related to the adze makers, said Mr. Leningrad Elarionoff:

> Because of their dedication to adze making and their craftsmanship---it is fitting that they be buried up there. The same honor afforded fisherman. A fisherman is buried in his canoe in a cave down by the ocean. The principle is the same. To

> have burials on the mountain is not a mystical thing like some strange god came down and got buried there. It's a normal thing. People die, and when they die, they rot. So what do you do? You bury them to hide the stench and protect the deceased from scavengers. The craftsman's life dedication to the culture was to make adze which earned him the right to be buried where he labored.

When asked about his knowledge of burials and burial practices on Maunakea, Mr. Keali'i Pihana mentioned:

> The burial grounds are much further out than that area, 13 North they call it, but even then it is too close to our kūpuna and early caretakers of the mountain have been put up there, some of our ali'i are buried up there. It would really be another hurt or you are going to put more salt on the wound so to speak and I don't think our people are going to accept that development. You are going to have a bigger protest than ever because of that.

Mr. Harp added the following cultural concerns about burials:

> Besides what I have already shared with you, my "cultural concerns" regarding Mauna Kea astronomy development includes fear of unintentional disturbance of kahiko burials on Mauna Kea, some of which are hundreds of years old or older. Many of these are burials of persons from the highest ranks of maoli society whose iwi (bones) were carried to Mauna Kea from all corners of Hawaii for interment on the summit, the realm of Wakea and Papa.

There are widespread perceptions among many Kānaka Maoli, some of which are backed by various types of documentary evidence, that the area holds or once held many more burials than archaeologists have been able to document. Further accounts regarding burials on Maunakea can be found on a website maintained by Nā Maka o ka 'Āina (see Section 3.8).

8.1.5 Trails

As depicted in Figure 6 (above), there are several trails traversing the Maunakea summit region including, from the west, the Waiki'i-Waiau Trail leading up to Waiau; from the northwest, the Makahālua-Kemole-Waiau Trail also leading up to Waiau; from the northeast, the Mauna Kea-'Umi Koa Trail, leading to and from the Hamakua area; and, from the south and leading to the Mauna Kea Adze Quarry, the Mauna Kea-Humu'ula Trail.

There are several historical references to the trails of Maunakea:

In Fornander's "Story of 'Umi: One of the Most Noted of Hawaiian Kings (*He Mo'olelo no 'Umi: Kekāhi Ali'i Kaulana o ko Hawai'i Nei Pae'āina*)," the ruling chief 'Umi-a-Liloa leads a war party out of Waipi'o, Hāmākua, to attack Hilo using the trail of Poli'ahu:

> Up through the mountains of Mauna Kea and right back of Kaūmana, running towards Hilo, was a short cut over the mountains to the trail of Poli'ahu and the well of Poli'ahu at the top of Mauna Kea, the trail leading down to Hilo. It was an old trail for those of Hāmākua, of Kohala and of Waimea to take when going to Hilo. Therefore, preparations were made and the army ascended the Mauna Kea

> mountain and descended on the upper side of Hilo…(Fornander 1919: Volume IV:224-225)

In his retelling of the Story of 'Umi-a-Līloa (the 16th century ruler of Hawai'i), Kamakau describes the time when 'Umi was mistreated by his in-laws at Hilo, and names a trail and a spring at the summit of Maunakea called "Poli'ahu":

> As soon as they were released in Hilo, 'Umi and his companions returned to Hamakua and went down to Waipi'o. There he conferred with his chiefs and his father's old war leaders. It was decided to make war on the chiefs of Hilo and to go without delay by way of Mauna Kea. From back of Ka'umana they were to descend to Hilo. It was shorter to go by way of the mountain to the trail of Poli'ahu and Poli'ahu's spring at the top of Mauna Kea, and then down toward Hilo. It was an ancient trail used by those of Hamakua, Kohala, and Waimea to go to Hilo. (Kamakau 1992:16)

Fornander (1919) provides an account of "Famous Men of Early Days (*Po'e Kaulana o ka Wā i Hala*)" he tells a story of Uma of Pūehuehu, Kohala, who lived in the time of Kamehameha I and has a number of adventures dispatching brigands and muggers as he proceeds from southern Kohala to Kapia to upper Hilo. The account notes that at the time "there was much robbery amongst the people in lonely places (*he nui loa ka pōwā ana o nā kanāka 'oia wā ma nā wahi mehameha*)," and certainly suggests that the trails around the north slope of Maunakea were among such lonely places (Fornander 1919: Volume V:500-501).

W.D. Alexander, Surveyor General, ascended Maunakea along the Waimea-Waiki'i trail in 1892. His description of the route is as follows:

> A wagon road made by the owners of the Humuula Sheep Ranch leads from Waimea around the western and southern sides of Mauna Kea. On the western side of the mountain it passes through a region which only needs more rainfall to make it a superb grazing country. The ancient forests here, as at Waimea have been nearly exterminated, but a fine grove of mamane trees still survives at the Auwaiakeakua Ranch. The manienie grass is gradually spreading and will in time add immensely to the value of the land. At the half-way station, called Waikii, water tanks and a rest house have been provided for teamsters.

There have also been references made to the trails in recent studies on Maunakea:

In 1936 the Civilian Conservation Corps carried out improvements to the old Maunakea-Humu'ula Trail from near the main base of the sheep station at Kalaieha to the summit (Bryan 1938). It was recorded that "the summit road only extended to Hale Pōhaku in 1938" (Bryan 1938:38).

In Holly McEldowney's 1982 Ethnographic Background report for the Maunakea Summit Region for the Research Corporation of the University of Hawai'i as part of an EIS for a Mauna Kea Science Reserve Master Plan states that guides and informants were often familiar with land features but traveled from landmark to landmark rather than on trails. She notes that access to the mountain in the second half of the 1800s appeared to utilize ranching establishments (Humuula

Sheep Station, Umikoa Ranch) and may not have related to pre-Contact approaches (McEldowney 1982). Many Hawaiian place names were noted to be modern.

The botanical components of the Lei-o-Poli'ahu, including *nohoanu, liko, mu'o of 'ōhia, pūkiawe and* white *limu*, can be found "along the eastern segment of the long trail in the saddle between Mauna Loa and Mauna Kea that connects Hilo and North Kona" (McDonald and Weissich 2003:72).

Documented in the PHRI study, SHPD identifies the Kūka'iau-'Umiko Trail, and the Mauna Kea-Humu'ula Trail as traditional cultural properties.

When CSH asked about Maunakea's cultural resources and sites, Mr. Pihana states:

> Early development where one of the observatories was on top of Pu'u Poli'ahu, prior to me working at the university that observatory was removed brought down and taken off Pu'u Poli'ahu I had brought the new established Office of Maunakea Management, Office of Hawaiian Affairs, Civic Clubs, and many other community leader, and other local community leaders to close the road to Poli'ahu. Today there is only a trail and the only way to get up there is by walking. No vehicles allowed on top of that mountain. No vehicles allowed at the Lake. No vehicles allowed into the area where we consider where our burial grounds are. Pu'u Māhoe and Pu'u Makanaka, those areas are off limits even to hikers.

Ms. Pisciotta, discussing cultural sites within the Project area and the mountain also mentions trails, "all over the mountain."

8.1.6 *Wahi Pana* (Storied Places)

The project area is associated with a wealth of *mo'olelo*, (stories, narratives) and *mele* (chants, songs) about its sacred cultural landscape. In native lore, it is known as Mauna a Wākea (The Mountain of Wākea), "the first-born mountain son of Wākea and Papa, who were also the progenitors of the Hawaiian race" (Maly and Maly 2005: A-3). It is also the dwelling of snow goddess Poli'ahu who is the rival of Pele (the fire goddess) and the residence of other deities such as Līlīnoe and Kūkahau'ula. The mountain represents the *piko* (umbilical cord) of the Hawai'i Island and is the link of the land to the heavens (Maly and Maly 2005: A-3). Located near the summit at 13, 020 feet, Lake Waiau is named after Waiau, the mountain goddess who is the one of the attendants to Poli'ahu who is said to bathe in its cooling waters. The name "Waiau" translates to "swirling water," and it is guarded by the powerful *mo'o* Mo'oinanea. Many contributors to this CIA such as Mr.Halealoha Ayau emphasized the *mana* (power) of Maunakea and its *kapu* space, with Mr. Pihana and Ms. Keakealani among many emphasizing its sacredness.

There is also a wealth of *'ōlelo no'eau* (proverbs or poetical sayings) describing the ethereal qualities of Maunakea. Two examples are "*Mauna Kea, kuahiwi ku ha'o i ka mālie* (Mauna Kea, standing alone in the calm)" and "*Poli'ahu, ka wahine kapa hau anu o Mauna Kea* (Poli'ahu, the woman who wears the snow mantle of Mauna Kea)" (Pukui 1983:234, 294).

The terrain of the mountain, including the many *pu‘u*, is also the subject of traditions and stories. It is said that Pu‘u o Kūkahau‘ula, the summit cluster of cones and named for a form of the god Kū, is where people took the *piko* of their newborn children “to insure long life and safety,” a tradition that is still ongoing (Maly and Maly 2005: A-3). Lake Waiau is also another place were the *piko* of newborns where placed, and from where some people collected the sacred water of Kāne or “*ka wai kapu o Kāne*” for its healing powers (Maly and Maly 2005: A-3).

Pu‘u were also named for goddesses, such as Pu‘u Poli‘ahu, Pu‘u Līlīnoe, and Pu‘u Waiau. As CIA contact Ms. Ku‘ulei Keakealani mentioned, the deities would like to be remembered and have their *pu‘u* respected (see section 7 for interview). Accounts of burials placed in *pu‘u* such as Pu‘u Mākanaka are also reported (McCoy et al 2008). In addition, ceremonies that mark life’s rites of passage take place in the numerous *heiau* and *‘ahu* which also double as navigational markers. There are also stories connected to important *heiau* like the four sites that Umi-a‘Umi-a-Liloa constructed to honor Halulu, the god who provided his power (Maly and Maly 2005:28-29).

Maunakea as a navigational guide is also mentioned in the *mo’olelo* of community participants, with Mr. Arthur Mahi emphasizing that the mountain is a *kupuna* who guides the people of Hawai‘i, especially when one is in the ocean and needs direction. *Pu‘u* not only contain burials but are critical astronomical alignments, stressed Ms. Kealoha Pisciotta. With help from *kūpuna*, she shared how she found the solstice equinox alignment and her discovery of how one view plane linked Maunakea to Poli‘ahu Heaiu on Kaua‘i and vice versa. Canoe navigators often climb up to Maunakea to consult the alignment of the *lele*, and of Lake Waiau. The navigators could then consult the reflection of the sky on the lake. She stated:

> They are codifying the alignments in their mind’s eye. That is how the *kūpuna* could see the pathway, see in the lake hold it in their minds and follow it on the sea. Some people say, “The navigation is all about the ocean.” But it is really all about the sky. That is where the difficulty is on finding the *mo‘olelo* on Maunakea. It isn’t just under Maunakea, it is under all the navigational lore. I remember Kepa Maly talking with me years ago, and I kept saying, “You know what you see on the ground, Kepa, is only the reflection of the heavens? This is our connection. When you are looking, you have to look for those things over head.” (see section 7 for full interview)

According to Ms. Pisciotta, ceremonies observing the winter and summer solstices and the equinoxes are held on Maunakea by the Royal Order of Kamehameha. But she indicated that many others come up at other times to use the navigation of the lakes and to check the *pu‘u*. Anything that obstructs a view plane on the mountain is bound to destroy the navigational purpose of that particular area by interrupting the alignment.

Then there is the connection of deities and their appearance to navigation, as pointed out by Ms. Pisciotta.

> Papa and Wākea, Wākea as Orion is super significant for navigation because Orion’s belt rises due east and sets due west, so you must know Orion and of course Orion comes winter and there was a time that I really got it because some say the sword is the ‘*ule* [penis], so at certain angles you can see right over the

> summit how they are touching is loving embrace. Papa is clear when there is no snow and then is Poliʻahu when there is snow. And those alignments are significant and major. There are different levels of each story as there are the levels of heavens. (see section 7 for interview)

Since Orion is always travelling east and west, and Mauna Kea sits in the middle, the whole archipelago can be set on a base line, said Ms. Pisciotta. She added that some *heaiu* built on Maunakea that are related to the deities are also aligned with their astronomical appearances.

The goddess Līlīnoe, whose name translates to "fine mist," can be seen when the right weather conditions are in place. Again, her figure can be drawn out with the help of the terrain of the land.

> I walked out and the snow had been perfect and there was a cloud bank, a typical cloud bank that always is on the mountain, and right there you could see her whole body, her face, her hair, her shoulder, and her arm, her *nene* [nipples of a woman's breast] and then of course the telescopes are right there by her *ʻōpū* [belly, stomach] and her *nene* and then you go down and then two *puʻu* on the mountain that if you look from Hilo side, like looking from Mokuʻula is a good way to see, and then you can see her two feet. Then what happens is that she floats like a cloud of the tree line. (see section 7 for full interview).

The different forms of Līliīnoe or her *kino lau* can be discerned especially during the solstice, when there is snow. Ms. Pisciotta notes that "the legends tell of her adorning her *kīhei* [shawl, cape], or mantle." Because of the leveling of the *puʻu*, however, the physical manifestations of deities such as Līlīnoe and Poliʻahu are being destroyed.

> Another level of the desecration is the leveling of the *puʻu*, or the cinder cones. The cinder cones are sacred in and of themselves because they make up some of the *kino lau*, or the divine bodily manifestations of the gods…Unfortunately though, Poliʻahu's image and bodily form is being destroyed. They are altering the images of our deities because the *puʻu*[s] are being leveled and the telescopes are being built on top of her. (see section 7 for full interview)

There are *ʻahu* all over the mountain, noted Ms. Pisciotta, and many by Lake Waiau are markers for directionals (see section 7 for interview). For example, Ahu-a-Umi is aligned with Venus, she said. "Our traditions are not antiquated, they are ancient, but that does not mean they are useless in the world today and their science. They are not just religious belief they have practical use to us every day."

For Ms. Kuʻulei Keakealani, the *moʻolelo* of what she calls Mauna a Wākea are critical to understanding the place itself. Knowing the *moʻolelo wahi pana* of a certain area can often change the way one views the place:

> If we went to another layer…or dimension, for me, the stories of a place are something that I almost don't even have words to describe. Sometimes, all I need to know, all you need to know, is the story of a place that's hundreds and thousands of years old that can change my perspective or your perspective of a place. (see section 7 for interview)

She narrated a traditional version of Poliʻahu and her fateful meeting with Kūkahauʻula. With the help of Moʻoinanea, her father Kāne reluctantly allows the two lovers to meet twice a day, at sunrise and sunset. When Mauna a Wākea turns into colors of pink, purple and red, we bear witness to the loving of the two deities. "So Kūkahauʻula is embracing and placing his love like no other man could, as he loves Poliʻahu two times, everyday, *no na kau a kau*, forever and ever" (see section 7 for full account).

Other *moʻolelo* such as the one from community contact Mr. Danny Akaka Jr. relates the battle that Poliʻahu has with Pele the fire goddess, her elemental opposite. In this story, the two goddesses fight over ʻAiwohikupua using fire and ice (see section 7 for full story).

Trails and springs can also be named after deities, such as the story of ʻUmi-a-Līloa (the 16^{th} century ruler of Hawaiʻi) when ʻUmi was mistreated by his in-laws at Hilo, and names a trail and a spring at the summit of Maunakea called "Poliʻahu." According to Kamakau, "It was an ancient trail used by those of Hamakua, Kohala, and Waimea to go to Hilo" (Kamakau 1992:16).

Other *moʻolelo* tells of spiritual entities like nightmarchers. CIA participant Mr. Kimo Kealiʻi Pihana told of many accounts, stating that the nightmarchers' appearances to visitors and employees are their way of saying the following:

> Who are you? What are you doing up here? Where are you from? Go home, you don't belong here."…Yes, these are guardians to the mountain and area, they are known as the night Marchers, not only walking below lands, but up here too. They show themselves because they don't really want to be exposed. They want everything up there now to be left alone."

For the use of Maunakea as a last landmark for the Hawaiian Islands, see Fornander 1919; Volume IV: 160-161. For other mentions of Maunakea, see for example, Fornander (1919; Volume IV: 224-225); Kalākaua (1888: 249-315), and Maly and Maly (2005).

Section 9 Summary

CSH is conducting this draft *preliminary* CIA at the request of Parsons Brinckerhoff International. The *preliminary* CIA includes broadly the *ahupuaʻa* of Kaʻohe, Hāmākua District, on the island of Hawaiʻi and more specifically on a portion of TMK: (3) 4-4-015: 009 and 012. The proposed Project includes the construction and operation of the Thirty Meter Telescope Observatory Project (TMT) on the Science Reserve located near the summit, a construction staging area and new electrical transformer, both of which are located at the Hale Pōhaku site at the 9,000 foot level on Maunakea.

9.1 Results of Background Research

Background research on the Project area and the surrounding summit region of Maunakea indicates:

- Maunakea is a sacred cultural landscape; symbolic of Wākea (the ʻSky Father' to all Hawaiians), home of Poliʻahu, the goddess of snow and foe of Pele (the fire goddess), and of many other resident deities and supernatural entities (e.g., Līlīnoe, Kūkahauʻula and Moʻoinanea) and the *piko* (umbilical cord) of the island-child, Hawaiʻi which connects the land to the heavens (Maly and Maly 2005:v); home of Waiau, the highest permanent lake in the Hawaiian Islands; location of the highest and most extensive basalt quarry in all of Polynesia and perhaps the entire world; and numerous trails, *ahu* (stone markers), religious shrines and cinder cone *puʻu* (hills), based on extensive historical and oral-historical documentation.
- Maunakea is rich in *moʻolelo*, *mele* (chants, songs), and *ʻōlelo noʻeau* (proverbs, poetical sayings) associated with *akua* (God, male and female deities, spirits) and storied places (*wahi pana*). Poliʻahu, the snow goddess and Pele, the volcano goddess engaged in legendary battles to control Maunakea. Pele also had legendary battles with the pig demi-god Kamapuaʻa on the summit of Maunakea. Numerous stories of Wākea and Papa, Poliʻahu, Līlīnoe, Kūkahauʻula and Moʻoinanea, to name a few, are written into the landscape.
- The TMT Observatory Project area is located on a ridge line north of the summit cone, Puʻu Kūkahauʻula, at approximately 13,700 feet elevation. The Hale Pōhaku Project area is located at approximately 9,160 feet in elevation. Maunakea, the tallest mountain in the Hawaiian Islands at 13,796 feet elevation, is also the tallest mountain on earth as measured from the ocean floor to the summit, a distance of some 29,500 feet (thus, exceeding by approximately 1,000 feet the non-volcanic Mount Everest).
- Vegetation is almost non-existent in the summit region of Maunakea; the tree-line is located nearly a mile in elevation below the summit (at approximately 9,000 feet elevation); the highest major vegetation zone, known as the Alpine Scrub Zone, generally ends at approximately 11,300 feet elevation. Plants in the so-called Alpine Stone Desert Zone of the summit region are mostly limited to small lichens and mosses. More plant life is present in the Hale Pōhaku Project area

characterized by scrub vegetation including a number of natives such as *māmane* (*Sophora chrysophylla*), *pūkiawe* (*Leptecophylla tameiameiae*) and the endangered endemic, *ahinahina*, also known as Maunakea silversword (*Argyroxiphium sandwicense*) as well as introduced exotics such as mullein (*Verbascum thapsus*) and various grasses.

- Maunakea translates literally as white (*kea*) mountain (*mauna*), so named for its breathtaking snow-capped summit. However, according to Nā Maka o ka ʻĀina (2008) and according to other authorities on Hawaiian culture (e.g., Kepa Maly, Pualani Kanahele), Maunakea has numerous other meanings and translations. It is a short version of Mauna a Wākea, a name that connects it to the sky father, Wākea; this would be one of its *kaona* (hidden or more subtle meanings).
- Hale Pōhaku literally "stone house," refers to the two stone cabins constructed by the Civilian Conservation Corps in 1936 and 1939 at an elevation of 9,220 feet on the southern slope of Maunakea. L.W. Bryan, who served as the Territorial Forestry Office and oversaw the construction of the "stone houses," also named them Hale Pōhaku.
- Puʻu Poliʻahu is named for Poliʻahu, "the woman who wears the snow mantle of Mauna Kea"; Poliʻahu, which is also the name of a land division on Maunakea, is translated as "garment [for the] bosom (referring to the snow)" by Pukui et al. (1974) and as "Snow goddess of Mauna Kea. Lit. Bosom goddess" by Pukui and Elbert (1986). Maly & Maly include a citation by W.D. Alexander regarding the naming of Puʻu Poliʻahu. As the peak was nameless, Alexander called it "Poliahu" since it had "a poetical name, being that of the demigoddess with snow mantle who haunts Mauna Kea" (Maly and Maly 2005:200).
- Waiau, the permanent lake located within Puʻu Waiau near the summit of Maunakea at approximately 13,020 feet elevation, translates as "swirling water," and is associated with the snow goddess Poliʻahu and is guarded by the supernatural water spirit (*moʻo*) known as Moʻoinanea. Queen Emma went to the top of Maunakea to bathe in the waters of Waiau. The ceremony was to cleanse in Lake Waiau at the *piko* (navel or center) of the island. The water caught at Lake Waiau is considered pure water of the gods much like the water caught in the *piko* of the *kalo* (taro) leaf and is thought of as being pure, therefore it is used medicinally (Nā Maka o ka ʻĀina 2008).
- The Mauna Kea Adze Quarry, also known as Ke-ana-kākoʻi, "the adze-making cave" (Pukui et al 1974:103), is located on the southern slopes of the mountain, at elevations up to 12,400 feet. The site was listed on the National Register of Historic Places in 1969, and the Hawaiʻi State Register of Historic Places in 1981.
- The *ahupuaʻa* of Kaʻohe was government land on which four native claims were made following the Māhele in 1848. Only one *kuleana* claim was awarded in the entire ahupuaʻa. The single awarded claim indicates coffee, arrowroot, banana, and taro were all cultivated in the lands of Kaʻohe. Kaʻohe was also known as a habitat

for *uwa'u*, or *'ua'u* (dark-rumped petrel) seabirds that reside in rocky, dry, elevated areas (Foster 1893).

- While historic accounts and *mo'olelo* tell of the presence burials on Maunakea (Maly and Maly 2005), archaeological evidence until recently, was relatively limited concerning confirmed human burials in the summit region. Prior to 2005, archaeological authorities on Maunakea, including Pat McCoy, had documented only one confirmed burial site (with multiple burials) and four possible burial sites in the summit region (McCoy 1991). All of these sites are located on Pu'u Mākanaka to the northeast of the subject Project area. In progress work by McCoy and Nees however, has documented 28 sites designated as burials and possible burials (McCoy et al 2008).
- Several extensive cultural studies have been previously carried out for Maunakea (McEldowney 1982; Kanahele and Kanahele 1997; Maly 1998; Langlas et al. 1999; Maly 1999; PHRI 1999; Maly and Maly 2005). The most comprehensive study by Maly and Maly (2005) builds on archival and oral- historical research conducted by the authors beginning in 1996 (to 2005) and presents a wide range of information on natural and cultural beliefs, resources and practices associated with Maunakea. Among the many critical findings of Maly and Maly's (2005) cumulative research is the emphasis on Maunakea as a sacred landscape and native lore associated with traditional knowledge of the heavens—documenting 270 Hawaiian names for stars.
- Past studies identify Traditional Cultural Properties (TCP) on Maunakea. Three places that have been identified by SHPD as TCPs and documented in a study done by PHRI (1999) are: (1) Kūkahau'ula, the summit (Site 21438), (2) Līlīnoe (Site 21439) and (3) Lake Waiau (Site 21440). Other traditional places may also qualify (Figure 6). Maly (1998:29) has suggested the entire Maunakea summit region down to the 6,000 foot elevation contour be designated a Traditional Cultural Property (Figure 16).
- Archival and oral-historical evidence confirms that Maunakea has long been, and continues to be, a place where significant cultural practices are carried out: where, the *piko* of newborn children is taken to Pu'u Kūkahau'ula and Lake Waiau to ensure long life and safety; the remains of individuals with generational ties to Maunakea are taken to *pu'u* and the summit plateau for interment (Maly and Maly 2005:vi); shrines and stone markers are erected and; ceremonial and other activities related to birth, death, healing, navigation and more, occur.

9.2 Results of Community Consultation

CSH attempted to contact 58 community members (government agency or community organization representatives, or individuals such as residents, cultural and lineal descendants, and cultural practitioners) for the purposes of this *preliminary* draft CIA. Thirty people responded and 13 *kūpuna* and/or *kama'āina* were interviewed for more in-depth contributions to the *preliminary* draft CIA. Community consultation with a few respondents is ongoing. The results of preliminary cultural consultations indicate that there are several major concerns (and ancillary ones) regarding potential adverse impacts on cultural and natural resources and associated beliefs and practices as result of the proposed development of the Thirty Meter Telescope, construction of the staging area for the TMT Observatory Project and the HELCO electrical transformer needed to supply electrical power to the TMT Observatory Project. Results of the community consultation indicate:

- All of the community consultants interviewed for this study stress that Maunakea is a sacred landscape and that any future development activities on the mountain proceed with greater awareness of, and the utmost respect for Hawaiian culture, Hawaiians' spiritual connection to the mountain, and the sanctity of Maunakea.
- Nine of the community consultants interviewed, and three of the respondents who provided brief commentary, explicitly stated their opposition to the proposed actions on Maunakea which is traditionally, and continues to be, one of the most sacred locations in all of Polynesia, not to mention Hawai'i Nei. These participants voiced sadness, frustration or negative feelings about the cumulative impacts of past and present developments on Maunakea. In the words of one participant (Ku'ulei Keakealani), "I think my first and foremost thoughts would be that it doesn't need to be done. Not because more research isn't needed or anything along those lines. The latest technology and research helps educate all of us, but at the same time, it's about the location. When is enough, enough?" She goes on to say, "I just think that, that Thirty Meter Telescope and all of those observatories up there have just overstepped the bounds of going into what is a sacred realm. I don't know how many people can go to the summit of Mauna a Wākea and not acknowledge that you are in a different realm. That truly is the realm of the goddess Poli'ahu and of all these other incredibly stronger forces above and beyond us as humans." Another (Isaac Harp) wrote, "Hawai'i's sacred and religious sites that have been desecrated and destroyed in the name of astronomy can never be returned to how they were before the astronomy community took aim at them" (Appendix D). Specific *mana'o* concerns and recommendations from those that oppose the proposed TMT Observatory Project and Hale Pōhaku Mid-Level Support Facilities Project are:
    - Three participants (Arthur Mahi, Isaac Harp, George Van Giesen) called for astronomy facilities to be removed and Maunakea be repaired to its original condition. Mr. Van Giesen specified that *if* the TMT Observatory Project is built, the plan should include an exit strategy from Maunakea once the technology has been deemed outdated stating that, "it has to be set on a timeline that if they put the [telescope] up, it's going to have to be dismantled and everything put back the way it was." He further recommended that, the proponents of the TMT Observatory Project make an effort to disclose and reach out to the community about the findings of the telescope commenting that, "[Carl Sagan] did a bunch of shows and expos…showing everybody what he was doing, the pictures he was taking and what he was finding." One participant (Isaac Harp) requested restitution to aggrieved parties. Mr. Kimo Pihana also stresses the value of, bringing "the telescopes back down to the level of the people" and reported the success of a program in 2001 in which a star gazing event was

held at the yearly Makahiki festival in Hilo, "That kind of brought about a new program into the University System of creating another position of people that would contribute their times and efforts doing outreach to the schools. It helps create the 'Imiloa Astronomy Center in Hilo. Today people who are not able to go to the top of Maunakea can enjoy the idea of science and culture right here at this level, here in Hilo at the University Park area, this way people don't feel being left out."

- One participant (Sheila Okin) recommended no further development until issues are rectified with the Hawaiian people.
- One participant (Ku'ulei Keakealani) called for the proposed TMT Observatory Project to be installed in Chile rather than in Hawai'i.
- A number of these participants discussed the importance of astronomy to Hawaiians, particularly citing voyaging traditions. One participant (Kimo Keali'i Pihana) remarked, "…astronomy is nothing new to the Hawaiian people. We are navigators of Polynesian; we are on the ocean and on these islands prior to western contact and Captain Cook" and commented that, contemporary western astronomy means that, "future generations are very near [to] colonizing other areas outside of the planet earth. Preparation and engineering and education play a very important role." Ms. Kealoha Pisciotta makes the point that study participants who oppose the building of the TMT Observatory Project should not be perceived as rejecting western science, "…we are not going to let you keep saying that Hawaiians or the environmentalists are against astronomy…we have stated publicly and in written form that astronomy is a noble endeavor that should be support[ed], however, not at the expense of everything else and good science should include environmental science, the geology, hydrology, the ethnographic studies, archaeology: all of it is science and our cultural tradition is science….I am saying give credit where it is due, and that we were able to circumnavigate the globe millennia before western science. So science would do well to recognize our star knowledge as science and stop calling it myth."
- Several interview participants and respondents express concern about the disturbance of burials and associated cultural artifacts, markers and shrines (*ahu*) and in *pu'u* as result of construction of the proposed TMT Observatory Project and support facilities. Mr. Pihana states that while the TMT Observatory Project is to be located on the northern plateau—far from burial grounds, "…even then it is too close to our *kūpuna* and early caretakers of the mountain have been put up there, some of our *ali'i* are buried up there. It would really be another hurt or you are going to put more salt on the wound so to speak and I don't think our people are going to accept that development. You are going to have a bigger protest than ever because of that…" Keoloha Pisciotta explains, "Burials are in the *pu'u* and along important astronomical alignments. Burials are hard to talk

about, on the one hand you need to speak to it to have them protected on the other hand culturally the different levels of *kapu* on speaking to it. One of our greatest concerns is that there has been no actual burial treatment plan. The one plan that the Hawaiʻi Island burial council basically said is the best treatment is no development, because the burials include not only important national figures, but also important spiritual figures. So, the question is what is the burial treatment for Līlīnoe? …Puʻu Makanaka, of course it is listed only as a burial, but really it is a burial complex, hence the name Makanaka….The *kūpuna* have testified extensively in the past as eyewitness that on Puʻu Makanaka that there is so many *iwi* that you can see them through the cinder. So they immediately know better not go over there…. So destruction of the cinder cones and the landscape itself is the danger to *iwi*." Mr. Harp wrote in an email that he fears, "unintentional disturbance of kahiko burials on Mauna Kea, some of which are hundreds of years old or older. Many of these are burials of persons from the highest ranks of maoli society whose iwi (bones) were carried to Mauna Kea from all corners of Hawaii for interment on the summit, the realm of Wakea and Papa."

- Five participants (Arthur Mahi, Kalikokalehua Kanaele, Isaac Harp, Kealoha Pisciotta, Kimo Pihana) discuss environmental concerns, particularly about Lake Waiau and the mountain aquifer, as well as other impacts to environmental services. These participants assert that Maunakea—the principle aquifier and watershed for Hawaiʻi Island—is being contaminated by human use (i.e., sewage and toxic chemicals leaching from astronomy facilities). Ms. Pisciotta points out that Maunakea is the "principle aquifer and water shed for Hawaiʻi Island" and that the waters, ice and snow collected from Mauna Kea are used for Native Hawaiian healing and other rituals. She refers to, "evidence of 10 thousand documents of hazardous materials used on the mountain and no record of UH removing them. Our evidence is that hazardous waste can go directly in the ground because they have no proper waste containment. If the community's water becomes toxic, where do we go? On the other hand they can fix that. It is completely fixable problem…" Mr. Kanaele comments, "The mountain itself is a great filtering system; inside of it has a hose that represents rivers underneath and on top. The melted ice and rain—all that seeps right into the aquifers and then down to the rest of the *ʻāina*. Mauna*k*ea is blue and Maunaloa is red. So you can see where the water goes. They are tampering with the main source of our water." In an email, Mr. Harp wrote, "I am concerned that the many toxic chemicals used by and the sewage produced by the astronomy industry have the potential of polluting of the sacred healing wai (waters) of Waiau. My concern also extends to the health and safety of the wai from our aquifer that maoli and non-maoli alike depend on for life. Perhaps the wai has already been polluted. Was a baseline study of the wai of Waiau and of the aquifer been conducted prior to astronomy development?" Other environmental concerns are expressed by Mr. Harp who fears the development may cause further threat to the endemic Maunakea Wēkiu Bug (*Nysius wekiuicola*). Mr. Pihana underscored that there should be a program that instills better responsibility to keeping Maunakea free of *‘ōpala* (rubbish) and stated, “We need to protect the environment up there, the animals, insects and all natural resources. We are conscious about that. The idea of being able to look up into the heaven and still be able to learn the old names of stars and constellations such as those we use in navigation. People like to go and practice at the night time too. They also need to learn to respect it more.”

- One participant (Kealoha Pisciotta) notes that the entire Mauna Kea Science Reserve have been identified by SHPD as an historic district, and suggests that a Cultural Reserve be created, and that the following landscape features qualify as TCPs: the Mauna Kea Adze Quarry Complex; the cluster of 3 *pu‘u* of Kūkahau‘ula that make up the summit region of Maunakea; Lake Waiau; and Līlīnoe, referring to the *pu‘u* southeast of the summit and within ther Science Reserve (Section 7.7, Appendix C).
- Three participants (P.F. Kwiatkowski, Kealoha Pisciotta, Isaac Harp) question legal aspects of the lease agreement between the University of Hawai‘i and the state and legitimacy of the Mauna Kea Science Reserve to operate on ceded and/or occupied lands (Appendix C and D). Mr. Kwiatkowski is a supporter of astronomy, but he questions the way that Maunakea has been managed by the UH and the State of Hawai‘i, as well as the proliferation of telescopes through the years, “Fast forward to just a few years ago....The University of Hawai‘i, the entity that ‘manages’ the mountain, now has the authority to do pretty much whatever it wants on the mountain, not taking into account that much of the land it ‘manages’ is actually ceded lands from the Kingdom of Hawai‘i. Whether or not that makes a difference is a moot point, as the will of the people is supposed to be manifested through the State Government, when, in actual fact, it is not.”
- Two participants (Arthur Mahi, Kalikokalehua Kanaele) question the benefits to the local economy and education promised by past and proposed telescope projects on Maunakea. Mr. Mahi discussed how the *kūpuna* of Hawai‘i did not give their permission for the other telescopes to be built, and whatever financial windfall the telescopes were promised to bring has never materialized. Mr. Kanaele, citing Ali‘i O Nā Moku commented, “Education to desecration isn’t education at all.”
- Two interview participants, the SHPD and OHA asked that the current proposed TMT Observatory and Hale Pōhaku Mid-Level Support Facilities Projects be viewed in light of the long history of development on Maunakea and cumulative impacts to cultural resources and practices and

not on an isoloated basis. Mr. Harp comments, "All aspects of the TMT proposal, including supporting utilities, supporting areas, supporting structures, and supporting activities on our sacred mauna must be disclosed and viewed in its entirety from a cumulative perspective rather than from a fractionalized section-by-section viewpoint."

- Three participants (Danny Akaka Jr., Kelly Greenwell, Leningrad Elarionoff) interviewed for this draft *preliminary* CIA, and one respondent who provided brief commentary (Karin Halemau), are in favor of the development of the TMT Observatory Project and its associated facilities on Maunakea. These participants recommend Project proponents proceed with care and respect to the sacredness of Maunakea and advised mitigation measures and/or alternatives to the current proposed design and location of the TMT Observatory Project and support facilities. In the words of Mr. Akaka Jr., "The future of Maunakea…can serve as an educational center and a place for man to view the stars and the universe but it has to remain a sacred and holy place. It's like stepping into a sanctuary, a very sacred place of peace, a place that one can learn the things beyond what man knows now." Mr. Halemau provided this brief statement for the CIA, "My whole feeling is anything concerned with this generation and the next is good…if anything could educate the next generation—that would be good." Mr. Kelly Greenwell considers the TMT Observatory Project as an important project that would bring back the cultural importance of consulting the heavens, "If you were to look back 500 years…at the …lifestyle and beliefs of people who lived here then, and realize that it was tied in to what we call science today, tied to how you ran your life and how you ran your society, the most important element in their belief system is the heavens…They are able to find direction in something that is constant. Something constant is all important and the heavens are a constant. So they used it as a tool of discovery. It's not only [Hawaiians] that did this, almost all ancient people did it. If you were then able to have a tool that allowed you to see the heavens in a much more advantaged way, a telescope for instance, that can actually look at what you're looking at, see what you're looking at, it would be hugely embraced. It wouldn't be thought of as a bad thing; it would be thought of as a miracle almost…" Mr. Greenwell further advises, "If they went in there with a degree of respect and understanding for those issues…it's like building any temple, you have to bless the land that's its built on. You cannot violate the land that the temple is built on. These stargazers, if you will, are akin to a series of temples. And they have to be appreciated as such…. But it's not an issue of 'no, we're not going to do this.' It's…who we're doing it for, and why we are doing it. Who we're doing it for is very important…When it comes to actually sitting down, and deciding how we are going to build these structures on this mountain, the attitude has to be 'we want to listen.' And that is said from both parts. It's not just the people who are speaking who have a future up there…we're going to have to think for everybody. It's a big responsibility….One of the things that we have to remember is that the mountain belonged to the old ancient Hawaiian culture. But now it belongs to the living, it belongs to the future….There's a way to build a relationship and it's going to come out of the culture of this place but has to be respected by people coming here. And that's what it boils down to. You are moving into an environment that's been fortified by a lot of grief, a grief that has come from theft. And this is an opportunity to show it doesn't have to be that way." Mana'o, concerns and recommendations from these participants are:

- One participant (Leningrad Elarionoff) believes the TMT Observatory Project should be built on a recycled site. He states that if an outdated telescope site on Maunakea is identified, the site should be recycled for the TMT Observatory Project usage to avoid unnecessary intrusions that detracts from the beauty and majesty of Maunakea. Mr. Elarionoff also calls for the removal of any debris resulting from the construction of the road in order to restore the dignity of the mountain. In his words, "If an outdated structure is identified and there is a need to build another telescope on the mountain, tear down the old structure and build the new one on the same footprint. The Mountain is valuable and respected by us. Do not sacrifice our cultural monuments for expedience or budget concerns. Another structure can be another unnecessary intrusion that detracts from the beauty and majesty of Maunakea."
- One participant (Kelly Greenwell) calls for a process to be put in place that respects community and allows projects such as TMT Observatory Project telescope to continue.
- One participant (Danny Akaka Jr.) suggests the removal of all other telescopes and that only one telescope be utilized and shared by interested parties.
- All three of these participants state that if the TMT Observatory Project proceeds, it should be developed to blend in with the natural environment setting and not detract from the natural beauty and sacredness of Maunakea. Mr. Greewell calls for a process of constructing the telescope that would respect the aesthetics of the mountain. One way that could be done is to not paint it white and to bring it down to a lower level. Respect needs to be woven throughout the process of building the telescope. Mr. Akaka, Jr. explained, "We need to instill that understanding to people who are going to be up there and who are going to work there. They need to have respect for this very sacred place. It's kind of like working on the grounds of a church, you don't want to be *kāpulu* [careless, slipshod, untidy, disgusting], you don't want to desecrate it. Maunakea is also a resting place for many of the ancients. So it's a very hallowed, very sacred place. So anything that is constructed up there not only has to fit into the nature of the mountain, but it has to be something that can also compliment Maunakea. One needs to understand that it's a place that at one time, not all Hawaiians were privileged to go to because it was the abode of the gods and a place that was greatly respected."

- Interviewees discussed salient features of the cultural landscape, resources and associated uses of Maunakea including, *mo'olelo* about Wākea and Papa, Poli'ahu, Līlīnoe, Kūkahau'ula and Mo'oinanea; the summit as an area where families take the *piko* of their babies to bury, and where the bones or ashes of deceased family members are placed, burials and burial complexes; shrines and stone markers; navigation traditions and astronomy; the adze quarry, ancient and historic trails; the healing and purifying waters of Lake Waiau and snow and ice collected for medicinal and ceremonial purposes; bird hunting; and other past and present cultural practices (Sections 7 and 8). One respondent (Arthur Mahi) states, "The mountain is our *kupuna* (grandparent, ancestor)." Study participants discussed:

- The summit as an area where families take the *piko* of their babies to bury, and where the bones or ashes of deceased family members are placed. Mr. Pihana explained, "The placing of the human piko or umbilical cord, an ancient and still a practice of today—the beginning point of our people. I was able to put my son's piko in Lake Waiau after I started working there and my son participated with me, he was turning seventeen at that time. I was just moved by being able by going out there and see the place clean not being desecrated, very serene. We consider this a tradition to the Hawaiians. It keeps it as a safe place for our future longevity of our family. There are many other families, generations that have done the same. Ms. Pisciotta stated, "I have familiar genealogical ties to the mountain and some of the *iwi* [bones, remains] there, actually ancient and modern. I feel it is important to mention modern because that is still in ongoing cultural practice continuing today. Famous people of today have their *ʻohana* there."
- The traditional Hawaiian practice of bathing in Lake Waiau; and, gathering ice and water from the summit of Maunakea for religious and ceremonial purposes. Ms. Pisciotta discusses ceremonies at the lake, "All different kinds, Queen Emma went there to *hiʻu wai* [bathe for water purification] before her election and to demonstrate her worthiness and *moʻokūʻauhau* or genealogy."
- The navigational significance of Maunakea due to its view of the constellations and also the seas surrounding the island of Hawaiʻi and Maui. Mrs. Kealoha Pisciotta mentions navigational alignment connections with Poliʻahu Heiau on Kauaʻi and the summit oh Maunakea. Mr. Pihana states, "Going back to the times of ʻUmi who had set up his shrines all over this island in celebration. By then the priest were concerned with studying the stars and navigation. Also the time of the year to celebrate the solstice and also the equinox. We were able to bring that practice up to the summit of Puʻu Wēkiu today. So that we can seek reverence towards the idea of our ancestors leaving behind information that we could go to higher places and do the same type of work they do below….ʻUmi was navigating the stars. The star chart, the moon phase and also the directional between from here to Hawaiʻi. Today teachers, cultural practitioners visit the Lake Waiau."
- The evidence of Poliʻahu as observed by people today. Mr. Pihana explains, "As far as we can see today, most of it looking at Poliʻahu, the

snow goddess, she comes along almost daily even though you don't see the snow, she is there, because of *hau*, the cold, the winds, *makani*." Mr. Pihana's words serve as one example of many stories told about Poli'ahu.

- SHPD, responding in a memo sent on May 4, 2009 states that, "As you may have discerned from the most recent Mauna Kea Comprehensive Management Plan (MCMP) for the UH Management Area (January 2009) and the public hearings for that plan that Mauna Kea is a very sensitive subject that truly needs and deserves more time to consider all the cultural impacts to this iconic symbol of all cultural connections including but not limited to the genealogical connections, and the spiritual connections to all of the deities in the Hawaiian cosmos and to the kanaka maoli world view." Additionally, SHPD recognizes Maunakea's place in Hawaiian navigation as "the first sighting for voyaging canoes to arrive safely to our islands in the middle of the Pacific [and] a significant part of the Pacific Rim mythological connections to all the Pacific Rim." SHPD recommends:
    - An assessment of buildings no longer functional be done before building new structures or "perhaps no more development on this sacred mountain";
    - access for cultural practitioners be clearly addressed and defined;
    - the entire summit of Maunakea be treated as one traditional cultural landscape and not as a piecemeal analysis of just the Science Reserve and that;
    - more community outreach occur for all cultural impacts on the summit and the proposed area to properly assessed—see the list of contacts in the MCMP.
- OHA, responding in a letter dated January 9, 2009 (Appendix B), acknowledges the different perspectives on Maunakea as a spiritual, sacred place, home to "wao akua" (dwelling, place of the gods) and the place where the presence of numerous ahu and iwi kūpuna provide silent testimony that generations of Hawaiians have worshipped and buried loved ones "at the highest point possible to rest in peace." The "life sustaining waters known as Kanekawaiola…contribute to a healthy natural environment, which in turn allow man to thrive." The letter describes the 40-year debate surrounding the development of Maunakea and recommends that the current proposed TMT Observatory Project study be viewed in context of this long history to "consider the overall impacts of development on Mauna Kea." OHA suggests several parties for consultation and is currently reviewing the Hale Pōhaku Mid-Level Support Facilities Project area information to determine whether they will provide additional comments.

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Appendix A Executive Summary Copied from Maly and Maly (2005:v-viii)

Executive Summary

At the request of Stephanie Nagata, on behalf of the University of Hawaiʻi-Office of Mauna Kea Management, *Kumu Pono Associates LLC* undertook research, compiled a detailed collection of archival-historical records, and conducted oral history interview with *kūpuna* and elder *kamaʻāina*, pertaining to the *ahupuaʻa* (native land divisions) of Kaʻohe, Humuʻula and neighboring *ʻāina mauna* (mountain lands) of Mauna Kea, on the island of Hawaiʻi. This work was undertaken as a part of ongoing archival and oral historical research conducted by *Kumu Pono Associates LLC*, since 1996, and builds upon the accounts published by Maly in 1997, 1999, 2002, and 2003. The study is multifaceted, and includes detailed verbatim accounts and descriptions of Mauna Kea, the larger Humuʻula-Kaʻohe lands, and *ʻāina mauna*, covering the periods of Hawaiian antiquity and traditions, to first-hand accounts of travel on and around Mauna Kea, dating from the early 1820s to the 1960s.

One of the primary goals of this study has been to bring a significant collection of historical resource material, describing – native Hawaiian traditions, traditional and customary practices and beliefs; early descriptions of the landscape, land use, and access; changes in the environment; efforts at conservation of the mountain landscape; and the events leading to development of observatories on Mauna Kea – into one manuscript. Such a manuscript will provide readers with access to the diverse, and at times, difficult to locate, historical narratives that document the cultural landscape, and history of land use on Mauna Kea. It being believed that this information may in turn serve as a platform for informed discussions – in the field of cultural and historical resources – in planning for the future well-being of Mauna Kea as a cultural, natural, and scientific resource.

Because of the nature of the Hawaiian system of beliefs and land management, this study looks not only at the upper regions of Mauna Kea, but also at the lands which lie upon the slopes of Mauna Kea. In the traditional and historical setting, the people living on the lands which rested upon, or even viewed Mauna Kea, shared ties to the upper mountain regions as will. The historical records – including oral testimonies of elder *kamaʻāina* of the mountain lands – provide readers with detailed descriptions of traditional and customary practices; the nature of land use, and the types of features found on the mountain landscape; and early efforts in conservation on Mauna Kea and the adjoining *ʻāina mauna*. The desciptions of land use and subsistence practices range from antiquity to the 1970s, and represent the knowledge of generations of life upon the land.

It is important to note that in the summit region of Mauna Kea (from approximately 11,000 feet and above) and on the lower mountain slopes are found several features named for, or associated with Hawaiian gods and deity. These associations are indicators of Mauna Kea's place in the cultural and history of Hawai'i as a scared [*sic*] landscape. With each part contributing to the integrity of the whole cultural, historical, and spiritual setting.

Through the collection of historical-archival texts and oral history interviews, we have found that a wide range of traditional knowledge and practices, including, but not limited to the following, are described for Mauna Kea and the adjoining *'āina mauna*:

- **Mauna Kea** - though simply translated as "White Mountain" since at least 1823, the name, Mauna Kea is also known in native traditions and prayers as Mauna a Wākea (Kea), "The Mountain of Wākea." It is the first-born mountain son of Wākea and Papa, who were also progenitors of the Hawaiian race. Mauna Kea is symbolic of the *piko* (umbilical cord) of the island-child, Hawai'i, and that which connects the land to the heavens.
- **Pu'u o Kūkahau'ula**[1], named for a form of the god Kū, where the *piko* of new-born children were taken to insure long life and safety. This practice is still participated in at the present time.
- **Waiau**, named for the mountain goddess, Waiau (Ka piko o Waiau), and home of the *mo'o* (water-form) goddess Mo'o-i-nanea. Place where *piko* of newborn children were taken to ensure long life; and from which *"ka wai kapu o Kāne"* (the sacred water of Kāne) was collected. These practices are still participated in at the present time.
- **Pu'u Poli'ahu**[2] and **Pu'u** Līlīnoe, named for, and the abode of goddesses of Mauna Kea.
- In 1823, the first missionary party to visit the summit of Mauna Kea learned from the natives that it was "the abode of the gods," and none could be induced to travel to the summit (Goodrich in Ellis, 1963:292).
- *Heiau* and *'ahu* – ceremonial sites, shrines, and places where *mele* (chants and offerings) were presented.
- *'Ah*u – stone mounds as land markers.
- *Ana* and *lua kā ko'i* (caves and quarries from which stone was harvested for making tools).
- *Ilina* (burial features) extending from the summit to the lowlands. Specific mention is made in several important historical accounts – recorded by both native witnesses and non-Hawaiians – of the presence of burials in the *pu'u* and summit plateau of Mauna

[1] The name of Pu'u o Kūkahau'ula is the traditional name of the summit cluster of cones on Mauna Kea, appearing in the native accounts and cartographic resources until ca. 1932. The recent names, Pu'u Wekiu, Pu'u Hau'oki and Pu'u Haukea, have unfortunately been used since the 1960s (since the development of astronomy on Mauna Kea), and have displaced the significant spiritual and cultural values and sense of place associated with the traditional name, Pu'u o Kūkanhou'ula.

[2] The place name Poli'ahu, was recorded in native texts (cf. Kamakau, 1961 in this study), and as a part of Boundary Commission proceedings in 1872 (in this study); it was also widely documented as the name of the primary goddess of Mauna Kea. The specific usage of the place name "Puu Poli'ahu" (also referred to a Peak A), was apparently given to the present-day location in 1892, by W.D. Alexander, commemorating the goddess, Poli'ahu (cs. Alexander and Preston, 1892-1893, in this study).

Kea. The remains of individuals who share ties to Mauna Kea are still taken to the various *puʻu* on Mauna Kea for interment.

- Native trails – portions of which, on the ascent to the summit, and around the base of Mauna Kea, are overlaid by modern routes of access.
- Shelters and habitation caves.
- Resource collection sties.
- Later features, dating from the middle 1800s, including pens – such as **Kulaka**, on Humuʻula above Puʻu ʻŌʻō; and **Aiakala**, in Kaʻohe, above the Puʻu Nanahu section of the mountain – walls and fence lines.
- Stone and wooden houses.
- Water collection and storage facilities;
- Bird hunting blinds – in the form of single, double or tri-sided stone walls; former garden plots; and other ranch "support" features.

Another facet of this study, was a review of native lore associated with traditional knowledge of the heavens. While we have uncovered no specific archival references to native astronomy on Mauna Kea, the association of the gods and deities whose forms are seen in the heavens and whose names are commemorated at locations on Mauna Kea is significant. We have found, that as is the case in all areas of Hawaiian life, the traditions, customs and practices associated with the *ʻoihana kilokilo* (astronomy) and *kilo hōkū* (observing and discerning the nature of the stars) were deeply tied to the spiritual beliefs of the Hawaiian people. The stars are physical manifestations of the gods who created the heavens, earth, and humankind, or are body-forms granted to select individuals or beings of nature (Malo, 1951 and Beckwith, 1951). The combined writings of native and foreign historians on this subject – recorded between the 1830s to 1935 – provide us with a list of more than 270 Hawaiian names for stars (not including alignments of stars which marked the heavens and pathways of traditional navigators).

Also, of importance in discussions regarding modern astronomy on Mauna Kea, the narratives cited in this collection provide readers with first-hand accounts – from archival documents and oral history interviews – of the early days of astronomy on the mountain, including the thoughts and recommendations of the pioneer scientists, responsible agencies, and community members on the Island of Hawaiʻi, in regards to use and limitations of Mauna Kea. An example of the kind of information recorded by the early scientists and community on the island of Hawaiʻi, between 1964 to 1980, was the development of telescope facilities on Mauna Kea should be carefully limited – by 1980, the recommended number being six observatories.

Historical Land Use on the Mountain Lands

As early as the 1820s, introduced cattle, sheep, goats, and wild dogs had made their way up to the mountain lands, and were bothersome to those who traveled the *ʻāina mauna*. In 1834, Scottish naturalist, David Douglas was killed by a wild bullock at Keahua-ai (now called Douglas Pit or Kaluakauka) near the boundary of Humuʻula and Laupāhoehoe. By 1850, the natural-cultural landscape of the *ʻāina mauna* was being significantly altered by the roving herds of wild bullocks, sheep and other ungulates, and ranching interests were being formalized in the region. In 1857, the Crown and Government mountain lands of Humuʻula and Kaʻohe – including the summit of Mauna Kea – were leased to Francis Spencer and the Waimea Grazing and Agricultural Company, which established ranching stations and operations around the mountain lands. Portions of the land of Piʻihonua were leased to native bird hunters in the middle 1860s, and subsequently to native and foreign bullock hunters. As a result, Humuʻula and the larger *ʻāina mauna* have been intensively ranched for more than 150 years.

Because hunting, and subsequently ranching of bullocks, cattle and sheep were the primary historic activities on the mountain lands, areas once forested soon became open pasture land. While the first formal lease of Humuʻula and Kaʻohe was issued in 1857 (Keoni Ana to F. Spencer), it was Samuel Parker and Parker Ranch that held the longest lease on the Humuʻula and Kaʻohe mountain lands. In between 1900 to 2002, their leases extended around Mauna Kea to the Puʻu Huluhulu vicinity, and for a period, the leases also included portions of the ʻĀina Hou lands. The Parker Ranch interests initially focused on sheep ranching in the Humuʻula-Kalaiʻeha section, but in 1964, the ranch terminated it's [*sic*] sheep program. Cattle operations were maintained till the end of the Parker lease in August, 2002.

Today, limited ranching of cattle is continued on the lands extending from Humuʻula to Hānaipoe, Pāʻauhau, and the Parker Ranch lands – the Humuʻula section being worked under a permit by the Department of Hawaiian Home Lands, and leases from the State of Hawaiʻi. While the Humuʻula section is still partially grazed, some 6,000 acres between the Puʻu ʻŌʻō and Puʻuloa, have succumb to an infestation of the introduced gorse (first recorded on the land in 1892), which has had little maintenance since ca. 1980.

As early as 1831, portions of theland of Piʻihonua Uka and neighboring forest lands were being worked by Daniel Castle, and later, by the Castle and Hitchcock brothers for lumber milling and bullock hunting operations. Subsequently by the 1860s, native lessees were granted the right of hunting in the Piʻihonua uplands. Then in 1887, the *ahupuaʻa* of Piʻihonua (everything form above Hilo Town to the upland boundary with Humuʻula) was leased to John Timoteo Baker, who undertook ranching operations in Piʻihonua in the 1890s.

Prior to Baker's lease, the Puu Oo Ranch Station had been established, with its buildings developed as part of the Humuula Sheep Station Company; this due to an error in locating the boundary between Humuʻula and Piʻihonua. In 1896, the boundary matter was settled, and Baker maintained cattle and livestock ranching operations in the area. Baker sold his lease to W.H. Shipman in 1899, which was followed by the sale of a 40 acre parcel – the Puʻu Oo Ranch headquarters – in Patent Grant No. 8970, to W.H Shipman, In 1902, Shipman secured leases on the lands of Pāpaʻikou, Makahanaloa and other Hilo District lands, which were incorporated into the Puʻu Oo ranching operation. W.H. Shipman, Limited, sold its interest in the Puʻu ʻŌʻō parcel in the 1970s, and it remains in prvate ownership to the present day.

Early leases of the Kaʻohe mountain lands date back to 1857 (Keoni Ana to F. Spencer), and the operations of Francis Spencer's Waimea Grazing and Agricultural Company. The lease took in all of the mountain lands (to the summit of Mauna Kea), across Kaʻohe to its' Mauna Loa boundary. Activities were all tied to sheep and cattle ranching. Subsequently, in 1870, the lease was acquired by Parker Ranch, which held most of the Kaʻohe mountain lands until their reomoval in 1905 for the Mauna Kea Forest Reserve, and later withdrawals as a part of the Pōhakuloa Military installation in 1956 (Governor's Executive Order No. 1719; and Presidential

Executive Order No. 1167). Portions of the land of Ka'ohe, generally those on the northern (Waimea) side of Mauna Kea, are still grazed by Parker Ranch. The land of Ka'ohe IV (the Pōhakuloa section), were turned over to the United States Army, and have been used for military training operations since that time.

The summit of Mauna Kea, situated in the *ahupua'a* of Ka'ohe, was noted as a site of importance for modern astronomical observations by the Pendulum Party of 1892. In 1964, the first modern observatory was built on top of Pu'u Poli'ahu. By 1965, the National Aeronautics and Space Administration (NASA) and the University of Hawaii initiated their program *"to exploit the exciting potentialities of the Mauna Kea site for astronomical purposes"* (cf. Newell to Hiatt, Feb. 16, 1965, in this study). In 1967, the University of Hawaii Institute for Astronomy was founded, and in 1968, the Board of Land and Natural Resources leased the entire summit of Mauna Kea to the University by Lease No. S-4191. While the practice and activities associated with astronomy on Mauna Kea represent the shortest of the periods of history and land use described in this study, its forty-one years (at the time of this writing) in the summit region of Mauna Kea, also represent the period of most significant changes in the natural and cultural landscapes on the mountain.

Archival Resources of the Present Study

Records cited – many as verbatim transcripts, allowing readers to understand the full context of the accounts as meant by the original authors – include native accounts translated form Hawaiian language sources; the records of Kingdom and Government agencies; journals of historic visitors; records of the lessees and ranching operations on the mountain lands; and narratives from scientific expeditions to Mauna Kea through the 1960s. There are also cited, a number of the early letters by participants in the development of astronomy on Mauna Kea, dating from 1963 to 1980.

Archival-historical resources were located in the collections of the Hawai'i State Archives, Survey Division, Land Management Division, and Bureau of Conveyances; the Bishop Museum Archives; the Hawaiian Historical Society; Universtiy of Hawai'i-Hilo Mo'okini Library; private family collections; the Parker Ranch & Paniolo Preservation Soceity (PPS) collections; the National Archives and Records Administration, and NOAA Central Library; the Houghton Library-Harvard; the USGS Central Library, Denver; the Hawaiian Historical Society; the Hawaiian Mission Children's Society Library; the Hilo Public Library; the Archives of the Institue for Astronomy; and in the collection of *Kumu Pono Associates LLC*. The oral history interviews cited in this study represent selected interviews conducted by Maly between 1999 to 2005, and reflect the recollections of elder native Hawaiians and *kama'āina* of lands of the *'āina mauna*. The interviewees ranged in age from their 60s to 90s, and in their stories they describe life upon the land, practices associated with travel and work on the mountain lands, and the early days of astronomy on Mauna Kea.

Appendix B Office of Hawaiian Affairs Letter

COPY

PHONE (808) 594-1888 FAX (808) 594-1865

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPI'OLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813

HRD08/3874B

January 9, 2009

Lehua Ka'uhane
Cultural Surveys Hawai'i
P.O. Box 1114
Kailua, Hawai'i 96734

RE: Cultural Impact Assessment consultation
Thirty Meter Telescope project
Mauna Kea, Ka'ohe Ahupua'a, Hāmākua District, Hawai'i Island
Tax Map Key: (3) 4-4-015:009 and 012

Aloha e Lehua Ka'uhane,

The Office of Hawaiian Affairs (OHA) is in receipt of your December 4, 2008 letter initiating consultation and seeking comments ahead of a cultural impact assessment (assessment) for the proposed construction and operation of the Thirty Meter Telescope (TMT) project. Based on the information within your letter the proposed TMT is an optical-infrared telescope and would be situated on an estimated 4 acres of presently undeveloped land within the 525-acre Astronomy Precinct of the Science Reserve near the summit of Mauna Kea.

From one perspective, the summit of Mauna Kea is a wao akua, home to deities such as Lilinoe, Kukahau'ula, Poli'ahu and Waiau to name but a few. This is the point where Papa and Wakea meet in the physical world. It is Mauna Kea who stops the rainclouds which provide pristine life sustaining waters known as Kanekawaiola. These waters contribute to a healthy natural environment, which in turn allows man to thrive. The numerous ahu and iwi kūpuna known to be situated in the summit area provide silent testimony that generation upon generation of Hawaiians have respected their gods and taken loved ones to the highest point possible to rest in peace.

From another perspective, Mauna Kea is a unique astronomical observation site. The dry and stable atmosphere in the summit area results in a proportion of clear nights that is among the highest in the world. This ideal astronomical atmosphere allows for observation of the faintest galaxies at the very edge of the observable Universe. For these reasons, Mauna Kea now hosts

Lehua Ka'uhane
Cultural Surveys Hawai'i
January 9, 2009
Page 2

the world's largest astronomical observatory with telescopes operated by astronomers from eleven countries.

In the forty years that have passed since the first telescope was constructed, the debate surrounding the continued development on Mauna Kea has intensified and the divide between the above mentioned perspectives has not changed. The proposed TMT project should be viewed as one part of this long history. With this in mind, your assessment should not only be focused on the proposed TMT project, but also consider the overall impacts of development on Mauna Kea.

OHA recommends that consultation occur with the following individuals and organizations who may be willing to share their thoughts with you: Kealoha Pisciotta, Clarence Ching, Reynolds Kamakawiwo'ole, Ke'alakahi Meyers, the Royal Order of Kamehameha I, KAHEA, the Edith Kanaka'ole Foundation, Kahu Ku Mauna and the ʻImiloa Astronomy Center. Please remember that this list is not all encompassing and we are sure you will identify additional individuals and organizations as you move forward with your consultation process.

OHA hopes to continue working with you to develop a paradigm shift in assessments which will truly identify the impacts proposed undertakings will have on cultural resources and traditional practices. OHA respectfully maintains the position that all parties bear a responsibility to work towards building successful working relationships with individuals, organizations and communities throughout Hawai'i which will result in a true understanding of what resources and practices are important to the Hawaiian people.

Thank you for initiating consultation at this early stage and we look forward to the opportunity to review the draft assessment and provide additional comments. Should you have any questions, please contact Keola Lindsey, Lead Advocate-Culture at (808) 594-1904 or keolal@oha.org.

ʻO wau iho nō me ka ʻoiaʻiʻo,

Clyde W. Nāmuʻo
Administrator

C: OHA-East and West Hawai'i CRC Offices

Appendix C Written Testimony of Kealoha Pisciotta

Kealoha Pisciotta
President
Mauna Kea Anaina Hou
P.O. Box 5664
Hilo, Hawai`i 96720
Tel: 808.968.7660

Hallett Hammatt, President
Cultural Surveys Hawai`i, Inc.
P.O. Box 1114
Kailua, Hawai`i 96734

DATE: 3-14-09

RE: Cultural Impact Statement for the Thirty Meter Telescope Project
Cultural Surveys Hawai`i, Inc., Kailua Hawai`i

Aloha Pumehana Hal and Auli`i,

I wish to thank you very much for your work on a Cultural Impact Statement (CIS) for the TMT Telescope Project, as well as your efforts to protect Mauna Kea, its sacred landscape and resources. As I am sure you are already aware, Mauna Kea has been the subject of extensive litigation over the last ten (10) years. In 2003 a federal court case was brought by OHA against NASA –that resulted in NASA being ordered to comply with the National Environmental Policy Act (*Please see*, Civil No. 02-0027 SOM BMK -- Office of Hawaiian Affairs v. Sean O`Keefe, in his capacity of Administrator, National Aeronautics and Space Administration et al.).

In 2007, the Third Circuit Court case (*Please see*, Civil No. 04-1-397 – Mauna Kea Anaina Hou *et al.*, v. State of Hawai`i *et al.*). In the case against NASA, I was a plaintiff witness testifying with regards to Mauna Kea sacred resources and associated customary and traditional practices. In the state's Third Circuit Court case, Mauna Kea Anaina Hou was a primary litigant along with the Royal Order of Kamehameha I, Moku O Mamalahoa, Heiau Helu `Elua (represented by Paul K. Neves), the Sierra Club Hawai`i Island Chapter (represented by Debbie Ward, and Nelson Ho), individual Practitioners Clarence Ku Ching and Hank Fergerstrom. Both cases (i.e. federal and state) the courts found in favor of the people, ruling specifically against the University, NASA and the State's BLNR.

Currently, our Third Circuit Court case is in the Intermediate Court of Appeals (ICA). The University Institute for Astronomy (UHIFA) filed the appeal seeking to have the Third Circuit Court Judge Glenn S. Hara's judgment overturned by the higher court. In response to the UHIFA appeal our lawyers (Alston, Hunt, Floyd and Ing) filed a cross appeal under the Private Attorney General Doctrine (PAGD), in short the PAGD, is a law that permits any party (private or public) that defends the public interest in a court of law (i.e. getting a

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Mar 23 09 01:11p Hulii Mitchell 808-965-6582 p.2

Kealoha Pisciotta
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state agency to follow its own rules etc.) to request the court award them their attorney fees and courts costs (or in our case returned to our lawyers.). Apparently, the UHIFA believes only their lawyers should be paid using tax dollars even when they loose and were found to be in violation of state law.

For the above legal reasons, I must request a few things from you both. First, the comments provided in section I (legal disclaimer information), must be included in full in the CIS if my name and testimony is to be used in the CIS.

I. Legal Disclaimer Information

It is my understanding that Cultural Surveys Hawai`i, Inc. (CSH) is performing a CIS pursuant to state law for the Thirty Meter Telescopes. It is also my understanding that this will not be used for any other purpose(s). I ask this because in the past and even the present our testimonies have been used in various documents for various purposes without our express consent. Therefore, any information provided by me in the interview with you for CSH, may be used only for the purposes stated, and may not be used for anything other purpose with out my express written consent.

I do not support the TMT project. I do not support the project, first, because the TMT project will exceed the carrying capacity of Mauna Kea, including the number and size of astronomical facilities legally permitted on Mauna Kea. The BLNR set a legal limit on the number of telescopes (also a limit on size and height of astronomical facilities), in the 1983-85 Mauna Kea Science Reserve Complex Development Plan. The BLNR limit is thirteen (13), that is eleven (11) major and two (2) minor telescopes. The 1995 plan while a plan meant to override the BLNR's 1983-85 plan, directs all astronomy related uses (and limits) to continue to comply with the 1983-85 BLNR plan. Therefore, the TMT may not be permitted under the current legal constraints provided in the BLNR rules and regulations.

The TMT has received significant federal funding and is a federal undertaking pursuant to the National Environmental Policy Act (NEPA), therefore, the TMT must begin NEPA and National Historic Preservation Act (NHPA) section 106 consultations. A state level CIS will not suffice under federal law. Furthermore, the TMT will have substantial, significant and adverse impact on the cultural and natural resources of Mauna Kea. This is so, because the cumulative impacts on the cultural and natural resources where previously evaluated in the NASA federal EIS (please see NASA EIS cumulative impact section). The NASA's EIS is the first and only federal EIS that has ever been conducted on the resources of Mauna Kea. More importantly the BLNR may not

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approve projects with significant and adverse impacts on the cultural and natural resources in any Conservation District.

I am providing the following testimony as a Native Hawaiian traditional and cultural practitioner with cultural and lineal ties to Mauna Kea. I can speak only from my own house of knowledge regarding traditional and customary practices on the various areas of Mauna Kea. While I absolutely appreciate the funds provided ($100.00) for my testimony, I personally do not take funds for my work for Mauna Kea, the funds you have provided to me will be sent to our legal team and or KAHEA to help with the Mauna Kea work. I appreciate the offer, and I believe this is important since many people are not paid for their expertise—it is only my personal policy not to receive funds for my work for Mauna Kea.

I could not complete the Hale Pohaku (HP) area comments, because the maps provided and project descriptions are unclear and inadequate. For example, the language used in the project description does not match the maps provided and the maps did not have color keys. The maps should include color indication lines of where the HELCO power lines will be located and what lands in particular at HP the TMT wants to use and for what purpose. Because Mauna Kea is a burial ground any land altering activities must be clearly delineated—in order to prevent impact to the burial(s).

We recommend you and your staff review the attached (1) OHA's position (3/9/09) on the UH-UHIFA's "Comprehensive Management Plan"(UH CMP), (2) CMP Draft EA and (3) Joint plaintiff testimonies in opposition to the UH-UHIFA Bills seeking to transfer authority and control of Mauna Kea to the UH-UHIFA.

II. **Additional Cultural Concerns**

The additional cultural concerns regarding the TMT project include but are not limited to the following:

1. Destruction of the landscape is the primary threat and "cultural concern" on Mauna Kea (because the landscape once destroyed can never be fully restored). The protection and prevention of the cultural and natural resources from further destruction and degradation cause by further construction of telescopes on and around the summit of Mauna Kea, is the greatest of the "cultural concern". Judge Hara, found the resource that needs to be protected is Mauna Kea itself, the entire summit, and not

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simply protection on a project by project basis. Conducting a CIS only for the TMT project is problematic and violates the circuit court ruling.

2. Mauna Kea is a burial ground containing the `iwi of our most sacred and revered ancestors. The ground altering activities involved in the construction of many of the telescopes included digging many stories under ground as well and many stories above ground. Mauna Kea is considered the Wao Akua, and the meeting place of Papa and Wakea. The landscape is comprises of countless traditional and cultural practices and properties. It is a national landmark and eligible for listing on the National Historic Register, as a historic district, a conservation district and NAR.
3. These rights and resources are what state and federal law protect not development. Conservation is the primary purpose of the Mauna Kea Conservation District, not development. Development therefore is not a guaranteed or protected land-use activity on Mauna Kea. Development in other words is a privilege specifically dependent on conservation and therefore, is not a right.
4. The historic properties that are of importance to Native Hawaiians and possess traditional cultural significance derived from associated cultural practices and beliefs (i.e. Traditional and Cultural Properties) of Mauna Kea include but are not limited to the following:

    1. The summit region from approximately 6,000 feet elevation to the Kukahau`ula (summit), including burial and burial complexes
    2. Many of the Pu`u [cinder cones], associated burials and kinolau;
    3. View plane (including mauka-makai and makai-mauka view planes)
    4. Mountain landscape in navigational traditions;
    5. Lake Waiau and adjacent cinder cone;
    6. Numerous Trail systems.
    7. Snow, ice and water collected for medicinal and ceremonial purposes, and kinolau.

The cluster of pu`u (cinder cones) forming the Summit of Mauna Kea have been identified by the State Historic Preservation Division ("SHPD") of the

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Department of Land and Natural Resources ("DLNR") as a **Historic Property and the summit region of including most of the Mauna Kea Science Reserve has been identified by SHPD as a Historic District**. Both Historic Properties are eligible for listing on the National Historic Register.

Generally a historic district is defined as a historic property that '...possesses a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development.

The Mauna Kea Summit as a "cultural landscape" has been determined eligible for the National and State Register of Historic Places under multiple criteria including cultural significance to the native Hawaiian People (cf. letter of D. Hibbard to R. Evans, September 12, 1991). As a result, archaeologists with DLNR-SHPD have referred the summit region of Mauna Kea as a "ritual landscape," with all of the individual parts contributing to the integrity of the whole summit region. (pers. comm. P. McCoy and H. McEldowney; Group 70 meetings of September 10, 1998). *Id* Citing McCoy and McEldowney).

The historic district of Mauna Kea incorporates virtually the entire Science Research area, extending beyondthe limits of the entire reserve, and also portions of the Natural Area Reserve and the district includes 93 archaeological sites, three landscape features which qualify as traditional cultural properties, including but not limited to the Mauna Kea Adze Quarry Complex, encompassing over 76 shrines of varying complexity, four are adze manufacturing workshops, burials.

The largest of the three traditional and cultural properties, 'Kukahau`ula refers to the cluster of three pu`u that merge and collectively make up the summit of Mauna Kea...The second property, 'Waiau' refers to the small lake and adjacent pu`u situated southwest of the summit and within the Natural Area Reserve. The third property, 'Lilinoe' refers to a pu`u situated southeast of the summit and within the Science Reserve.

Cultural and Social impacts must be considered

The social impacts, those impacts that specifically impact Native Hawaiian cultural and religious beliefs relating to the sacred landscape and the Temple-Mauna Kea, must be considered. For the Native Hawaiian People Mauna Kea is home of Na Akua (the Divine Deities), Na 'Aumakua (the Divine Ancestors), and the meeting place of Papa (Earth Mother) and Wakea (Sky Father)

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who are considered the progenitors of the Hawaiian People. Mauna Kea, it is said, is where the Sky and Earth separated to form the Great-Expanse-of-Space and the Heavenly Realms. Mauna Kea in every respect represents the zenith of the Native Hawaiian people's ancestral ties to Creation itself.

The upper regions of Mauna Kea reside in Wao Akua, the realm of the Akua-Creator. It is also considered the Temple of the Supreme Being.

There are over 93 Astronomical Observatories and Observatory complexes around the world in which to do world class astronomy. Mauna Kea is already considered a world premier site for astronomy work, and houses the largest and most advanced observatories in the world. However, **TMT must consider that Mauna Kea represents the only place on earth where the special and unique Native Hawaiian ritual and ceremonies are conducted**. TMT must consider the impacts to the Native Hawaiian Communities cultural and religious practices. The TMT must also consider the socio-economic impacts this project will have on the Hawaiian Community. The U.S. Civil Rights Commission statistics reports that there are approximately 6000 pure blooded Hawaiian people left in the world today, and their projected survival is only through the year 2044. the Commission further reports that approximately 54% of native Hawaiian people (those with 50% or more blood), make less than 9000 dollars per year.

Cumulative Impacts: Hydrology, Hazardous Materials and Sewage Treatment

TMT must consider and evaluate the impacts from the use, storage and handling of hazardous materials, and sewage upon the Mauna Kea aquifer system (water shed lands of Mauna Kea). Mauna Kea is the principle aquifer and water shed for Hawai`i Island.

The waters, ice and snow collected from Mauna Kea are used for Native Hawaiian healing and other ritual and ceremony.

There is serious concern also for the protection of the waters of Lake Waiau, and the other Pu`u (cinder cones) that also pool water. The Lake is a Traditional Cultural Property, and is home to deities. Waters are harvested for ceremony from Lake Waiau, and other pooling waters.

The TMT is obligated to ensure the Public Trust doctrine is protected.

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During the NASA EIS process, copies of the over 10,000 Material Safety Data Sheets (MSDS) we received by subpoena in the State CCH. The TMT must consider the impacts of these hazardous materials on the TCP and associated Native Hawaiian practices (i.e. collection of snow, ice and snow) and should also consider the watershed conditions after thirty years of sewage and hazardous material release into the ground of Mauna Kea.

According to the Material Safety Data Sheets ("MSDS") received, the following Observatory/Telescope Facilities were found to use "elemental" mercury. The University Of Hawai`i 88 inch or 2.2 meter Observatory ("UH88") (Exhibit F-64), The Canada-France-Hawaii Telescope ("CFHT") (Exhibit F-62), The William M. Keck Observatory I and II ("WMKO") (Exhibit F-61), The NASA Infrared Telescope Facility ("IRTF") (Exhibit F-60), and The United Kingdom Infrared Telescope ("UKIRT").

There have been 3 Mercury spills reported at the William M Keck Telescope. August 10, 1995, September 15, 1995, and November 6, 1995. There have been 7 recorded spills from other facilities over the years.

The Hazardous materials listed below were found to be stored and used at the Observatories/Telescope Facilities they include but are not limited to, the following:

Hydrochloric-Acid (Note: not listed in JCMT Exhibit F-66)
Potassium Hydroxide
Hydraulic, Motor, and Lubricating Oils
Pesticides
Insecticides
Calcium Carbonate
Sulfuric Acid
Diesel, Jet Fuel, and Unleaded Gasoline
Ethylene Glycol
Kerosene
Methyl Ethel Keytone
Toluene
Paints, Thinners and Solvents
Rush Treatments and Inhibitors
Carbon Disulfide
Elemental Mercury

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I hope this information helps. If you have any further questions please feel free to contact me at the contacts above.

Mahalo for your time, consideration, hard work and Aloha for Mauna Kea,
In Aloha I remain,
Kealoha Pisciotta

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Appendix D Resolution on TMT Observatory (Isaac Harp)

Resolution in Opposition to Thirty Meter Telescope (TMT), as amended, was adopted at the duly convened November 15, 2008 meeting of Na Kupuna O Moku O Keawe ("Na Kupuna") held at Kapa'au, North Kohala, Island of Hawai'i

WHEREAS, Na Kupuna states that the Hawaiian Kingdom was and remains a neutral independent nation, was a member of the Family of Nations until removed under false representation by the United States, and has Treaties with many major nations of the world, including the U.S., France and Great Britain. Here we list for the record those Treaties, Conventions, and other International Agreements of the Hawaiian Kingdom:

United States of America, December 23rd, 1826 (Treaty)
Great Britain, November 13th, 1836 (Lord E. Russell's Treaty)
France, July 17th, 1839 (Captain LaPlace's Convention)
France, March 26th, 1846 (Treaty)
Great Britain, March 26th, 1846 (Treaty)
Denmark, October 19th, 1846 (Treaty)
Hamburg, January 8th, 1848 (Treaty)
Agreement Touching Consular Notices (Danish and Hamburg Treaties), January 25th, 1848
United States of America, December 20th, 1849 (Treaty)
Sweden and Norway, July 1, 1852 (Treaty)
Tahiti, November 24th, 1853
Bremen, March 27th, 1854 (Treaty)
France, September 8th, 1858 (Treaty)
Belgium, October 4th, 1862 (Treaty)
Netherlands, October 16th, 1862 (Treaty)
Italy, July 22nd, 1863 (Treaty)
Spain, October 9th, 1863 (Treaty)
Swiss Confederation, July 20th, 1864 (Treaty)
Russia, June 19th, 1869 (Treaty)
Japan, August 17th, 1871 (Treaty)
New South Wales, March 10th, 1874 (Postal Convention)
United States of America, January 30th, 1875 (Reciprocity Treaty)
German Empire, 1879-80 (Treaty)
Portugal, May 5, 1882 (Provisional Convention)
United States of America, December 6, 1884 (Supplementary Convention)
Hong Kong, December 13th, 1884 (Money Order Regulations)

Universal Postal Union, March 21st, 1885 (Additional Act of Lisbon)
Japan, January 28th, 1886 (Convention)
Universal Postal Union, November 9th, 1886 (Ratification)
Samoa, March 20th, 1887 (Treaty)

WHEREAS, Na Kupuna states that the Hawaiian Kingdom continues to exist - as recognized by the Permanent Court of Arbitration at the Hague, Netherlands, that entertained the case of Larsen vs. Hawaiian Kingdom, an arbitration that the U.S. refused to participate in for fear of being cited by the Permanent Court of Arbitration as a belligerent occupier of Hawaiʻi;

WHEREAS, Na Kupuna - in the absence of an operating government of the Hawaiian Kingdom, and in the absence of a line of succession to a monarch (Hawai'i is a constitutional monarchy) – states henceforth that as recognized under international law, the elders of descendants of Hawaiʻi subjects are among the next in line of lawful authority having sole lawful jurisdiction over Hawai'i island. This is an adjunct of Hawaiian Kingdom law that continues, although the present U.S./State of Hawaiʻi regimes ignore international laws of occupation by applying their own fabricated laws rather than the laws of the occupied Hawaiian Kingdom. The current situation reflects intentional misrepresentation, deceit and fraud by the U.S./State of Hawaiʻi;

WHEREAS, Na Kupuna states that the so-called "ceded lands" are lands unlawfully taken from the Hawaiian Kingdom in 1893 and unlawfully "ceded" to the U.S. as part of the unlawful annexation of Hawaiʻi to the U.S. in 1898;

WHEREAS, Na Kupuna states that the so-called annexation of Hawaiʻi to the U.S. in 1898 is a myth, as the attempt was made by a "resolution" of the U.S. Congress - a domestic document having no legal significance outside of the boundaries of the sponsoring nation, the U.S. - and not by legally accepted treaty. Hawaiʻi was and remains a foreign nation to the U.S.;

WHEREAS, Na Kupuna states that the Republic of Hawaiʻi that allegedly "ceded" the Hawaiian Kingdom National lands to the U.S. had no title to those lands. There is no "chain of title" giving any degree of good and legal title to the Republic of Hawaiʻi;

WHEREAS, Na Kupuna states that the Mauna Kea Science Preserve – upon which numerous astronomical observatories have been built - is part of the so-called "ceded lands" of the State of Hawaiʻi;

ADDITIONALLY, following current U.S. law - a law that Na Kupuna disagrees with -- under Section 5(f) of the Admissions Act (1959) – the so-called "ceded" lands were transferred to the so-called "State" of Hawaiʻi "in trust," among other things, for the benefit of Native Hawaiians;

WHEREAS, Na Kupuna claims lawful jurisdiction and authority over these so-called "ceded" lands;

RECOGNIZING, the U.S. congress, in U.S. Public Law 103-150, dated November 23, 1993, states: *Whereas, the indigenous Hawaiian people never directly relinquished their claims to their inherent sovereignty as a people or over their national lands to the United States, either through their monarchy or through a plebiscite or referendum;*

WHEREAS, Na Kupuna suggests that the time line offered by TMT's sponsors, allowing 7-years for construction of the facility is grossly understated. Na Kupuna notes that litigation based on the Conservation District Use Application for the Keck Observatories Outrigger Telescope Project is on-going (7 years at the moment). Na Kupuna predicts a probable timeline for the TMT project of: litigation taking place on the Comprehensive Management Plan (CMP) that is in progress (estimated at 7 years), litigation on the TMT EIS (estimated at another 7 years - which will NOT take place concurrently with the CMP litigation), construction of TMT (if the project survives the 14 years of predicted litigation - of another 7 years) and 3 years for decommissioning. The total of 24 years - added to the present date of 2008 moves us into the year 2032 - leaving 1 year for operation of the TMT before termination of University of Hawaiʻi's general lease of the Science Reserve that terminates in 2033;

THEREFORE, Na Kupuna states that the $1.1 Billion budget for TMT, combined with costs of litigation, payment of Plaintiffs' attorneys fees, etc., will increase total costs for the TMT to over U.S. $5 Billion. This figure enormously exceeds any practical cost/benefit;

WHEREAS, Na Kupuna states that in recent years, as part of the process for permitting the Keck Observatories Outrigger Telescopes, that NASA generated an EIS that concluded that "past, present and 'reasonably foreseeable' future astronomical activities at the summit of Mauna Kea have had a substantial and adverse cumulative impact on the mountain's cultural resources.";

FURTHERMORE, while TMT attempts to disengage its project from the conclusions of the NASA EIS by stating that it is not a "federal agency" and thus not affected by conclusions of the NASA EIS, it is. TMT is a "federal agency" as it has applied for federal operational funds, or is expected to do so in the future;

FURTHERMORE, even if TMT were not a "federal agency," Na Kupuna believes that any EIS generated by TMT MUST, when considering the same or similar issues as the NASA EIS, come up with the same or similar conclusions;

FURTHERMORE, Na Kupuna believes that even if TMT is not a "federal agency," that BLNR (so-called "State" of Hawaiʻi Board of Land and Natural Resources), no matter what the conclusion of a proposed "State" EIS might be - that any and all incremental impacts attributed to the TMT would add further substantial impacts to the conclusions of the NASA EIS of "substantial and adverse cumulative impact ...," and MUST reject such an application for conservation use permit;

MOREOVER, in the event that the proposed TMT EIS results in a conclusion substantially different from NASA's EIS, Na Kupuna believes that the conclusion of NASA's EIS (of substantial and adverse cumulative impact) would be the effective determining factor that would attach to all present and proposed astronomy activities on Mauna Kea, including the proposed TMT permit application;

FURTHERMORE, Na Kupuna believes that in the case above, there is no alternate method to handle such potentially conflicting conclusions, but to adopt the conclusion (of the NASA EIS) that best protects the cultural resources, cultural practices, and environmental protections on Mauna Kea;

WHEREAS, Na Kupuna and its individual representatives (of the several districts of Hawai'i Island) maintain their cultural beliefs in the sacredness of Mauna Kea;

WHEREAS, the principals of TMT Corporation, the sponsors of this proposed telescope with a proposed budget of $1.1 Billion (U.S.) to be potentially situated on Area E of the Mauna Kea Science Preserve are the California Institute for Astronomy, the University of California and the Association of Canadian Universities for Research in Astronomy;

WHEREAS, Na Kupuna objects to the involvement of the Association of Canadian Universities for Research in Astronomy, as it is a foreign-based organization of a nation (Canada) that is a participant in the RIMPAC Naval Exercises held periodically in and around Hawaiʻi, where in the past, it has taken part in the bombardment of Hawaiian island targets, which are actions Kupuna Council continues to condemn;

FURTHERMORE, Na Kupuna further objects to the involvement of the Association of Canadian Universities for Research in Astronomy, as it is a foreign-based organization of a nation (Canada) that does not support Indigenous

Peoples (such as the Hawaiian people of Hawai'i) by refusing to vote in support of the recently passed UN Declaration of the Rights of Indigenous Peoples, which it now wants to use, in its hypocrisy, Hawaiian Indigenous lands - the so-called "ceded" lands - to build its telescope on;

FURTHERMORE, Na Kupuna objects to the TMT being sited on Area E of the Mauna Kea Science Reserve as it will begin (and result in) the degradation of a pristine area of sacred Mauna Kea by necessarily building new roads and extending various pernicious infrastructure;

ADDITIONALLY, Na Kupuna believes that initiating construction in the currently pristine Area E will set a precedent for opening up this area to further construction of future observatories that will desecrate an increasingly larger area of the sacred temple;

FURTHERMORE, Na Kupuna believes that the power requirements of TMT will substantially squander the increasingly deficient power capacity of Hawai'i island - eventually mandating construction of new generating system capacity that will result in increasing the cost of citizens' electric bills, pro rata or otherwise;

ADDITIONALLY, Na Kupuna believes that situating the TMT where it is proposed, with its expected (approximately) 360 feet diameter dome (the ten meter Keck lenses have domes with a diameter of 120 feet), will be very detrimental to the observation and enjoyment of the natural beauty of Mauna Kea. This is especially so for observers from the South Kohala/Waimea area - where this dome - approximately three (3) times the diameter of the individual Keck domes - will be an extreme eyesore. The existing, and much smaller observatories on Mauna Kea already create an excessively ugly scene that is directly responsible for degrading the natural beauty of Mauna Kea;

WHEREAS, Na Kupuna states that the Mauna Kea lands are "conservation" lands of the so-called State of Hawai'i, and are administered and managed with priority as conservation lands;

WHEREAS, Na Kupuna believes that no comprehensive studies of the Insecta, Aves and Mammalia classes on Mauna Kea have been done. Members of Na Kupuna, for instance, have knowledge that there are other insects, other than the Wekiu bug, that at times inhabit Mauna Kea, including a number of spiders, lady bugs, etc. Members of Na Kupuna also suggest that the Hawaiian Hoary Bat (*Lasiurus cinereus semotus*) may be a visitor to the summit areas (the Science Reserve) of Mauna Kea. In addition, there is the report by Kealoha Pisciotta that at a ceremony held outdoors on the summit (a number of years ago when she was an employee on the mountain), that she observed a Hawaiian Hawk or 'Io (*Buteo solitarius*) circling directly above the summit;

WITH CONCERN, Na Kupuna inquires about the possible use of insecticides/pesticides in and around a possible TMT at Mauna Kea;

WHEREAS, Na Kupuna states that astronomy, whose participants enthusiastically consider their activity to be superior to all other uses on Mauna Kea, is, by law, only a sub-use of the conservation lands on Mauna Kea, not THE major use of Mauna Kea;

WHEREAS, Section 171 of Hawaiʻi Revised Statutes requires that fair market rent be paid for the lease of any of the so-called "ceded" lands;

WHEREAS, Na Kupuna has serious objections to past and present practices that allows lease rent paid by the University of Hawaiʻi (lessee - hereinafter "U.H") of the so-called "ceded" lands from the State of Hawaiʻi (lessor) for $1 per year;

HOWEVER, Na Kupuna states that if TMT wants to maintain a "legal and lawful" project under Section 171 of Hawaiʻi Revised Statutes in the highest ethical and legal standards, then even if not required by U.H. - a fair market lease rent should be voluntarily paid to the Board of Land and Natural Resources ("BLNR") as agent for the State of Hawaiʻi (to whom the rent is owed);

WHEREAS, Na Kupuna believes that while public lands are often set aside to public agencies for use in serving the public, subsequent transfer to 3rd parties outside of Hawaiʻi government, especially when the benefits go to foreign nations that are obtuse to the Indigenous peoples of Hawaiʻi, are, or should be, subject to fair market rents. This is especially so as fair market rents are statutorily mandated by Hawaiʻi Revised Statutes;

HOWEVER, Na Kupuna suggests that a fair market lease rent be 120% of proposed rents and viewing times that TMT would pay for a similar site in Chile. The additional 20% would make up for detriments (such as deficiencies for currency transactions, access to site, travel time, language, schools for employee children, standard of living,
utilities, TV, shopping, site amenities such as wind flow and lower altitude, cultural differences, transportation difficulties, living communities, etc.) that a Chilean location would necessitate;

WHEREAS, while BLNR continues to complain of not having sufficient budget for the management and administration of Mauna Kea, Na Kupuna believes that the statutory fair market lease rents could go far to remedy the financial straight-jacket that BLNR is currently saddled with, particularly in this time of U.S. and Hawaiʻi state financial instabilities;

WHEREAS, Na Kupuna also objects to other foreign-nation telescopes built on its sacred lands, including the Japan National Telescope and the Canada-France

Telescope. All telescopes built on Mauna Kea burden the Hawaiian Nation culturally and (by subsidy) economically by paying an insulting rent of $1 a year;

WHEREAS, Na Kupuna believes that the foreign-nation telescopes built on our sacred temple constitutes further unlawful occupation of our national lands and these telescopes should be deconstructed and rebuilt on the subject nations' own national lands;

THEREFORE, Na Kupuna believes that the Association of Canadian Universities for Research in Astronomy should join other similar agencies and/or organizations - to pursue astronomical facilities and projects in its own country;

FURTHERMORE, Na Kupuna states that the Hawaiian community, through the Hawaiʻi State Office of Hawaiian Affairs ("OHA"), is benefited by 20% of the $1 annual rent (from each observatory) - amounting to 20 cents per year;

FURTHERMORE, Na Kupuna states [that] with 13 observatories currently on Mauna Kea, that OHA's income from astronomy activities amounts to the ridiculous sum of a mere $2.60 per year;

WHEREAS, Na Kupuna states that with the inclusion of adaptive optics and interferometry - the twin Keck telescopes having an equivalent resolution of approximately 8 times the lens' effective diameter – or 80 meters - which when compared with the TMT (of a "single" lens of only 30 meters) - has almost 3 times TMT's resolving power. Other than TMT's light gathering ability - the resolution of the TMT is inferior when compared to the adoptive optic- and interferometry-assisted Keck telescopes and therefore have cost-effective issues;

MOREOVER, Na Kupuna believes that the cost/benefit ratio of TMT, when compared to such telescopes as the Keck's, is skewed to the side of inefficiency;

WHEREAS, Na Kupuna observes that Mauna Kea is positioned over one of the major aquifers of Hawaiʻi island and MUST be conserved and protected to insure that the life-giving water from this aquifer remains pure for future generations of Hawaiʻi Island;

WHEREAS, Na Kupuna believes that all water and chemicals taken to the summit of Mauna Kea in support of TMT's telescope operation, and all human wastes and trash produced, must be taken back down the mountain and disposed of properly. What goes up, must come down;

WHEREAS, as the term "Sustainable Astronomy" has been used relative to public relations materials supporting the construction of TMT, Na Kupuna requests a full and comprehensive definition for the term "Sustainable Astronomy;"

WHEREAS, Na Kupuna believes that it is a matter of U.S. policy that the American Indian Religious Freedom Act applies to Hawaiians' use of Mauna Kea and that in due respect and compliance, TMT must comply with its requirements;

"It is the policy of the United States, in furtherance of the policy established in the joint resolution entitled "Joint Resolution American Indian Religious Freedom," approved August 11, 1978 (42 U.S.C. 1996), to protect and preserve the inherent right of any Native American to believe, express, and exercise his or her traditional religion, including, but not limited to, access to any Native American religious site, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites."
NATIVE AMERICAN FREE EXERCISE OF RELIGION ACT OF 1993

Senate Bill 1021
Item Key: 4770

Introduced to 103rd Congress
May 25, 1993

* * *
American Indian Religious Freedom Act Amendments of 1994
A BILL

To assure religious freedom to Native Americans.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

* * *
SEC. 2.

It is the policy of the United States, in furtherance of the policy established in the joint resolution entitled "Joint Resolution American Indian Religious Freedom," approved August 11, 1978 (42 U.S.C. 1996), to protect and preserve the inherent right of any Native American to believe, express, and exercise his or her traditional religion, including, but not limited to, access to any Native American religious site, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites.

SEC. 3. DEFINITIONS.

For the purposes of this Act, the following definitions shall apply:

(1) AGGRIEVED PARTY.

--The term "aggrieved party" means any Native American practitioner, Native American traditional leader, Indian tribe, or Native Hawaiian organization [including Na Kupuna] as defined by this Act.

(8) LAND.--The terms "land," "lands," or "public lands" mean surface and subsurface land within the jurisdiction of the United States or the respective States, including submerged land of any kind or interest therein and all water and waterways occupying, adjacent to, or running through the land.;

WHEREAS, Na Kupuna recognizes that Native Hawaiians, especially the elderly, suffer very serious health issues relative to the general population of Hawaiʻi;

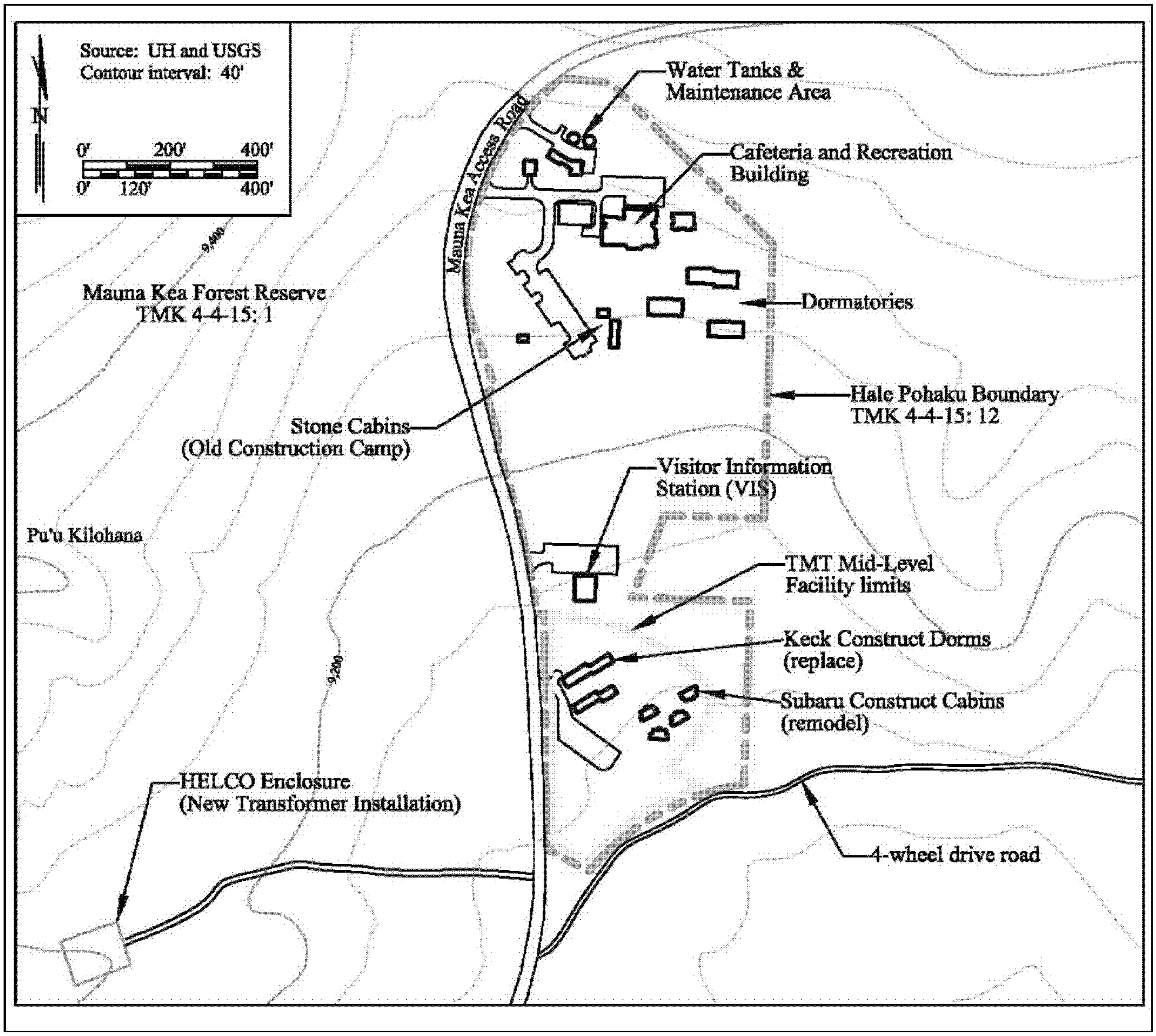
WHEREAS, Na Kupuna, on behalf of all kupuna (elders), Native Hawaiians and the general populace of Hawaiʻi Island, and the so-called State of Hawaiʻi, suggests that, if TMT is eventually permitted to build (after meeting all legal requirements and cultural concerns), although, hopefully, in an area other than Area E, that its Canadian partner,
Association of Canadian Universities for Research in Astronomy, advocate for and participant in a program to import pharmaceuticals from Canada - where pharmaceuticals can be acquired for a substantially lesser expense than in the U.S. - to be sold by licensed participating pharmacies for a set (minimal) markup, thereby significantly benefiting citizens' in their necessary healthcare;

NOW, THEREFORE, Na Kupuna O Moku O Keawe opposes the permitting and construction of the TMT and any other telescopes on the sacred mountain of Mauna Kea, Hawaiʻi Island, so-called State of Hawaiʻi. We also call for the removal of all telescopes and related equipment on the sacred mountain of Mauna Kea as these were never intended for Hawaiian cultural or religious practices.

DATED: November 15, 2008, at Kapa'au, North Kohala, Hawaiʻi Island,

Signed: Kihei Niheu   Witnessed: Isaac Harp

Appendix E Hale Pōhaku Mid-Level Support Facilities Map


Source: UH and USGS
Contour interval: 40'
N
0' 200' 400'
0' 120' 400'
9,400
9,200
Mauna Kea Access Road
Water Tanks & Maintenance Area
Cafeteria and Recreation Building
Dormatories
Mauna Kea Forest Reserve TMK 4-4-15: 1
Hale Pohaku Boundary TMK 4-4-15: 12
Stone Cabins (Old Construction Camp)
Visitor Information Station (VIS)
Pu'u Kilohana
TMT Mid-Level Facility limits
Keck Construct Dorms (replace)
Subaru Construct Cabins (remodel)
HELCO Enclosure (New Transformer Installation)
4-wheel drive road

DRAFT ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2 – APPENDIX E: ARCHAEOLOGICAL ASSESSMENT REPORT, AREA E

Thirty Meter Telescope Project

Island of Hawai‘i

Proposing Agency:
University of Hawai‘i at Hilo

Archaeological Assessment for the Thirty-Meter-Telescope (TMT) Observatory Project, Maunakea, Ka‘ohe Ahupua‘a, Hāmākua District, Hawai‘i Island TMK: [3] 4-4-015:009 por.

Prepared for

PB Americas, Inc.

Prepared by

Hallett H. Hammatt, Ph.D

Cultural Surveys Hawai‘i, Inc.

Kailua, Hawai‘i

(Job Code: MAUNAKEA 1)

May 2009

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Management Summary

Reference	Archaeological Assessment for the Thirty-Meter-Telescope (TMT) Observatory Project, Maunakea, Ka‘ohe Ahupua‘a, Hāmākua District, Hawai‘i Island TMK: [3] 4-4-015:009 por.
Date	May 2009
Project Number (s)	Cultural Surveys Hawai‘i Inc. (CSH) Job Code: MAUNAKEA 1
Investigation Permit Number	The fieldwork component of the archaeological assessment study was carried out under archaeological permit number 08-14, issued by the Hawai‘i State Historic Preservation Division / Department of Land and Natural Resources (SHPD/DLNR), per Hawai‘i Administrative Rules (HAR) Chapter 13-13-282.
Project Location	The proposed Project area is located on the northern plateau of the Maunakea summit area, within Area E of the Astronomy Precinct of the Mauna Kea Science Reserve. The survey area for the current study is depicted on the U.S. Geological Survey 7.5-Minute Series Topographic Map, Mauna Kea Quadrangle (1993).
Land Jurisdiction	The Mauna Kea Science Reserve is owned by the State of Hawai‘i, under the jurisdiction of the UH
Agencies	Hawai‘i State Historic Preservation Division / Department of Land and Natural Resources
Project Description	The proposed TMT Observatory Project involves the construction of a thirty meter diameter telescope and associated infrastructure on an approximately 5-acre site within Area E of the Astronomy Precinct. Minimally, land disturbing activities would include grading of the TMT Observatory site and Access Way and excavations associated with building construction and installation of subsurface utilities.
Project Acreage	5 acres
Area of Potential Effect (APE) and Survey Acreage	As the precise location of the 5-acre Project area was not yet determined, the survey area for this study included the entire approximately 36-acre Area E of the Astronomy Precinct. The area of potential effect (APE) is defined as the entire approximately 36-acre survey area.

Historic Preservation Regulatory Context	At the request of PB, CSH conducted an archaeological inventory survey investigation for the proposed TMT Observatory Project. Per the requirements of Hawaiʻi Administrative Rules (HAR) Chapter 13-13-276, the study was conducted to identify, document, and make Hawaiʻi Register of Historic Places (Hawaiʻi Register) eligibility recommendations for the survey area's historic properties. Because no historic properties were identified in the survey area, this investigation is termed an archaeological assessment per HAR Chapter 13-13-275-5. This archaeological assessment report was prepared to support the proposed Project's historic preservation review under Hawaiʻi Revised Statutes (HRS) Chapter 6E-8 and HAR Chapter 13-13-275. It is also intended to support any Project-related historic preservation consultation with stake-holding State or County agencies and interested Native Hawaiian and community groups.
Fieldwork Effort	The CSH field crew included: David W. Shideler, M.A.; Todd Tulchin, B.S.; Trevor Yucha, B.S.; and Lehua Kaʻuhane, B.A., under the overall supervision of Hallett H. Hammatt, Ph.D. Fieldwork was conducted on August 26, 2008 and required 4 person-days to complete.
Number of Historic Properties Identified	None
Effect Recommendation	No historic properties were identified within the approximately 36-acre survey area. Previously identified historic properties in the vicinity of the survey area were re-identified and confirmed to be outside of the survey area. CSH's effect recommendation for the proposed Thirty-Meter-Telescope (TMT) Observatory Project is "no historic properties affected."
Mitigation Recommendation	No historic preservation mitigation measures are recommended for the proposed TMT Observatory Project. The probability of any unmarked burials or human skeletal remains being present is regarded as very low inasmuch as: a) burials near the summit have only been reported at cinder cones (primarily on the south and east sides of the summit), b) most reports of burials are at lower elevations, c) no burials have been encountered during development thus far in the Astronomy Precinct, d) there are no burial markers or surface indicators of burials present, and e) the absence of caves in the area and the general desert pavement geology would not be conducive for burial location selection. However, in the unlikely event that cultural resources, including human skeletal remains or other significant cultural deposits, are encountered during the course of Project-related construction activities, all work in the immediate area should stop and the State Historic Preservation Division should be promptly notified.

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Section 1 Introduction

1.1 Project Background

At the request of PB Americas, Inc. (PB), Cultural Surveys Hawaiʻi Inc. (CSH) completed an archaeological assessment for the proposed Thirty-Meter-Telescope (TMT) Observatory Project, Kaʻohe Ahupuaʻa, Hāmākua District, Hawaiʻi Island TMK: [3] 4-4-015:009 por. The proposed Project area is located on the northern plateau of the Maunakea summit area, within Area E of the Astronomy Precinct of the Mauna Kea Science Reserve. As the precise location of the 5-acre Project area was not yet determined, the survey area for this study included the entire approximately 36-acre Area E (Figures 1-3). The survey area for the current study is depicted on the U.S. Geological Survey 7.5-Minute Series Topographic Map, Mauna Kea Quadrangle (1993) (Figure 1).

The Mauna Kea Science Reserve is owned by the State of Hawaiʻi, and is leased by the UH. The proposed TMT Observatory Project involves the construction of a thirty (30) meter diameter telescope and associated infrastructure on an approximately 5-acre site within Area E of the Astronomy Precinct. Minimally, land disturbing activities would include grading of the TMT Observatory site and Access Way and excavations associated with building construction and installation of subsurface utilities. The area of potential effect (APE) is defined as the entire approximately 36-acre survey area.

At the request of PB, CSH conducted an archaeological inventory survey investigation for the proposed TMT Observatory Project. Per the requirements of Hawaiʻi Administrative Rules (HAR) Chapter 13-13-276, the study was conducted to identify, document, and make Hawaiʻi Register of Historic Places (Hawaiʻi Register) eligibility recommendations for the Project area's historic properties. Because no historic properties were identified in the Project area, this investigation is termed an archaeological assessment per HAR Chapter 13-13-284-5. This archaeological assessment report was prepared to support the proposed Project's historic preservation review under Hawaiʻi Revised Statutes (HRS) Chapter 6E-8 and HAR Chapter 13-13-275. It is also intended to support any Project-related historic preservation consultation with stake-holding State or County agencies and interested Native Hawaiian and community groups.

1.2 Scope of Work

The following scope of work satisfies the State requirements for an archaeological inventory survey, per HAR Chapter 13-13-276:

1. Historic and archaeological background research, including a search of historic maps, written records, Land Commission Award documents, and the reports from prior archaeological investigations. This research focused on the specific Project area's past land use, with general background on the pre-contact and historic settlement patterns of the *ahupuaʻa* and district. This background information was used to compile a predictive model for the types and locations of historic properties that could be expected within the Project area.

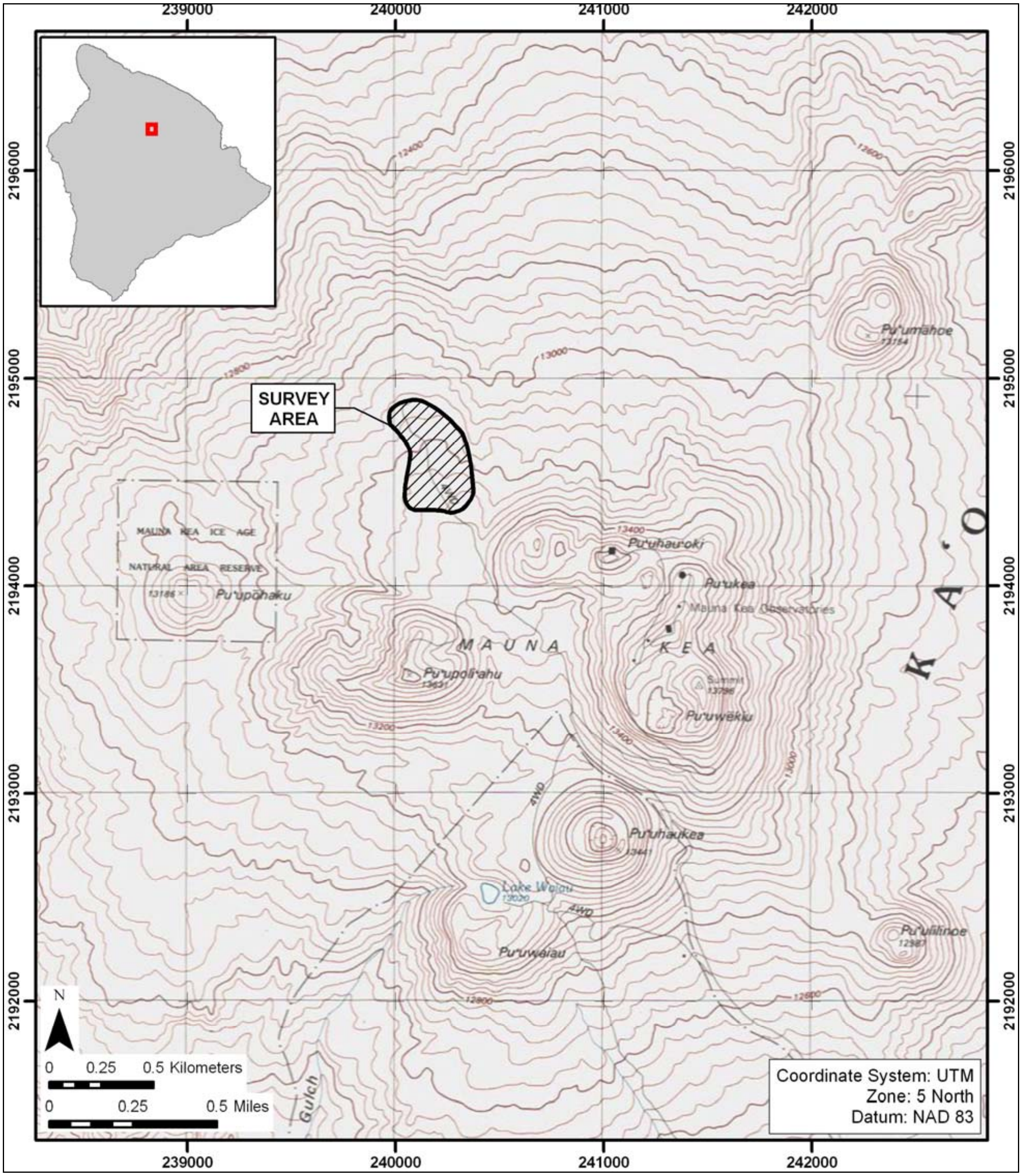

Figure 1. U.S. Geological Survey 7.5-Minute Series Topographic Map, Mauna Kea Quadrangle (1993), showing the location of the survey area

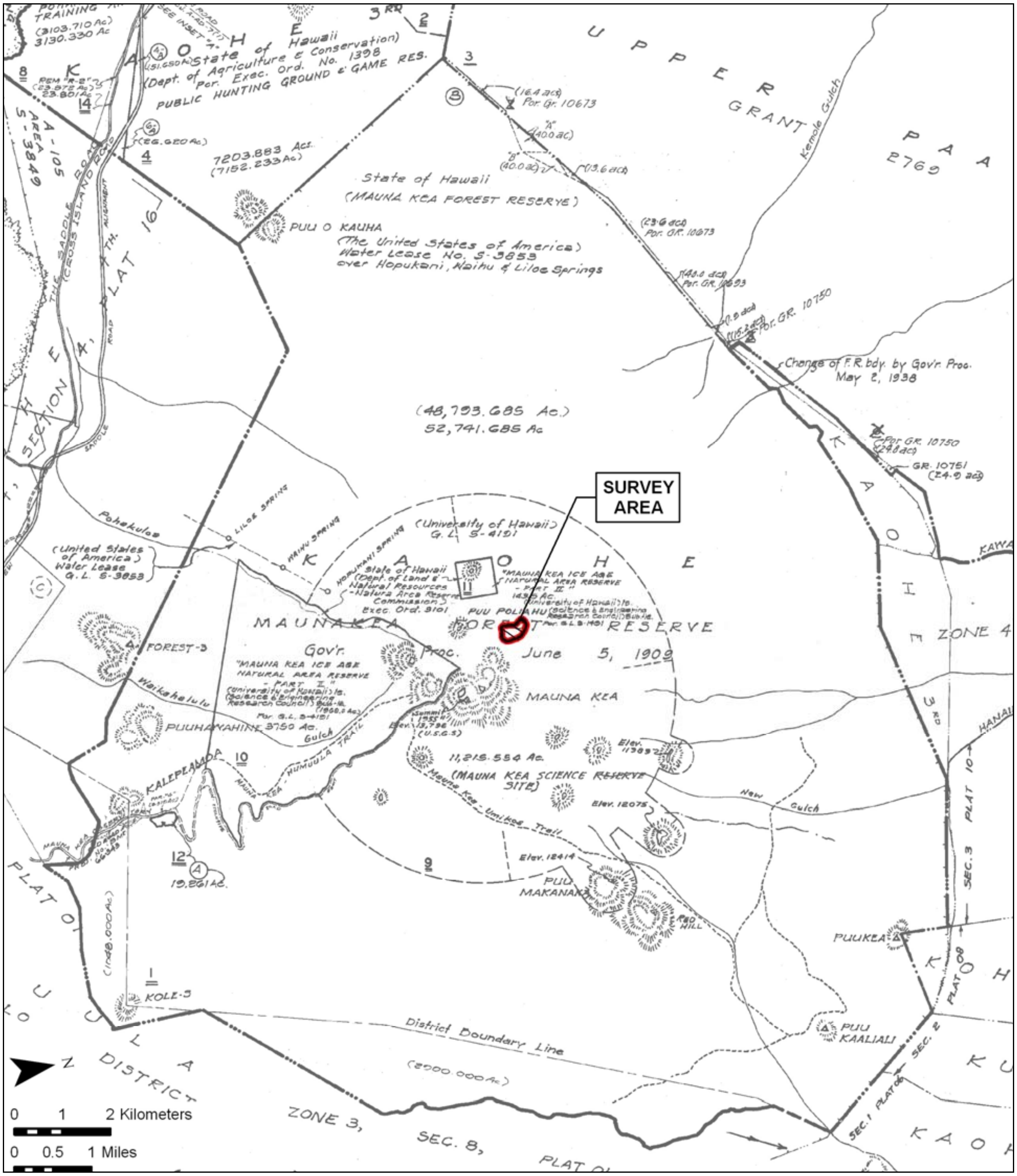

Figure 2. Portion of Tax Map Key (TMK) 4-4-015, showing the location of the survey area

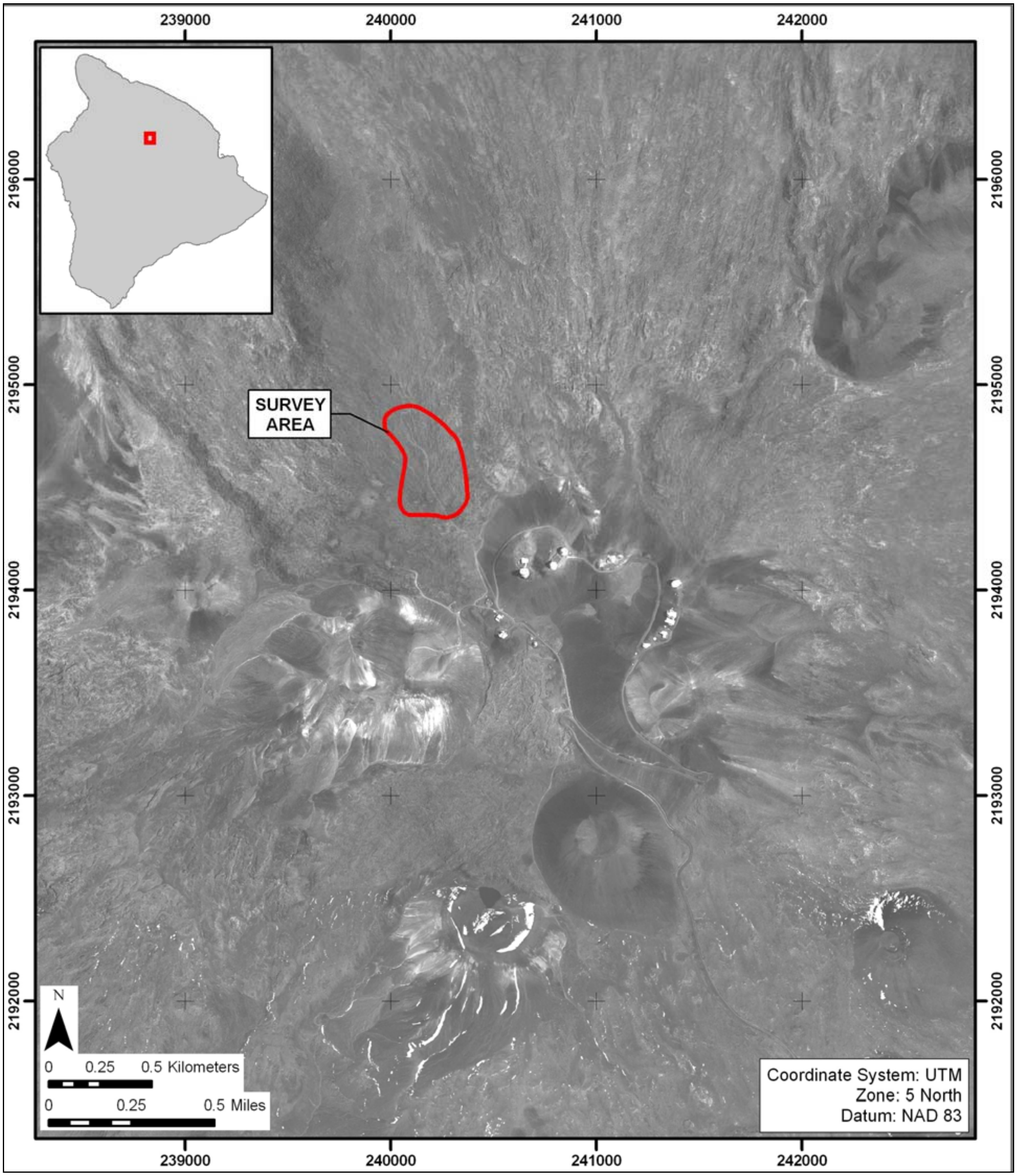

Figure 3. Aerial photograph (source: U.S.D.A. 2000), showing the location of the survey area

2. A complete (100% coverage) systematic pedestrian inspection of the Area E survey area to identify any potential surface historic properties. Surface historic properties were recorded with an evaluation of age, function, interrelationships, and significance. Documentation included photographs, scale drawings, and, if warranted, limited controlled excavation of select sites and/or features, and location of historic properties with GPS survey equipment.
3. As appropriate, consultation with knowledgeable individuals regarding the Project area's history, past land use, and the function and age of the historic properties documented within the Project area.
4. As appropriate, laboratory work to process and gather relevant environmental and/or archaeological information from collected samples.
5. Preparation of this archaeological inventory survey report, including the following:
   a) A Project description;
   b) A section of a USGS topographic map showing the survey area boundaries and the location of all recorded historic properties;
   c) Historical and archaeological background sections summarizing prehistoric and historic land use of the Project area and its vicinity;
   d) Descriptions of all historic properties, including selected photographs, scale drawings, and discussions of age, function, laboratory results, and significance, per the requirements of HAR 13-13-276. Each historic property was assigned a Hawaiʻi State Inventory of Historic Properties (SIHP) number;
   e) If appropriate, a section concerning cultural consultations [per the requirements of HAR 13-276-5(g) and HAR 13-275].
   f) A summary of historic property categories, integrity, and significance based upon the Hawaiʻi Register of Historic Places evaluation criteria;
   g) A Project effect recommendation;
   h) Treatment recommendations to mitigate the Project's potential adverse effect on historic properties identified in the Project area that are recommended eligible to the Hawaiʻi Register of Historic Places.

This scope of work includes full coordination with the State Historic Preservation Division (SHPD), and County relating to archaeological matters. This coordination takes place after consent of the landowner or representatives.

1.3 Environmental Setting

1.3.1 Natural Environment

The Project area for the proposed TMT Observatory site is located on a gently sloping plateau area northwest of the Maunakea summit cone, Puʻu Wēkiu (13,796 ft. elevation). Elevations within the survey area range from approximately 13,120-13,290 ft. above mean sea level. In general, the summit region of Maunakea is arid, with an average annual rainfall of less than 15 inches (380 mm). Most of the precipitation is in the form of freezing fog and snow. The monthly average temperature ranges from 25-60 degrees Fahrenheit, with winter storms often depositing up to several feet of snow in the higher elevations.

The primary geological activity shaping the Maunakea summit terrain is glaciation. Several main glacial features present on the summit region include glacial striations on bedrock outcrop, the sculpted configuration of cinder cones, and the formation of Lake Waiau and Pōhakuloa Gulch as a result of glacial melt water. The summit region’s ground surface is generally characterized by rubbly ground moraine deposits and Hawaiite *‘a‘ā* flows of Late Pleistocene origin, partially mantled by cinder, coarse ash, and spindle bombs from the similar-age Pu‘u Hau Oki and Pu‘u Wēkiu cinder cones (McCoy 1982: A-29). Sediments within the survey area are listed as Very Stony Land (rVS) (Figure 4). Very Stony Land is described as a “miscellaneous land type consisting of very shallow soil material and a high proportion of *‘a‘ā* lava outcrops” (Sato et al. 1973).

Vegetation is almost non-existent in the summit region of Maunakea, with the tree line located at approximately 9,000 foot elevation). The highest major vegetation zone, known as the Alpine Scrub Zone, generally ends at approximately 11,300 feet elevation. Plants in the so-called Alpine Stone Desert Zone of the summit region are mostly limited to small lichens and mosses.

1.3.2 Built Environment

The Project area is located within the Astronomy Precinct of the Mauna Kea Science Reserve. At present, there are eleven astronomical observatories within the precinct, including large telescope domes, radio dishes, and associated infrastructure. Lands within the Project area are undeveloped, with the exception of an existing unpaved 4-wheel drive road that traverses the central portion of the survey area.

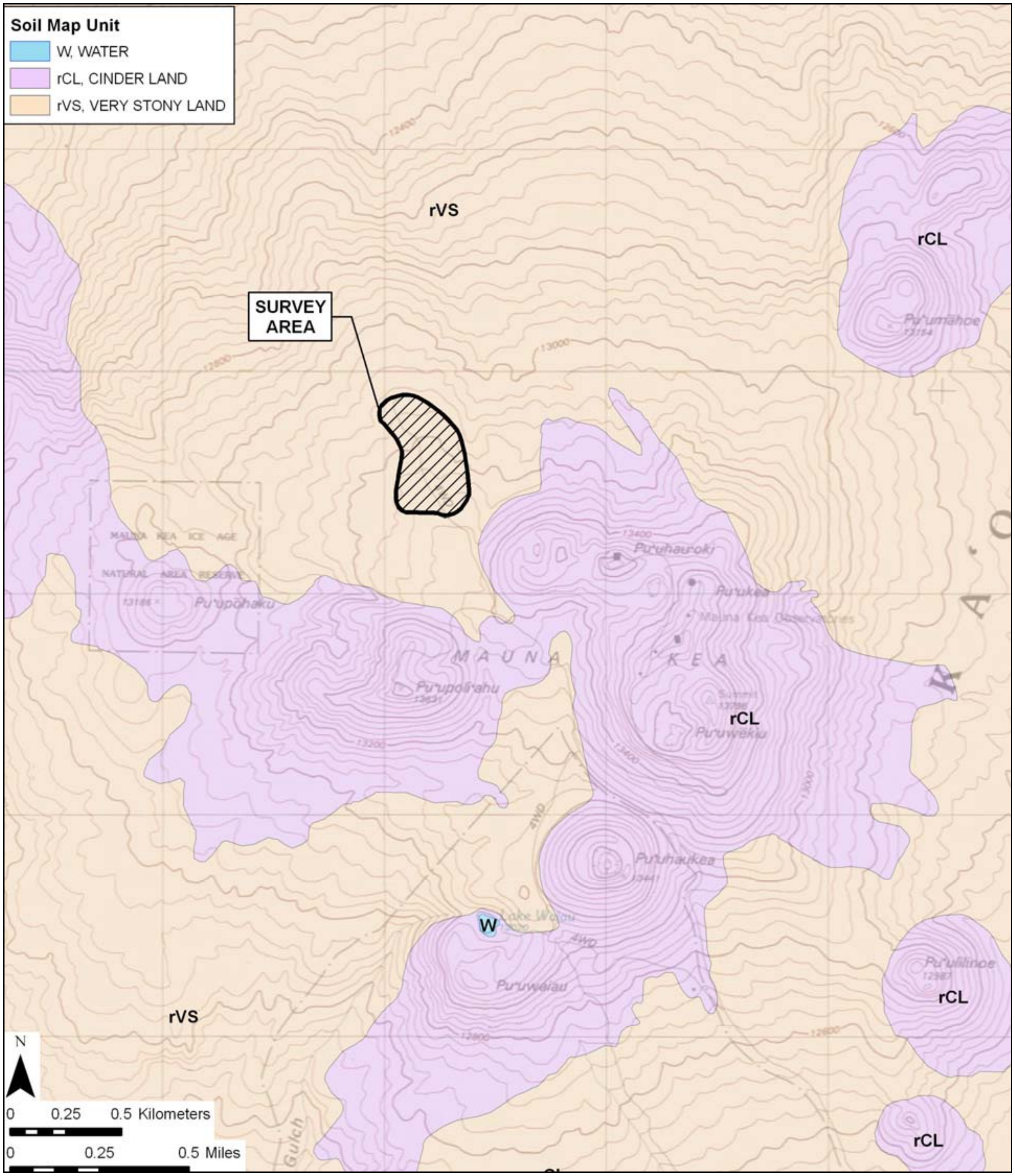

Figure 4. U.S. Geological Survey Topographic Map, Mauna Kea Quadrangle (1993) with overlay of the Soil Survey of the Island of Hawai‘i (Sato et al. 1972), showing sediment types within the survey area

Section 2 Methods

2.1 Field Methods

The fieldwork component of the archaeological assessment study was carried out under archaeological permit number 08-14, issued by the SHPD, per HAR Chapter 13-13-282. The CSH field crew included: David W. Shideler, M.A.; Todd Tulchin, B.S.; Trevor Yucha, B.S.; and Lehua Kaʻuhane, B.A., under the overall supervision of Hallett H. Hammatt, Ph.D. Fieldwork was conducted on August 26, 2008 and required 4 person-days to complete.

The archaeological assessment fieldwork consisted of a complete (100% coverage) pedestrian inspection of the Area E survey area. The pedestrian inspection was accomplished through systematic sweeps, generally oriented east-west across the survey area. The interval between the archaeologists was generally approximately 33 feet. The lack of vegetation made for excellent visibility. All potential historic properties encountered were recorded and documented with a written field description, scale drawings, photographs, and each feature was located using Garmin GPSMAP 60CSx GPS survey technology (3-5 m accuracy).

2.2 Document Review

Historic and archival research included information obtained from the UH Mānoa Hamilton Library, the State Historic Preservation Division Library, the Hawaiʻi State Archives, the State Land Survey Division, and the Archives of the Bishop Museum. Previous archaeological reports for the area were reviewed, as were historic maps and primary and secondary historical sources. Information on Land Commission Awards was accessed through Waihona ʻĀina Corporation's Māhele Data Base (www.waihona.com).

2.3 Consultation

The community consultation effort for the proposed TMT Observatory Project is detailed in the companion Cultural Impact Assessment report (Kaʻuhane et al. 2009; in progress). In general, Native Hawaiian organizations, government agencies and community members were contacted in order to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the Project area and the vicinity. The agencies consulted included the SHPD, the Office of Hawaiian Affairs (OHA), and the Hawaiʻi Island Burial Council (HIBC).

Section 3 Background Research

3.1 Traditional and Historic Background

The traditional and historical background for the Project area is presented at length in a companion Cultural Impact Assessment study (Ka‘uhane et al. 2009; in progress) to which the reader is referred. A synopsis is presented below.

3.1.1 Mythological and Traditional Accounts

Holly McEldowney's (1982) ethnographic background study of the Maunakea Summit Region notes the common case (as exemplified in Haleole's Laieikawai and Fornander's Hawai‘i Loa legend) of characters and themes inserted into more recent versions of older myths and legends and relatively modern fabrication of lore about Maunakea that has a semblance of antiquity. McEldowney notes that "Otherwise Mauna Kea is mentioned only briefly and rarely as the backdrop to more compelling events, or to characterize the attributes of a figure or an event by analogy."

A common reference to Maunakea is as a last landmark that can be seen and hence the Maunakea summit becomes symbolic for the Hawaiian Islands. In Fornander's (1919; Volume IV: 160-161) "The Legend of Kila" and in Fornander's (1919; Volume V: 124-125) "Legend of Kūapāka‘a" we see that, as the first sight of land for long-distance voyagers, the summit of Maunakea is symbolic of Hawai‘i (Island).

In Fornander's (1919; Volume IV: 224-225) "Story of ‘Umi: One of the Most Noted of Hawaiian Kings" (and in Thrum's 1923: 98-103 *More Hawaiian Folk Tales)* the ruling chief ‘Umi-a-Līloa leads a war party out of Waipi‘o, Hāmākua arcing far up the slope of Maunakea to attack Hilo. In this account, the name "Poli‘ahu" is associated specifically with a trail and with a water source near the summit.

In Fornander's (1919; Volume V: 340-341) "Tradition of Kamapua‘a" the pig deity sees the fires of Pele the goddess of volcanoes and begins to chant. The brilliant whiteness of the snows of Maunakea provides poetic contrast with the darkening smoke of Pele.

In Kalākaua's *Legends and Myths of Hawaii* (1888: 249-315) account of "‘Umi, the Peasant Prince of Hawai‘i" are a number of passing references to Maunakea (such as comparing the color of an old priest's hair to the snows of Maunakea) but one account merits particular mention. In a story about the fabulous conch shell trumpet known as the Kiha-pū is an account that: "In obedience to the revelation of a *kaula* [seer] of great sanctity, he [Kiha] had secretly deposited it [the Kiha-pu] in a cave near the summit of Mauna Kea …" The trumpet is transformed by the deity Lono so that a battle blast "was heard the distance of a day's journey." Thus the summit region of Maunakea is associated with the actions of deity, transformation of the Kiha-pū, and the imparting of qualities of awe and wonder.

In Kalākaua's *Legends and Myths of Hawaii* (1888: 319-331) account of Lono and Kaikilani is an account of the prowess of the ruling chief Lonoikamakahiki: "He outran the fleetest…as in bringing a ball of snow from the top of Mauna Kea" (Kalākaua 1888: 322). In Thomas G.

Thrum's *Hawaiian Folk Tales* (1923: 108-116) is a chapter on Lono and Kaikilani that understands Lono as the deity Lono whom we encounter: "reclining on the bosom of a cloud that rested over Mauna Kea."

In Kalākaua's (1888: 455-480) account of: "Laie i ka Wai" a supernatural (*kupua*) chief of Wailua Kauaʻi named Aiwohikupua is sailing the seas of Hāmākua, Hawaiʻi and:

> …saw a woman of extraordinary beauty reclining on a cliff by the shore. She was graceful in every movement and wore a snow-white mantle. They landed and made her acquaintance. Her name was Poliʻahu of Mauna Kea" (Kalākaua 1888: 462). She relates that she is also supernatural ("*kupua*").

The goddess could produce a snow mantle or a sun mantle at will sending waves of cold or heat over her rivals.

In Kalākaua's (1888: 501-507) account of: "Kahavari, Chief of Puna" is a brief discussion of the demi-god "Kana" who had the capacity to elongate himself so as to walk between the islands of the Hawaiian chain. It is asserted that when Kana waded back from the southern lands of Kahiki: "he hung his mantle to dry on Mauna Kea, which was then an active volcano" (Kalākaua 1888: 503). The tale seems to play on the height of the mountain and appears to provide an alternate explanation for whose cape explains the summit mantle of snow.

A number of accounts of a great flood as in the days of Noah have Maunakea as the only land remaining above the deluge.

3.1.2 Historic Accounts

The first recorded ascent of Maunakea was in 1823 by the missionary Joseph Goodrich (1794-1852). Like many missionaries, the Yale educated Goodrich was also a naturalist and he published his observations on Hawaiʻi Island volcanoes in the *American Journal of Science* in 1826 and 1829. He approached via Kawaihae and Waimea. Goodrich attained the highest of several summits around 3:00 AM noting the presence of a pile of stones which he assumed had been constructed by Hawaiians. He then more or less retraced his steps back to the vicinity of Waimea. Few details are recorded. Goodrich made a second trip up Maunakea in 1825 noting (at a surprisingly early date) dead sheep on one of the cones at an estimated 13,612 ft elevation and speculating they had been driven there by wild dogs.

William D. Alexander (1892) described a trip up Maunakea with a surveying party recording that:

> [on] the summit of Lilinoe, a high rocky crater, a mile southeast of the central hills [the "summit"] and a little over 13,000 feet in elevation. Here, as at other places on the plateau ancient graves are to be found. In olden times it was a common practice of the natives in the surrounding region to carry up the bones of their deceased relatives to the summit plateau for burial.

Jerome Kilmartin (1974) published a brief reminiscence reflecting on his involvement in a 1925 United States Geological Survey Project to map the Lake Waiau topographic quadrangle. That 1925 work put him in the summit region for more than five months and then seemingly he did not return again until 1971. Kilmartin's 1925 U.S. Geological Survey work approached the summit via the Umikoa Ranch based at approximately 3,500 foot elevation above Kūkaʻiau in Hāmākua. Kilmartin reports little archaeological detail but does note a grave at Puʻu Mākanaka (elevation 12,414 feet). He also notes:

> Ancient stone piles, quarries, walls, platforms, and burial caves are sufficient evidence that early Hawaiians were familiar with Mauna Kea's highlands. Stone chips from adze manufacture are found near a cave at 12,360 feet…[Kilmartin 1974:13]

It may also be noted in passing that the U.S. Geological Survey 1926 survey party created archaeological sites of their own (and perhaps many):

> …the wind was so strong I thought surely we would be blown away. However the *ahu* (stone pile) that we built did give a little protection after I had made a setup with the plane table only two feet above the ground. [Kilmartin 1974:15]

Kenneth Pike Emory is understood (following McCoy 1999:15) as the first person to have described the distinctive shrine features of Maunakea in a brief, popular piece published in *Paradise of the Pacific* magazine (April 1938). Emory was struck by the "immense quantity of chipped stone" and posited that the piles of debitage were "the largest so far recorded anywhere in the world." Emory concluded that the evidence of "chips and rejects" was the result of skilled adze makers and that "they were able to create a stone-tool industry on a scale unequaled in the stone-age because of the superior social organization of the Hawaiian people." Emory posited that in the shrines "each upright stone stood for a separate god" and referred to them as "*ʻeho*" ("a collection of stone gods") – a term evidently used in the Tuamotus as well as Hawaiʻi to designate an alignment of upright stones.

Wentworth and Powers (1943) carried out geological studies on Maunakea in 1939 that noted archaeological sites in the Hopukani and Liloe Springs area. They noted stone walls that they interpreted as a trap to impound wild cattle that frequented the springs and certain older sites:

> In the area to the east and up the slope from the springs are numerous small heaps of pre-European stone adze workings. Certain lava caves contain evidence of habitation, suggesting that the springs were frequented by adze workers. The latter not only secured adze material from lava flows in places but carried on a surprising amount of casual prospecting on dense basalt boulders included in the moraines and outwash strewn several thousand feet down the mountain. [Wentworth and Powers 1943:544]

Holly McEldowney in her summary of the ethno-graphic background of the Maunakea summit region (1982:A-11) notes:

> Although most accounts speak in general terms, those that specifically locate the presence of human bones, "graves", "burial caves" or mortuary features indicate that burials are "not uncommon" between 7,800 ft and 13,000 ft elevation along the northern and eastern slopes of Mauna Kea. [Alexander 1892; Preston 1895:601; Gregory 1921; Aitken 1935:48; Gregory and Wentworth 1937:1720;

Kilmartin 1974:15; Bryan 1927:106; Hāmākua Site Records, Dept. Anthropology, B.P. Bishop Museum]

3.1.3 Modern Land Use

It is understood that in 1936 the Civilian Conservation Corps carried out improvements to the old Maunakea-Humuʻula Trail from near the main base of the sheep station at Kalaiʻeha to the summit and that the first stone cabin at Hale Pōhaku was constructed at about that time.

In the early 1960s, researchers from the UH determined that the Maunakea Summit area was exceptional for making astronomical observations. Development of observatories began in 1964 with the construction of the Lunar and Planetary Station atop Puʻu Poliʻahu. The Mauna Kea Science Reserve was established in 1968. Currently there are eleven observatories in the Maunakea summit area and one observatory located on the southeastern flank at 12,000 feet. A 1978 aerial photograph of (Figure 5) shows the extent of development in the Maunakea summit area at that time. Note the 4-wheel drive road through the current survey area was constructed by this date.

3.2 Previous Archaeological Research

3.2.1 Previous Archaeological Studies

A summary of previous studies is presented in Table 1, with a more detailed summary of previous archaeological studies on Maunakea following. Previously identified historic properties in the Maunakea summit area are summarized in Table 2.

3.2.1.1 Cleghorn (1982)

Paul Cleghorn (1982) produced his UH Ph.D. dissertation in Anthropology on Maunakea adze quarry lithics focusing on technological analysis and experimental tests. Some 534 archaeological site components of 38 designated sites of the Maunakea adze quarry complex in the vicinity of Puʻu Koʻokoʻolau are briefly summarized (sites are referred to by Bishop Museum site nomenclature).

3.2.1.2 McCoy (1982)

Patrick McCoy (1982) documents reconnaissance level surveying of approximately 1,000 acres of the summit and north-slope (down to 13,000 ft). McCoy notes that:

> Few, if any, archaeological sites were predicted to occur within the boundaries of the project area, given the high altitude location and presumed absence of exploitable resources, including adze-quality stone, which on present evidence is restricted to the south slope of the mountain.

Thus it was far beyond expectations when 22 sites were recorded including an open air shelter and 21 shrine sites. McCoy was quite familiar with the "occupational shrines" near the adze quarries but concluded the function of these shrines was unknown. McCoy posits:

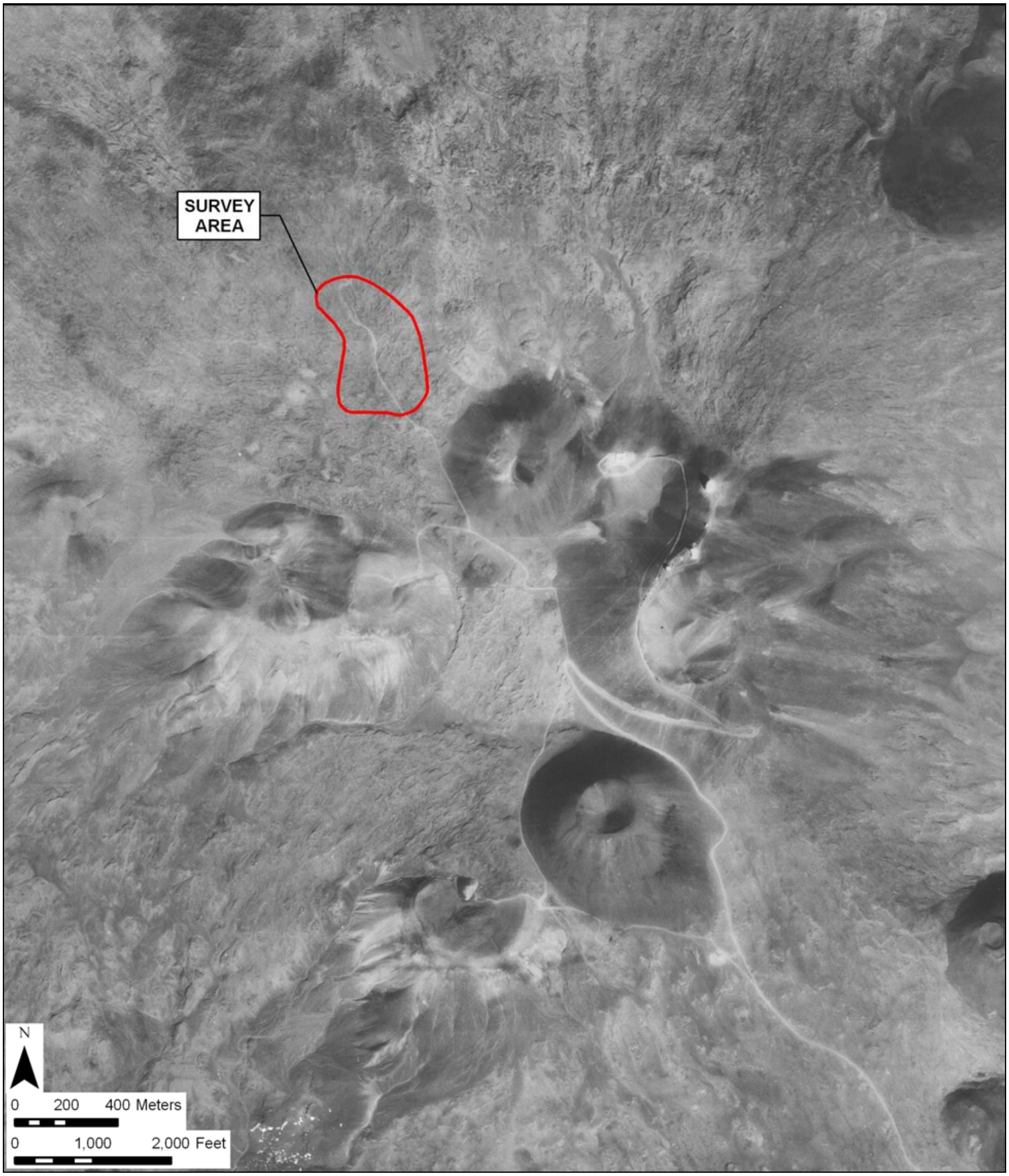

Figure 5. U.S. Geological Survey Orthophotograph, Mauna Kea Quadrangle (1978), showing the location of the survey area

Table 1. Summary of Previous Archaeological Studies on Maunakea

Reference	Nature of Study	Area of Study	Comments
McCoy 1976	"The Mauna Kea Quarry Project: A First Analysis."	Maunakea Adze Quarry Complex	--
McCoy 1977a	"Archaeological Investigations at the, Mauna Kea Adze Quarry Complex, Hawaii: Preliminary Results of the 1975-76 Fieldwork."	Maunakea Adze Quarry Complex	--
McCoy 1977b	A Summary of the 1975 Field Investigations."	Maunakea Adze Quarry Complex	--
McCoy 1978	Account of the "The B.P. Bishop Museum Mauna Kea Adze Quarry Project."	Maunakea Adze Quarry Complex	--
Allen 1981	Master’s thesis, UH at Mānoa	An analysis of the Maunakea Adze Quarry archaeobotanical assemblage.	--
McCoy 1981	"Stones For the Gods: Ritualism in the Mauna Kea Adze Quarry Industry, Hawaii."	Maunakea Adze Quarry Complex	--
Cleghorn 1982	UH Ph.D. dissertation in Anthropology on Maunakea adze quarry lithics	Maunakea adze quarry complex in the vicinity of Pu‘u Ko‘oko‘olau	Focuses on technological analysis and experimental tests. Some 534 archaeological site components of 38 designated sites are briefly summarized
McCoy 1982a	Reconnaissance survey	Approximately 1,000 acres of the summit and north slope (down to 13,000’ el.)	Documents 22 sites including an open air shelter and 21 shrine sites

Reference	Nature of Study	Area of Study	Comments
McCoy 1982b	Archaeological Survey	Proposed Site of the Caltech 10-Meter Telescope	--
McEldowney 1982	Ethnographic Background report	Maunakea Summit Region	Documents legends, visitor’s accounts, land use and place names
Kam and Ota 1983	Archaeological Reconnaissance Survey	Mauna Kea Observatory Power line: Upper Portions	--
McCoy 1984a	A Summary of the 1984 Fieldwork	Maunakea Summit Region	--
McCoy 1984b	Archaeological reconnaissance	Hopukani, Waihu, and Liloe Springs area on the west side of Pōhakuloa Gulch between 8,640’ and 10,400’ elevation	Documents six archaeological sites and a number of find spots (More thorough coverage is presented in McCoy 1986)
McCoy 1985	Reconnaissance survey	Approximately 40 acres extending on both sides of the Maunakea Access Road between 9,080’ and 9,400’	Preliminary report for the Pu‘u Kalepeamoa Site documenting five lithic scatters and 2 shrines used for the manufacture of hammer stones and octopus lure sinkers. Ritual was an integral part of the manufacturing process.
McCoy 1986	Report on archaeological investigations	Hopukani and Liloe Springs area located on the west side of Pōhakuloa Gulch well southwest of the Maunakea summit region	Documents 3 mid-level sites (that were initially discussed in McCoy 1984). Eight radio-carbon dates indicated use spanning A.D. 1000 to A.D. 1800. It was concluded that these camps were used for acclimatization and for procuring water, food (primarily fowl) and fuel.
Williams 1987	Post-field letter report on an Archaeological Reconnaissance Survey	Summit Road between Hale Pōhaku and a stockpile area	--

Reference	Nature of Study	Area of Study	Comments
Hammatt and Borthwick 1988	Reconnaissance survey	Two locations: an approximately 15-acre location between 11,560' and 11,840' on the west side of the present summit road and another approximately 100-acre location on the east side of the summit road in a saddle between 2 cinder cones at 12,100' to 12,225' elevation	4 sites were documented (none of which appear to have been previously recorded). Sites 11,076, 11,077 are probable pre-contact shrines; Site 11,078 is a probable pre-contact overhang shelter, and Site 11,079 included a probable pre-contact shrine and a probable pre-contact *ahu* or cairn with basalt flakes and an adze perform present.
Borthwick and Hammatt 1990	Reconnaissance survey	Two locations (total 2 acres) on the summit of Maunakea.	No finds – the areas had been "fully graded" for existing telescope facilities.
McCoy 1990	Study of: Factors of Production	Maunakea Adze Quarry Complex	--
Robins and Hammatt 1990	Reconnaissance survey	Two locations: 5.1 acre area on Puʻu Hau Oki cinder cone at summit and a 21-acre lot near Hale Pōhaku	There were no finds at the JNLT summit Project area which had been largely graded. In the Hale Pōhaku area 3 lithic scatters that were described in McCoy, 1985 are discussed.
McCoy 1991	Survey and Test Excavations report	Puʻu Kalepeamoa Site	--
Borthwick and Hammatt 1993	Reconnaissance survey	Proposed Gemini Telescope location at approximately 13,700' on a ridge line north of the summit cone	Study notes that the entire summit ridge on which the Project area was located had been graded for existing telescope facilities. There were no finds.
McCoy 1993	Letter Report on an Archaeological Inspection	Two Sites Located in the Vicinity of the Smithsonian Sub millimeter Array	--
McCoy 1999	Analysis of a site complex (site 50-10-23-16204), that he had described 24 years earlier	Located on the east side of the Maunakea Access Road between 12,240' and 12,300' elevation just south of Puʻu Līlīnoe	McCoy posits a ritual significance to the site specifically as a location for a rite of passage.

Reference	Nature of Study	Area of Study	Comments
Hammatt and Shideler 2002	Data Recovery report for two lithic scatters	Sites 50-10-23-10,310 and 50-10-23-10,311 located in the Hale Pōhaku area between 9,080’ and 9,160’ elevation	Documentation of data recovery of sites identified in McCoy, 1985 and Robins and Hammatt, 1990. Two carbon dates (AD 1260-1410 and AD 1510-1950 at 95% probability) were both thought to be problematic. Possible ritual associations with healing and the deity Kanaloa are explored.
McCoy et al. 2005	Archaeological Inventory Survey Interim Report No. 1	Mauna Kea Science Reserve	--
McCoy and Nees 2006	Archaeological Inventory Survey Interim Report No. 2	Mauna Kea Science Reserve	--

Table 2. Previously Identified Historic Properties in the Summit Region of Maunakea

SIHP #	Elevation (ft.)	Description	Function
11077	12320	Single upright	Shrine
11079	12313	Lithic scatter of adze manufacturing byproducts and 2 associated cairns	"Workshop" and possible shrine
16163	12880	Platform/pavement with 14 uprights	Shrine
16164	13397	3 to 5 uprights on platform and 1 isolated upright	Shrine
16165	13362	Single row of 2 uprights	Shrine
16166	13422	2 rows of uprights, 8 to possibly 9 total	Shrine
16167	13395	Single row of 2 uprights	Shrine
16168	13098	Semi-enclosure with 21 to possibly 25 uprights	Shrine
16169	13210	Single row of 2 uprights	Shrine
16170	13139	2 cairns with 3 to possibly 4 uprights	Shrine
16171	13087	Single upright	Shrine
16172	13218	Single upright	Shrine
16173	13009	7 dispersed uprights	Shrine
16174	13075	Boulder with 1 to possibly 8 uprights on the side	Shrine
16175	NA	5 cairns with 1 upright each	Shrine
16176	13078	Single row of 3 uprights	Shrine
16177	13118	Single row of 3 uprights	Shrine
16178	13236	Single upright	Shrine
16179	13122	Single row of 3 uprights	Shrine
16180	13086	Boulder with 3 uprights	Shrine
16181	13401	Single upright	Shrine
16182	13155	3 to 5 uprights	Shrine
16184	13072	Semi-enclosure with 24 uprights	Shrine
16185	13008	Single row of 3 uprights	Shrine
16186	13076	Single row of 2 and possibly 3 uprights	Shrine
16187	12775	Single row of 9 uprights	Shrine
16188	12857	Single upright	Shrine
16189	12902	Single row of 3 and possibly 4 uprights	Shrine
16190	12956	Single row of 10 and off-set uprights	Shrine
16191	12889	Single row of 4 uprights	Shrine

SIHP #	Elevation (ft.)	Description	Function
16192	12842	2 sets of uprights, 6 total	Shrine
16193	12843	Single upright	Shrine
16194	12673	Single row of 12 - 14 uprights	Shrine
16195	NA	2 cairns	Possible burial
16196	12953	Single row of 2 uprights	Shrine
16197	12953	Single upright	Shrine
16198	12930	2-tiered platform with 7 uprights	Shrine
16199	12991	1 to possibly 4 uprights	Shrine
16200	12975	Single row of 5 to possibly 6 uprights	Shrine
16201	12990	Single row of 3 uprights	Shrine
16202	13006	Single upright	Shrine
16203	13145	Single row of 2 to possibly 3 uprights and a lithic scatter of adze manufacturing byproducts	Adze “workshop” and shrine
16204	12332	5 shrines, 26 stone-walled enclosures and a lithic scatter of adze manufacturing byproducts	Adze “workshop” and shrine complex
16248	NA	Series of cairns	Burial
18682	12955	Single row of 3 uprights	Shrine
18683	13012	Single row of 2 uprights	Shrine
21197	13052	2 platforms with a total of 5 uprights	Shrine
21198	13043	Single upright	Shrine
21199	12876	Single upright	Shrine
21200	13165	Single upright	Shrine
21201	13087	Single row of 2 uprights	Shrine
21202	13048	Single row of 6 to possibly 7 uprights	Shrine
21203	13034	Single row of 2 uprights	Shrine
21204	12925	3 areas of stacked rock	Unknown
21205	13484	Single upright	Shrine
21206	12754	Single upright	Shrine
21207	12787	Single upright	Shrine
21208	12799	1 to 2 uprights on a boulder	Shrine
21209	NA	Cairn on summit	Unknown
21210	12233	Single upright	Shrine
21211	12275	Single row of 2 uprights on a platform and a lithic scatter of adze manufacturing byproducts	Adze “workshop” and shrine

SIHP #	Elevation (ft.)	Description	Function
21212	12385	Single row of 2 uprights	Shrine
21213	12249	3 piles of rocks with 1 upright	Shrine
21214	12241	Single row of 5 to possibly 7 uprights	Shrine
21406	NA	Single upright	Shrine
21407	12952	Single row of 2 uprights	Shrine
21408	12913	Single upright	Shrine
21409	12984	Single upright	Shrine
21410	12801	Single row of 5 uprights	Shrine
21411	12815	Cairn	Marker?
21412	NA	Cairn	Marker?
21413	NA	Cairn	Possible burial
21414	NA	Cairn	Possible burial
21415	13130	Cairn on boulder	Unknown
21416	12792	Cairn	Possible burial
21417	12974	Cairn	Unknown
21418	12889	3 to possibly 4 uprights on top and to the side of a boulder	Shrine
21419	12495	Single upright	Shrine
21420	12152	Enclosure with 11 to possibly 12 uprights and a nearby stone platform	Shrine
21421	12731	2 cairns, one with a possible upright and an isolated upright	Shrine
21422	12847	Single upright	Shrine
21423	NA	Stones on boulder	Marker?
21424	12320	4 to 5 uprights on a platform and boulder	Shrine
21425	12523	Single upright	Shrine
21426	12568	Single row of 4 uprights	Shrine
21427	12635	Terrace with possible upright	Unknown
21428	12720	Single upright	Shrine
21429	12719	Single upright	Shrine
21430	13111	Single row of 3 uprights	Shrine
21431	12532	Semi-enclosure with 7 to 10 uprights	Shrine
21432	13044	Single row of 2 uprights	Shrine
21433	12579	Single upright	Shrine

SIHP #	Elevation (ft.)	Description	Function
21434	12551	8 stones on a boulder	Unknown
21435	12564	Cairn and boulder with 1 upright	Shrine

> …that these structures were erected by travelers, most probably in propitiation of mountain spirits. Such practices are universal in the high mountain regions of the world. [McCoy 1982:A-37]

McCoy does note however that the majority of the shrines were located in a narrow 200-foot contour interval band between 12,900 foot and 13,100-foot elevation. He posits reasonably that this clearly defined vertical zonation site pattern is the result of utilization of a break in slope at the edge of a summit plateau where: "when viewed from either the base of the steep inclined slope directly below, or from the base of the summit cones above, is a relatively flat horizon on which the shrine uprights are silhouetted and therefore visible from some distance." McCoy associates these shrines with "the request for permission to pass over the summit" and notes that this indicates a preponderance of access from the northern, windward side of the islands consistent with the inclusion of the land within Hāmākua District. He further posits that the distribution of the shrines may relate to "the lower margins of snow fields" and possibly by extension to the goddess Poliʻahu. McCoy notes that at one of the more complex "*Marae*" sites "the placement of offerings and whatever other ritual took place here appear to have been intentionally directed away from Maunakea. The possibility of astronomical concepts being operative is explored." McCoy also posits that smaller sites were built and utilized by one or a few individuals while more complex shrines were built and utilized by a larger kin group and that perhaps "each structure would represent a separate social unit that had exclusive use rights." McCoy recommends intensive archaeological survey and avoidance of construction and related activities on or in proximity to known archaeological sites.

3.2.1.3 McEldowney (1982)

Holly McEldowney (1982), then of the B.P. Bishop Museum Department of Anthropology, produced an Ethnographic Background report for the Maunakea Summit Region for the Research Corporation of the UH as part of an Environmental Impact Statement for a Mauna Kea Science Reserve Master Plan. The data is presented in three sections addressing 1) myths and legends and "oral traditions", 2) land use practices and cultural activities, and 3) a study of place names.

McEldowney starts by relating a tradition of the goddess Poliʻahu from Haleole's (1863) story of Laieikawai. While McEldowney relates this as a "Hawaiian tradition recorded by S.N. Haleole", Laieikawai has increasingly been recognized as a "romance", a Cinderella-like story that undoubtedly utilized pre-contact traditions and motifs but was self-consciously more in the nature of a fairy-tale or work of imagination than a recordation of traditional legends. At any rate Haleole's traditions of Poliʻahu have almost nothing to do with Maunakea (although "Lilinoe" is given as the name of one of Poliʻahu's companions). McEldowney then goes on to discuss Westervelt's (originally published in 1916) accounts of Poliʻahu and opines that Westervelt "took the unwarranted license to assign each of the 'goddesses of the snow covered mountains' to specific localities." This appears to be the case – that popular assignations of the names of deities to specific land-forms are basically modern appellations. McEldowney goes on to briefly discuss mentions of Maunakea, Poliʻahu, and Līlīnoe in works by Fornander, Kamakau, Kalākaua and Thrum. She notes the common case (as exemplified in Haleole's Laieikawai and Fornander's Hawaiʻi Loa legend) of characters and themes inserted into more recent versions of older myths and legends. McEldowney notes that "otherwise Maunakea is mentioned only briefly and rarely as the backdrop to more compelling events, or to characterize the attributes of a figure or an event by analogy."

McEldowney notes that: "several early accounts report that Hawaiians were reluctant to travel or serve as guides on inland journeys, or that they professed no knowledge of these areas, leading to the false impression that these regions constituted a wilderness unknown to the Hawaiian people." This generality is even more pronounced for the summit plateau of Maunakea, where almost all early historic visitors made the final ascent to the summit without native guides. The only substantiated report of Hawaiians on Maunakea prior to the 1870s Boundary Commission accounts is Kamakau's (1961:285) reference to Kaʻahumanu's 1828 visit "to Hawaii to fulfill a vow that she had made to attempt the recovery of the bones of Lilinoe on Mauna Kea…" It is unclear whether Kaʻahumanu or her retainers actually ascended the mountain but: "It is said Kaʻahumanu did not find the bones of Lilinoe…." (Kamakau 1961:285).

McEldowney relates various western visitors' accounts of Hawaiians acquiring fowl, hardwoods, fine-grained basalt, sandalwood and wild cattle in "this region." The first specific Hawaiian account of activities on the mountain brought to light in the McEldowney (1982) study appear to be in the Boundary Commission Testimony of a certain Haiki who asserts that: "my parents told me Humuʻula went to Kaluakaakoi and Poliʻahu. We used to go there after adzes for Humuʻula people." As McEldowney notes: "Haiki's overall testimony and placement of the boundary was rejected by the commission."

Somewhat in keeping with her study of legends and myths and early accounts of land use, McEldowney's accounts of place names also emphasizes the dearth of information, the lack of specificity of the information, and the suspicious nature of what little early data we do have. McEldowney points out that guides and informants were often familiar with land features but traveled from landmark to landmark rather than on trails per se. She notes that access to the mountain in the second half of the 1800s appeared to utilize ranching establishments (Humuʻula Sheep Station, Umikoa Ranch) and may not have related to pre-contact approaches. Many Hawaiian place names were noted to be basically modern.

3.2.1.4 McCoy (1984b)

Pat McCoy's (1984b) archaeological reconnaissance report for the Hopukani, Waihu, and Liloe Springs area documents six archaeological sites and a number of find spots located on the west side of Pōhakuloa Gulch between 8,640' and 10,400' elevation. The work was associated with a Pōhakuloa Training Area (PTA) Pipe Line Project. This preliminary report was elaborated upon in McCoy's (1986 study).

3.2.1.5 McCoy (1985)

Pat McCoy's (1985) preliminary report for the Puʻu Kalepeamoa Site documents three archaeological surveys for a proposed new construction laborer camp at Hale Pōhaku located just above and below the Hawaii Institute for Astronomy's Mid-Level Facility encompassing a total of approximately 40 acres located on both sides of the Maunakea Access Road between 9,080 and 9,400-foot elevation. Five lithic scatters and 2 shrines were recorded. These archaeological features were understood as functionally integrated components of a single activity system and one Bishop Museum site number was assigned (lithic scatters no. 1 & 2 would subsequently be given SIHP #s 50-10-23-10310 and 50-10-23-10311 respectively). McCoy concluded that the primary activity at the site was the manufacture of hammer stones and octopus lure sinkers from the crystalline dunite and gabro deposits on the slopes of Puʻu Kalepeamoa but he noted that ritual was an integral part of the manufacturing process. Further research was recommended. The lithic scatters would be subject to further documentation (Robins and Hammatt 1990) and data recovery work (Hammatt and Shideler 2002).

3.2.1.6 McCoy (1986)

Pat McCoy's (1986) report on archaeological investigations for the Hopukani and Liloe Springs area documents three mid-level sites located on the west side of Pōhakuloa Gulch well southwest of the Maunakea summit region (that were initially discussed in McCoy 1984). These sites included a rock shelter at Hopukani Spring (10,400 foot elevation), the Hopukani Rock Shelter (10,160 foot elevation) and an open camp site at Liloe Spring (8,921 foot elevation) Eight radio-carbon dates indicated use spanning A.D. 1000 to A.D. 1800. It was concluded that these camps were used for acclimatization and for procuring water, food (primarily fowl) and fuel.

3.2.1.7 Hammatt and Borthwick (1988)

Cultural Surveys Hawaiʻi (Hammatt and Borthwick 1988) carried out an archaeological reconnaissance survey of two locations for proposed antennas for the National Radio Astronomy Observatory. An approximately 15-acre relatively level location between the 11,560 foot and 11,840 foot elevations on the southeastern slope of the summit region on the west side of the present summit road was examined but no archaeological sites were observed. Another approximately 100-acre location on the east side of the summit road in a saddle between 2 cinder cones at 12,100 to 12,225 foot elevation was also examined and four archaeological sites were documented (none of which appear to have been previously recorded). Sites -11076, -11077 are probable pre-contact shrines; Site -11078 is a probable pre-contact overhang shelter with a stacked stone alignment, and Site -11079 had two components: a probable pre-contact shrine and a probable pre-contact *ahu* or cairn with basalt flakes and an adze perform present. Preservation of the four sites was recommended but it was thought that the Antenna Project potentially would be compatible with such preservation of the four relatively small and discrete sites in the large acreage.

3.2.1.8 Borthwick and Hammatt (1990)

Cultural Surveys Hawaiʻi (Borthwick and Hammatt 1990) carried out an archaeological reconnaissance survey for two locations for the proposed Galileo Telescope on the summit of Maunakea. The study was of an approximately 2 acre portion of the summit ridge that (at that time) included the UKRT, U.H. 2.2 m, U.H. 24-inch, and Medical Support facilities. The study notes that previous work (McCoy 1982) had identified no sites in the summit region (above approximately 13,330 foot elevation). The study notes that the entire summit ridge on which the

Project Areas were located had been "fully graded" for existing telescope facilities and no archaeological features were observed and no further work was recommended.

3.2.1.9 Robins and Hammatt (1990)

Cultural Surveys Hawai'i (Robins and Hammatt 1990) carried out an Archaeological Reconnaissance Survey Project for the Subaru Observatory at both the summit and the Hale Pōhaku area. The actual summit construction area was an approximately 5.1 acre area on Pu'u Hau Oki cinder cone in the northern portion of the Mauna Kea Science Reserve approximately 200 feet west of the existing W. M. Keck Observatory and 800 feet north of a paved "spur road" passing by the Caltech Sub-millimeter Observatory (CSO) facility. The summit project area had been largely graded although certain undisturbed outcrop formations were present. No archaeological features were identified within the Subaru Observatory summit project area.

The Robins and Hammatt (1990) study also included several areas near the Mid-Level Facility Complex ("Onizuka Center for International Astronomy (OCIA)") including a small dormitory construction area located approximately 440 feet east of the Maunakea Access Road at 9,245 foot elevation (where no sites were observed) and an approximately 21-acre lot surrounding the dormitory delineated on the west and north side by the Maunakea Access Road and to the south by an existing jeep road. Two archaeological features were newly described and three previously identified sites were recorded in the approximately 21-acre lot. The two newly described features included a small oval enclosure and a roughly square enclosure that were both thought to be relatively recent constructions (no formal SIHP site numbers were assigned). The three previously recorded (McCoy 1985) sites included three lithic scatters (lithic scatters # 1, # 2, and #5) that McCoy had understood as being functionally integrated components of a single site. Further work at the lithic scatters was recommended. Cultural Surveys Hawai'i (Hammatt and Shideler 2002) completed a Data Recovery report for lithic scatters # 1, # 2).

3.2.1.10 Borthwick and Hammatt (1993)

Cultural Surveys Hawai'i (Borthwick and Hammatt 1993) carried out an archaeological reconnaissance survey for the proposed Gemini Telescope location at approximately 13,700 foot elevation on a ridge line north of the summit cone. The study notes that previous work (McCoy 1982) had identified no sites in the summit region above approximately the 13,330 foot elevation. The study notes that the entire summit ridge on which the project area was located had been graded for existing telescope facilities and no archaeological features were observed and no further work was recommended.

3.2.1.11 McCoy (1999)

Patrick McCoy (1999) wrote up an analysis of a site complex (SIHP # 50-10-23-16204), that he had described 24 years earlier, located on the east side of the Maunakea Access Road between 12,240 ft and 12,300 foot elevation just south of Pu'u Līlīnoe that included five shrines and three enclosure complexes. The complex was notably located about a quarter mile from the nearest known source of worked raw lithic material and was perceived as "isolated". McCoy (1999:14) noted that when viewed in terms of the natural environment and human productivity "the location of this site appears to be irrational" Of particular interest were some 26 very small open-air enclosures (typical interior area c. 17 square feet). This led McCoy to posit a ritual significance to the site specifically as a location for a rite of passage.

McCoy goes on to consider the form of the upright slabs of (typically un-worked) basalt that were arranged into the many shrines of Maunakea and Site -16204 in particular. McCoy posits that pointed uprights symbolize male gods and that flat-topped ones symbolize female gods (McCoy assumes that the Hawaiian goddesses Līlīnoe and Poliʻahu were worshipped). Determining the affinities of the slabs is complicated by the presence of other forms ("angled", "gabled", "rounded" and "notched") and the general difficulty of determining whether a particular stone was an upright at all.

McCoy posits that evidence supporting an unusual ritual function (rites of passage) includes:

- Unusual orientations of 4 of the 5 shrines,
- Lack of evidence of actual habitation,
- Unusual "lack of a cohesive structure" among the lithic byproducts present in the artifact assemblages – suggesting "symbolic manufacture and use"
- The numerous (26) very small open-air enclosures that were "too small to accommodate a person and a fire hearth" of no obvious purpose and believed to relate to temporary day-time use.

McCoy concludes that the small enclosures "may symbolically represent both a womb and a grave" and that the site "was the locus of initiation rites" related to "formal initiation rites for groups of apprentices".

3.2.1.12 Hammatt and Shideler (2002)

Cultural Surveys Hawaiʻi (Hammatt and Shideler 2002) completed a data recovery report for two lithic scatters (SIHP #s 50-10-23-10310 and 50-10-23-10311) located in the Hale Pōhaku area between 9,080 foot and 9,160 foot elevation. These sites were first recorded by McCoy (1985:11-12) as Lithic Scatter # 1 (SIHP # 50-10-23-10310) and Lithic Scatter # 2 (SIHP # 50-10-23-10311) of the Puʻu Kalepeamoa Complex. Initially the UH Institute for Astronomy planned to preserve the two lithic scatters, however, dormitory construction increased erosion in the vicinity and in consultation with the State Historic Preservation Division a data recovery program was agreed to. Data recovery field work included mapping, surface collection and four $1m^2$ test units (2 at each of the two sites). Two carbon dates (AD 1260-1410 and AD 1510-1950 at 95% probability) were obtained but both were thought to be problematic. It was concluded that the sites were modest, out-lying, open, lithic workshop sites with octopus lure sinker manufacture of both "coffee-bean" and "bread-loaf" morphological types. It was concluded that the location of the sites was associated with a micro-climate of slightly greater moisture, slightly greater soil and slightly greater protection from the wind at the top of a natural drainage that favored *māmane* forest growth – which in turn provided greater protection from the elements, fuel and construction materials. It is suggested that the endeavor to produce octopus lures may have had other than quotidian purposes of food procurement and the affinities with healing prayers (*Pule heʻe*) dedicated to the deity Kanaloa are explored.

3.2.1.13 McCoy et al. (2009 in progress)

As this Archaeological Assessment was being prepared, the authors interacted with Dr. Patrick McCoy at the offices of Pacific Consulting Services, Inc. and also within the Project Area. We are thankful for his guidance. We were aware that a major study of the historic properties of the summit region was on-going by Pacific Consulting Services. This study, that should greatly advance our knowledge of traditional Hawaiian use of the Maunakea summit region, was not available as early drafts of this study were being prepared. If publicly available prior to the submission of this study to the SHPD for review it is the intent of the authors to include appropriate reference and germane summary of findings.

3.2.2 Traditional Cultural Properties

The State Historic Preservation Division has designated several prominent localities on Maunakea as Traditional Cultural Properties (TCP) due to their cultural significance to the Hawaiian people. The approximate boundaries of the TCPs are indicated on Figure 6. Maly (1997:29) has suggested the entire Maunakea summit region down to the 6,000 foot elevation contour (Figure 7) be designated a Traditional Cultural Property.

3.3 Background Summary and Predictive Model

3.3.1 Burials and Possible Burials

3.3.1.1 Archaeological Data on Burials

McCoy 1999 presents a summary discussion of burials and possible burials on Maunakea noting that there are numerous traditions of burials at high elevations on Maunakea. He starts by presenting the account of Jerome Kilmartin (1974) that in 1925 Kilmartin personally observed human remains on Puʻu Mākanaka. McCoy (1999:26) relates that in 1991 he and others observed human bones within several cairns on the southern rim of Puʻu Mākanaka. McCoy notes that "several other spatially discrete groups of cairns, each comprised of two to three individual cairns, were found on the southern or eastern rim" [of Puʻu Mākanaka] – suggesting that these may also contain human skeletal remains.

As far as we know, Puʻu Mākanaka is the only place in the uplands of Maunakea in which human remains have been confirmed – although McCoy makes reference to "the well-known burial center at Kanakaleonui" and also to "a small group of cairns on the eastern rim of Puʻu Waiau that are also believed to be burials."

McCoy (1999:26) then goes on to discuss four "possible burial sites" (SIHP #s -16195, -21413, -21414 and -21416). Although no human remains were observed, these sites were thought to be burials because of: 1) the morphological similarity of these cairns to those on Puʻu Mākanaka and Kanakaleonui and dissimilarity to other cairns (which are more cylindrical) and the presence on the eastern or southern rim of cinder cones.

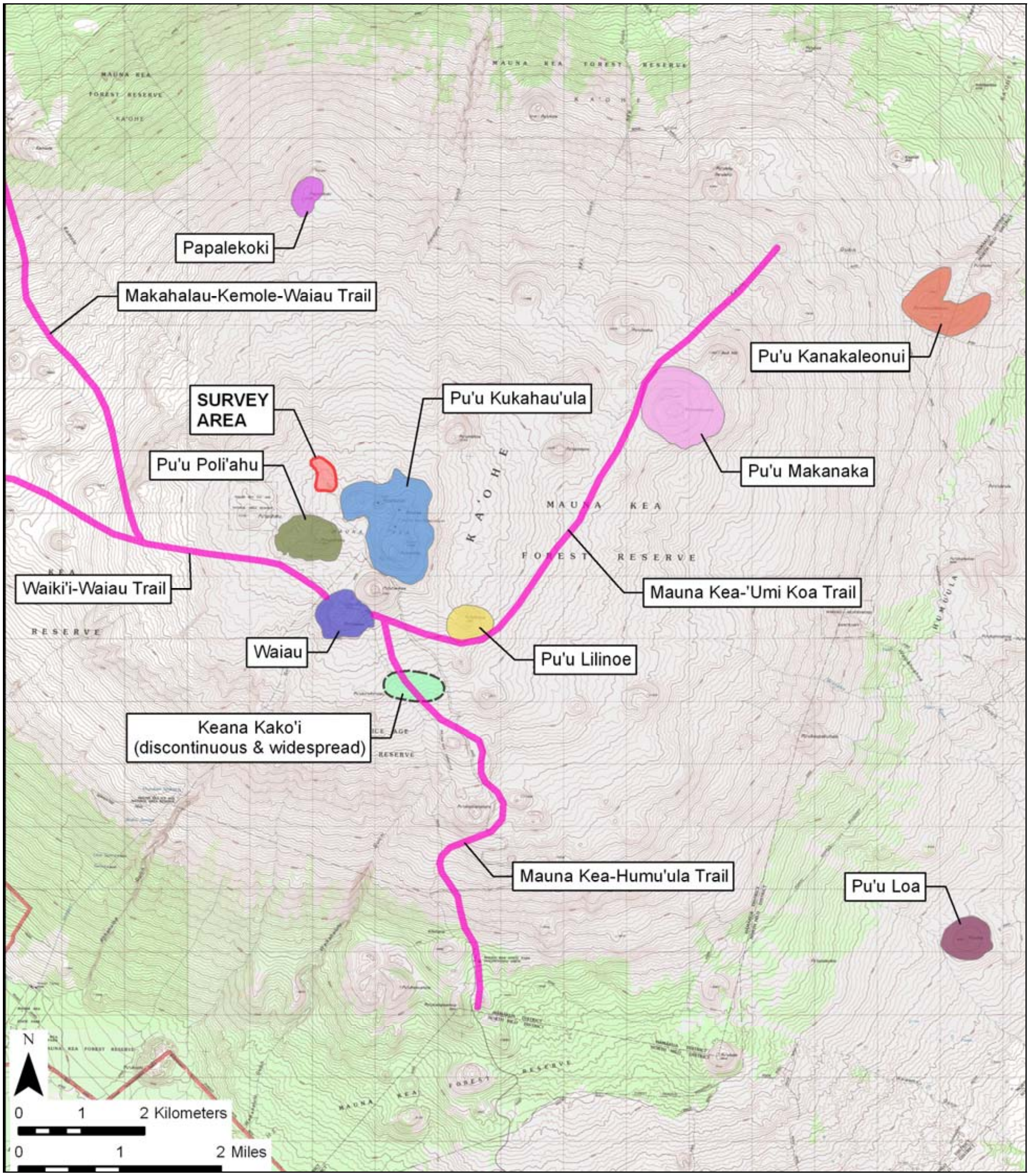

Figure 6. U.S. Geological Survey Map, Mauna Kea Quadrangle (1993), showing Traditional Cultural Properties in the summit region of Maunakea (adapted from Maly 1997:Table 2 & Figure 2; Note: All of Maunakea down to the 6,000 foot elevation has been suggested to be a Traditional Cultural Property) (Boundaries shown should be understood as approximate)

Figure 7. 1:250,000 Scale U.S. Geological Survey Map showing “Ka Mauna a Wākea or Mauna Kea” Traditional Cultural Property (TCP) down to the recommended 6,000 foot contour (following Maly 1997:29); estimated area approximately 150,000 acres

McCoy (1999:27) clearly suggests that SIHP # -16195 consisting of 2 adjacent cairns on the eastern rim of Puʻu Līlīnoe (recorded by McCoy in 1975) are "possible burials". This conclusion appears to be based on William D. Alexander's 1892 account of "ancient graves" on the summit of Puʻu Līlīnoe. McCoy (1999:27) comments that: "If the cairns that were recorded in 1975 were in fact the same graves [as described by William D. Alexander in 1892] the remains had been removed sometime prior because no human bone was visible at that time." Thus it appears that by 1975 these features were not graves but they may or may not have functioned as such previously.

McCoy (1999:27) then discusses three possible burial cairn sites (SIHP #s -21413, -21414 and -21416) located on the southern and eastern rim of an unnamed (approximately 12,840-foot high cinder cone located approximately 0.7 miles northwest of the Mauna Kea Ice Age Natural Area Reserve) indicating that these may well be graves on the basis of form and location.

McCoy (1999:28) concludes:

> There is good reason to expect that more burials are to be found in the Science Reserve on the tops of cinder cones, either in cairns or in a small rock shelter or overhang. The basis of this prediction is that all of the known and suspected burial sites on the summit plateau are located on the tops of cinder cones and, more particularly, on the southern and eastern sides. No burials have been found on the sides or at the base of a cone, or on a ridge top amongst any of the shrines. There in fact appears to be a clear separation between burial locations and shrine locations.

3.3.1.2 Informant Data on Burials

In striking contrast to the archaeological data (in which the closest confirmed burial appears to be 3 miles from the summit at Puʻu Makanaka) is the belief of some contemporary Hawaiians that the summit region of Maunakea is something of a burial ground ("There's lot of *kūpuna* been buried up there…"; and several similar stated concerns at www.mauna-a-wakea.info/maunakea/F4_burials.html). Allied with this line of thinking are rumors of burials being disturbed and destroyed by prior observatory developments ("Would bulldozing cemeteries be allowed anywhere else in the world?" and similar stated concerns at www.mauna-a-wakea.info/maunakea/F4_burials.html).

3.3.2 Shrines

In McCoy's (1999:3) analysis of a total of 93 sites identified in the Maunakea summit area Science Reserve some 76 or 81.7% are classified as shrines (and an additional 8 shrines are components of adze manufacturing workshop sites). McCoy (1999:6) concludes that; "The vast majority of shrines are conspicuously sighted in the landscape, either on a ridge top, or at a break in the slope, which generally seems to correspond to either a lava flow margin or a change in the slope of a glacial moraine." Of some interest, McCoy notes that "there are no shrines in the Science Reserve located on top of a cinder cone."

As previously noted (McCoy 1982:A-37), an unusually high density of shrines are located in a narrow 200-foot contour interval band between 12,900 foot and 13,100-foot elevation on the north side of Maunakea in proximity to the present study area. He posits reasonably that this clearly defined vertical zonation site pattern is the result of utilization of a break in slope at the edge of a summit plateau where: "when viewed from either the base of the steep inclined slope directly below, or from the base of the summit cones above, is a relatively flat horizon on which the shrine uprights are silhouetted and therefore visible from some distance."

3.3.2.1 Kahe Ule Subincision and the Maunakea Summit Region of Kaʻohe Ahupuaʻa, Hāmākua District

A central thesis of McCoy's (1979:27) study of "A Rite of Passage Site" is that a certain site complex (SIHP # 50-10-23-16204) located at approximately the 12,280-foot level of Maunakea was the locus of initiation rites possibly related to formal initiation rites for groups of apprentices. This argument has support in the curious presence of some twenty-six open air shelters of quite small diameter that appear to have had temporary use. Few would dispute that some of the shrines of the summit region of Maunakea are "occupational shrines" specifically those near the adze quarries incorporating quarried lithic material. However it seems clear that the vast majority of the shrines of the summit region of Maunakea are not near the known adze quarries and do not incorporate quarried lithic material. This gives rise to the consideration that some quite different function may have been operative for many of the Maunakea shrines. One theory is that "these structures were erected by travelers most probably in propitiation of mountain spirits" (McCoy 1982:A-37) While this certainly seems probable as a partial explanation it may be noted that the distribution of shrines does not suggest travel corridors so much as a broad band of elevation that was preferred for shrine construction.

An alternative theory offered here is that at least some of the shrines of Maunakea are related to the *Kahe Ule* or subincision practice of Kaʻohe Ahupuaʻa of Hāmākua District. What follows admittedly is less than a convincing argument and is offered only for future consideration.

We know little about the Hawaiian practice of *Kahe Ule* or subincision of the foreskin but it was almost certainly a ritualized practice involving a group of men, a religious expert (kahuna), a special bladed tool (understood as typically a bamboo knife) and a male youth to be subincised. Gutmanis (1983:55) relates a subincision prayer (bold added for emphasis)

E Kiʻi ***kaʻohe*** *i Ho-mai-****ka-ʻohe***.	Bring the bamboo from Ho-mai-ka-ʻohe
Eia ***kaʻohe*** *lauliʻi a Kāne*	Here is the small leafed bamboo of Kāne.
ʻOkia i ka maka o ka maʻi	Cut now the foreskin
Ua moku	It is divided

Notably the noun "*Kaʻohe*" is mentioned three times. While on the one hand the phrase simply means "the bamboo" there seems little question the reference is to a ritual bamboo subincision knife. The general shape of Kaʻohe bears a vague similarity to a knife as it cuts across the *piko* of Maunakea and Maunaloa dividing the island.

3.3.3 Adze Quarries and Manufacturing Workshops

It appears from McCoy's (1999) summary analysis of site typology that the only quarries were in the extreme southern portion of the Mauna Kea Science Reserve (the Koʻokoʻolau

Complex Maunakea Adze Quarry; site 50-10-23-4136). McCoy does describe four adze manufacturing workshops (sites 11079, 16203, 16204 and 21211) defined in part by their being located where there is no naturally occurring stone-tool quality raw material. All four of these adze manufacturing workshops are on the south face of the mountain on the east side of the main Maunakea Access Road. Thus it would appear that few, if any, sites associated with quarrying or adze manufacture would be expected in the present study area.

3.3.4 Trails and Temporary Habitations

We have very little real documentation on pre-contact patterns of access to, and temporary habitation on, the summit region of Maunakea. There appears to be general agreement that: "Neither historic accounts nor archaeological surveys provide firm evidence for the prehistoric trails….historic accounts of trails used don't necessarily reflect the prehistoric trails in the area." (Maly 1997: D-12). Notably: "…no trails were mentioned by Hawaiians in the 1870s Boundary Commission records nor do any appear on the 1862 Wiltse map." (Maly 1997:D-5). The four major trail systems documented in the summit region (from North clockwise: 1. the Maunakea-ʻUmi Koa Trail, 2. the Maunakea-Humuʻula Trail, 3. the Waikiʻi-Puʻu Lāʻau-Waiau Trail, and 4. the Makahālau-Kemole-Waiau Trail) may all be largely or even entirely post-contact and primarily horse trails.

Land Boundary Commission testimony, particularly that of a certain Haiki (Boundary Commission Hawaii Volume B page 41), suggests that people of Humuʻula, North Hilo District accessed the resources of the Maunakea summit from the southeast.

Variously there is an oral history account from Mr. William Akau:

> …as a child, William Akau heard his elders talking about visits made by people from other islands to Hawaii. In ancient times, canoes would land in the Kīholo vicinity, and people walked the trails along the gentle slopes of Mauna Loa-Mauna Kea to the summit to harvest and shape stone. [Maly 1997:22]

While this account suggests access from North Kona, from due west (Kīholo in north, North Kona), it seems unlikely that Hawaiians from other islands accounted for a significant percentage of the pre-contact traffic to the summit region.

Despite these differing accounts mentioned above, the general conception has followed the Land Boundary Commission that determined that the entire summit region of Maunakea lies within Kaʻohe Ahupuaʻa of Hāmākua District and that the socio-political connectedness of the summit lands lay to the north in Hāmākua. This certainly suggests that most of the access would be expected from the north. This would lead to the expectation that much of the evidence of access to the summit region in the form of trail markers or temporary habitation sites might be expected on the north slope.

The prevailing nighttime temperatures and wind would place a premium on any lava tubes or caves that might provide substantial shelter. In the general absence of such landforms on the north slope and summit plateau travelers would be expected to seek very temporary occupation at open habitation sites seeking what protection might be available on the lee side of rock outcroppings and ridges. While too great an emphasis should not be placed on any one account, the pattern of access in the first recorded ascent of Maunakea in 1823 by the missionary Joseph Goodrich may be notable. The preacher appears to have hiked from Waimea to the Maunakea summit and back to Waimea in one 24-hour marathon. In the vicinity of Waimea he spent the night (at approximately 2,700 foot elevation). Leaving early, and approaching the summit from the north, he followed a steep ravine reaching the tree line at about 9,000 feet elevation approximately 15 miles from Waimea where he rested for a few hours recording the temperature at 43^{o} F at sunset. At 11:00 PM he pushed on in bright moonlight encountering snow at 1:00 AM and recording a temperature of 27^{o} F. Goodrich attained the highest of several summits around 3:00 AM and quickly descended.

Section 4 Results of Fieldwork

4.1 Survey Findings

The pedestrian inspection of the Area E survey area was completed at 100% coverage. The lack of vegetation within the survey area allowed for excellent visibility. An existing unpaved 4-wheel drive road (Figure 8) traverses the central portion of the survey area, in a roughly north-south orientation, generally dividing the survey area into east and west portions. The land surface within the western portion of the survey area is generally gently sloping, with little surface undulations (Figure 9). The land surface within the eastern portion of the survey area is relatively rough, with many lava channels bisecting the land surface, in a generally northwest to southeast orientation (Figure 10). During the pedestrian inspection, areas thought to have higher potential for encountering historic properties, including prominent ridges and hawaiiite basalt exposures (Figure 11) were carefully examined.

Two potential historic properties were identified within the survey area (Figure 12 and Figure 13). CSH 1 was initially interpreted to be a possible pre-contact shrine, consisting of two upright stones, located in the northwestern portion of the survey area. CSH 2 was initially interpreted to be a possible pre-contact temporary habitation complex, consisting of a C-shaped enclosure and two small terraces, located within a lava channel in the northern portion of the survey area. Documentation of the find spots is presented in Appendix A.

In addition to the pedestrian inspection of the Project Area, previously identified historic properties in the vicinity of the Project Area were re-identified. SIHP #s 50-10-23-16166, -16167, and -16172 shrines were confirmed to be located outside of the survey area.

Following the completion of the pedestrian inspection of the survey area, a site visit was conducted with State Historic Preservation Division (SHPD) staff and Dr. Patrick McCoy to discuss the significance of the two potential historic properties that were identified within the survey area. Following discussions, CSH 1 and CSH 2 were determined to not warrant historic property designation and were therefore not assigned SIHP numbers. CSH 1 was determined to most likely be a modern structure, likely constructed within the last 10 years. This interpretation was based on prior surveys undertaken by McCoy within the current survey area that did not identify the feature. CSH 2 was determined to most likely represent natural geological features that only appeared to have been man-made.

The probability of any unmarked burials or human skeletal remains being present is regarded as very low inasmuch as: a) burials near the summit have only been reported at cinder cones (primarily on the south and east sides of the summit), b) most reports of burials are at lower elevations, c) no burials have been encountered during development thus far in the Astronomy Precinct, d) there are no burial markers or surface indicators of burials present, and e) the absence of caves in the area and the general desert pavement geology would not be conducive for burial location selection.

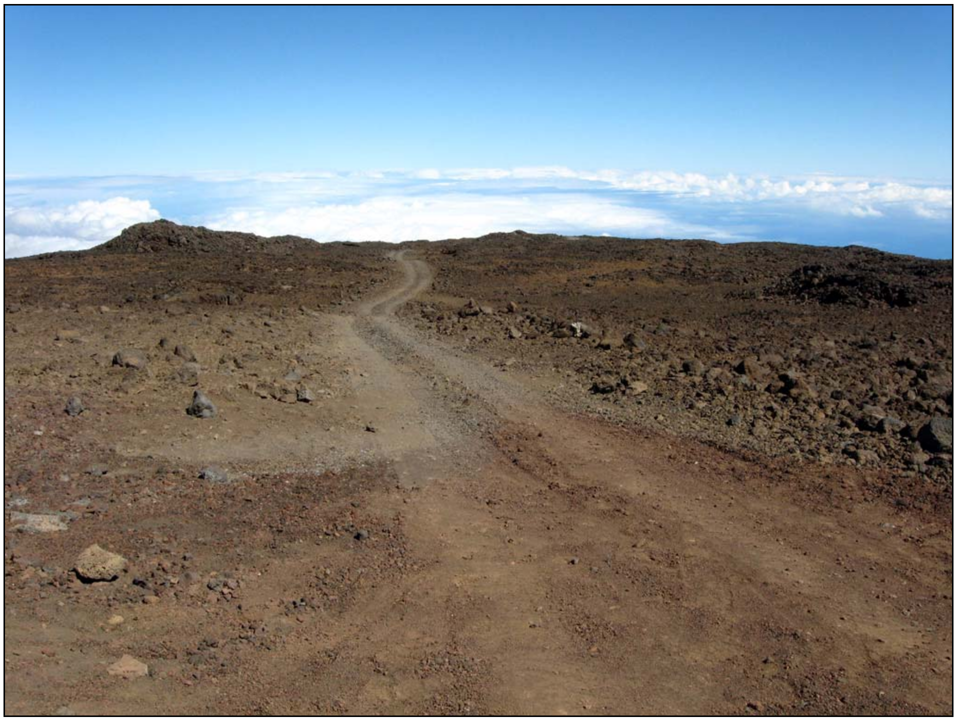

Figure 8. General view of the southern portion of the survey area, view to northwest, showing existing 4-wheel drive road and proposed Access Way through the central portion of the survey area

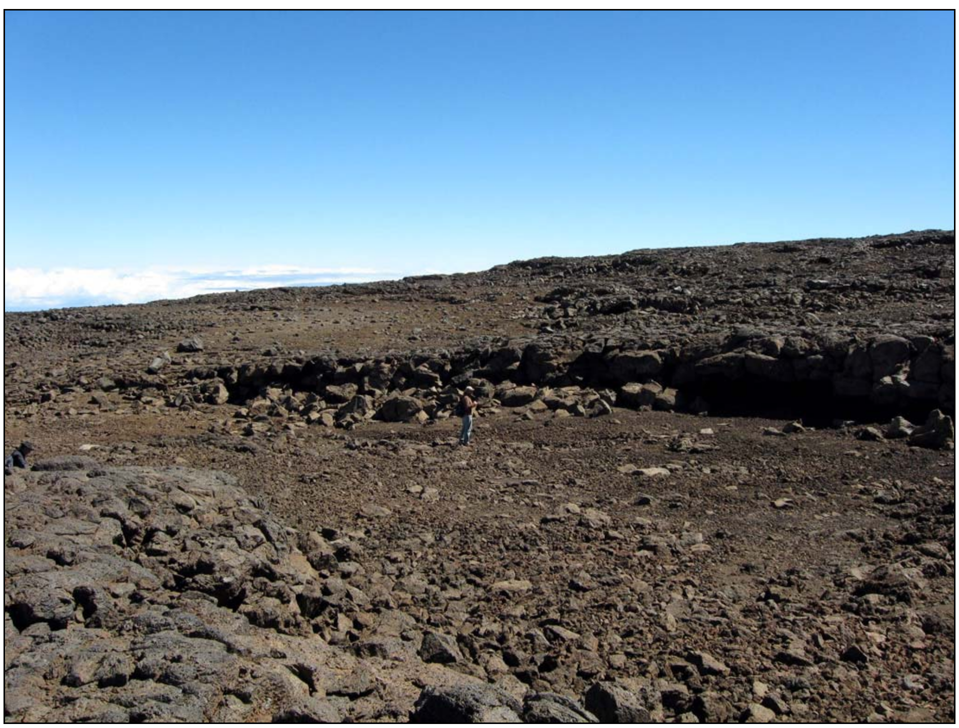

Figure 9. General view of the western portion of the survey area, view to northeast

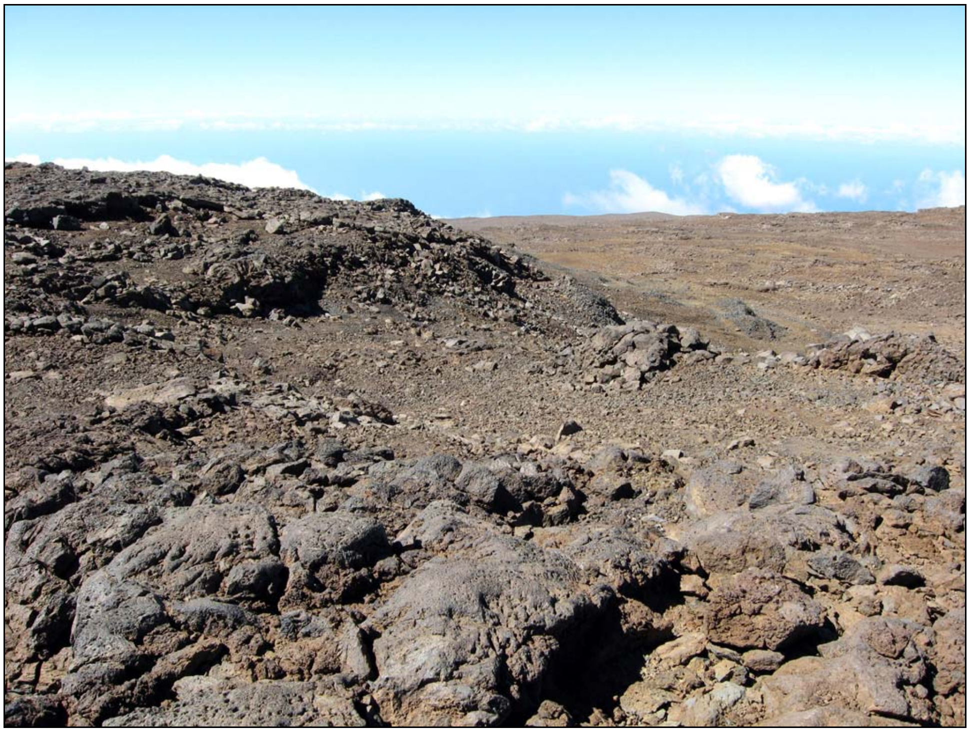

Figure 10. General view of the eastern portion of the survey area, view to north

Figure 11. Example of hawaiiite basalt exposure within the survey area

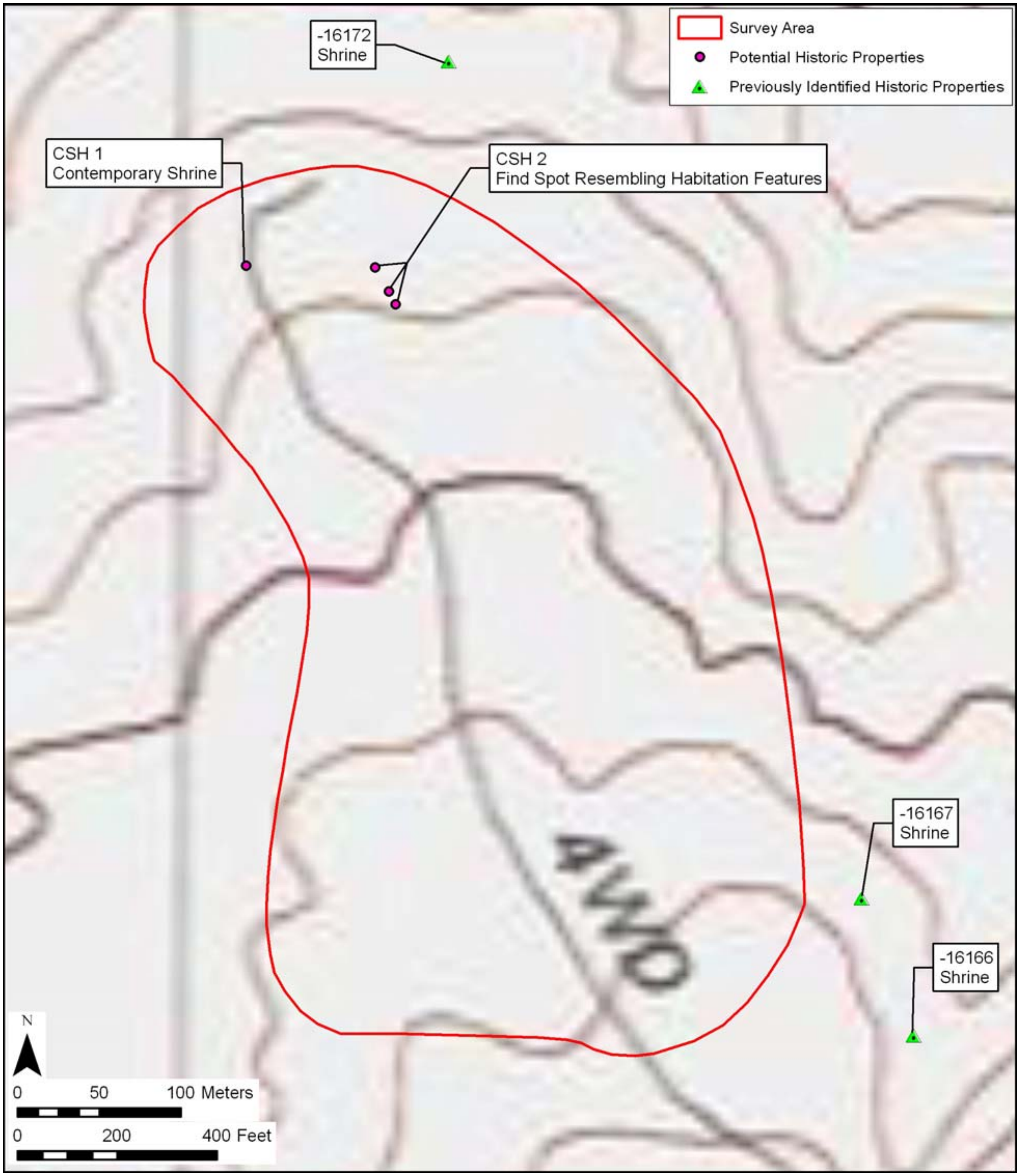

Figure 12. U.S. Geological Survey 7.5-Minute Series Topographic Map, Mauna Kea Quadrangle, showing the locations of find spots within the Project Area and previously identified historic properties in the vicinity of the Project Area

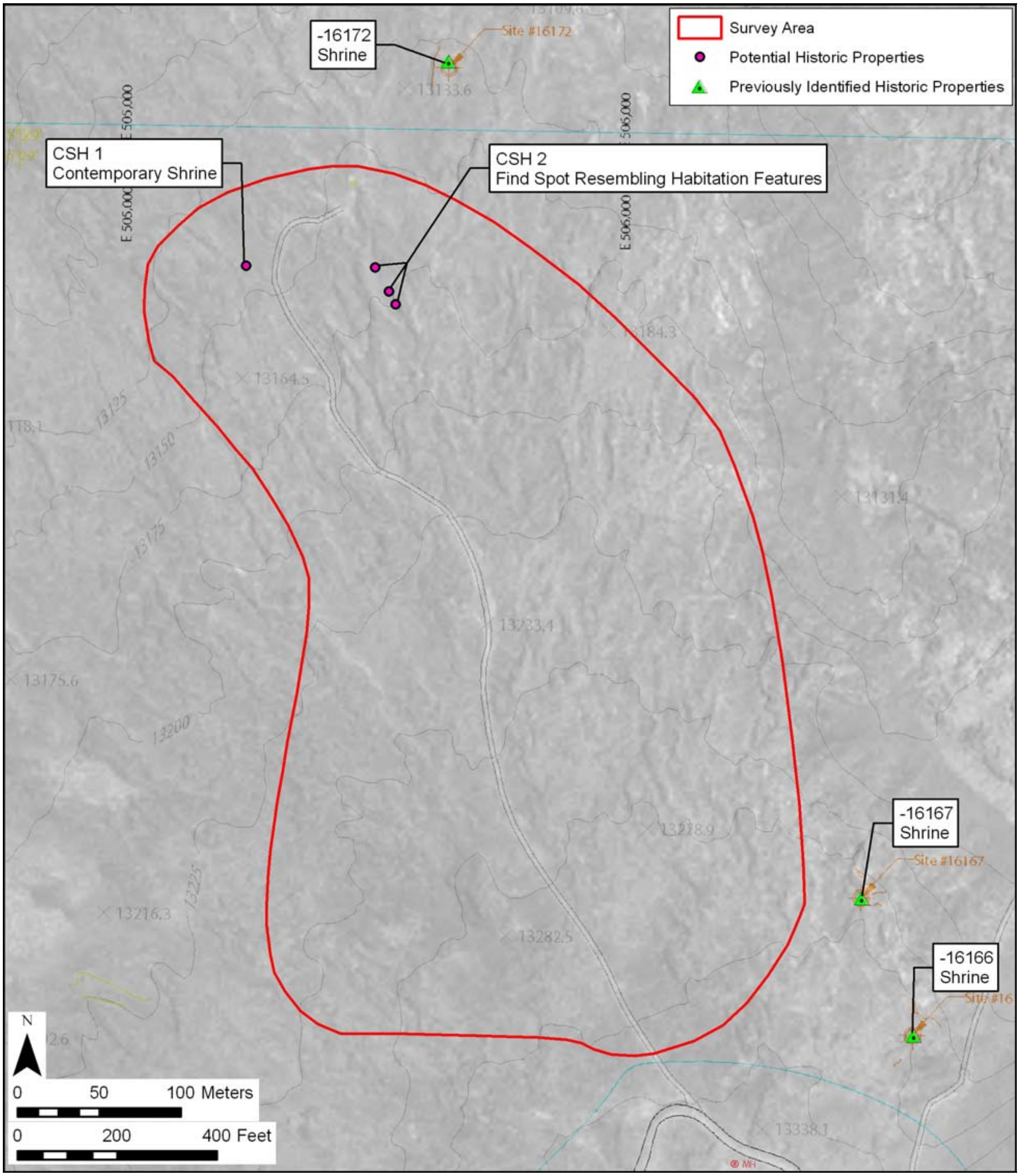

Figure 13. Aerial photograph (source: U.S. Department of Agriculture 2000) with overlay of client-provided topographic map, showing the locations of find spots within the survey area and previously identified historic properties in the vicinity of the survey area

Section 5 Project Effect and Mitigation Recommendations

5.1 Project Effect

No historic properties were identified within the approximately 36-acre survey area. Previously identified historic properties in the vicinity of the survey area were identified and confirmed to be outside of the survey area (designated Area E). CSH's effect recommendation for the proposed TMT Observatory Project is "no historic properties affected."

5.2 Mitigation Recommendations

No historic preservation mitigation measures are recommended for the proposed TMT Observatory Project.

Three historic properties (-16166, -16167 & -16172) understood to all be pre-contact shrines are all located in the general vicinity (see Figures 12 & 13). As specified in a 2000 Master Plan it is understood that Project activities should maintain a 200-foot buffer from these sites. All three of these sites lie at a distance of more than 200-feet from the designated Area E and hence as long as Project activities remain within the designated Area E there should be no adverse impact to these historic properties.

The probability of burials or human skeletal remains within the Project Area is regarded as very low for reasons given in Section 4.1 above. However, in the unlikely event that cultural resources including but not limited to human remains or other significant cultural deposits are encountered during the course of Project-related construction activities, all work in the immediate area should stop and the State Historic Preservation Division should be promptly notified.

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Appendix A Documentation of Potential Historic Properties

CSH 1

INITIALLY INTERPRETED SITE TYPE:	Shrine
INITIALLY INTERPRETED FUNCTION:	Ceremonial
FEATURES:	1
DIMENSIONS:	6.6 feet NW/SE x 3.3 ft. NE/SW
CONDITION:	Excellent
PROBABLE AGE:	Modern
TAX MAP KEY:	[3] 4-4-015:009

DESCRIPTION:

CSH 1 consists of two upright stones, located in the northwestern portion of the survey area (see Figure 12 and Figure 13). The upright stones, consisting of flat slabs of hawaiiite basalt, are situated on the edge of a natural basalt boulder terrace, measuring approximately 50 ft. long and 2 ft. in height (Figure 14). The upright stones are wedged into cracks within or between the top surface of large boulders, with cobbles used to fill the remaining gaps (i.e. chinking) and support the stones in an upright position (Figure 15 and Figure 16). The upright stones are spaced 4 ft. apart, at a bearing of 132° true north. The southeastern upright stone measures 22 inches high and 10 inches wide, with a thickness of 2 inches. The northwestern stone measures 18.5 inches high and 12 inches wide, with a thickness of 1.5 inches. CSH 1 was initially interpreted to be a pre-contact shrine, similar to shrines previously identified in the vicinity of the project area. However, following consultation with SHPD staff and Dr. Pat McCoy within the project area, the shrine was determined to be a modern structure, likely constructed within the last 10 years.

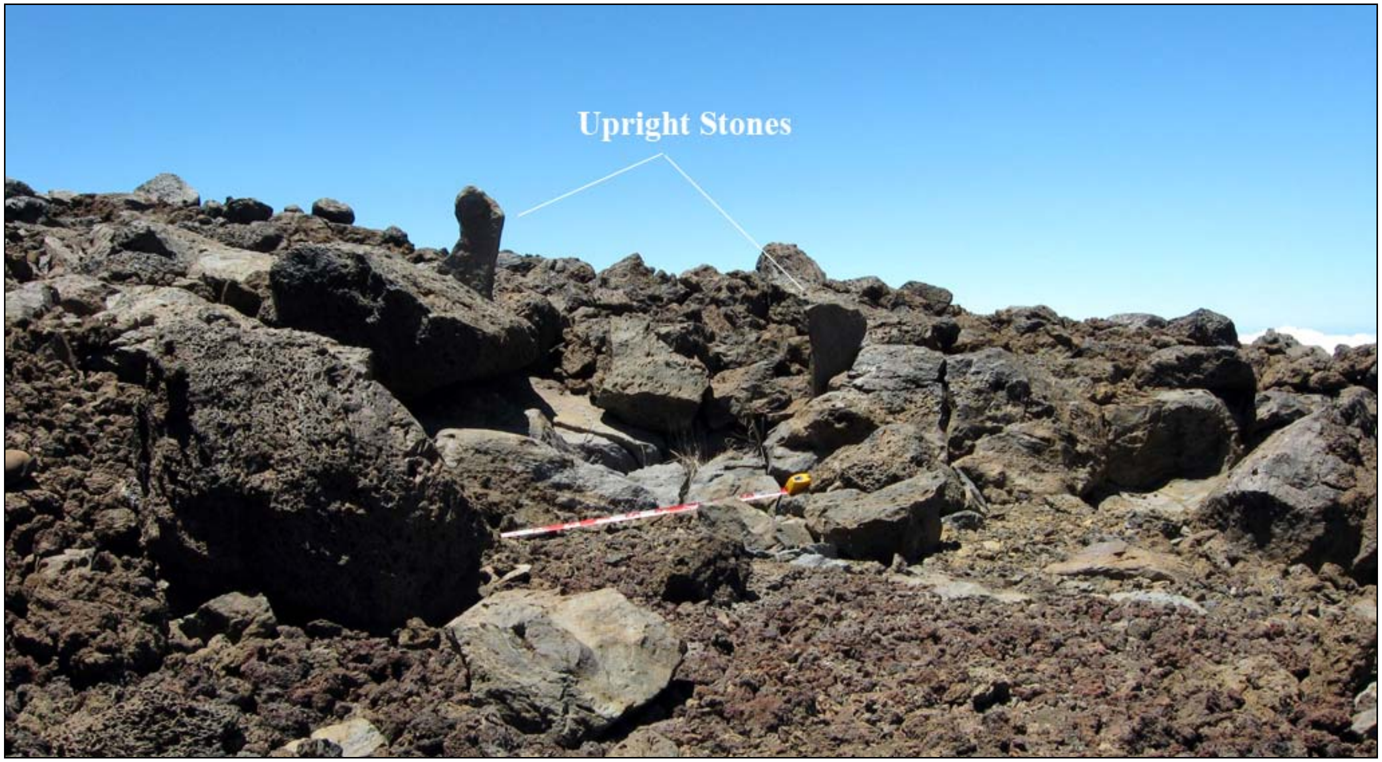

Figure 14. Photograph of CSH 1 understood as a contemporary shrine, view to southwest, showing two upright stones

Figure 15. Photograph of CSH 1 understood as a contemporary shrine, showing southeastern upright stone

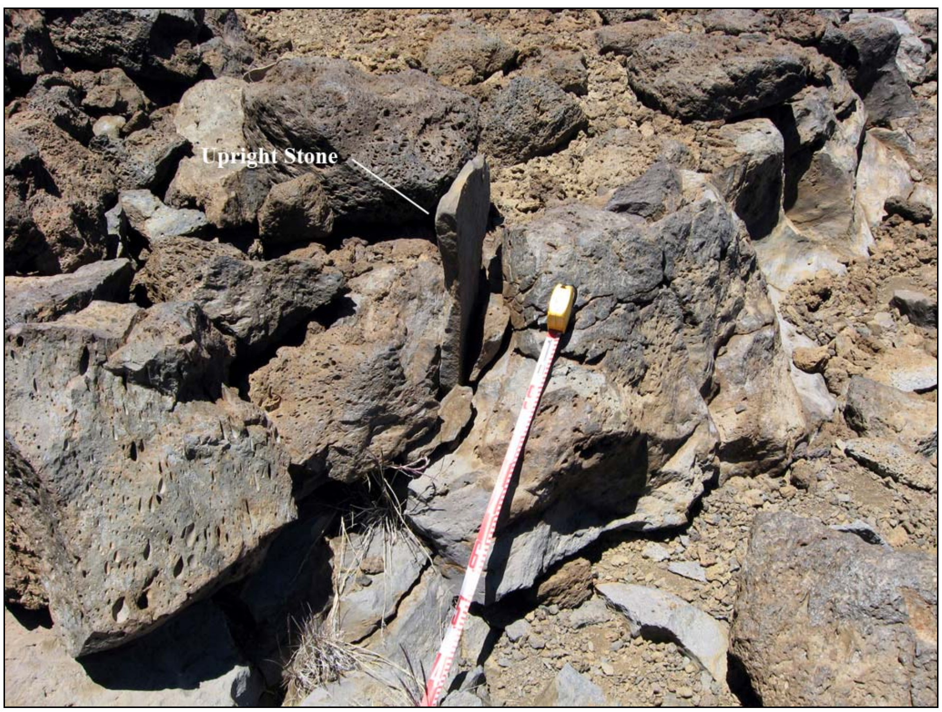

Figure 16. Photograph of CSH 1 understood as a contemporary shrine, showing northwestern upright stone

CSH 2

[The following account relates to how this find spot was initially recorded]

INITIALLY INTERPRETED SITE TYPE:	Temporary Habitation Complex
INITIALLY INTERPRETED FUNCTION:	Temporary Habitation
FEATURES:	3
DIMENSIONS:	100 feet NW/SE x 22 feet NE/SW
CONDITION:	n/a
PROBABLE AGE:	n/a
TAX MAP KEY:	[3] 4-4-015:009

DESCRIPTION:

CSH 2 was originally believed to consist of three possible temporary habitation structures, located in the northwestern portion of the project area (see Figure 12 and Figure 13). The possible temporary habitation structures are located within a northwest to southeast trending lava channel, sheltered from the prevailing northeasterly winds. Feature A, the northernmost of the possible structures, is a C-shaped enclosure located at the base of the lava channel (Figure 17). Feature A measures 6.2 feet by 4.9 ft. wide, and utilizes an 2.6 ft. high bedrock outcrop along the eastern edge of the structure, with a 2 ft. high, 1-3 course, stacked boulder and cobble wall along the southeastern edge, forming a C-shaped windbreak. The interior of Feature A is a level, pebble-paved surface, cleared of larger stones. Feature B, located approximately 17 m southeast of Feature A, is a terrace constructed against the northeastern ridge of the lava channel (Figure 18). Feature B measures 6.2 ft. by 4.3 ft. wide and is constructed with a 3.9 ft. high, 3-5 course, roughly stacked boulder and cobble retaining wall along the north and west edges of the structure. The wall retains a level, pebble-paved terrace surface. Feature C, the southernmost of the structures, is a terrace located approximately 30 ft. southeast of Feature B (Figure 19). Feature C, measuring 8.5 ft. by 5 ft., is constructed against the northeastern ridge of the lava channel. A 2.6 ft. high, 2-4 course, roughly stacked boulder and cobble retaining wall is constructed along the southwest portion of the structure, retaining a level, pebble paved terrace surface.

CSH 2 was initially interpreted to be a pre-contact temporary habitation complex. However, following a subsequent on-location consultation with SHPD staff and Dr. Pat McCoy, CSH 2 was determined to most likely consist of natural features.

Figure 17. Photograph of CSH 2 Feature A, initially perceived as a C-shaped temporary habitation structure, view to east

Figure 18. Photograph of CSH 2 Feature B, initially perceived as a temporary habitation terrace, view to east

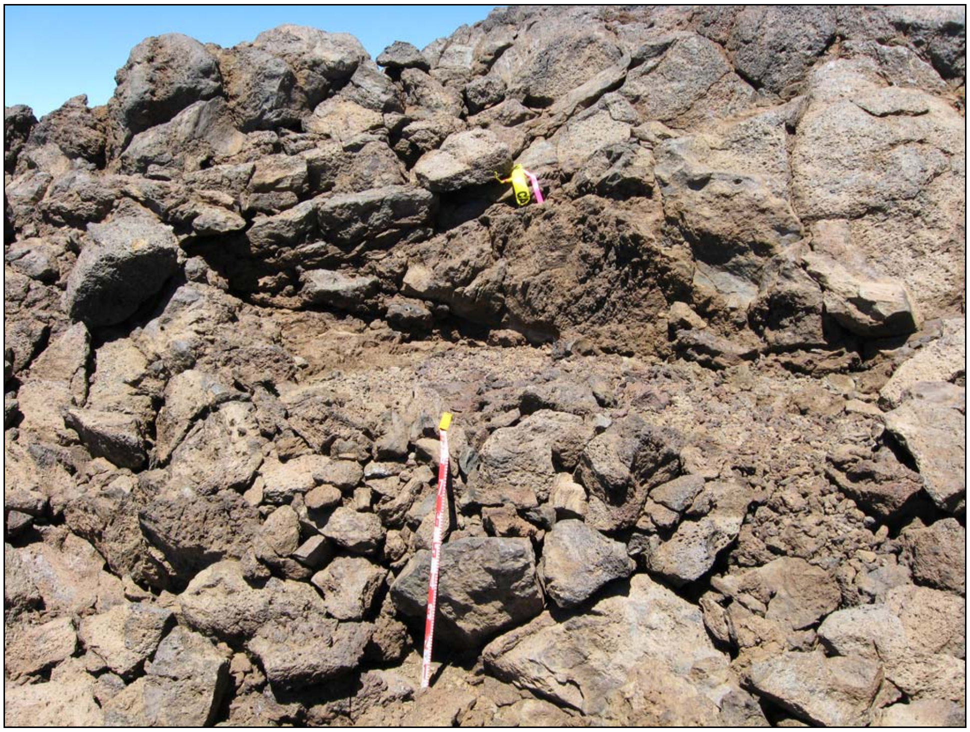

Figure 19. Photograph of CSH 2 Feature C, initially perceived as a temporary habitation terrace, view to northeast

DRAFT ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2 – APPENDIX F: ARCHAEOLOGICAL ASSESSMENT REPORT, HALE PŌHAKU

Volume 2

Thirty Meter Telescope Project

Island of Hawai‘i

Proposing Agency:
University of Hawai‘i at Hilo

Archaeological Assessment for the Thirty-Meter-Telescope (TMT) Observatory Project Ancillary Facilities, Hale Pōhaku Area, Maunakea, Ka‘ohe Ahupua‘a, Hāmākua District, Hawai‘i Island TMK: [3] 4-4-015:001 por., 012 por.

Prepared for

PB Americas, Inc.

Prepared by

Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai‘i, Inc.

Kailua, Hawai‘i

(Job Code: MAUNAKEA 4)

May 2009

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Management Summary

Reference	Archaeological Assessment for the Thirty-Meter-Telescope (TMT) Observatory Project Ancillary Facilities, Hale Pōhaku Area, Maunakea, Kaʻohe Ahupuaʻa, Hāmākua District, Hawaiʻi Island TMK: [3] 4-4-015:001 por., 012 por. (Hammatt 2009)
Date	May 2009
Project Number (s)	Cultural Surveys Hawaiʻi Inc. (CSH) Job Code: MAUNAKEA 4
Investigation Permit Number	The fieldwork component of the archaeological assessment study was carried out under archaeological permit number 09-20, issued by the Hawaiʻi State Historic Preservation Division / Department of Land and Natural Resources (SHPD/DLNR), per Hawaiʻi Administrative Rules (HAR) Chapter 13-13-282.
Project Location	The approximately 6-acre Project area consists of two discreet parcels located in the Hale Pōhaku area, at approximately 2,800 m (9,200 ft.) elevation on the southern slope of Maunakea. The Project area is depicted on the U.S. Geological Survey 7.5-Minute Series Topographic Map, Mauna Kea Quadrangle (1993) (Figure 1).
Land Jurisdiction	State of Hawaiʻi
Agencies	Hawaiʻi State Historic Preservation Division / Department of Land and Natural Resources
Project Description	The proposed TMT Observatory Project involves the construction of a thirty (30) meter diameter telescope and associated infrastructure at the Maunakea Summit Area. The current Project area is proposed for use as construction staging areas and development of housing for TMT Project staff and contractors. The proposed Project also involves upgrades to the existing Hawaiʻi Electric Light Company (HELCO) power substation at Hale Pōhaku. Minimally, land disturbing activities would include grading of the construction staging areas, and excavations associated with construction of residential and associated structures, installation of subsurface utilities, and substation upgrades.
Project Acreage	Approximately 6-acres
Area of Potential Effect (APE) and Survey Acreage	The area of potential effect (APE) is defined as the entire approximately 6-acre Project area.

Historic Preservation Regulatory Context	At the request of PB, CSH conducted an archaeological inventory survey investigation for the proposed TMT Observatory Project, Hale Pōhaku area. Per the requirements of Hawai‘i Administrative Rules (HAR) Chapter 13-13-276, the study was conducted to identify, document, and make Hawai‘i Register of Historic Places (Hawai‘i Register) eligibility recommendations for the survey area's historic properties. Because no historic properties were identified in the survey area, this investigation is termed an archaeological assessment per HAR Chapter 13-13-275-5. This archaeological assessment report was prepared to support the proposed Project's historic preservation review under Hawai‘i Revised Statutes (HRS) Chapter 6E-8 and HAR Chapter 13-13-275. It is also intended to support any Project-related historic preservation consultation with stake-holding State or County agencies and interested Native Hawaiian and community groups.
Fieldwork Effort	The CSH field crew included: David W. Shideler, M.A.; Todd Tulchin, B.S.; Auli‘i Mitchell, B.A.; Brian Cruz, B.A.; Momi Wheeler, B.A; and Lisa Gollin, Ph.D., under the overall supervision of Hallett H. Hammatt, Ph.D. Fieldwork was conducted on February 26, 2009 and required 6 person-days to complete.
Number of Historic Properties Identified	None
Effect Recommendation	No historic properties were identified within the approximately 6-acre Project area. Previously identified historic properties in the vicinity of the survey area were re-identified and confirmed to be outside of the Project area. CSH's effect recommendation for the proposed Thirty-Meter-Telescope (TMT) Observatory Project is "no historic properties affected."

Mitigation Recommendation	No historic preservation mitigation measures are recommended for the proposed TMT Observatory Project, Hale Pōhaku Area. The HELCO Substation is also free of historic preservation concerns, however, it is recommend that should there be any proposed development more than 66 feet north and west from the northwest corner of the HELCO Substation exclosure that there be prior consultation with Dr. Patrick McCoy regarding the formerly designated lithic scatter Site 8 and the lithic finds documented here as CSH 6 to see if he has any concerns. The probability of any unmarked burials or human skeletal remains being present is regarded as very low inasmuch as: a) burials in the Maunakea uplands have only been reported at cinder cones, b) no burials have been encountered during development thus far in the astronomy precinct, c) there are no burial markers or surface indicators of burials present, and d) the absence of caves in the area and the general desert pavement geology would not be conducive for burial location selection. However, in the unlikely event that cultural resources, including human skeletal remains or other significant cultural deposits, are encountered during the course of Project-related construction activities, all work in the immediate area should stop and the State Historic Preservation Division should be promptly notified.

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Section 1 Introduction

1.1 Project Background

At the request of PB Americas, Inc. (PB), Cultural Surveys Hawaiʻi Inc. (CSH) completed an archaeological assessment for the proposed Thirty-Meter-Telescope (TMT) Observatory Project, Hale Pōhaku Mid-Level Facilities Area, Kaʻohe Ahupuaʻa, Hāmākua District, Hawaiʻi Island (TM:K [3] 4-4-015:001 por., 012 por.). The approximately 6-acre Project area consists of two discreet parcels located in the Hale Pōhaku area, at approximately 2,800 m (9,200 ft.) elevation on the southern slope of Maunakea (Figures 1-3). The Project area is depicted on the U.S. Geological Survey 7.5-Minute Series Topographic Map, Mauna Kea Quadrangle (1993) (Figure 1).

Lands within the Project area are owned by the State of Hawaiʻi. The eastern portion of the Project area is leased to, and is managed by, the UH as the Hale Pōhaku Mid-Level Astronomy Facilities. The western portion of the Project area, which consists of the existing Hawaiʻi Electric Light Company (HELCO) power substation, is located within the Mauna Kea Forest Reserve. The proposed TMT Project involves the construction of a thirty (30) meter diameter telescope and associated infrastructure at Area E of the Astronomy Precinct below the summit of Maunakea. The current Project area is proposed for use as construction staging areas and development of housing for TMT Project staff and contractors. The proposed Project also involves upgrades to the existing HELCO power substation at Hale Pōhaku. Minimally, land disturbing activities would include grading of the construction staging areas, and excavations associated with construction of residential and associated structures, installation of subsurface utilities, and substation upgrades. The area of potential effect (APE) is defined as the entire approximately 6-acre Project area.

At the request of PB, CSH conducted an archaeological inventory survey investigation for the proposed TMT Project, Hale Pōhaku Area. Per the requirements of Hawaiʻi Administrative Rules (HAR) Chapter 13-13-276, the study was conducted to identify, document, and make Hawaiʻi Register of Historic Places (Hawaiʻi Register) eligibility recommendations for the Project area's historic properties. Because no historic properties were identified in the Project area, this investigation is termed an archaeological assessment per HAR Chapter 13-13-284-5. This archaeological assessment report was prepared to support the proposed Project's historic preservation review under Hawaiʻi Revised Statutes (HRS) Chapter 6E-8 and HAR Chapter 13-13-275. It is also intended to support any Project-related historic preservation consultation with stake-holding State or County agencies and interested Native Hawaiian and community groups.

1.2 Scope of Work

The following scope of work satisfies the State requirements for an archaeological inventory survey, per HAR Chapter 13-13-276:

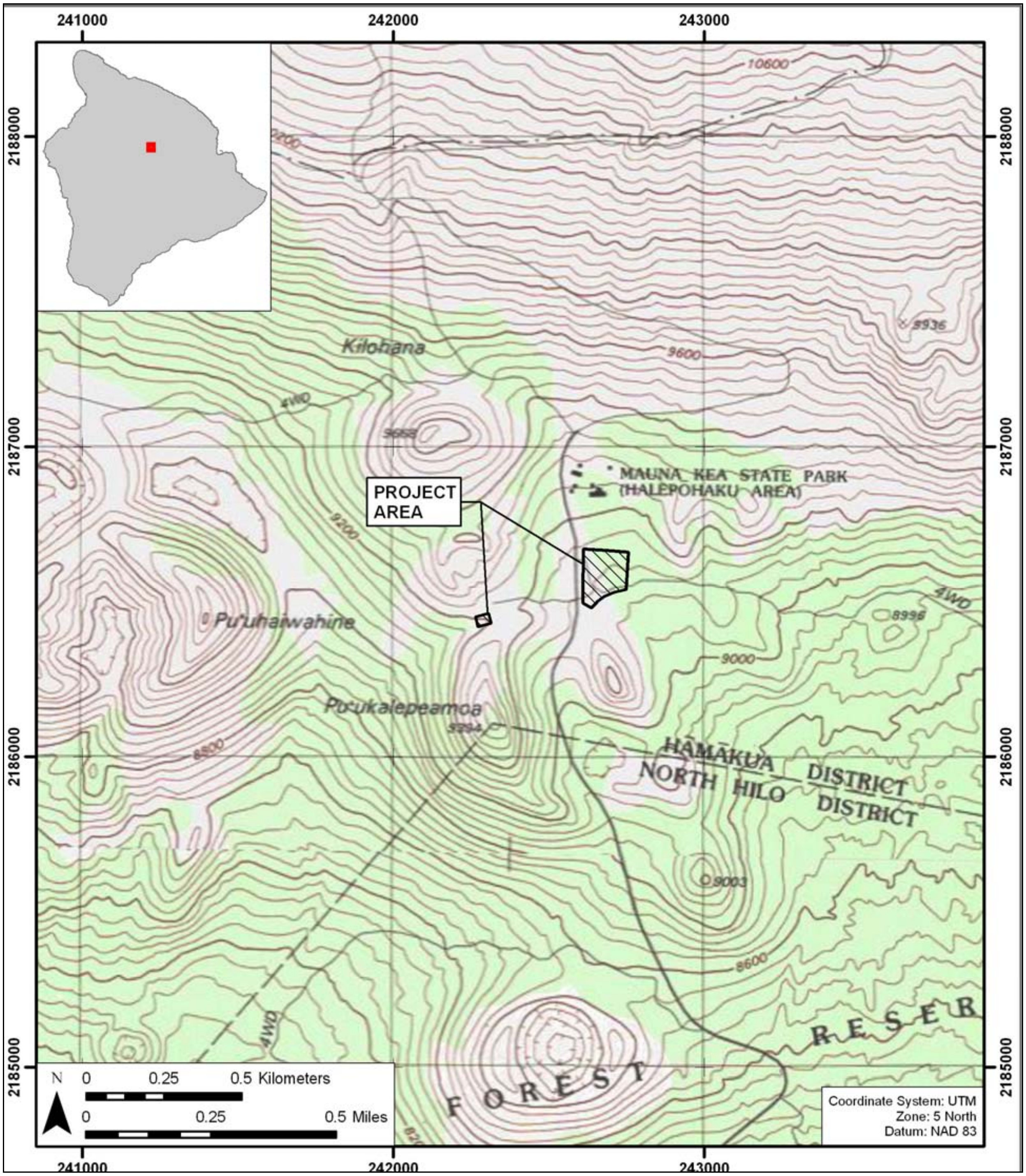

Figure 1. U.S. Geological Survey 7.5-Minute Series Topographic Map, Mauna Kea Quadrangle (1993), showing the location of the Project areas

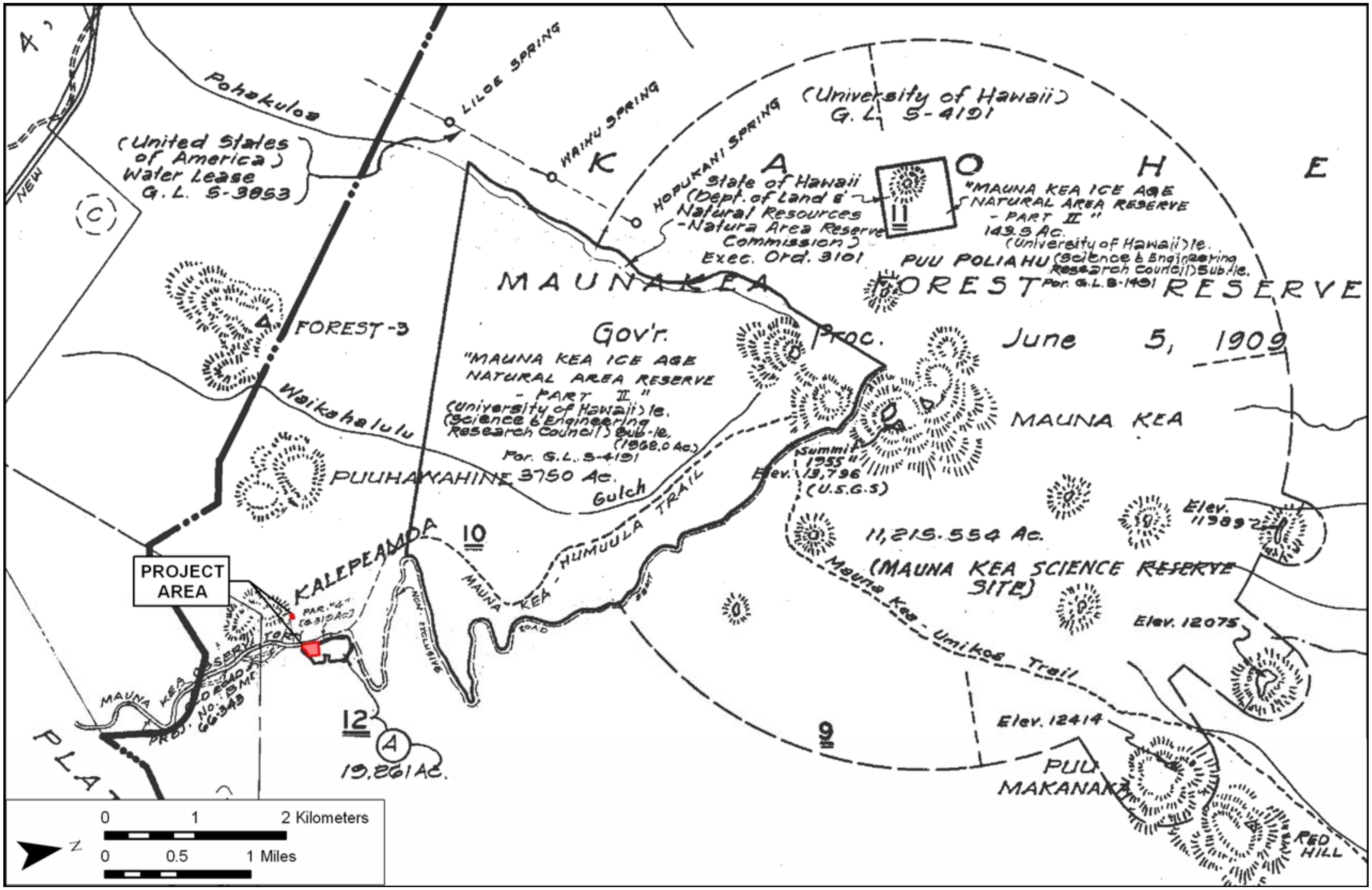

Figure 2. Portion of Tax Map Key (TMK) 4-4-015, showing the location of the Project areas

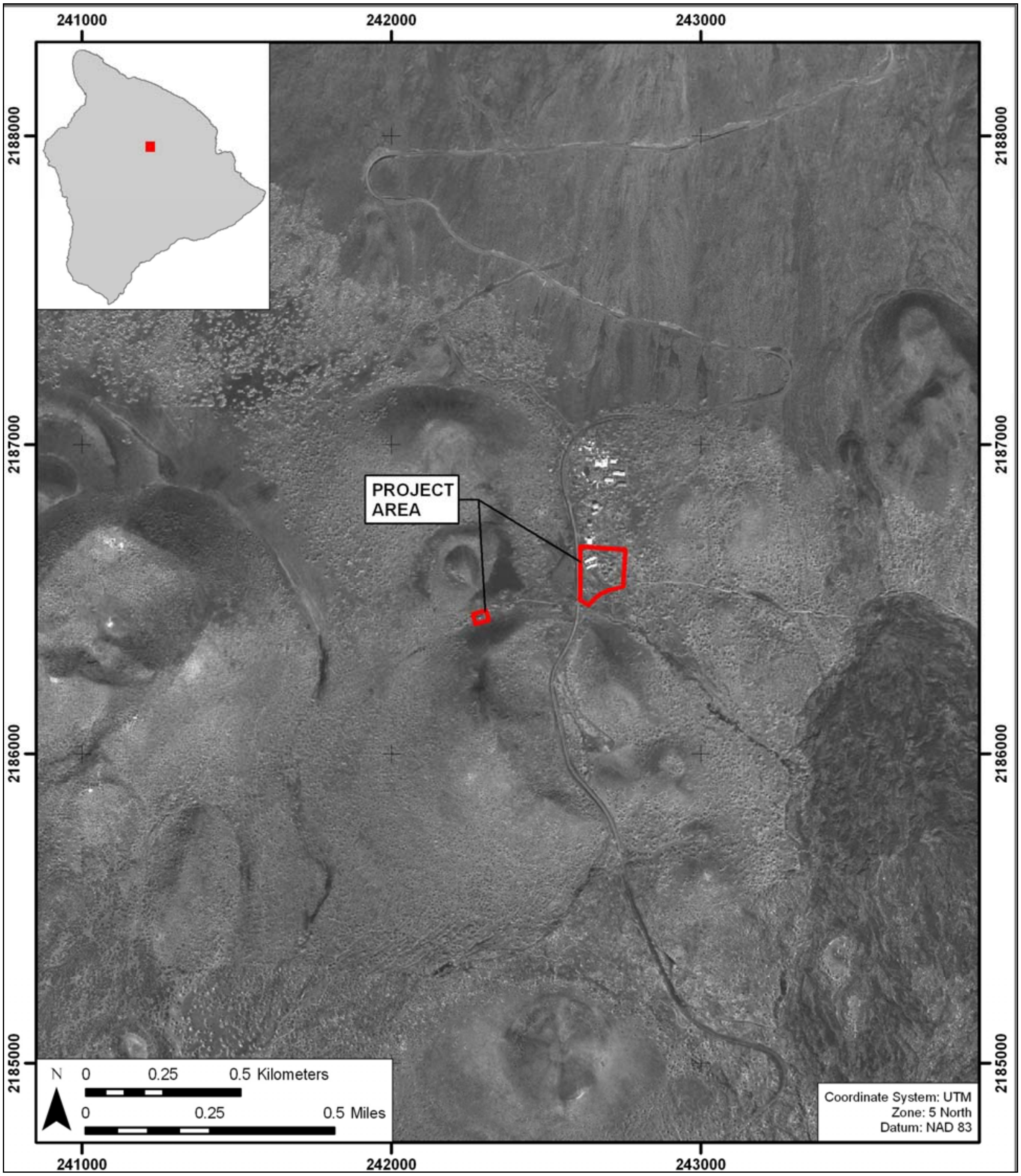

Figure 3. Aerial photograph (source: U.S.D.A. 2000), showing the location of the Project areas

1. Historic and archaeological background research, including a search of historic maps, written records, Land Commission Award documents, and the reports from prior archaeological investigations. This research focused on the specific Project area's past land use, with general background on the pre-contact and historic settlement patterns of the *ahupua‘a* and district. This background information was used to compile a predictive model for the types and locations of historic properties that could be expected within the Project area.
2. A complete (100% coverage) systematic pedestrian inspection of the Project area to identify any potential surface historic properties. Surface historic properties were recorded with an evaluation of age, function, interrelationships, and significance. Documentation included photographs, scale drawings, and, if warranted, limited controlled excavation of select sites and/or features, and location of historic properties with GPS survey equipment.
3. As appropriate, consultation with knowledgeable individuals regarding the Project area's history, past land use, and the function and age of the historic properties documented within the Project area.
4. As appropriate, laboratory work to process and gather relevant environmental and/or archaeological information from collected samples.
5. Preparation of this archaeological assessment report, including the following:
    a) A Project description;
    b) A section of a USGS topographic map showing the survey area boundaries and the location of all recorded historic properties;
    c) Historical and archaeological background sections summarizing prehistoric and historic land use of the Project area and its vicinity;
    d) Descriptions of all historic properties, including selected photographs, scale drawings, and discussions of age, function, laboratory results, and significance, per the requirements of HAR 13-13-276. Each historic property was assigned a Hawai‘i State Inventory of Historic Properties (SIHP) number;
    e) If appropriate, a section concerning cultural consultations [per the requirements of HAR 13-276-5(g) and HAR 13-275].
    f) A summary of historic property categories, integrity, and significance based upon the Hawai‘i Register of Historic Places evaluation criteria;
    g) A Project effect recommendation;
    h) Treatment recommendations to mitigate the Project's potential adverse effect on historic properties identified in the Project area that are recommended eligible to the Hawai‘i Register of Historic Places.

This scope of work includes full coordination with the State Historic Preservation Division (SHPD), and County relating to archaeological matters. This coordination takes place after consent of the landowner or representatives.

1.3 Environmental Setting

1.3.1 Natural Environment

The environmental setting of the Hale Pōhaku area has been well described by McCoy (1990:237-92; 1991:4-9) and the reader is referred to his work for a thorough study and references. A brief overview is presented in this study, based on Dr. McCoy’s work. The current Project area is located on a gently sloping saddle area surrounded by prominent cinder cones, including Pu‘u Kalepeamoa, Pu‘u Haiwahine, and Kilohana. Pu‘u Kalepeamoa is understood as an older hawaii-ite cone which contains a large number of cored bombs many of which are formed of angular mafic blocks with dunnite and gabbro inclusions (McCoy 1991:6). Pu‘u Kalepeamoa is understood as the likely source for much of the raw material worked at the Pu‘u Kalepeamoa site complex (see Section 3.2 Previous Archaeological Research). The surrounding geology includes cinder cones, lava flows and air fall deposits termed Laupahoehoe Volcanics understood as probably less than 40,000 years old.

Elevations within the Project area range from approximately 2,780-2,805 m (9,120-9,200 ft.) above mean sea level. The Project area receives an average of approximately 26 inches of annual rainfall (Giambelluca et al. 1986). Sediments within the Project area are listed as Huikau Extremely Stony Loamy Sand (rHLD) and Cinder Land (rCL) (Figure 4). Soils of the Huikau Series are described as “somewhat excessively drained loamy sands that formed in volcanic ash, pumice, and cinders” (Sato et al. 1973). Cinder Land is described as “bedded cinders, pumice, and ash…The particles have jagged edges and a glassy appearance and show little or no evidence of soil development” (Sato et al. 1973).

The Project area lies close to the timberline and the vegetation is generally a subalpine xerophytic scrub of *pūkiawe* (*Styphelia tameiameiae*), *noho-anu* (*Geranium cuneatum*), *‘ōhelo* (*Vaccinium reticulatum*), *na‘ena‘e* (*Raillardia ciliolata*), *kalamoho* fern (*Pellaea ternifolia*), *‘āheahea* (*Chenopodium oahuensis*), *pilo* (*Coprosma montana*), *māmane* (*Sophora chrysophylla*), and a variety of native and exotic grasses. It seems probable that prior to human utilization of this area, and the presence of feral goats and sheep, that the *māmane* vegetation was more extensive and diverse (McCoy 1990:91). The work of McCoy has also emphasized the “non-subsistence” nature of this alpine environment, and it is understood that virtually all food to support temporary habitation in the area would have been imported from lower elevations.

1.3.2 Built Environment

The eastern portion of the Project area is adjacent to the Maunakea Access Road and includes components of the Hale Pōhaku Mid-Level Astronomy Facilities. Development in the Hale Pōhaku area includes the Onizuka Center for International Astronomy, the Visitor Information Station (a.k.a. Ranger Station), and construction laborer residences. The construction laborer residences are located within the current Project area and include two dormitory structures and four cabins (Figure 5). The western portion of the Project area consists of the existing HELCO power substation within a fenced exclosure (Figure 6). The vicinity of the Project area is generally undeveloped, with the exception of jeep roads.

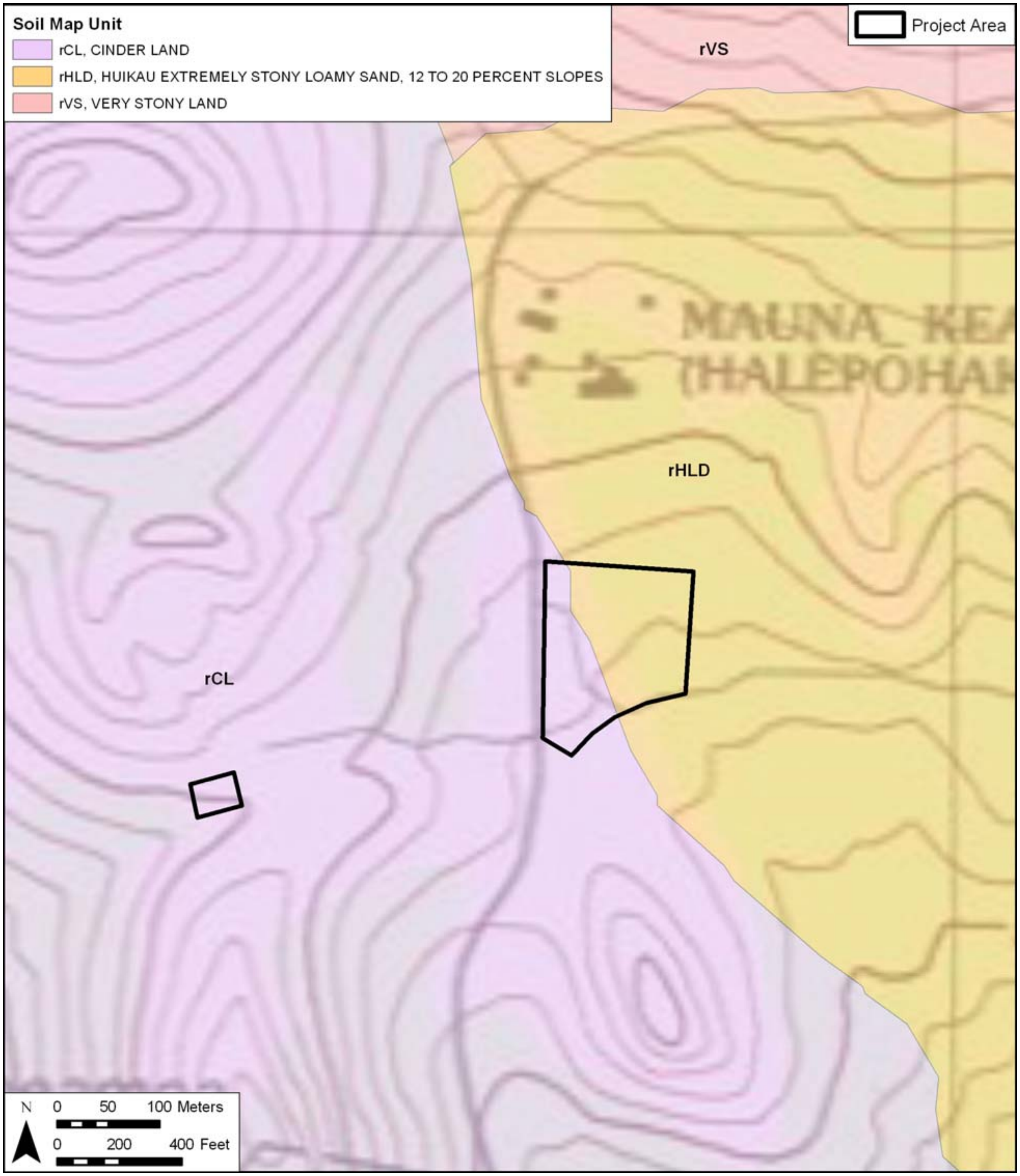

Figure 4. U.S. Geological Survey Topographic Map, Mauna Kea Quadrangle (1993) with overlay of the Soil Survey of the Island of Hawai‘i (Sato et al. 1972), showing sediment types within the Project area

Figure 5. General view of the Hale Pōhaku portion of the Project area, showing existing residential structures within the Project area located immediately east of the Maunakea Access Road, view to east

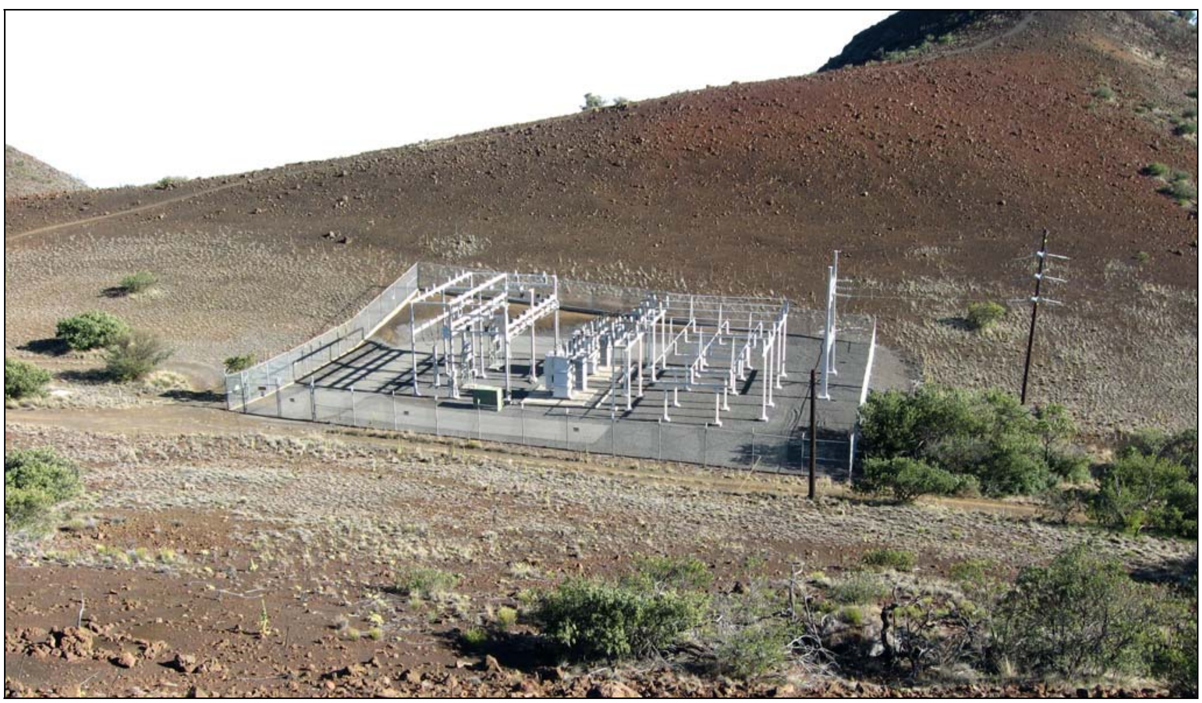

Figure 6. General view of the HELCO substation portion of the Project area, showing the existing power substation area located approximately 820 feet (250 m) west of the Maunakea Access Road, view to north

Section 2 Methods

2.1 Field Methods

The fieldwork component of the archaeological assessment study was carried out under archaeological permit number 09-20, issued by the Hawaiʻi State Historic Preservation Division / Department of Land and Natural Resources (SHPD), per Hawaiʻi Administrative Rules (HAR) Chapter 13-13-282. The CSH field crew included: David W. Shideler, M.A.; Todd Tulchin, B.S.; Auliʻi Mitchell, B.A.; Brian Cruz, B.A.; Momi Wheeler, B.A; and Lisa Gollin, Ph.D.; under the overall supervision of Hallett H. Hammatt, Ph.D. Fieldwork was conducted on February 26, 2009 and required 6 person-days to complete.

The archaeological assessment fieldwork consisted of a complete (100% coverage) pedestrian inspection of the Project area. The pedestrian inspection was accomplished through systematic sweeps. The interval between the archaeologists was generally 33 feet (10 m). The general lack of vegetation made for excellent visibility. All potential historic properties encountered were recorded and documented with a written field description, scale drawings, photographs, and each feature was located using Garmin GPSMAP 60CSx GPS survey technology (10 to 16 ft or 3-5 m accuracy).

In a number of areas, physical evidence of human activity (typically stone constructions representing a small investment in labor) was observed, but there were believed to be good grounds for concluding that the specific construction was less than fifty years old, and hence the physical evidence of human activity was regarded as inappropriate for designation as a historic property. In order to provide a more complete record, these cases are documented in the present "Appendix A Documentation of Find Spots". These find spots are not regarded as significant under formally established criteria for designation as historic properties by virtue of their modernity.

2.2 Document Review

Historic and archival research included information obtained from the UH Mānoa Hamilton Library, the State Historic Preservation Division Library, the Hawaiʻi State Archives, the State Land Survey Division, and the Archives of the Bishop Museum. Previous archaeological reports for the area were reviewed, as were historic maps and primary and secondary historical sources. In some cases within this study we have standardized Hawaiian language spelling to conform to current orthography.

2.3 Consultation

The community consultation effort for the proposed TMT Observatory Project is detailed in a companion Cultural Impact Assessment report (Kaʻuhane et al., 2009 in progress). In general, Native Hawaiian organizations, government agencies and community members were contacted in order to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the Project area and vicinity. The agencies consulted included the SHPD, the Office of Hawaiian Affairs (OHA), and the Hawaiʻi Island Burial Council (HIBC).

Section 3 Background Research

3.1 Traditional and Historic Background

The traditional and historical background for the Project area is presented at length in a companion Cultural Impact Assessment study (Ka‘uhane et al. 2009; in progress) to which the reader is referred. There is very little traditional information regarding the Hale Pōhaku area.

‘Umi-a-Liloa, the renowned mid 1500s king, constructed *heiau* in honor of Halulu, the god who provided his power. The following excerpt from Maly and Maly (2005:28-29) tells of ‘Umi’s *heiau* including one constructed in the vicinity of Hale Pōhaku:

> …He (‘Umi) also built a *heiau* (temple) below Pohaku Hanalei, it is called the ahua o Hanalei (altar of Hanalei); and on the side of Mauna Kea, by where one travels to Hilo, he built the third of his temples, at the place called Puukekee [also written Puu Keekee in historical texts]; and there at Mauna Halepohaku he built the fourth of his temples; there, it is said, Umi dwelt with his many people. It is said that Umi was a chief who dwelt upon the mountain, it was because of his love of his people, that he (‘Umi) returned and dwelt in the middle of the island [Ahu-a-Umi], that is where he dwelt with his beloved people. His commoners lived along the shores, and they brought food for them (in the uplands), from one side of the island to the other… [*Ke Au Okoa*; Mei 22, 1865; Maly, translator] (Maly and Maly 2005:28-29).

There has to our knowledge never been a positive identification of this *heiau* of ‘Umi “at Mauna Halepohaku.” The reference possibly could be to “Shrine 1” (described below in Section 4.1.2.1) but this is only conjecture.

3.1.1 Historic Accounts

The first recorded ascent of Maunakea was in 1823 by the missionary Joseph Goodrich (1794-1852) (Goodrich 1826). He approached via Kawaihae and Waimea and thus was never near the Hale Pōhaku area. The vast majority of ascents to the Mauna Loa summit prior to the 1930s appear to have been from the north or east and little discussion of the Hale Pōhaku area is available.

3.1.2 Modern Land Use

L. W. Bryan, of the Territorial Forestry Office for the island of Hawai‘i from 1922 to 1949, and from 1949 to 1961 the Territorial Forester, built the two stone houses at Hale Pōhaku with the Conservation Corps in 1936 and 1939 (Rosendahl 1999:C-6). He named Hale Pōhaku after a *heiau* (Maly, personal communication 2009).

It is understood that in 1936 the Civilian Conservation Corps carried out improvements to the old Maunakea-Humu‘ula Trail from near the main base of the sheep station at Kalaieha to the summit.

In the early 1960s, researchers from the University of Hawaiʻi determined that the Maunakea Summit area was exceptional for making astronomical observations. Development of observatories began in 1964 with the construction of the Lunar and Planetary Station atop Puʻu Poliʻahu. The Mauna Kea Science Reserve was established in 1968. Currently there are eleven observatories in the Maunakea summit area and one observatory located on the southeastern flank at 12,000 feet. A 1978 aerial photograph of (Figure 7) shows the extent of development in the Maunakea summit area at that time. Note the access road through the current survey area was constructed by this date.

3.2 Previous Archaeological Research

3.2.1 Previous Archaeological Studies

A summary of previous archaeological studies in the Hale Pōhaku area is presented in Table 1, with a more detailed discussion below. Previously identified historic properties in the Hale Pōhaku area are summarized in Table 2.

3.2.1.1 McCoy (1979)

Patrick McCoy (1982) documents an archaeological reconnaissance survey for the Mauna Kea Mid Level Facilities Master Plan but documented no sites at that time.

3.2.1.2 McCoy (1985)

Pat McCoy's (1985) preliminary report for the Puʻu Kalepeamoa Site documents three archaeological surveys for a proposed new construction laborer camp at Hale Pōhaku located just above and below the UH Institute for Astronomy's Mid-Level Facility encompassing a total of approximately 40 acres located on both sides of the Maunakea Access Road between 9,080 and 9,400-foot elevation. Five lithic scatters and 2 shrines were recorded. These archaeological features were understood as functionally integrated components of a single activity system and one Bishop Museum site number was assigned (lithic scatters no. 1 & 2 would subsequently be given SIHP #s 50-10-23-10310 and 50-10-23-10311 respectively). McCoy concluded that the primary activity at the site was the manufacture of hammer stones and octopus lure sinkers from the crystalline dunite and gabro deposits on the slopes of Puʻu Kalepeamoa but he noted that ritual was an integral part of the manufacturing process. Further research was recommended. The lithic scatters would be subject to further documentation (Robins and Hammatt 1990) and data recovery work (Hammatt and Shideler 2002).

3.2.1.3 Bonk (1986)

In 1986 William Bonk of UH Hilo conducted a reconnaissance level survey for a proposed HELCO transmission line and the substation area that is a focus of the present study. No historic properties were identified.

3.2.1.4 Sinoto (1987)

Aki Sinoto then of the B. P. Bishop Museum began data recovery documentation with survey and surface collections at eleven different lithic scatter areas. In this and the subsequent McCoy

1991 work a total of 2,364 artifacts were recovered along with 129 samples of faunal remains. The lithic assemblage included debitage related to adze manufacture, octopus sinker production

Figure 7. U.S. Geological Survey Orthophotograph, Mauna Kea Quadrangle (1978), showing the location of the Project area

Table 1. Summary of Previous Archaeological Studies in the Hale Pōhaku Area

Reference	Nature of Study	Area of Study	Comments
McCoy 1979	Letter Report Dated August 22, 1979 to Mr. Francis Oda on Archaeological Reconnaissance Survey	Prepared for the Preparation of the Mauna Kea Mid-Elevation Facilities Master Plan.	No sites found
McCoy 1985	Reconnaissance survey	Approximately 40 acres extending on both sides of the Maunakea Access Road between 9,080’ and 9,400’	Preliminary report for the Pu‘u Kalepeamoa Site documenting five lithic scatters and two shrines used for the manufacture of hammer stones and octopus lure sinkers. Ritual was an integral part of the manufacturing process.
Bonk 1986	An Archaeological Survey - *Papers in Ethnic and Cultural Studies* 86-2	Middle Level, Southern Flank of Maunakea	No sites found
Sinoto 1987	Post-Field Report on the Archaeological Surface Survey	Halepōhaku Substation Site and Overland Transmission line-Mauka Approach Areas, Halepōhaku	Survey and surface collections at eleven different lithic scatters and limited test excavations at two of the scatters
Robins and Hammatt 1990	Reconnaissance survey	Two locations: 5.1 acre area on Pu‘u Hau Oki cinder cone at summit and a 21-acre lot near Hale Pōhaku	There were no finds at the JNLT summit project area which had been largely graded. In the Hale Pōhaku area 3 lithic scatters that were described in McCoy, 1985 are discussed.
McCoy 1991	Survey and Test Excavations report	Pu‘u Kalepeamoa Site	Survey and surface collections at eleven different lithic scatters and limited test excavations at two of the scatters

Reference	Nature of Study	Area of Study	Comments
Hammatt and Shideler 2002	Data Recovery report for two lithic scatters	Sites 50-10-23-10,310 and 50-10-23-10,311 located in the Hale Pōhaku area between 9,080’ and 9,160’ elevation	Documentation of data recovery of sites identified in McCoy, 1985 and Robins and Hammatt, 1990. Two carbon dates (AD 1260-1410 and AD 1510-1950 at 95% probability) were both thought to be problematic. Possible ritual associations with healing and the deity Kanaloa are explored.
McCoy 2005	Archaeological Monitoring Report	Four Septic Tank Excavations at the Mid-Level Facilities at Hale Pōhaku, (TMK: [3] 4-4-015:012).	Notes that while all known surface features in the lease area have undergone data recovery and no longer exist there is a possibility that buried cultural deposits might exist in undisturbed areas

Table 2. Previously Identified Historic Properties in the Hale Pōhaku Region of Maunakea

SIHP #	Elevation (ft.)	Description	Function
BPBM # 50-Ha-G28-87 (SIHP #s including 50-10-23-10,310 and -10,311 were subsequently assigned)	Between 9,080 and 9,200 ft elevation	Puʻu Kalepeamoa site including two shrines and twelve lithic scatters	Shrine and lithic manufacturing

and some 20 special purpose bird cooking stones or *pōhaku ʻeho*. Three radio-carbon dates on charcoal samples indicated late pre-contact occupation circa AD 1600 – 1700.

3.2.1.5 Robins and Hammatt (1990)

Cultural Surveys Hawaiʻi (Robins and Hammatt 1990) carried out an archaeological reconnaissance survey project for the Subaru Observatory at both the summit and the Hale Pōhaku area. The Robins and Hammatt (1990) study included several areas near the Mid-Level Facility Complex ("Onizuka Center for International Astronomy (OCIA)") including a small dormitory construction area located approximately 134 m (440 feet) east of the Maunakea Access Road at 9,245 foot elevation (where no sites were observed) and an approximately 21-acre lot surrounding the dormitory delineated on the west and north side by the Maunakea Access Road and to the south by an existing jeep road. Two archaeological features were newly described and three previously identified sites were recorded in the approximately 21-acre lot. The two newly described features included a small oval enclosure and a roughly square enclosure that were both thought to be relatively recent constructions (no formal SIHP site numbers were assigned). The three previously recorded (McCoy 1985) sites included three lithic scatters (lithic scatters # 1, # 2, and #5) that McCoy had understood as being functionally integrated components of a single site. Further work at the lithic scatters was recommended. Cultural Surveys Hawaiʻi (Hammatt and Shideler 2002) completed a Data Recovery report for lithic scatters # 1, # 2.

3.2.1.6 McCoy (1991)

Patrick McCoy (1999) wrote up data recovery work and results expanding on the Sinoto (1987) documentation.

3.2.1.7 Hammatt and Shideler (2002)

Cultural Surveys Hawaiʻi (Hammatt and Shideler 2002) completed a data recovery report for two lithic scatters (SIHP #s 50-10-23-10310 and 50-10-23-10311) located in the Hale Pōhaku area between 9,080 foot and 9,160 foot elevation. These sites were first recorded by McCoy (1985:11-12) as Lithic Scatter # 1 (SIHP # 50-10-23-10310) and Lithic Scatter # 2 (SIHP # 50-10-23-10311) of the Puʻu Kalepeamoa Complex. Initially the UH Institute for Astronomy planned to preserve the two lithic scatters, however, dormitory construction increased erosion in the vicinity and in consultation with the State Historic Preservation Division a data recovery program was agreed to. Data recovery field work included mapping, surface collection and four 1m^2 test units (2 at each of the two sites). Two carbon dates (AD 1260-1410 and AD 1510-1950 at 95% probability) were obtained but both were thought to be problematic. It was concluded that the sites were modest, out-lying, open, lithic workshop sites with octopus lure sinker manufacture of both “coffee-bean” and “bread-loaf” morphological types. It was concluded that the location of the sites was associated with a micro-climate of slightly greater moisture, slightly greater soil and slightly greater protection from the wind at the top of a natural drainage that favored *māmane* forest growth – which in turn provided greater protection from the elements, fuel and construction materials. It is suggested that the endeavor to produce octopus lures may have had other than quotidian purposes of food procurement and the affinities with healing prayers (*Pule he‘e*) dedicated to the deity Kanaloa are explored.

3.2.1.8 McCoy (2005)

The McCoy (2005) archaeological monitoring report for four septic tank excavations at the Mid-Level Facilities at Hale Pōhaku identified no new sites. Notes that while all known surface features in the lease area have undergone data recovery and no longer exist there is a possibility that buried cultural deposits might exist in undisturbed areas.

3.2.1.9 McCoy et al. (2009 in progress)

As this Archaeological Assessment was being prepared, the authors interacted with Dr. Patrick McCoy at the offices of Pacific Consulting Services, Inc. and also within the Project area. We are thankful for his guidance. We were aware that a major study of the historic properties of Maunakea was on-going by Pacific Consulting Services. This study, that should greatly advance our knowledge of traditional Hawaiian use of the upper reaches of Maunakea, was not available as early drafts of this study were being prepared. If publicly available prior to the submission of this study to the SHPD for review it is the intent of the authors to include appropriate reference and germane summary of findings.

3.2.2 Traditional Cultural Properties

The State Historic Preservation Division has designated several prominent localities on Maunakea as Traditional Cultural Properties (TCP) due to their cultural significance to the Hawaiian people. The approximate boundaries of the TCPs are indicated on Figure 8. Maly (1997:29) has suggested the entire Maunakea summit region down to the 6,000 foot elevation contour (Figure 9) be designated a Traditional Cultural Property.

3.3 Background Summary and Predictive Model

3.3.1 Burials and Possible Burials

3.3.1.1 Archaeological Data on Burials

McCoy 1999 presents a summary discussion of burials and possible burials on Maunakea noting that there are numerous traditions of burials at high elevations on Maunakea. He starts by

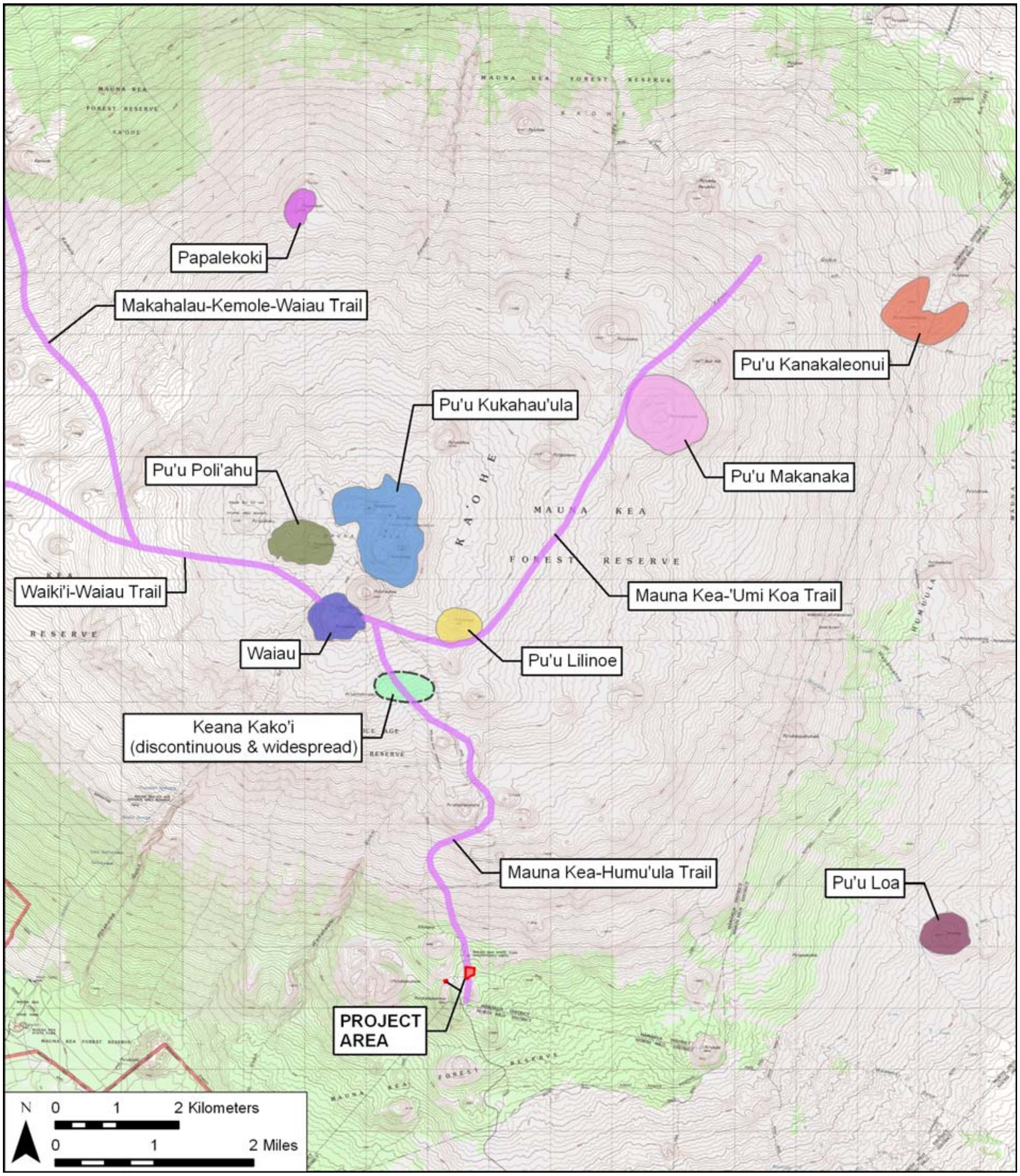

Figure 8. U.S. Geological Survey Map, Mauna Kea Quadrangle (1993), showing Traditional Cultural Properties in the summit region of Maunakea (adapted from Maly 1997:Table 2 & Figure 2; Note: All of Maunakea down to the 6,000 foot elevation has been suggested to be a Traditional Cultural Property) (Boundaries shown should be understood as approximate)

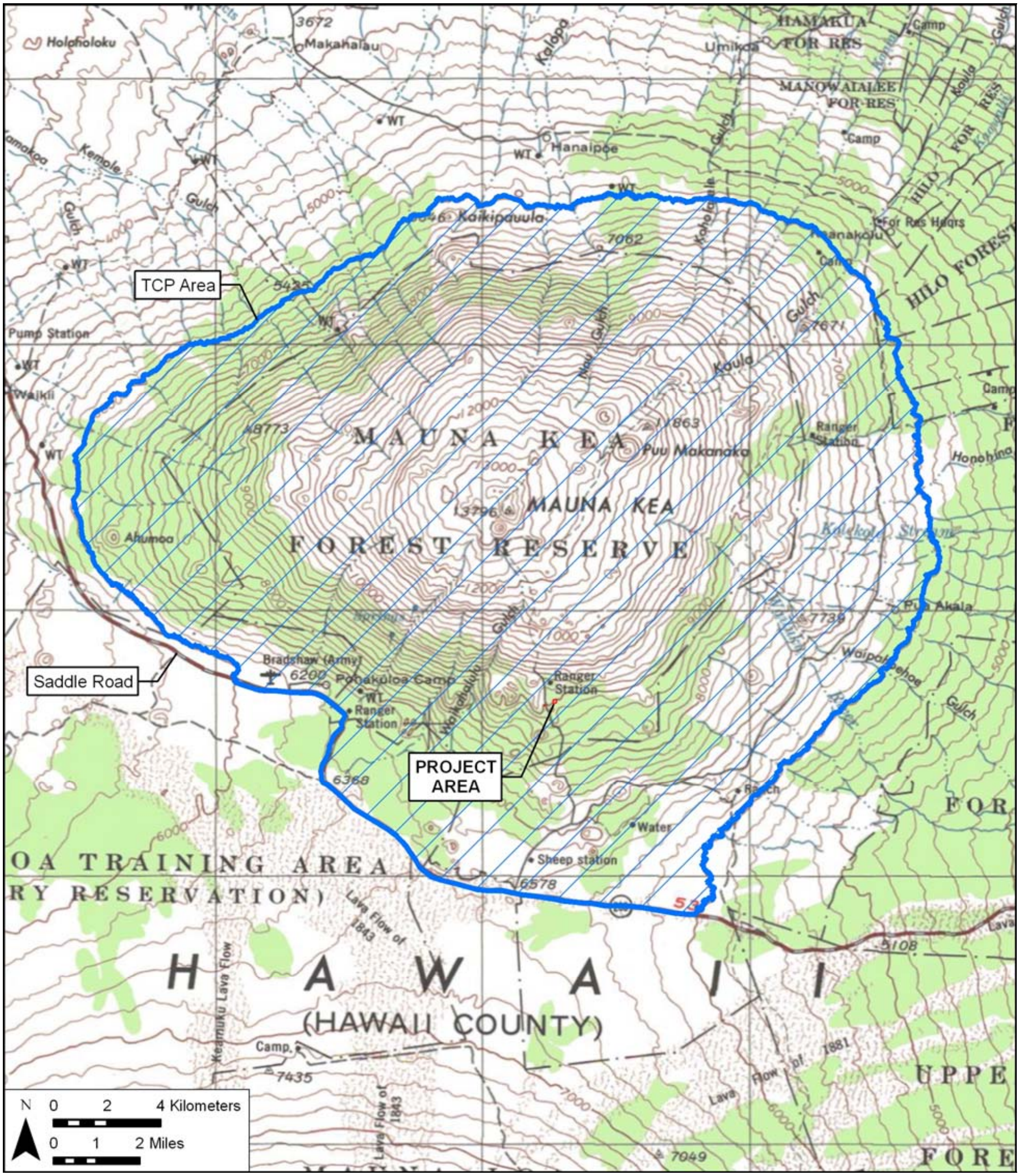

Figure 9. 1:250,000 Scale U.S. Geological Survey Map showing “Ka Mauna a Wākea or Mauna Kea” Traditional Cultural Property (TCP) down to the recommended 6,000 foot contour (following Maly 1997:29); estimated area approximately 150,000 acres

presenting the account of Jerome Kilmartin (1974) that in 1925 Kilmartin personally observed human remains on Pu‘u Mākanaka. McCoy (1999:26) relates that in 1991 he and others observed human bones within several cairns on the southern rim of Pu‘u Mākanaka. McCoy notes that “several other spatially discrete groups of cairns, each comprised of two to three individual cairns, were found on the southern or eastern rim” [of Pu‘u Mākanaka] – suggesting that these may also contain human skeletal remains.

As far as we know, Pu‘u Mākanaka is the only place in the uplands of Maunakea in which human remains have been confirmed – although McCoy makes reference to “the well-known burial center at Kanakaleonui” and also to “a small group of cairns on the eastern rim of Pu‘u Waiau that are also believed to be burials.”

McCoy (1999:26) then goes on to discuss four “possible burial sites” (SIHP #s -16195, -21413, -21414 and -21416). Although no human remains were observed, these constructions were thought to be burials because of: 1) the morphological similarity of these cairns to those on Pu‘u Mākanaka and Kanakaleonui and 2) dissimilarity to other cairns (which are more cylindrical) and 3) the presence on the eastern or southern rim of cinder cones.

McCoy (1999:27) clearly suggests that SIHP # -16195 consisting of two adjacent cairns on the eastern rim of Pu‘u Līlīnoe (recorded by McCoy in 1975) are “possible burials”. This conclusion appears to be based on William D. Alexander’s 1892 account of “ancient graves” on the summit of Pu‘u Līlīnoe. McCoy (1999:27) comments that: “If the cairns that were recorded in 1975 were in fact the same graves [as described by William D. Alexander in 1892] the remains had been removed sometime prior because no human bone was visible at that time.” Thus it appears that by 1975 these features were not graves but they may or may not have functioned as such previously.

McCoy (1999:27) then discusses three possible burial cairn sites (SIHP #s -21413, -21414 and -21416) located on the southern and eastern rim of an unnamed (approximately 12,840-foot high cinder cone located approximately 0.6 miles northwest of the Mauna Kea Ice Age Natural Area Reserve) indicating that these may well be graves on the basis of form and location.

McCoy (1999:28) concludes:

> There is good reason to expect that more burials are to be found in the Science Reserve on the tops of cinder cones, either in cairns or in a small rock shelter or overhang. The basis of this prediction is that all of the known and suspected burial sites on the summit plateau are located on the tops of cinder cones and, more particularly, on the southern and eastern sides. No burials have been found on the sides or at the base of a cone, or on a ridge top amongst any of the shrines. There in fact appears to be a clear separation between burial locations and shrine locations.

3.3.1.2 Informant Data on Burials

In striking contrast to the archaeological data (in which the closest confirmed burial appears to be 3.1 miles from the summit at Pu‘u Mākanaka) is the belief of some contemporary Hawaiians that the summit region of Maunakea is something of a burial ground (“There’s lot of *kūpuna* been buried up there…"; and several similar stated concerns at www.mauna-a-wakea.info/maunakea/F4_burials.html). Allied with this line of thinking are rumors of burials being disturbed and destroyed by prior observatory developments ("Would bulldozing cemeteries be allowed anywhere else in the world?" and similar stated concerns at www.mauna-a-wakea.info/maunakea/F4_burials.html).

3.3.2 Shrines

In McCoy's (1999:3) analysis of a total of 93 sites identified in the Maunakea summit area Science Reserve some 76 or 81.7% are classified as shrines (and an additional 8 shrines are components of adze manufacturing workshop sites). McCoy (1999:6) concludes that; "The vast majority of shrines are conspicuously sighted in the landscape, either on a ridge top, or at a break in the slope, which generally seems to correspond to either a lava flow margin or a change in the slope of a glacial moraine." Of some interest, McCoy notes that "there are no shrines in the Science Reserve located on top of a cinder cone."

As previously noted (McCoy 1982:A-37), an unusually high density of shrines are located in a narrow 200-foot contour interval band between 12,900 foot and 13,100-foot elevation on the north side of Maunakea in proximity to the present study area. He posits reasonably that this clearly defined vertical zonation site pattern is the result of utilization of a break in slope at the edge of a summit plateau where: "when viewed from either the base of the steep inclined slope directly below, or from the base of the summit cones above, is a relatively flat horizon on which the shrine uprights are silhouetted and therefore visible from some distance."

3.3.2.1 Kahe Ule Subincision and the Maunakea Summit Region of Ka‘ohe Ahupua‘a, Hāmākua District

A central thesis of McCoy's (1979:27) study of "A Rite of Passage Site" is that a certain site complex (SIHP # 50-10-23-16204) located at approximately the 12,280-foot level of Maunakea was the locus of initiation rites possibly related to formal initiation rites for groups of apprentices. This argument has support in the curious presence of some twenty-six open air shelters of quite small diameter that appear to have had temporary use. Few would dispute that some of the shrines of the summit region of Maunakea are "occupational shrines" specifically those near the adze quarries incorporating quarried lithic material. However it seems clear that the majority of the shrines of the summit region of Maunakea are not near the known adze quarries and do not incorporate quarried lithic material. This gives rise to the consideration that some quite different function may have been operative for many of the Maunakea shrines. One theory is that "these structures were erected by travelers most probably in propitiation of mountain spirits" (McCoy 1982:A-37) While this certainly seems probable as a partial explanation it may be noted that the distribution of shrines does not suggest travel corridors so much as a broad band of elevation that was preferred for shrine construction.

An alternative theory is that at least some of the shrines of Maunakea are related to the *Kahe Ule* or Subincision practice of Ka‘ohe Ahupua‘a of Hāmākua District. What follows admittedly is less than a convincing argument but is offered for future consideration.

We know little about the Hawaiian practice of *Kahe Ule* or Subincision of the foreskin but it was almost certainly a ritualized practice involving a group of men, a religious expert (kahuna), a special bladed tool (understood as typically a bamboo knife) and a male youth to be subincised. Gutmanis (1983:55) relates a subincision prayer (bold added for emphasis)

E Ki'i ***ka'ohe*** *i Ho-mai-****ka-'ohe****.*	Bring the bamboo from Ho-mai-ka-'ohe
Eia ***ka'ohe*** *lauli'i a Kāne*	Here is the small leafed bamboo of Kane.
'Okia i ka maka o ka ma'i	Cut now the foreskin
Ua moku	It is divided

Notably the noun "*Ka'ohe*" is mentioned three times. While on the one hand the phrase simply means "the bamboo" there seems little question the reference is to a ritual bamboo subincision knife.

The general shape of Ka'ohe bears a vague similarity to a knife as it cuts across the *piko* of Maunakea and Maunaloa dividing the island.

3.3.3 Adze Quarries and Manufacturing Workshops

It appears from McCoy's (1999) summary analysis of site typology that the only quarries were in the extreme southern portion of the Mauna Kea Science Reserve (the Ko'oko'olau Complex Maunakea Adze Quarry; site 50-10-23-4136). McCoy does describe four adze manufacturing workshops (sites 11079, 16203, 16204 and 21211) defined in part by their being located where there is no naturally occurring stone-tool quality raw material. All four of these adze manufacturing workshops are on the south face of the mountain on the east side of the main Maunakea Access Road. Thus it would appear that few, if any, sites associated with quarrying or adze manufacture would be expected in the present study area.

3.3.4 Trails and Temporary Habitations

We have very little real documentation on pre-contact patterns of access to, and temporary habitation on, the summit region of Maunakea. There appears to be general agreement that: "Neither historic accounts nor archaeological surveys provide firm evidence for the prehistoric trails….historic accounts of trails used don't necessarily reflect the prehistoric trails in the area." (Maly 1997: D-12). Notably: "…no trails were mentioned by Hawaiians in the 1870s Boundary Commission records nor do any appear on the 1862 Wiltse map." (Maly 1997:D-5). The four major trail systems documented in the summit region (from North clockwise: 1. the Maunakea-'Umi Koa Trail, 2. the Maunakea-Humu'ula Trail, 3. the Waiki'i-Pu'u Lā'au-Waiau Trail, and 4. the Makahālau-Kemole-Waiau Trail) may all be largely or even entirely post-contact and primarily horse trails.

Land Boundary Commission testimony, particularly that of a certain Haiki (Boundary Commission Hawaii Volume B page 41), suggests that people of Humu'ula, North Hilo District accessed the resources of the Maunakea summit from the southeast.

Variously there is an oral history account from Mr. William Akau:

> …as a child, William Akau heard his elders talking about visits made by people from other islands to Hawaii. In ancient times, canoes would land in the Kīholo

> vicinity, and people walked the trails along the gentle slopes of Mauna Loa-Mauna Kea to the summit to harvest and shape stone. [Maly 1997:22]

While this account suggests access from North Kona, from due west (Kīholo in north, North Kona), it seems unlikely that Hawaiians from other islands accounted for a significant percentage of the pre-contact traffic to the summit region.

Despite these differing accounts mentioned above, the general conception has followed the Land Boundary Commission that determined that the entire summit region of Maunakea lies within Ka‘ohe Ahupua‘a of Hāmākua District and that the socio-political connectedness of the summit lands lay to the north in Hāmākua. This certainly suggests that most of the access would be expected from the north. This would lead to the expectation that much of the evidence of access to the summit region in the form of trail markers or temporary habitation sites might be expected on the north slope.

The prevailing nighttime temperatures and wind would place a premium on any lava tubes or caves that might provide substantial shelter. In the general absence of such landforms on the north slope and summit plateau travelers would be expected to seek very temporary occupation at open habitation sites seeking what protection might be available on the lee side of rock outcroppings and ridges. While too great an emphasis should not be placed on any one account, the pattern of access in the first recorded ascent of Maunakea in 1823 by the missionary Joseph Goodrich may be notable. The preacher appears to have hiked from Waimea to the Maunakea summit and back to Waimea in one 24-hour marathon. In the vicinity of Waimea he spent the night (at approximately 2,700 foot elevation). Leaving early, and approaching the summit from the north, he followed a steep ravine reaching the tree line at about 9,000 feet elevation approximately 15 miles from Waimea where he rested for a few hours recording the temperature at 43^{o} F at sunset. At 11:00 PM he pushed on in bright moonlight encountering snow at 1:00 AM and recording a temperature of 27^{o} F. Goodrich attained the highest of several summits around 3:00 AM and quickly descended.

Section 4 Results of Fieldwork

4.1 Survey Findings

On February 26 a Cultural Surveys Hawai‘i field crew of six began traversing the Project area. The pedestrian inspection was accomplished through systematic sweeps. The interval between the archaeologists was generally 33 feet. The general lack of vegetation made for excellent visibility. All potential historic properties encountered were recorded. The Project area was understood as in two physically separate areas: the “Hale Pōhaku” portion of the Project area that lies on the east side of the Maunakea Access Road and just south of the Visitor Information Station (Figures 10, 12 & 13) and the “HELCO substation” (Figures 11, 12 & 14) portion of the Project area that lies on the west side of the Maunakea Access Road.

In a number of areas, physical evidence of human activity (typically stone constructions representing a small investment in labor) was observed but there were believed to be good grounds for concluding that the specific construction was less than fifty years old and hence the physical evidence of human activity was regarded as inappropriate for designation as a historic property. In order to provide a more complete record, and to avoid any possible misunderstanding, these cases are documented in the present “Appendix A Documentation of Find Spots”. These find spots (designated CSH 1-5, CSH 7-13, and “Modern Refuse Disposal Areas”) are not regarded as significant under formally established criteria for designation as historic properties by virtue of their modernity.

4.1.1 “Hale Pōhaku” portion of the Project area

The fieldwork began in the “Hale Pōhaku” portion of the Project area that lies on the east side of the Maunakea Access Road and just south of the Visitor Information Station (a.k.a. Ranger Station) (Figures 10, 12 & 13). No historic properties were identified within this portion of the Project area. Only one find spot (CSH 1,– described in Appendix A of this study) a modern *ahu* or small cairn was observed (see Figures 12, 13 & 22) within the Hale Pōhaku portion of the Project area. Confidence is high that this is contemporary in date, took only a couple of minutes to construct, does not meet established criteria of significance, and is of no formal historic-preservation concern.

An oval, outlined on the relatively clear ground with a single course of the locally-available, scoria, *‘a‘ā* cobbles, was observed just north (outside) of the Hale Pōhaku portion of the Project area and was designated as CSH 2 (see Figures 12, 13 & 23 and description in Appendix A of this study). This was understood as a contemporary shrine. Confidence is high that this is contemporary in date, took only a few minutes to construct, does not meet established criteria of significance, and is of no formal historic-preservation concern.

Two small areas of late Twentieth century trash disposal (“Modern Refuse Disposal Areas”) were observed east (outside) of the Hale Pōhaku portion of the Project area and were briefly documented (see Figures 12, 13, 35 & 36 and description in Appendix A of this study). Confidence is high that these refuse disposal areas are less than fifty years old, took only a few minutes to create, do not meet established criteria of significance, and are of no formal historic-preservation concern.

Figure 10. General view of the Hale Pōhaku portion of the Project area, view to north

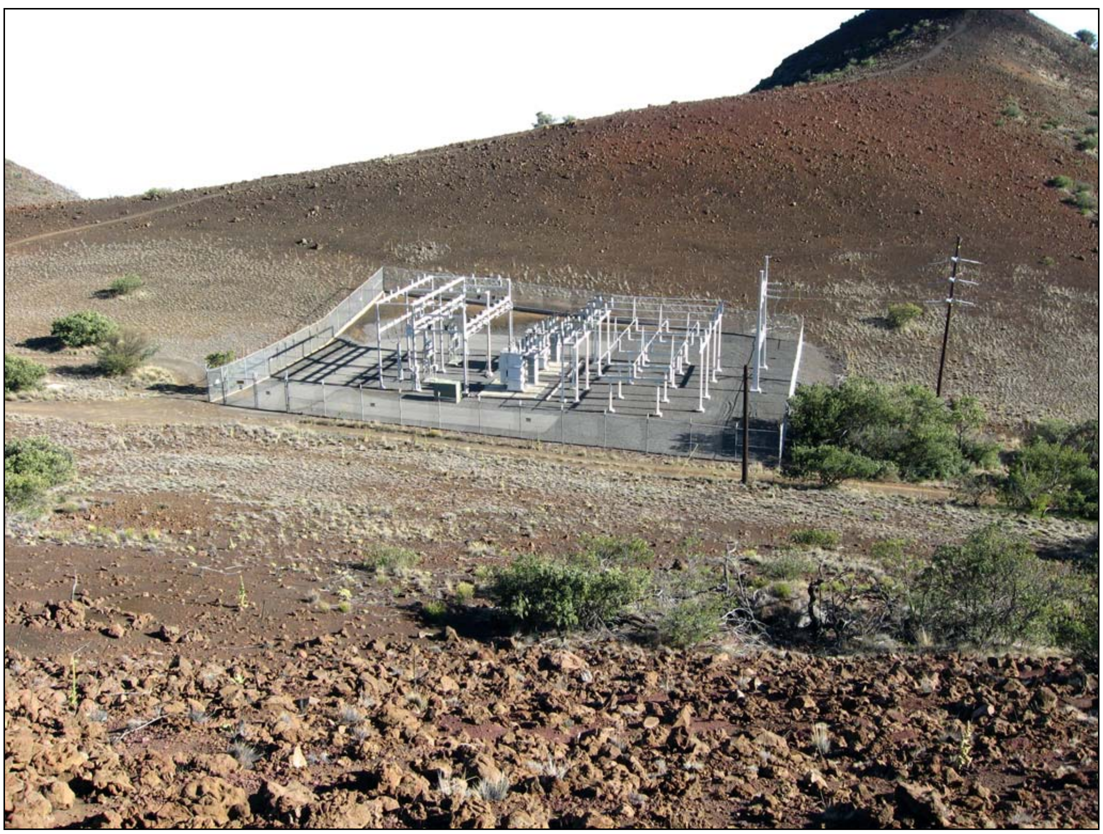

Figure 11. General view of the HELCO substation portion of the Project area and vicinity, view to north

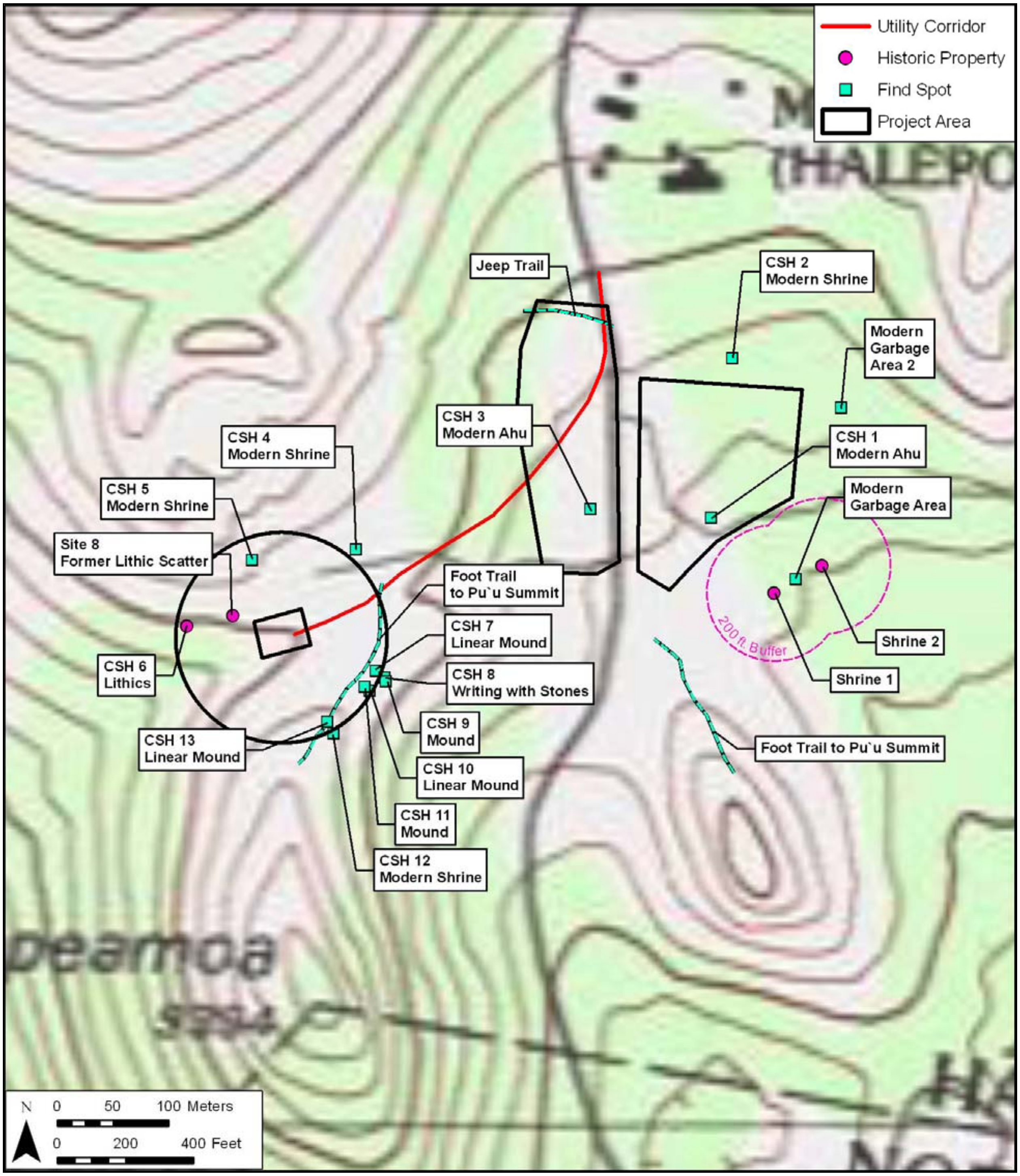

Figure 12. U.S. Geological Survey Topographic Map, Mauna Kea Quadrangle (1993), showing the locations of historic properties and find spots in the vicinity of the Project area

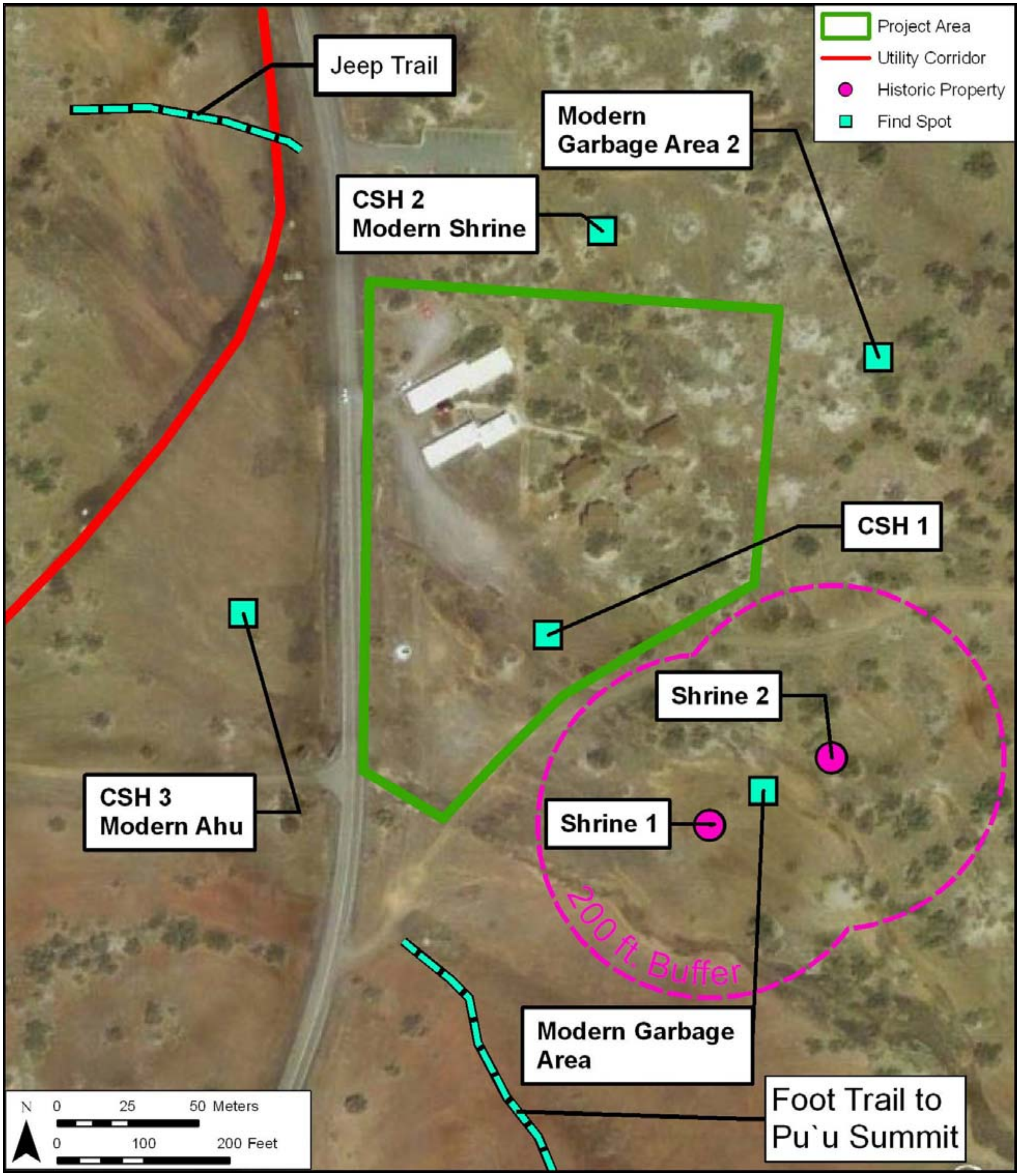

Figure 13. Aerial photograph (source: Google Earth 2009) showing the locations of historic properties and find spots in the vicinity of the Hale Pōhaku portion of the Project area

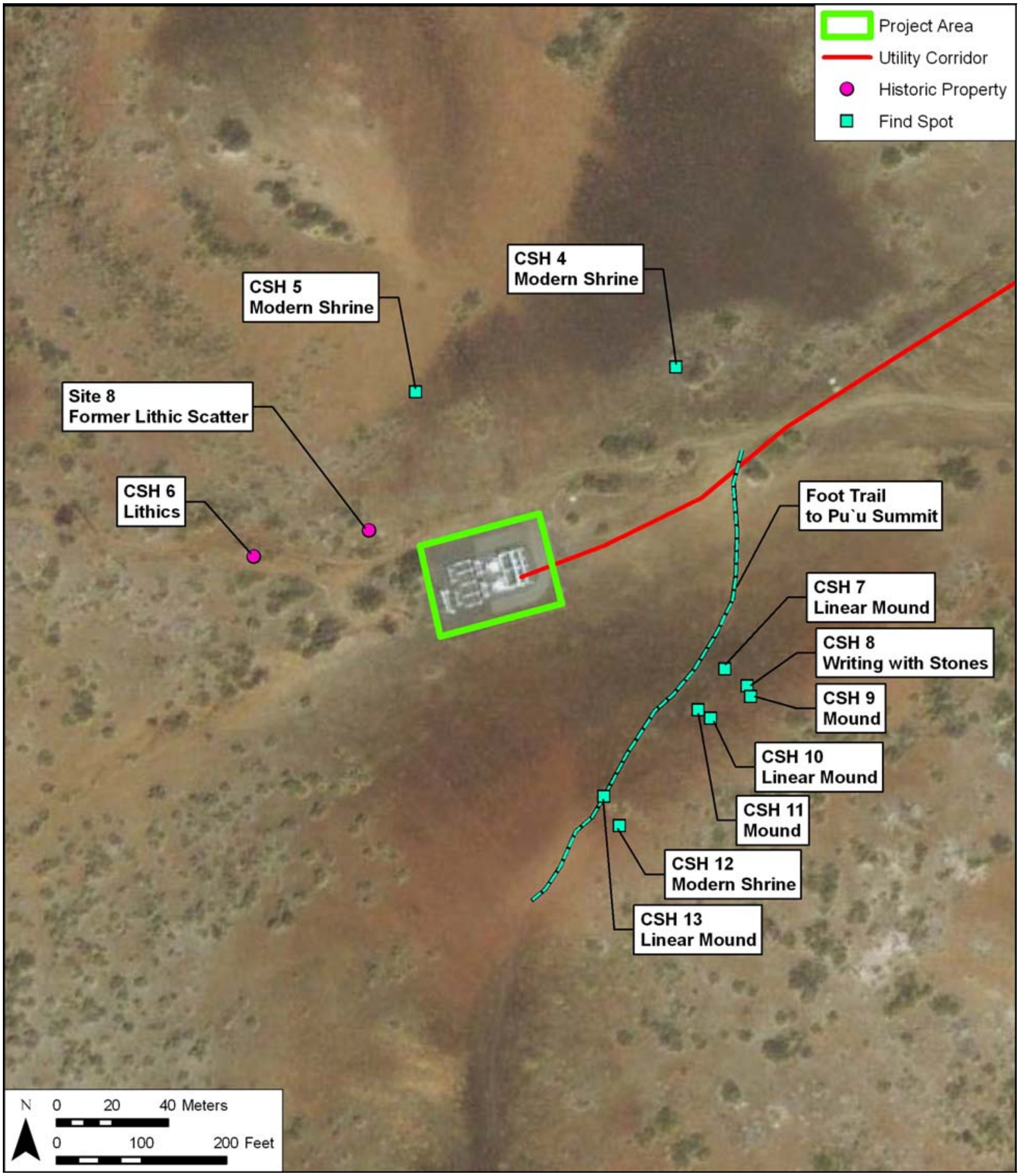

Figure 14. Aerial photograph (source: Google Earth 2009) showing the locations of historic properties and find spots in the vicinity of the HELCO substation portion of the Project area

4.1.2 Historic Property Descriptions (located approximately 200 feet southeast of the Hale Pōhaku portion of the Project area

Only two historic properties were identified in the course of the archaeological assessment fieldwork and we need to be very clear they both lie at a distance of 200 feet or more southeast (outside) of the Project area. The preservation boundaries of these sites are understood as 200-feet in radius and it is our understanding these 200 foot buffers will be maintained (see Figures 12 and 13).

4.1.2.1 Shrine 1

SITE TYPE: Shrine
FUNCTION: Ceremonial
FEATURES: 1
DIMENSIONS: 18 feet NE/SW x 5 feet NW/SE
CONDITION: Good
PROBABLE AGE: Pre-contact
TAX MAP KEY: [3] 4-4-015:001

DESCRIPTION:

This site was designated as “Shrine 1” (and as B.P. Bishop Museum Site 50-Ha-G28-87-S1) by McCoy (1985) and was described as follows:

> The southernmost structure, designated Shrine 1, is a low, rectangular stone-filled terrace with three and possibly five uprights located on the eastern edge of a rubbly *‘a‘ā* outcrop. The terrace measures 5.5 m long, 1.5 m wide, and 35 to 50 cm in maximum height along the east, down slope wall. All three walls are crudely stacked chunks of *‘a‘ā*, one to several courses high. The east wall is partially collapsed, thus explaining the irregular profile in the plan view map [present Figure 15, following]. The row of uprights, which define the back side of the shrine, are located on essentially level ground, which is the basis for describing the main structure as a terrace rather than a platform since not all four side are free-standing walls. There are three standing uprights of similar dimensions projecting 50 cm above ground surface and oriented 21° E of magnetic north, and two other elongated stones that are tentatively regarded as possible uprights. They are all unmodified chunks of *‘a‘ā*, like the rest of the structure.
>
> On the surface of the terrace, centered in front of the two central uprights, is a “cache” of some 40 angular to subangular stones in the 5 to 10 cm size range (avg. c. 7 cm), with a distinctively red cortex, except for a few smaller broken pieces revealing the internal crystalline matrix of light and dark minerals. These rocks, subsequently identified as dunite and gabbro were clearly deposited on the shrine after it was built., thus leading to the conclusion that they are offerings.

> Two smaller caches of these same rocks (also interpreted as ritual offerings) were found in close proximity to the shrine on the south, in a similar topographic position on the eastern edge of the same outcrop. The first cache, located 4.7 m to the southwest of upright No. 1, consists of two chunks and a number of smaller fragments at the downslope base of a stacked pile of *‘a‘ā* rubble, one to two courses high. This feature, which can be described as a cairn, has a basal diameter of 90 cm. The height above the outcrop varies between 35 cm on the upslope side to 80 cm on the lower side. Further to the south, near the southern edge of the *‘a‘ā* outcrop and downslope of a solitary *māmane* tree (Fig. 3), is the second cache, comprised of three stones adjacent to some larger chunks of naturally occurring *‘a‘ā* rubble.

The site as observed on February 26, 2009 (Figures 16 & 17) was very much as described by McCoy in 1985.

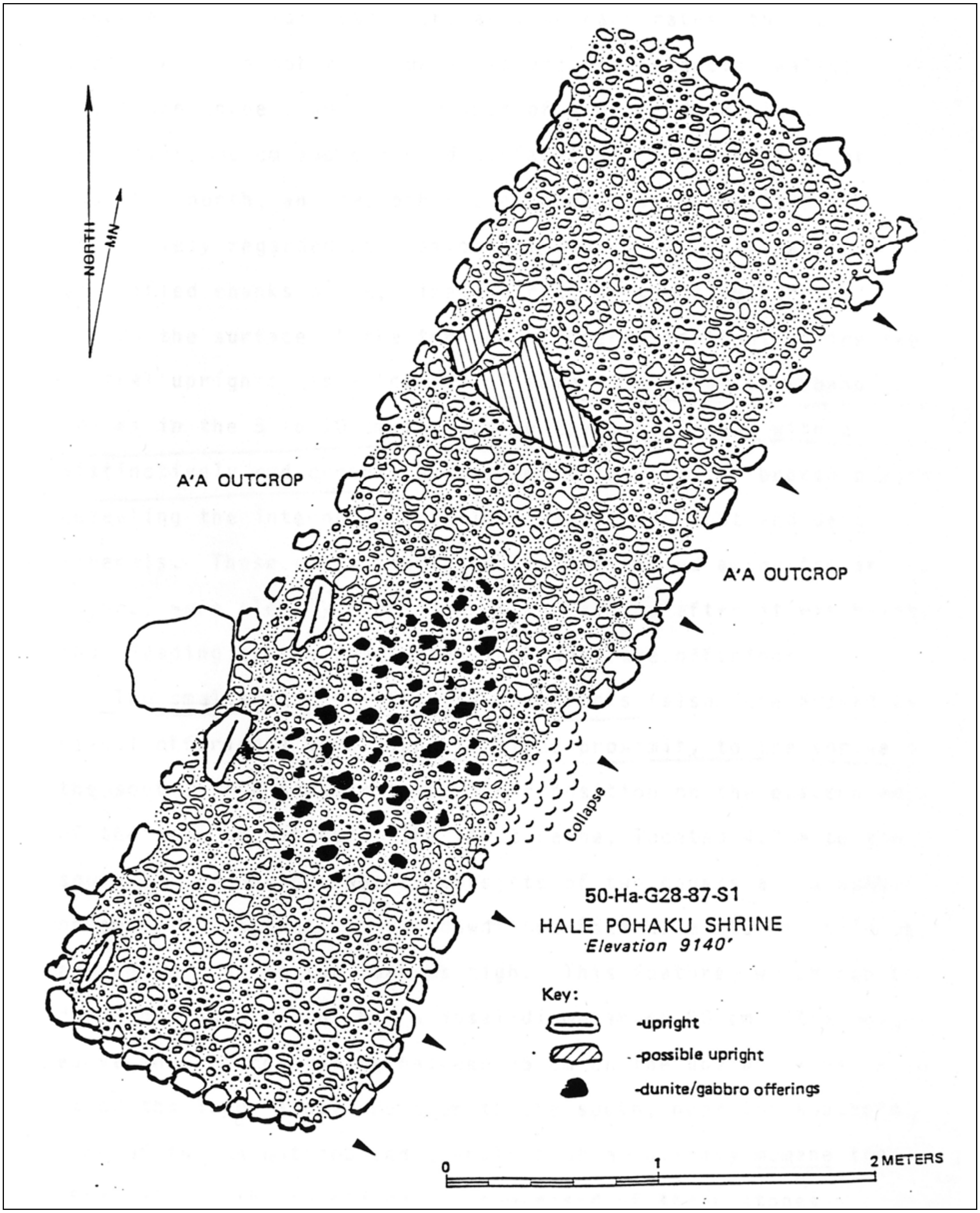

Figure 15. Plan-view diagram of Shrine 1 (B.P.B.M. Site 50-Ha-G28-87-S1) (from McCoy 1985:17)

Figure 16. Shrine 1, showing upright stones and dunite/gabbro offerings, view to north

Figure 17. Shrine 1, showing upright stones and dunite/gabbro offerings, view to west

4.1.2.2 Shrine 2

SITE TYPE: Shrine
FUNCTION: Ceremonial
FEATURES: 1
DIMENSIONS: 8.2 feet E/W x 5 feet N/S
CONDITION: Good
PROBABLE AGE: Pre-contact
TAX MAP KEY: [3] 4-4-015:001

DESCRIPTION:

The site as observed on February 26, 2009 (Figures 18 & 19) was very much as described by McCoy in 1985:

> Shrine 2
>
> The second shrine, located c. 47 m to the northeast of the first, is similarly located on the eastern edge of an *‘a‘ā* outcrop. A single upright of *‘a‘ā* lava, measuring 38 cm high, 35 cm wide, and 17 cm thick, is situated in the approximate center of a small terrace demarcated by the edge of the lava flow and a possible stone alignment on the southwest. A line through the north-south axis of the upright is oriented 8° E of magnetic north. The perpendicular azimuth through the middle of the up right is 78° W of magnetic north, which is aligned with the approximate center of one of the volcanic cone peaks. Five stones of the same type as those described above, including the same colored cortex, are located on the eastern side of the upright on the surface. A few meters northwest is a second possible artificial terrace measuring c. 2 by 2 m.

McCoy then provides the following discussion:

> A preliminary interpretation of the data obtained in this project has already been made in terms of the argument that the constellation of dispersed lithic scatters and shrines represent functionally integrated components of a single activity system. In support of this argument, reference has been made to the patterned association of workshops and shrines with comparable material offerings in the Mauna Kea Adze Quarry. It is on the strength of this evidence, denoting ritual as an integral part of the manufacturing process, that the same site definition criteria and rationale employed in the Mauna Kea Adze Quarry research have been adopted in the definition of the Pu‘u Kalepeamoa site.

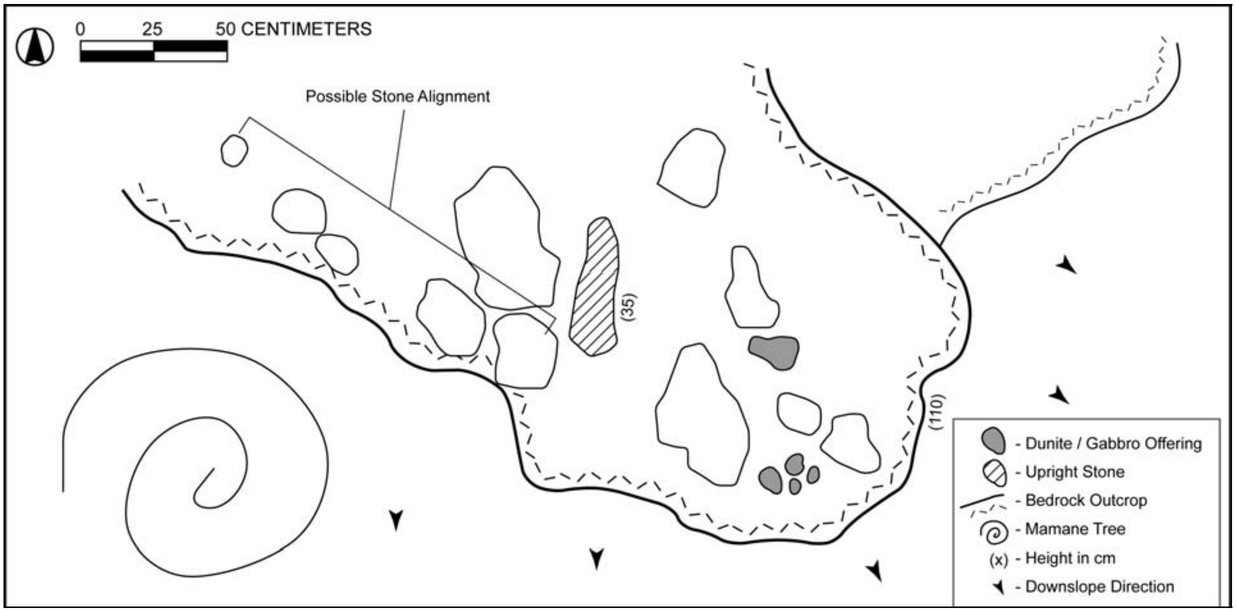

Figure 18. Plan-view diagram of Shrine 2 (B.P.B.M. Site 50-Ha-G28-87-S2)

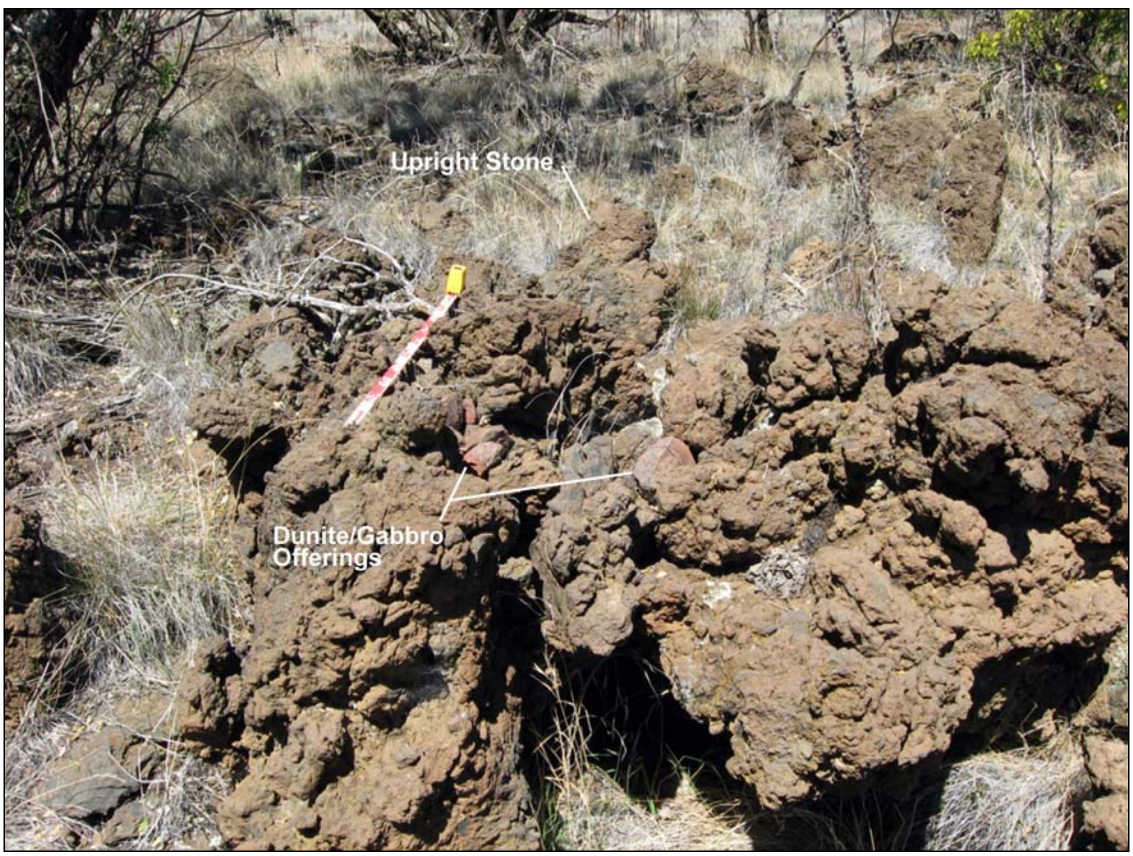

Figure 19. Shrine 2, showing upright stone and dunite/gabbro offerings, view to northwest

4.1.3 HELCO Substation portion of the Project area

The 4.1.3 HELCO Substation portion of the Project area (see Figures 11, 12 & 14) was associated with a number of find-spots including CSH 7 to CSH 13 along a trail ascending Puʻu Lepeamoa on the southeast side and two contemporary shrines (CSH 4 and CSH 5) on the north side (see Figures 25 to 34 and description in Appendix A of this study). These were almost all understood as contemporary shrines. Confidence is high that these are contemporary in date, took only a few minutes to construct, do not meet established criteria of significance, and are of no formal historic-preservation concern. A find approximately 200 feet west of the northwest corner of the HELCO Substation exclosure fence merits further discussion (below).

4.1.4 CSH 6

SITE TYPE: Lithic Material
FUNCTION: stone-working
FEATURES: 4
DIMENSIONS: 1.2 m E/W x 0.5 m N/S
CONDITION: Good
PROBABLE AGE: Pre-contact
TAX MAP KEY: [3] 4-4-015:001

DESCRIPTION:

A small quantity of what appeared to be quarried lithic material (Figures 20 and 21) was observed approximately 200 feet west of the northwest corner of the HELCO Substation exclosure, adjacent to the upslope side of the jeep road and near utility pole # 118502. This was near (160 feet WSW of) a formerly described lithic scatter designated Site 8 by McCoy (and may be a possible remnant portion of McCoy's Site 8) The lithic specimens included a broken, anomalous, water worn pebble of dense, polished vesicular basalt (Figure 21) that may be a possible "bird stone" that measured 2.0 inches x 1.1 inches wide x 0.6 inches thick. Three cobble-sized fragments of particularly dense lithic material (Figure 20) that appeared to be a dunite/gabro were noted in the immediate vicinity. None of these are believed to be in a natural deposition but rather have been picked up and placed on the side of a modern road cut in recent times. Because these were not in an archaeological context it was not thought appropriate to give an SIHP designation.

4.1.5 A comment about burials

The probability of any unmarked burials or human skeletal remains being present is regarded as very low inasmuch as: a) burials in the Maunakea uplands have only been reported at cinder cones, b) no burials have been encountered during development thus far in the astronomy precinct, c) there are no burial markers or surface indicators of burials present, and d) the absence of caves in the area and the general desert pavement geology would not be conducive for burial location selection.

Figure 20. CSH 6, cluster of lithic material, view to north

Figure 21. CSH 6 lithic material, showing water-rounded pebble (possible *pōhaku ʻeho* or "bird stone")

Section 5 Project Effect and Mitigation Recommendations

5.1 Project Effect

No historic properties were identified within the approximately 6-acre Project area. Previously identified historic properties in the vicinity of the Project area were relocated and confirmed to be outside of the Project area. CSH's effect recommendation for the proposed Thirty-Meter-Telescope (TMT) Observatory Project, Hale Pōhaku Area, is "no historic properties affected."

5.2 Mitigation Recommendations

No historic preservation mitigation measures are recommended for the proposed TMT Project, Hale Pōhaku Area.

We do however recommend that should there be any proposed development more than 20 m north and west from the northwest corner of the HELCO Substation exclosure that there be prior consultation with Dr. Patrick McCoy regarding the formerly designated lithic scatter Site 8 and the lithic finds documented here as CSH 6 to see if he has any concerns.

As specified in a 2000 Mauna Kea Master plan it is understood that Project activities should maintain a 200-foot buffer from shrine sites such as the two shrines (documented at a distance of 200-feet or more south of the Hale Pōhaku Project area). As long as Project activities remain within the designated Hale Pōhaku Project area there should be no adverse impact to these historic properties.

The probability of burials or human skeletal remains within the Project area is regarded as very low for reasons given in Section 4.1.5 above. However, in the unlikely event that cultural resources including but not limited to human remains or other significant cultural deposits are encountered during the course of Project-related construction activities, all work in the immediate area should stop and the State Historic Preservation Division should be promptly notified.

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Appendix A Documentation of "Find Spots"

CSH 1

INITIALLY INTERPRETED SITE TYPE: *Ahu* (Cairn)
INITIALLY INTERPRETED FUNCTION: Ceremonial
FEATURES: 1
DIMENSIONS: 20 inches diameter
CONDITION: Excellent
PROBABLE AGE: Modern
TAX MAP KEY: [3] 4-4-015:012

DESCRIPTION:

This structure was the only construction documented within the Hale Pōhaku survey area. Located in the south central portion of the Hale Pōhaku survey area (see Figures 12 and 13), the construction (Figure 22) consists of approximately 15 cobble-sized pieces of the locally-available, scoria, *'a'ā* mounded on a small scoria, *'a'ā* outcrop. The bedrock outcrop is in a generally open area and measures approximately 31 inches by 31 inches by 24 inches high with the pile of scoria occupying an area of about 20 inches in diameter and adding another 8 inches above the outcrop. The absence of any dessert varnish, patterns of weathering or retained wind-blown sediment within the small construction suggest that the construction is quite recent. The use of such small pebbles would be atypical of pre-contact Hawaiian *ahu* construction. The structure is interpreted as a contemporary shrine. Our on-site Hawaiian cultural expert, Mr. Auli'i Mitchell, supported the conclusion that the modest structure is in fact less than ten years old.

Figure 22. CSH 1, modern *ahu*, view to northwest

CSH 2

INITIALLY INTERPRETED SITE TYPE: Shrine
INITIALLY INTERPRETED FUNCTION: Ceremonial
FEATURES: 1
DIMENSIONS: 6.9 feet N/S x 3.9 feet E/W
CONDITION: Good
PROBABLE AGE: Modern
TAX MAP KEY: [3] 4-4-015:012

DESCRIPTION:

This structure lies approximately 115 feet east (outside) of the northeast corner of the Hale Pōhaku survey area (see Figures 12 and 13) and just southeast and down slope of a visitor center parking lot and picnic area. This construction (Figure 23) consists of a single course of the locally-available, scoria, *'a'ā* cobbles delineating an oval perimeter retaining a soil interior that slopes significantly down to the south. The construction is approximately 3.9 foot NE/SW by 6.9 foot NW/SE and was located in the lee of a *māmane* (*Sophora chrysophylla*) tree. A 3.3 foot long piece of steel rebar was observed on the surface at the upslope end of the feature, passing between perimeter stones. Modern trash was observed 13 feet to south. The absence of any settling of the perimeter pebbles into the earth or build-up of wind-blown sediment suggested that the structure was modern. The small size of the selected stones and general casualness of construction suggest that it is not of any antiquity. The structure is interpreted as a contemporary shrine. Our on-site Hawaiian cultural expert, Mr. Auli'i Mitchell, supported the conclusion that the modest structure is in fact less than ten years old.

Figure 23. CSH 2, modern shrine, view to north

CSH 3

INITIALLY INTERPRETED SITE TYPE: *Ahu* (Cairn)
INITIALLY INTERPRETED FUNCTION: Ceremonial
FEATURES: 1
DIMENSIONS: 3.9 feet diameter
CONDITION: Good
PROBABLE AGE: Modern
TAX MAP KEY: [3] 4-4-015:001

DESCRIPTION:

This structure lies approximately 35 m west of the Maunakea Access Road and is hence approximately 42 m west (outside) of the south portion of the Hale Pōhaku survey area (see Figures 12 and 13). This cairn consists of approximately 30 large cobbles of locally-available, scoria, *ʻaʻā* piled in an area approximately 3.9 feet in diameter and 20 inches high (Figure 24). The absence of any settling of the lowest course of cobbles into the earth or build-up of wind-blown sediment suggested that the structure was modern. The structure is interpreted as a contemporary shrine.

This *ahu* or cairn was indeed mapped as a portion of McCoy's (1991) Locality 4 and was believed by him to be modern – a conclusion which we fully support.

Figure 24. CSH 3, modern *ahu*, view to west

CSH 4

INITIALLY INTERPRETED SITE TYPE: Shrine
INITIALLY INTERPRETED FUNCTION: Ceremonial
FEATURES: 1
DIMENSIONS: 31 inches in diameter
CONDITION: Good
PROBABLE AGE: Modern
TAX MAP KEY: [3] 4-4-015:001

DESCRIPTION:

This modest construction is located approximately 720 feet west of the Maunakea Access Road and approximately 260 feet northeast of the northeast corner of the fenced perimeter of the HELCO substation (see Figures 12 and 13). The structure consists of a circular ring of nine small boulders of locally-available, scoria, *ʻaʻā* with one upright on the east side (Figure 25). The absence of any settling of the lowest course of cobbles into the earth or build-up of wind-blown sediment suggested that the structure was modern. The structure is interpreted as a contemporary shrine.

Figure 25. CSH 4, modern shrine, view to north

CSH 5

INITIALLY INTERPRETED SITE TYPE: Shrine
INITIALLY INTERPRETED FUNCTION: Ceremonial
FEATURES: 3
DIMENSIONS: 12.1 feet E/W x 7.9 feet N/S
CONDITION: Excellent
PROBABLE AGE: Modern
TAX MAP KEY: [3] 4-4-015:001

DESCRIPTION:

This construction is located approximately 200 feet north of the central portion of the northern fenced perimeter of the HELCO substation (see Figures 12 and 13). The structure is roughly oval, measuring approximately 12.1 feet E/W x 7.9 feet N/S with the perimeter alignment, 1-2 courses of small, locally-available, scoria, *‘a‘ā* boulders high, and 1-2 course of small boulders wide (Figure 26). The structure is built around a large bedrock *‘a‘ā* boulder, 3.3 feet x 3.3 feet wide and 31 inches high that dominates the central portion of the structure giving something of a heart-shaped appearance. A *māmane* (*Sophora chrysophylla*) branch was propped up on the large central boulder with piled cobbles. An upright stone is set at the down slope apex, with a stone alignment extending approximately 3 feet (1 m) down slope (SSE) from the upright. The interior surface is relatively clear and level soil. Branch points to Pu‘u Kalepeamoa. A small *ahu* or cairn was noted a meter to the NE, approximately 24 inches x 20 inches wide and 24 inches high A similar, but collapsed, small *ahu* or cairn was noted approximately a meter to the NW. The absence of any settling of the lowest course of boulders into the earth or build-up of wind-blown sediment suggested that the structure was modern. The structure is interpreted as a contemporary shrine.

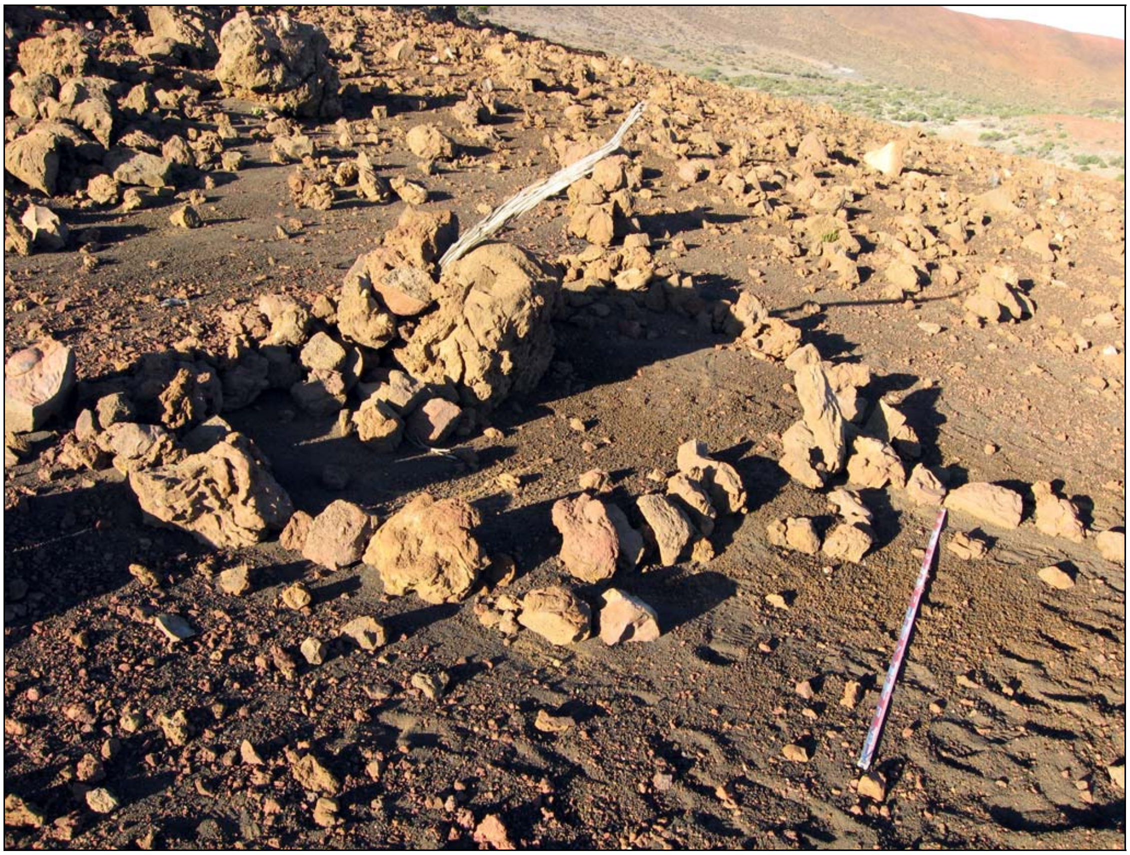

Figure 26. CSH 5, modern shrine, view to northeast

CSH 7

INITIALLY INTERPRETED SITE TYPE: Linear Mound/ Shrine
INITIALLY INTERPRETED FUNCTION: Ceremonial
FEATURES: 1
DIMENSIONS: 12.5 feet E/W x 6.9 feet N/S
CONDITION: Good
PROBABLE AGE: Modern
TAX MAP KEY: [3] 4-4-015:001

DESCRIPTION:

The find spot designated CSH 7 is located just southeast of an unimproved foot trail ascending the NNE side of the Puʻu Lepeamoa cinder cone approximately 200 feet southeast of the southeast corner of the fenced perimeter of the HELCO substation (see Figures 12 and 13). This was the northeastern-most of several mounded piles of boulders along the trail. The structure measures 12.5 feet E/W x 6.9 feet N/S by 3.3 feet high (Figure 27). This linear mound showed no facing, and was constructed of rather informally piled locally-available, scoria, *ʻaʻā* boulders and cobbles with no clear uprights. Modern garbage was noted within structure. The absence of any settling of the lowest course of boulders into the earth or build-up of wind-blown sediment suggested that the structure was modern. The structure is interpreted as a contemporary shrine.

Remnants of lei or twisted rope offerings were observed within the structure (Figure 28).

Figure 27. CSH 7, linear mound, view to northeast

Figure 28. CSH 7, linear mound, showing lei offering

CSH 8

INITIALLY INTERPRETED SITE TYPE:	Writing with Stones
INITIALLY INTERPRETED FUNCTION:	Commemorative demarcation with arranged boulders (graffiti)
FEATURES:	1
DIMENSIONS:	5 feet NW/SE x 3.3 feet NE/SW
CONDITION:	Good
PROBABLE AGE:	Modern
TAX MAP KEY:	[3] 4-4-015:001

DESCRIPTION:

The find spot designated CSH 8 is located adjacent to CSH 7 and just southeast of an unimproved foot trail ascending the NNE side of the Puʻu Lepeamoa cinder cone approximately 200 feet southeast of the southeast corner of the fenced perimeter of the HELCO substation (see Figures 12 and 13). This construction consists of what appears to be three letters delineated with a single course of small of small, locally-available, scoria, *ʻaʻā* boulders (Figure 29). The letters (and meaning) were unclear - possibly "OHS" or "OWS"? The absence of any settling of the alignments of boulders into the earth or build-up of wind-blown sediment suggested that the structure was modern. The structure is interpreted as contemporary graffiti.

Figure 29. CSH 8, letters written with stones

CSH 9

INITIALLY INTERPRETED SITE TYPE: Mound
INITIALLY INTERPRETED FUNCTION: Ceremonial
FEATURES: 1
DIMENSIONS: 5.6 feet NE/SW x 4.6 feet NW/SE
CONDITION: Good
PROBABLE AGE: Modern
TAX MAP KEY: [3] 4-4-015:001

DESCRIPTION:

The find spot designated CSH 9 is a small mound located in the immediate vicinity of CSH 7 and CSH 8 and just southeast of an unimproved foot trail ascending the NNE side of the Pu‘u Lepeamoa cinder cone approximately 200 feet southeast of the southeast corner of the fenced perimeter of the HELCO substation (see Figures 12 and 13). The mound measures approximately 5.6 feet NE/SW x 4.6 feet NW/SE and approximately 28 inches high. The mound appears to be constructed of locally-available, scoria, *‘a‘ā* small boulders placed around a somewhat fragmented in situ large lava bomb rock formation (Figure 30). The absence of any settling of the lowest course of boulders into the earth or build-up of wind-blown sediment suggested that the structure was modern. The structure is interpreted as a contemporary shrine.

Figure 30. CSH 9 mound, view to southwest

CSH 10

INITIALLY INTERPRETED SITE TYPE: Linear Mound
INITIALLY INTERPRETED FUNCTION: Ceremonial
FEATURES: 1
DIMENSIONS: 34 feet NE/SW x 6.6 feet NW/SE
CONDITION: Good
PROBABLE AGE: Modern
TAX MAP KEY: [3] 4-4-015:001

DESCRIPTION:

The find spot designated CSH 10 is a large mound located a few meters southwest of the CSH 7, CSH 8 and CSH 9 constructions and just southeast of an unimproved foot trail ascending the NNE side of the Pu‘u Lepeamoa cinder cone approximately 213 feet southeast of the southeast corner of the fenced perimeter of the HELCO substation (see Figures 12 and 13). The mound measures approximately 34 feet NE/SW x 6.6 feet NW/SE and approximately 24 inches high (Figure 31). The mound averages 3.6 feet wide, is typically 2-3 courses high, and 6-7 courses wide of roughly piled locally-available, scoria, *‘a‘ā* boulders (Figure 30). There are no clear uprights. The absence of any settling of the lowest course of boulders into the earth or build-up of wind-blown sediment suggested that the structure was modern. The structure is interpreted as a contemporary shrine.

Figure 31. CSH 10, linear mound, view to northwest

CSH 11

INITIALLY INTERPRETED SITE TYPE: Mound
INITIALLY INTERPRETED FUNCTION: Ceremonial
FEATURES: 1
DIMENSIONS: 3.6 feet diameter
CONDITION: Good
PROBABLE AGE: Modern
TAX MAP KEY: [3] 4-4-015:001

DESCRIPTION:

The find spot designated CSH 11 is a small mound located a few meters from CSH 10 and just southeast of an unimproved foot trail ascending the NNE side of the Pu‘u Lepeamoa cinder cone approximately 213 feet (65 m) southeast of the southeast corner of the fenced perimeter of the HELCO substation (see Figures 12 and 13). The mound measures approximately 3.6 feet in diameter and approximately 24 inches high (Figure 32). The structure is really just a group of approximately twenty locally-available, scoria, *‘a‘ā* boulders a single course high. The absence of any settling of the lowest course of boulders into the earth or build-up of wind-blown sediment suggested that the structure was modern. The structure is interpreted as a contemporary shrine.

Figure 32. CSH 11, mound, view to west

CSH 12

INITIALLY INTERPRETED SITE TYPE: Shrine
INITIALLY INTERPRETED FUNCTION: Ceremonial
FEATURES: 1
DIMENSIONS: 31 inches diameter
CONDITION: Good
PROBABLE AGE: Modern
TAX MAP KEY: [3] 4-4-015:001

DESCRIPTION:

The find spot designated CSH 12 is a small mound located in the immediate vicinity of CSH 13 and just southeast of an unimproved foot trail ascending the NNE side of the Puʻu Lepeamoa cinder cone approximately 230 feet south of the southeast corner of the fenced perimeter of the HELCO substation (see Figures 12 and 13). The mound measures approximately 31 inches in diameter and approximately 2.3 feet high. The mound appears to be constructed of locally-available, scoria, *ʻaʻā* small boulders (Figure 33). Offerings of American coins (dates of 1979, 1989, 1987, 2006, 1999), shell lei (including one of exotic *Cyprea annulus*) and a metal cross with green glass inlay were observed. The absence of any settling of the lowest course of boulders into the earth or build-up of wind-blown sediment suggested that the structure was modern. While we cannot rule out that the coins were a recent addition to an older structure it appears most likely they are roughly contemporaneous (i.e. the construction does not pre-date 2006 by much). We note in passing that the shell lei are of exotic shells native to the South Pacific but not Hawaiʻi. Should such shells be identified in a pre-contact structure they would be of great interest! The structure is interpreted as a contemporary shrine.

Figure 33. CSH 12, modern shrine, view to west. Note metal cross and cowry shell lei offerings

CSH 13

INITIALLY INTERPRETED SITE TYPE: Linear Mound
INITIALLY INTERPRETED FUNCTION: Ceremonial
FEATURES: 1
DIMENSIONS: 14.7 feet (4.5 m) E/W 3.9 feet (1.2 m) N/S
CONDITION: Good
PROBABLE AGE: Modern
TAX MAP KEY: [3] 4-4-015:001

DESCRIPTION:

The find spot designated CSH 13 is a large mound located near the CSH 11 construction and just northwest of an unimproved foot trail ascending the NNE side of the Pu‘u Lepeamoa cinder cone approximately 230 feet south of the fenced perimeter of the HELCO substation (see Figures 12 and 13). The mound measures approximately 14.7 feet E/W by 3.9 feet N/S and approximately 31 inches high (Figure 34). The mound utilizes a large in situ boulder and is constructed of roughly piled locally-available, scoria, *‘a‘ā* boulders (Figure 34). There are no clear uprights. The absence of any settling of the lowest course of boulders into the earth or build-up of wind-blown sediment suggested that the structure was modern. The structure is interpreted as a contemporary shrine.

Figure 34. CSH 13, linear mound, view to southwest. Note trail to *pu‘u* summit in background

Modern Refuse Disposal Areas

INITIALLY INTERPRETED SITE TYPE:	Artifact scatter
INITIALLY INTERPRETED FUNCTION:	Late Twentieth century refuse disposal
FEATURES:	2
DIMENSIONS:	Approximately 0.4 acres each
CONDITION:	Good
PROBABLE AGE:	Modern
TAX MAP KEY:	[3] 4-4-015:001, 012

DESCRIPTION:

Two late Twentieth century scatters of bottles and cans ("Modern Garbage Area" and "Modern Garbage Area 2") were observed just east (outside) of the Hale Pōhaku Project area (see Figures 12 and 13).

Each of these scatters (Figures 35 and 36) was relatively dense with each having on the order of 150 bottles and cans within an area of approximately 0.4 acres (each) suggesting deliberate disposal of refuse. The presence of "No deposit No return" embossing on some bottles suggested late twentieth century disposal. The timeframe of disposal might be early 1960s. No particular import is attributed to these small refuse disposal areas but they are documented for future reference.

Figure 35. Modern garbage area, near Shrines 1 and 2, view to northeast

Figure 36. Modern garbage area 2, view to northeast

DRAFT ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2 – APPENDIX G: BIOLOGICAL RESOURCES TECHNICAL REPORT

Volume 2

Thirty Meter Telescope Project

Island of Hawai‘i

Proposing Agency:
University of Hawai‘i at Hilo

ARTHROPOD AND BOTANICAL INVENTORY AND ASSESSMENT

THIRTY METER TELESCOPE PROJECT
MAUNA KEA SCIENCE RESERVE
NORTHERN PLATEAU AND HALE PŌHAKU
HĀMĀKUA DISTRICT, ISLAND OF HAWAIʻI

May 2009

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Honolulu, Hawaiʻi

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Thirty Meter Telescope (TMT) Observatory Corporation is preparing an Environmental Impact Statement (EIS) for the proposed construction and operation of an optical/infrared observatory within the Astronomy Precinct of the Mauna Kea Science Reserve on Hawaiʻi Island in the State of Hawaiʻi. The proposed TMT Observatory would be located within the western portion of the area known as the Northern Plateau. During construction, support activities would occur within the existing Batch Plant Staging Area and at a Construction Staging Area within or near the Hale Pōhaku Mid-Elevation Support Facilities.

Sampling of the flora and arthropod fauna in the proposed use areas was conducted September 25 through October 8, 2008. A second visit occurred February 23 – 25, 2009 to evaluate options for the TMT Mid-Level Facility at and near Hale Pōhaku. A third visit occurred April 17 – 23, 2009 to sample for Wēkiu bugs in Area E, the Batch Plant Staging Area, and along the three options for the Access Way, and to sample for vegetation and arthropods at the proposed TMT Mid-Level Facility.

During the September 2008 sampling, forty-five live-traps were deployed in Area E, along the 4-wheel drive road, at the Batch Plant Staging Area, and at two control sites (Puʻu Poliʻahu and the unnamed puʻu[1] above the 4-wheel drive road on which the Subaru Observatory sits) for a three-day detection of Wēkiu bug (*Nysius wekiuicola*) presence. Three Wēkiu bugs were captured (one 5th instar nymph on Puʻu Poliʻahu, one 5th instar nymph and adult female on the unnamed puʻu). No Wēkiu bugs were detected at any of the sites proposed for construction activity. Sixteen other arthropods were detected at the Astronomy Precinct project areas, six of which are endemic to Hawaiʻi.

Two days during the Fall sampling period were spent surveying Area E for lichens and mosses; ten lichen and two moss species were found. Seven species of vascular plants were also detected; two native grasses, two non-indigenous weedy species, and three ferns.

Six days during the Fall sampling period were used to survey for arthropods and plants at portion of the planned TMT Mid-Level Facility within Hale Pōhaku. Twenty-six species of arthropods, nine endemic to Hawaiʻi, and sixteen species of plants, none that are endemic to Hawaiʻi, were identified there.

During the April 2009 sampling, twenty-four live-traps were deployed in Area E, along the 4-wheel drive road, at the Batch Plant Staging Area, and at two control sites (Puʻu Poliʻahu and the unnamed puʻu) for a three-day detection of Wēkiu bug (*Nysius wekiuicola*) presence. One hundred and five Wēkiu bugs of various life stages were captured at the control sites (forty-five on Puʻu Poliʻahu and sixty on the unnamed puʻu). Forty-one Wēkiu bugs of various life stages were detected along the 4-wheel drive road (Access Way Options 2 and 3), but none were seen in Area E or at the Batch Plant Staging Area.

[1] In the past this puʻu, on which both Subaru and Keck site, has been referred to as Puʻu Hauʻoki. Puʻu Hauʻoki is actually the puʻu on which the IRTF sits. Both of these puʻu are part of Puʻu Kūkahauʻula, the traditional Hawaiian name of the summit puʻu.

Additional sampling at the planned TMT Mid-Level Facility detected seven additional arthropod species, (five endemic, one indigenous, and one purposeful introduction), one endemic snail, and four additional plants (three endemic and one nonindigenous).

The results of the surveys indicate there are no special concerns or legal constraints related to arthropod and botanical resources in the Project areas. No species listed as endangered or threatened species were detected at the Project construction areas (DLNR 1997, Federal Register 1999, 2005, 2006). There are endangered silversword (*Argyroxiphium sandwicense sandwicense*) in an exclosure adjacent to the proposed TMT Mid-Level Facility which lies within critical habitat of the endangered bird, *palila* (*Loxioides bailleui*). One species currently proposed for federal listing, *Nysius wekiuicola*, was detected along the 4-wheel drive road, within the limits of proposed Access Way Options 2 and 3. Species of Concern were detected at Area E, (the Douglas' bladder fern, *Cystopteris douglasii*), and at the proposed TMT Mid-Level Facility (*Hylaeus difficillis, H. flavipes, and Succinea konaensis*).

Sampling for Wēkiu bugs at the edge of snow on Pu'u Poli'ahu in April, 2009.

1.0 INTRODUCTION

1.1 TMT Project

The TMT Observatory is proposed to be located on Maunakea on Hawaiʻi Island in the State of Hawaiʻi. Maunakea currently hosts eight optical and/or infrared observatories; the first Maunakea observatories were built in the 1960s. The TMT Observatory would be located on a roughly 5-acre site within the 525-acre Astronomy Precinct of the 11,288-acre Mauna Kea Science Reserve (tax map key [TMK] 4-4-15: 9), below the summit of Maunakea. The entire Science Reserve is designated as part of the State of Hawaiʻi Conservation District, resource subzone.

The TMT Observatory would be located in the western portion of the area known as the Northern Plateau within the Astronomy Precinct, within the area identified as Area E in the Mauna Kea Science Reserve Master Plan (UH, 2000). The 2000 Master Plan identified Area E as a preferred location for the future development of a Next Generation Large Telescope (NGLT). Area E, a 36-acre area, was identified as a preferred location because it was anticipated to provide suitable observation conditions with minimum impact on existing facilities, Wēkiu bug habitat, archaeological sites, and viewplanes. Area E ranges in elevation from 13,100 to 13,300 feet; the summit of Maunakea is at elevation 13,796 feet. Area E is located approximately 1/2-mile northwest of the eight existing optical/infrared observatories located near the summit, at elevations of 13,600 to 13,775 feet.

Within Area E, the TMT Observatory would be located at one of two locations:

- The Project site near the end of the existing 4-wheel drive road, at an elevation of approximately 13,150 feet at a location known as “13N” in reference to its elevation and its location on the Northern Plateau, or
- An alternative site designated “E2” by the Project because it is a second site being considered within Area E; the area is approximately 500 feet south of 13N along the existing 4-wheel drive road.

The TMT Observatory would be the primary development of the Project, but not the only one. The “Project” is the sum of the following components:

- “TMT Observatory” refers to the components of the Project located below the summit, in the upper elevations of Maunakea. The TMT Observatory generally consists of the 30-meter telescope, instruments, dome, support building, and parking within a roughly five acre area.
- The “Access Way” refers to the portion of road and other infrastructure that would be provided to access and operate the TMT Observatory. Improvements in the Access Way would generally include a surface roadway and underground utilities. Beyond the core of the SMA facility the route of the Access Way would follow the existing SMA roads and

existing 4-wheel drive road to the extent possible. There are three options being considered for the portion of the Access Way from the Maunakea Access Road through the core of the SMA area:

1. Option 1 – Through SMA. This option would follow the primary SMA road off the Maunakea Access Road, and then proceed through the lava flow before reconnecting with the SMA road.
2. Option 2 – Near SMA. This option would cut off the Maunakea Access Road at the currently blocked old 4-wheel drive road and connect with the SMA road once beyond the SMA core.
3. Option 3 – 4-Wheel Drive Road. This option would follow the currently blocked old 4-wheel drive road and then connect with the SMA road.

- "TMT Mid-Level Support Facility" refers to facilities and improvements located at or near the existing 20 acre Hale Pōhaku facility to support the TMT Observatory. This includes all permanent improvements at or near Hale Pōhaku, which would generally consist of dormitory, office, cafeteria, and recreations facilities in the eastern portion of the lower part of Hale Pōhaku; a parking area in the western portion of the lower part of Hale Pōhaku; and electrical and communications equipment.
- "Headquarters" refers to facility located in the lower elevations of Hawaiʻi Island to manage activities at and support operation of the TMT Observatory and TMT Mid-Level Support Facility. This includes all permanent improvements at a lower elevation location in Hilo but is not discussed in this report.
- "Satellite Office" refers to the smaller facility located in the lower elevations of Hawaiʻi Island to provide additional support to the TMT Observatory and TMT Mid-Level Facility. This includes all permanent improvements at a lower elevation location in Waimea but is not discussed in this report.
- "Construction Areas" would include:
  1. "Batch Plant Staging Area" is an approximately 4 acre staging area where the Maunakea Access Road forks near the summit. This area would primarily be used for storing bulk materials and a cement batch plant.
  2. "Hale Pōhaku Staging Area" is an area at or near Hale Pōhaku that would be used for construction staging. This area would be used for parking, vehicle washing and inspection prior to proceeding up to the observatory site, and the storage of materials needed for construction work at Hale Pōhaku.
  3. "Port Staging Area" is an existing warehouse and/or yard near the port where Project components are received. This area would be used for receiving materials and assembly of those materials to the extent possible prior to transport to either another staging area or the construction site. This area is not discussed in this report.

1.2 Physical Setting

Maunakea is a dormant shield volcano and the tallest mountain on earth, rising more than 32,000 feet from the ocean floor to its summit, 13,796 feet above sea level. At the summit the night sky is dark and transparent, providing what is considered to be among the best astronomical observation conditions in the world (Parker 1994).

The Mauna Kea Science Reserve (MKSR), an 11,288-acre area at the top of Maunakea, is home to the largest observatory complex in the world. The MKSR is leased by the State of Hawaiʻi to the University of Hawaiʻi (UH), which in turn subleases certain areas to various observatories. Astronomy institutes worldwide make use of the unparalleled astronomical capabilities on Maunakea.

The MKSR is also home to unique plants and animals living in an alpine ecosystem. The summit region is an island within an island, separated from other ecosystems by high elevations as well as vast oceans. The species found there are not only unique; they are sometimes rare[2] and limited in population and area of distribution. For example, the Wēkiu bug lives only in loose cinder habitats on the cinder cones above 11,715 feet on Maunakea (Porter and Englund 2006). There is a similar species, *Nysius aa* that occurs in the upper elevations on Maunaloa (Polhemus 1998).

The upper elevations of the MKSR receive almost no rainfall and snow accumulates only during the winter season. Temperatures often drop below freezing at night and reach up to 50º F during the day. Solar radiation is extreme, and evaporation rates are high. The harsh environmental conditions limit the composition of the resident floral and faunal communities found there. Under these harsh conditions, only hardy lichens, mosses, and scattered grasses, shrubs, ferns and arthropods have managed to adapt and survive (Cuddihy 1989).

Below 11,700 feet is an alpine shrublands and grasslands ecosystem growing on ʻaʻa lava flows, cinder cones, and air-fall deposits of lapilli and ash (Wolfe and others 1997). Growing well above the tree line (~9,500 feet), and becoming sparser with increasing elevation, are native shrubs, grasses, sedges, and ferns (Cuddihy 1989). The fauna of the alpine shrub zone has not been well studied. Many species of birds have been observed flying in this zone, but because the principal food resources do not occur here, they are presumably just passing through. There may be resident arthropod species in this zone, but no systematic survey has been conducted.

Below the alpine shrublands and grasslands are the *māmane* subalpine woodlands that extend down to the Saddle Road. The open-canopied *māmane* forest is home to the endangered bird,

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[2] There are several terms that are used to describe the status of species. These include:
Endangered species – Any species which is in danger of extinction throughout all or a significant portion of its range.
Threatened species – Any species which is likely to become endangered within the foreseeable future.
Candidate species – Any species being considered by the Secretary of the Interior for listing as an endangered or a threatened species, but not yet the subject of a proposed rule.
Species of Concern – Those species about which regulatory agencies have some concerns regarding status and threats, but for which insufficient information is available to indicate a need to list the species under the Endangered Species Act (ESA).
Rare species – Those species that occur very seldom, but are not classified threatened or endangered.
Sensitive species – Those species which rely on specific habitat conditions that are limited in abundance, restricted in distribution, or are particularly sensitive to development.

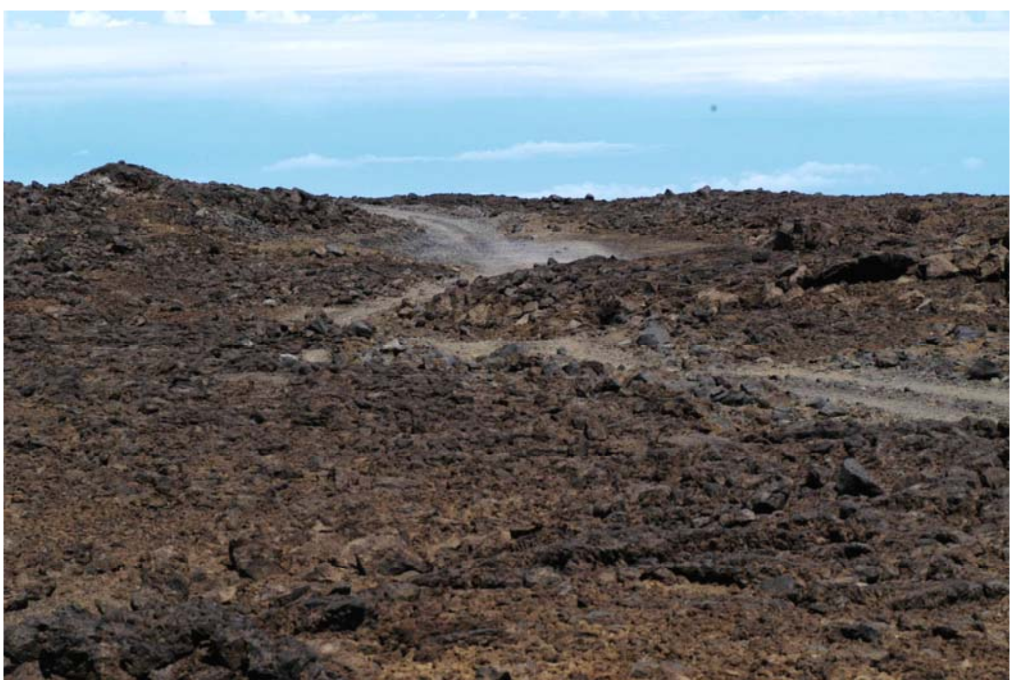
palila (*Loxioides bailleui*). The subalpine woodlands are dry most of the year, and *māmane* trees (*Sophora chrysophylla*) intercept fog that provides them and other plant species with the small amounts of moisture they need to survive (Gerrish 1979). The understory of the subalpine forest is comprised largely of native shrubs. In undisturbed areas clumps of the native grasses are the most abundant ground cover. Non-indigenous plants and grasses are the most abundant ground cover in areas that have been disturbed around Hale Pōhaku. The *māmane* forest on Maunakea has a diverse arthropod fauna. More than 200 arthropod species have been collected there.

Cattle grazing has degraded much of the forest along the lower sections of the Maunakea Access Road. The vegetation of the open pastures is largely introduced grasses including rattail grass, velvetgrass, sweet vernal grass, hairy oatgrass, and fescues (Mueller-Dombois and Fosberg 1998).

1.3 Current Study

The Thirty Meter Telescope (TMT) Observatory Corporation, a non-profit organization, is preparing an Environmental Impact Statement (EIS) for the proposed Project. Pacific Analytics, LLC was contracted by Parsons Brinckerhoff, the company preparing the TMT EIS, to conduct an arthropod and botanical inventory and assessment of Area E, the proposed Access Way, the Batch Plant Staging Area, and TMT Mid-Level Support Facility, including a special survey for Wēkiu bugs in the affected areas above 11,715 feet.

The primary objectives of the inventory and assessment are to provide a general description of the flora and arthropod fauna of the TMT Project sites, evaluate the habitats, and search for and assess the potential for threatened and endangered species as well as species of concern (DLNR 1997, Federal Register 1999, 2005, USFWS unpublished).



View of Area E and existing 4-wheel drive road.

2.0 METHODS

2.1 Permit

An application for a Research, Collection and Access Permit was submitted August 14, 2008 to the Hawai‘i Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) and after review, a permit (FHM09-170) was granted on September 24, 2008, valid through September 23, 2009. The Wēkiu bugs were sampled under separate Research, Collection and Access Permits (FHM08-135 and FHM09-181) granted to Jesse Eiben, valid from December 1, 2007 through April 1, 2010.

2.2 Schedule and Personnel

Sampling of the flora and arthropod fauna in Area E, the proposed Access Way, the Batch Plant Staging Area, and portions of the TMT Mid-Level Support Facility was conducted September 25 through October 8, 2008. Wēkiu bug traps were opened and operated from September 25 – 28, 2008. A lichen survey in Area E was conducted over two days September 29 – 30, 2008. Arthropod sampling and botanical surveying continued through October 10, 2008.

Additional botanical sampling by was conducted at the proposed TMT Mid-Level Support Facility February 23-24, 2009.

Additional Wēkiu bug and arthropod sampling was conducted in the summit region April 20 – 23, 2009 and at the TMT Mid-Level Support Facility April 17 – 23, 2009.

Gregory Brenner, Pacific Analytics, LLC and Jesse Eiben, UH Mānoa, were the investigators conducting the arthropod sampling. Dr. Brenner has a PhD in entomology from Oregon State University, Corvallis, and fourteen years of experience studying the arthropod fauna of Hawai‘i, during which he has conducted numerous scientific studies of the arthropods on Maunakea. Mr. Eiben is a Doctoral candidate in the University of Hawai‘i’s Department of Plant and Environmental Protection Sciences and has been conducting research on Wēkiu bug autecology and systematics for his dissertation since 2005.

Gregory Brenner and Clifford Smith were the investigators conducting the lichen, bryophyte and botanical sampling. Dr. Brenner is familiar with the flora of Hawai‘i having conducted many scientific studies of the plants on Maunakea and elsewhere in Hawai‘i. Dr. Smith has a PhD in botany and is Professor Emeritus of the Department of Botany, UH Mānoa. He is the leading expert in lichens of Hawai‘i, and has conducted research on Hawaiian lichens since 1958.

2.3 Nomenclature

The nomenclature used in this report follows the Hawaiian Terrestrial Arthropod Checklist, Third Edition (Nishida 1997) and the Manual of the Flowering Plants of Hawai‘i (Wagner and others 1990). Hawaiian and scientific names are italicized.

Species are discussed as being endemic, indigenous, non-indigenous, adventive, and purposely introduced. These terms are defined as:

- Endemic – A species native to, or restricted to Hawaiʻi.
- Indigenous – A species native to Hawaiʻi but that naturally occurs outside of Hawaiʻi as well.
- Non-indigenous – A species not native to Hawaiʻi.
- Adventive – Not native, a species transported into a new habitat by natural means or accidentally by human activity.
- Purposely introduced – A species released in Hawaiʻi for a particular purpose, usually to control a weedy plant or another insect.

2.4 Arthropod Sampling

2.4.1 Trapping

Wēkiu Bug Traps

Pitfall live-traps were used to sample Wēkiu bugs in Area E and at the Batch Plant Staging Area. A live-trap design very similar to those described by Englund and others (2002) and Brenner (2002a) was used to attract Wēkiu bugs. The modifications in design are as follows.

Two 10oz clear plastic cups were used for each trap. The upper cup was punctured with one small hole in the bottom center through which a small absorbent wick made of tissue (Kimtech Science) was pushed. A small amount of water was poured into the bottom of the lower reservoir cup. The attractant shrimp paste was placed in the upper cup contacting the wick, on a few small pieces of rock in the cup, smeared on the side of the cup, and on a cap rock.

Installing pitfall live-trap

The traps were dug into the available ground substrate with a goal of achieving a depth where moisture was present in the ash layer. The lip of the cup was not necessarily placed flush with the ash layer, and there was no wire mesh surround to provide structure surrounding the cups. This cup design has been successful for attracting and capturing Wēkiu bugs during 2007 and 2008 (Eiben, unpublished). A cap rock was placed over the traps and elevated above the ground approximately 0.6 in with smaller rocks.

Most sites selected for sampling used a pair of traps within 16.4 feet of each other in different microhabitat types (ex. large rock jumble vs. ash layer near the surface) to attempt to sample the diversity of the habitat. The traps were checked daily for three consecutive days after installation. Wēkiu bugs captured were removed for the duration of the sampling period to prevent recounts and were held for up to three days in captivity with food and water sources. After sampling was complete, all Wēkiu bugs were released near the trap in which they were captured.

In September, 2008, forty-five pitfall live-traps were used to sample for Wēkiu bugs. Thirty-three traps were installed within Area E, and three traps were placed along the unused portion of the 4-wheel drive road that is blocked (Figure 1), two pairs and one single trap were installed at the Batch Plant Staging Area, and one pair was placed on both the unnamed pu‘u and Pu‘u Poli‘ahu as controls (Figure 2).

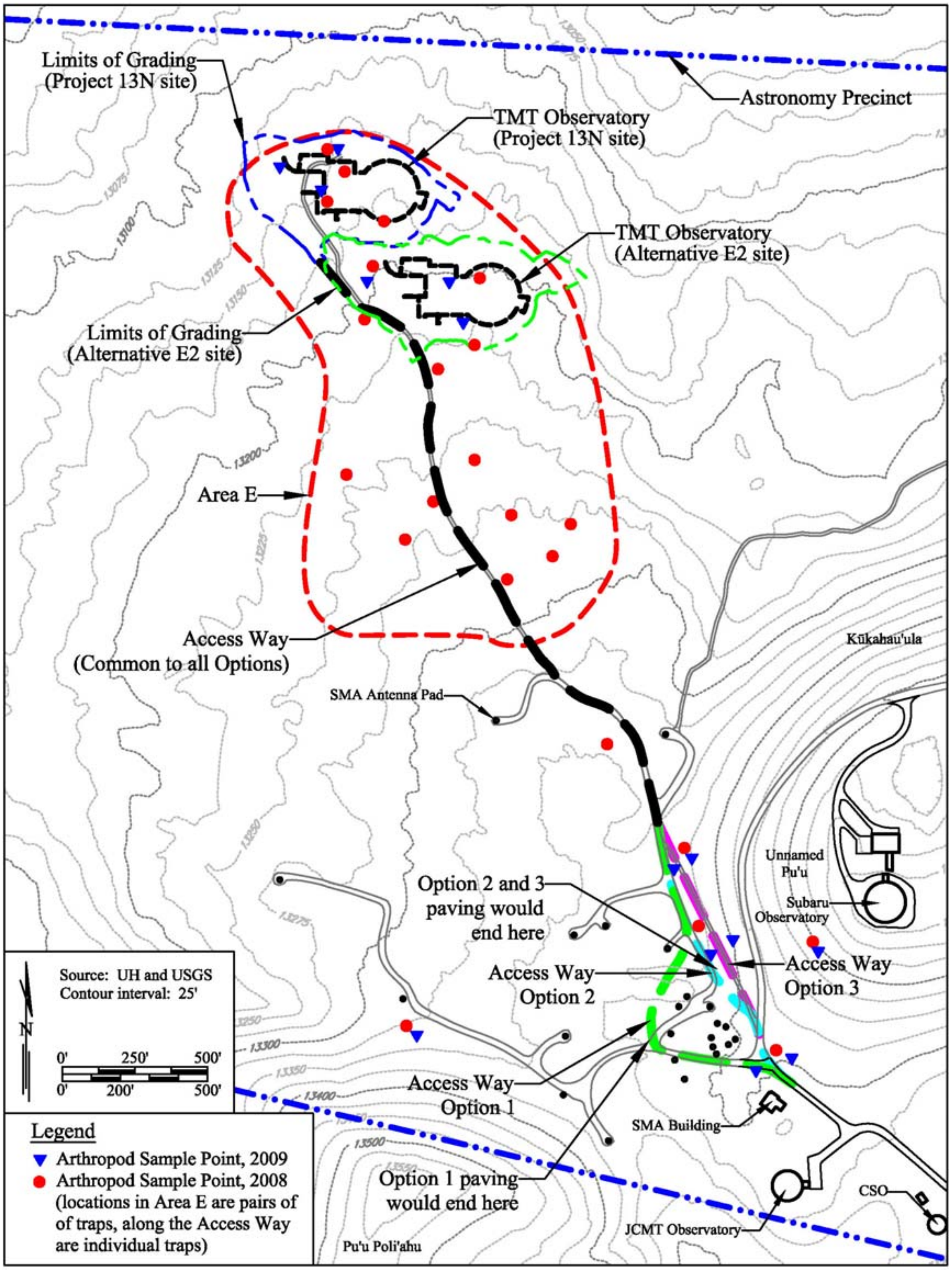


Figure 1. Pitfall Live-Traps sites within Area E and along Access Way options.

In April, 2009, twenty-four traps were used to sample for Wēkiu bugs. Twelve traps were installed within Area E, six traps were placed along the unused portion of the 4-wheel drive road (Figure 1), one pair was installed at the Batch Plant Staging Area, and one pair was placed on both the unnamed puʻu and Puʻu Poliʻahu as controls (Figure 2).

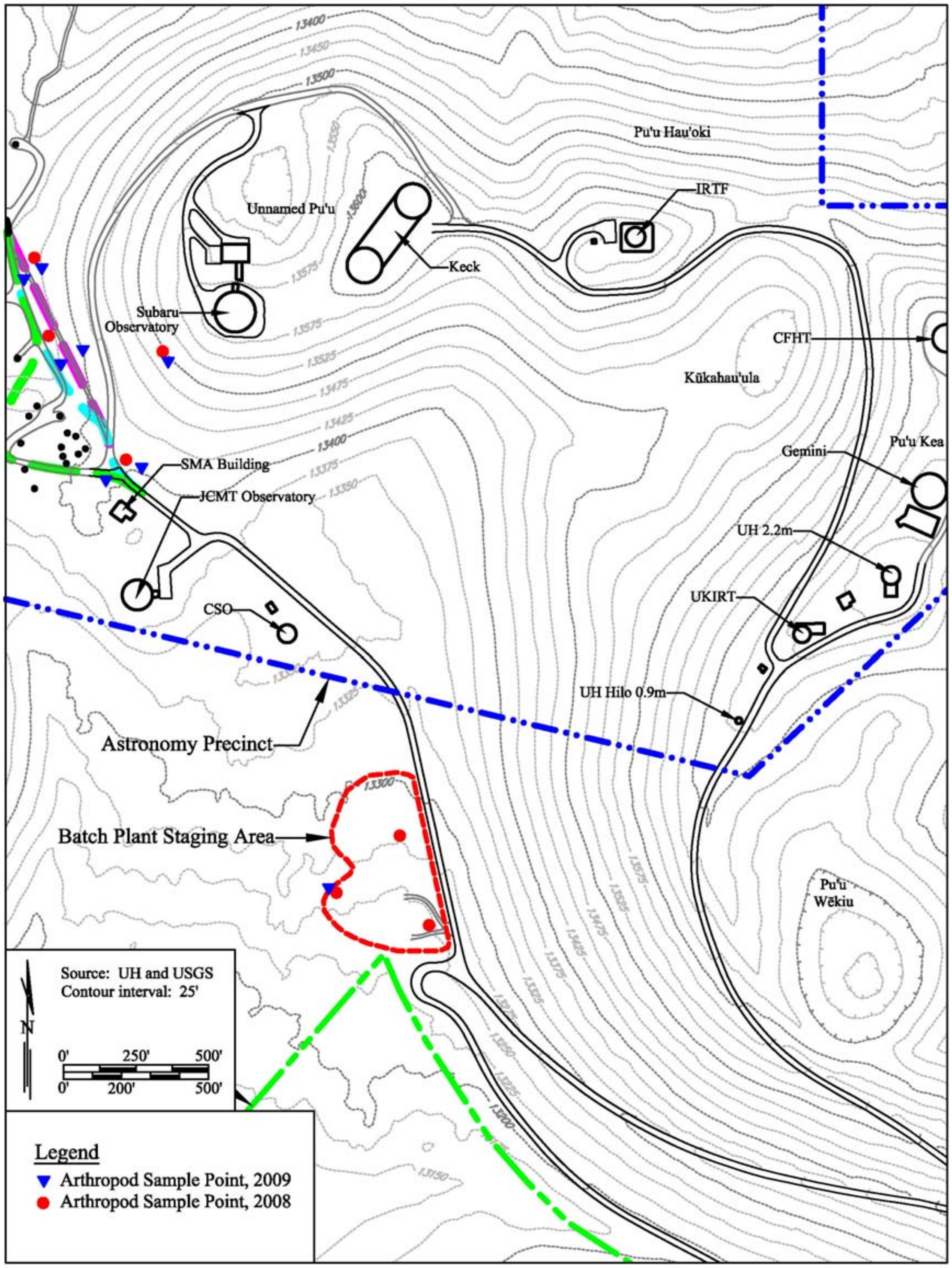


Figure 2. Pitfall Live-Traps sites at the Batch Plant Staging Area, Puʻu Poliʻahu, and the Unnamed Puʻu.

Pitfall Traps

Pitfall traps were used to sample the arthropod ground fauna in Area E, along the 4-wheel drive road, and at the Batch Plant Staging Area, in the same locations used to sample for Wēkiu bugs (Figures 1 and 2), and at the TMT Mid-Level Support Facility (Figure 3). These traps were 10oz cups placed into the ground so that the lip of the cup is level with the substrate. A small amount of soapy water was placed into the trap to kill and preserve specimens that fall into the traps. A cap rock was placed over the traps and elevated above the ground approximately 0.6 inches with smaller rocks.

The target of pitfall trapping in this study was ground-active arthropod species. Three pitfall traps were set at the Batch Plant Staging Area, and eight were installed in vegetation surrounding the proposed TMT Mid-Level Support Facility. Traps were open for 6 to 8 days, October 2 through October 10, 2008. During the Spring 2009 sampling, two traps were set at the Batch Plant Staging Area, and ten at the TMT Mid-Level Support Facility. Traps were open April 17 through April 23, 2009.

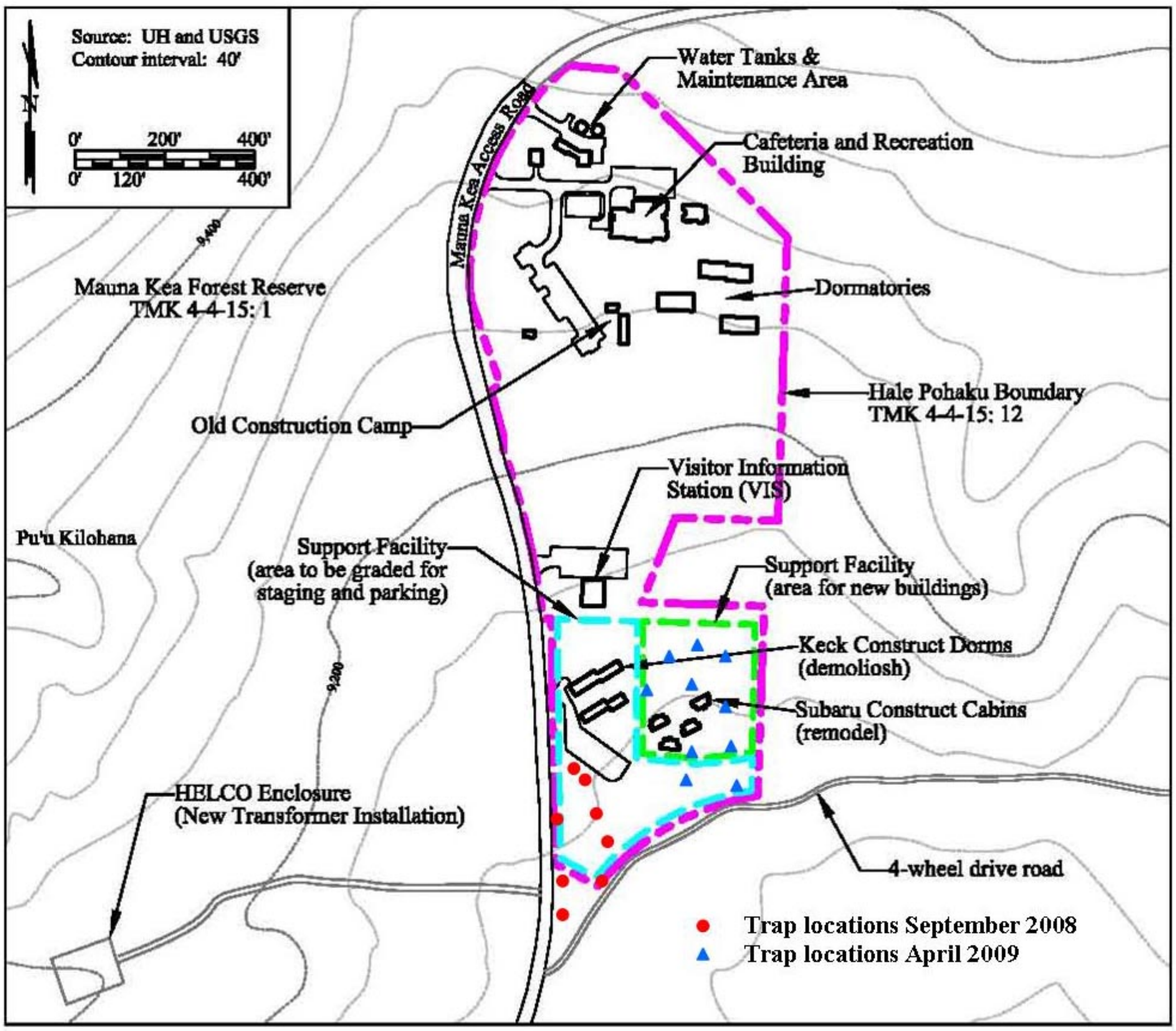


Figure 3. Pitfall Live-Traps sites at the TMT Mid-Level Support Facility.

Bait Trapping
Meat is a good attractant for some flies, ants, and beetles. Some insects are attracted to the smell of the rotting meat and come to the trap. The trap consisted of a small plate filled with soapy water with a rock in the center covered with Spam© (Hormel Foods Corporation). Two bait traps were used at the Batch Plant Staging Area and four bait traps were set at the Hale Pōhaku Construction Staging Area. The traps were left open for 4 days and checked daily in October 2008.

2.4.2 Foliage Sampling
Approximately four hours per day for eight days (in October 2008 and April 2009) were used to sample foliage in and surrounding the TMT Mid-Level Support Facility. The entire site and the areas of surrounding foliage were sampled.

- Aerial Netting – Flying insects were captured in aerial nets and placed into killing jars. After the specimens died they were transferred into collecting vials and processed in the laboratory at the end of each day.
- Sweep Netting – Grasses, small shrubs and other low-lying vegetation was sampled with a sweep net. The heavy net was brushed along the top of the vegetation or grass, capturing insects. The insects were placed into killing jars, and later into collecting vials for processing.
- Foliage Beating – Foliage was sampled using beating sheets. A 19.7 inch square sheet was placed under a branch and the stem was struck with a short stick. Arthropods on the foliage were dislodged and fell onto the sheet where they were collected with an aspirator into vials.
- Visual Inspection – Plants were visually inspected for arthropods that were not collected by other methods.

Litter Sifting
Rocks and dead logs were turned over and leaf litter was sorted through to locate and collect arthropods. Arthropods were collected into vials using an aspirator or forceps.

Night Sampling
UV lights were used to attract moths and other nocturnal insects. A cloth sheet was hung on a rope at night with an ultraviolet fluorescent tubes placed at the top of the sheet. As insects were attracted and alighted on the sheet, they were captured in vials. High winds some nights required that the sheet be placed on the ground with the light suspended a few feet above it to attract insects.

The phases of the moon can influence the attraction of insects to artificial light (Williams and others 1956). A bright moon may compete with the light source resulting in a reduced catch. The moon was waxing during the September/October 2008 sampling period, with approximately 15 to 50 percent illumination.

The Batch Plant Staging Area with Pu‘u Hau Kea in the background.

2.4.3 Specimen Curation

The contents of the traps were cleaned in 70 percent ethyl alcohol and sorted into the morpho-species for identification. Hard-bodied species, such as beetles, true bugs, large flies and bees were mounted on pins, either by pinning the specimen or by gluing the specimens to paper points. Soft-bodied specimens, such as immature stages, spiders, Collembola, Psyllids, Aphids, small flies and wasps, and centipedes, were stored in vials filled with 90 percent ethyl alcohol.

2.4.4 Identification

Identification to the species level for all specimens was not feasible in the time frame for this study. Important groups of endemic species, species of concern, and potentially threatening non-indigenous species were given first priority for identification. Specimens will be deposited in the B.P. Bishop Museum when sampling and identification are complete.

References for general identification of the specimens included *Fauna Hawaiiensis* (Sharp (ed) 1899-1913) and the 17 volumes of *Insects of Hawai‘i* (Zimmerman 1948a, 1948b, 1948c, 1948d, 1948e, 1957, 1958a, 1958b, 1978, Hardy 1960, 1964, 1965, 1981, Tentorio 1969, Hardy and Delfinado 1980, Christiansen and Bellinger 1992, Liebherr and Zimmerman 2000, and Daly and Magnacca 2003). Other publications which were useful for general identification included *The Insects and Other Invertebrates of Hawaiian Sugar Cane Fields* (Williams 1931), *Common Insects of Hawai‘i* (Fullaway and Krauss 1945), *Hawaiian Insects and Their Kin* (Howarth and Mull 1992), and *An Introduction to the Study of Insects Sixth Edition* (Borror, Triplehorn, and Johnson 1989).

For specific groups specialized keys were necessary. Keys used to identify Heteroptera included those by Usinger (1936, 1942), Ashlock (1966), and Gagné (1997). Keys used to identify Hymenoptera included Cushman (1944), Watanabe (1958), Townes (1958), Beardsley (1961, 1969, 1976), Yoshimoto and Ishii (1965), and Yoshimoto (1965a, 1965b).

2.5 Lichen, Bryophyte, and Botanical Sampling

Prior to field work, a search was made of the literature to review previous botanical, lichen and bryophyte studies conducted in or near the project area. Identification guides were also consulted to prepare the investigators for field identification.

2.5.1 Lichen and Bryophyte Sampling

An intensive walk-through survey method was used to inventory the lichens and bryophytes. Over two eight-hour days, September 29-30, 2008, two people walked through all of Area E with special attention to the TMT Observatory footprint sites, recording lichen and bryophyte species as encountered. All principal habitat types were investigated. Small caves were given extra sampling attention to confirm all species of lichens and bryophytes were detected. Care was taken to avoid disturbance of flagged archaeological sites and any other site that gave the appearance of archaeological significance.

Three habitat types found within Area E were examined. Those types are:

Type 1 - Pahoehoe lave flows covered about 50 percent of the area. The general topography was essentially flat and smooth with many folds. In several areas small caves were found which ranged from about one foot to almost six feet deep.
Type 2 - Small islands of ash covered about 10 percent of Area E. The ash was typically covered with small stones or broken lava.
Type 3 - Rubble of shattered stones constituted about 40 percent of the habitat. Three different subtypes were found in Type 3 habitat;

1. with stones somewhat embedded in ash;
2. where stones rested on ash subsurface; and
3. where there was no evidence of ash between or below the stones.

The undersurfaces of twenty-five rocks were examined each of the three rubble habitats subtypes and counts were made of lichens present to quantify abundance. All rocks that were examined were replaced in their original position as precisely as possible.

Dr. Clifford Smith examines lichens in a lava tube at Area E of the MKSR.

Small samples of all species detected were taken as vouchers. Voucher specimens will be deposited in the B.P. Bishop Museum in Honolulu. Larger specimens were taken of several species whose identity could not be confirmed in the field. These samples were studied in the laboratory or were sent to other lichen experts for identification confirmation.

2.5.2 Botanical Sampling

An intensive walk-through survey method was used to record the flora at the three Project construction areas – Area E, the Batch Plant Staging Area, and Mid-Level Support Facility area at Hale Pōhaku. Plant identifications were made in the field. Plants that could not be positively identified were collected for later determination using plant keys and other identification aides. Notes were taken of the distribution of species within and surrounding each of the sites.

The botanical inventory of Area E and the Batch Plant Staging Area was conducted concurrently with the arthropod and Lichen sampling over six days. Plant species were examined repeatedly as they were encountered to confirm identification.

The botanical inventory at Hale Pōhaku was conducted over six days between October 1 and October 10, 2008. Species of plants around the perimeter of the Construction Staging Area were visited several times over the six day period to confirm identifications. Additional botanical sampling was conducted February 23-24, 2009 and April 17-23, 2009 to survey the TMT Mid-Level Support Facility beyond the Construction Staging Area.

2.5.3 Identification

References for general identification of the specimens included *Field Guide to Rare and Unusual Plants on the Island of Hawai'i* (Delay et al 2004), *Handbook of Hawaiian Weeds* (Haselwood and Motter 1966), *Hawaiian Heritage Plants* (Kepler 1984), *Trailside Plants of Hawai'i's National Parks* (Lamoureux 1976), *Hawaiian Forest Plants* (Merlin 1995), *Hawai'i's Vanishing Flora* (Kimura and Nagata 1980), *In Gardens of Hawai'i* (Neal 1965), *Plants and Flowers of Hawai'i* (Sohmer and Gustafson 1987), *A Tropical Garden Flora* (Staples and Herbst 2005), *Ferns of Hawai'i* (Valier 1995), *Manual of the Flowering Plants of Hawai'i* (Wagner and others 1990), and *Hawai'i's Ferns and Fern Allies* (Palmer 2003).

Construction Staging Area at Hale Pōhaku.

3.0 RESULTS and ANALYSIS

3.1 Area E, the Access Way, and Batch Plant Staging Area

3.1.1 Arthropods

Previous Studies

The first reports of insects at high elevations on the Island of Hawaiʻi were from Maunaloa (Guppy 1897, Meinecke 1916, Bryan 1916). The first published collection of insects from Maunakea was by Bryan (1923), followed by Bryan (1926) and Swezey and Williams (1932). These first investigators believed that the summit areas were "absolutely sterile" and that all the insects found there were aeolian, i.e., blown up from surrounding lowlands by wind. These early reports mention a few species of parasitic wasps, flies, true bugs, and butterflies that were more commonly found at lower elevations. It is interesting to note that the first hint of a high elevation resident was by Guppy (1897), when he mentioned a "parasitical bug" that was feeding on the bodies of dead butterflies. This insect may have been the *aʻa* bug not formally described until 1998 (Polhemus 1998).

Insects from high elevations on Maunakea were not mentioned in the literature again until 1971 (Gagné 1971) when acacia psyllids (a lowland species that infests *koa*) were found in great numbers on observatory walls and washed up in shore debris at Lake Waiau. Howarth (1971) was the first to hypothesize aeolian ecosystems in Hawaiʻi in which the major nutrient source is windblown material from outside the ecosystem. While that study was conducted on Kilauea, his new paradigm was soon to be applied to Maunakea.

In 1980, Howarth and Montgomery described the ecology of a high altitude aeolian ecosystem on Maunakea based on new observations of arthropods near the summit (Mull and Mull 1980, Mull 1980). In this landmark paper, the authors report the "discovery" of a new flightless lygaeid bug of the genus *Nysius*, called the Wēkiu bug (Mull and Mull 1980). Ashlock and Gagné (1981) described this new species as *Nysius wekiuicola*.

At least five studies for Maunakea arthropods have been used to support Environmental Assessments (EA) or EISs. In preparation of the EIS for the Mauna Kea Science Reserve: Complex Development Plan (RCUH 1983), an assessment was made of the arthropod fauna and aeolian ecosystem near the summit of Maunakea (Howarth and Stone 1982). That study found Wēkiu bugs in high density on the summit cinder cones, in moderate density on the plateau northeast of the cinder cones, and in low density on the northwest plateau where Area E and the 4-wheel drive road are located (Figure 4). The investigators reported seventeen resident arthropod species, ten presumed to be indigenous Hawaiian arthropods. Besides Wēkiu bugs from the area of study, a Lycosid spider (*Lycosa* sp[3].), two mites (Families Anystidae and Eupodidae), three sheetweb spiders (*Erigone* spp. and one unknown genus), a centipede (*Lithobius* sp.), two Collembola (*Entomobryoides* spp.), and a noctuid moth (*Archanarta* sp.) were also found. Only the lycosid spider was found in high abundance in Area E and along the

[3] The abbreviation "sp." is used when the actual specific name cannot be specified.

4-wheel drive road. The noctuid moth was widely dispersed but nowhere abundant, and was hypothesized to feed on foliose lichens (Howarth and Stone 1982). A third species of Collembola that was found was unidentified, and its status was unknown.

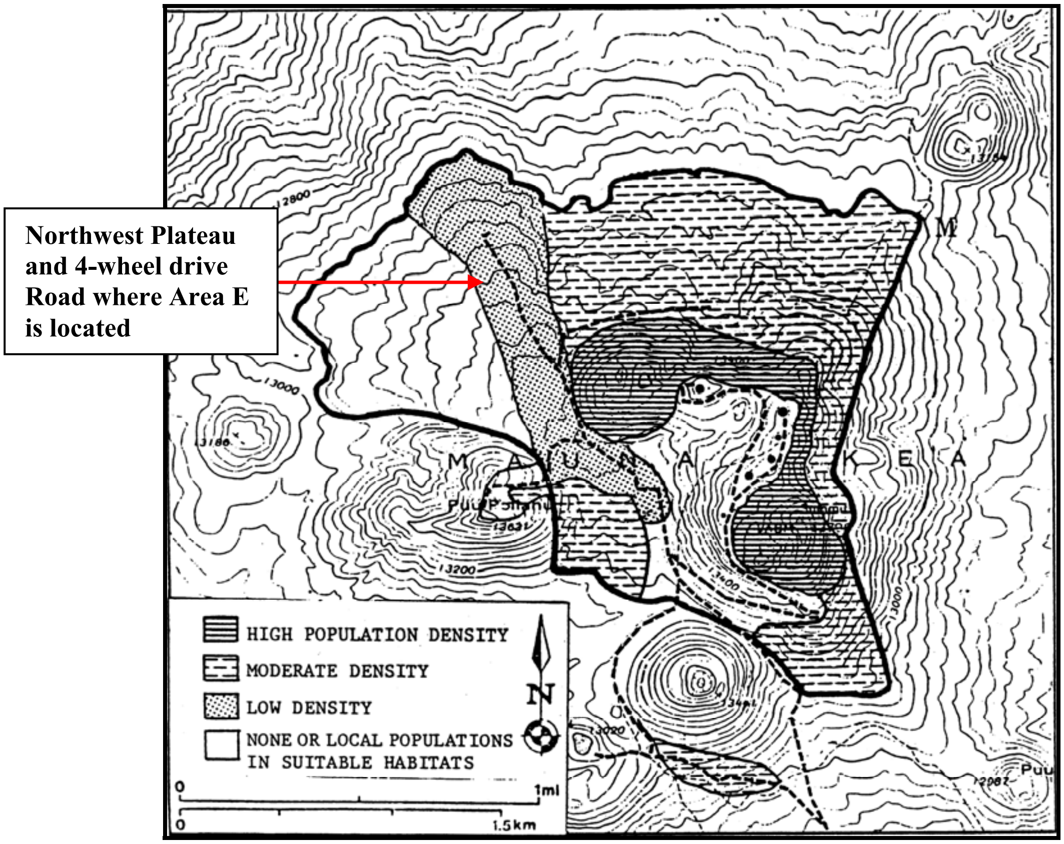


Figure 4. Population Densities of Wēkiu Bugs during 1982 Study.
(Source Howarth and Stone 1982)

The study also reported a large number of transient (aeolian) species presumably that were blown up the mountain by wind, and that represented a food source for resident species.

The study concluded that the lava flows and andesitic rocks of Area E and the 4-wheel drive road were habitat to the noctuid moth, Lycosid spider and centipede, and that Wēkiu bugs were relatively rare because of the rarity of suitable microhabitat. The islands of talus slopes and highly fractured rocks surrounded by lava flows were thought to have moderately high populations of Wēkiu bugs, presumably because the stable rocks provide favorable microclimates.

The next study was a provisional arthropod assessment conducted for the Caltech Submillimeter Observatory (CSO) (Howarth 1982). No Wēkiu bugs were detected during the March sampling, but many of the other species identified from the previous study were found to occur at the CSO site.

The 1988 study of the invertebrate fauna at the proposed Very Long Baseline Array (VLBA) site (Montgomery 1988) found no Wēkiu bugs, but at least four of the resident native species mentioned in the 1982 study along with several non-indigenous species of flies and wasps.

An arthropod assessment of selected areas of the MKSR (Howarth and others 1999) was conducted over two years, 1997 and 1998, to support the revised MKSR Master Plan EIS (UH 1999). The investigators reported nine resident species detected during the sampling, four endemic to Hawaiʻi. A total of sixty-nine species of arthropods were collected in this study, ten that were likely endemic to Hawaiʻi.

In July 1998, twenty-five pitfall traps were placed along the 4-wheel drive road on the North Plateau (now known as Area E). No Wēkiu bugs were detected there during that study, though they were collected on nearby cinder cones.

Wēkiu bugs were relatively rare during the 1997/98 study and analysis revealed an average decline of 99.7% in Wēkiu bug capture rates compared to the 1982 study. The investigators cited possible causes for the decline as changing weather patterns, habitat disturbances, presence of harmful alien species, and long-term population cycles. Because Wēkiu bugs were more abundant in disturbed areas compared to non-disturbed areas, the investigators raised "the possibility that observatory construction had not impacted Wēkiu bug or lycosid spider distributions at the summit, outside of the immediate vicinity of paved and covered areas" (Howarth and others 1999).

A 2001 study by the Smithsonian Institution (Polhemus 2001), found Wēkiu bugs abundant on Puʻu Hau Kea inside the Mauna Kea Ice Age Natural Area Reserve adjacent to the MKSR. The cinder cone was found to be composed almost entirely of deep layers of cinder lying over a basal layer of moist, compacted ash. The study was conducted over four days in June 2001 and deployed traps similar to those used during the 1982 Howarth and Stone study. No other arthropods were reported from the sampling.

Adult Wēkiu bug captured in a live-trap during June, 2005.

A long-term baseline monitoring study was started in February 2002 for the Outrigger Telescopes Project proposed for the W.M. Keck Observatory (Brenner 2002a – 2006b). The study comprised ten pitfall live-traps at permanent sampling stations inside the unnamed puʻu crater below the Keck Observatory and at ten permanent sampling stations inside Puʻu Wēkiu. Sampling was conducted quarterly from February, 2002 through May, 2006. Microclimate data were taken using HOBO© data loggers to gain understanding about the relationship between Wēkiu bug abundance and habitat temperature.

Seven thousand nine hundred and twelve Wēkiu bugs were collected over the four and one-half years of sampling. Wēkiu bugs were more abundant on the unnamed puʻu where both Subaru and Keck sit than on Puʻu Wēkiu (Table 1). The results of this study supported the conclusion of the 1999 study, that observatory construction had not impacted Wēkiu bug and lycosid spider distributions at the summit, outside of the immediate vicinity of paved and covered areas.

The study also found that Wēkiu bug activity appeared to vary with temperature (Figure 5), and populations fluctuated year to year. These results suggest that the 1999 study may have been conducted during years of particularly low Wēkiu bug abundance and that the decline reported was an artifact of timing.

While the presence of other arthropods was regularly reported in the Quarterly Reports, many of the same species collected in previous studies were detected during this study (Pacific Analytics unpublished data). The noctuid moth was found to be present on both cinder cones that were sampled, along with Lycosid spiders, centipedes, and many other species.

TABLE 1: Quarterly Baseline Monitoring Average Trap Capture Rates

Location	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year Avg.
Pu‘u Wēkiu 2002*	0.03	0.03	0.3	0.2	0.1
Pu‘u Wēkiu 2003	2.8	11.5	0.5	0.0	3.7
Pu‘u Wēkiu 2004	0.00	2.0	0.03	0.06	0.5
Pu‘u Wēkiu 2005	1.14	0.64	1.26	0.12	0.79
Pu‘u Wēkiu 2006	0.00	3.12			1.56
Unnamed pu‘u 2002	1.0	10.3	4.0	4.0	4.8
Unnamed pu‘u 2003	18.5	90.6	12.4	0.8	30.6
Unnamed pu‘u 2004	2.1	8.8	0.4	0.21	2.9
Unnamed pu‘u 2005	15.92	5.09	5.99	0.62	6.91
Unnamed pu‘u 2006	0.00	30.16			15.08

The average number of Wēkiu bugs per trap per 3-days for each of the Quarterly Baseline Monitoring Sampling Sessions.
Yearly average trap capture rates for Baseline Monitoring are in RED.
* - different trap locations on Pu‘u Wēkiu in 2002 (Source Brenner 2006b)

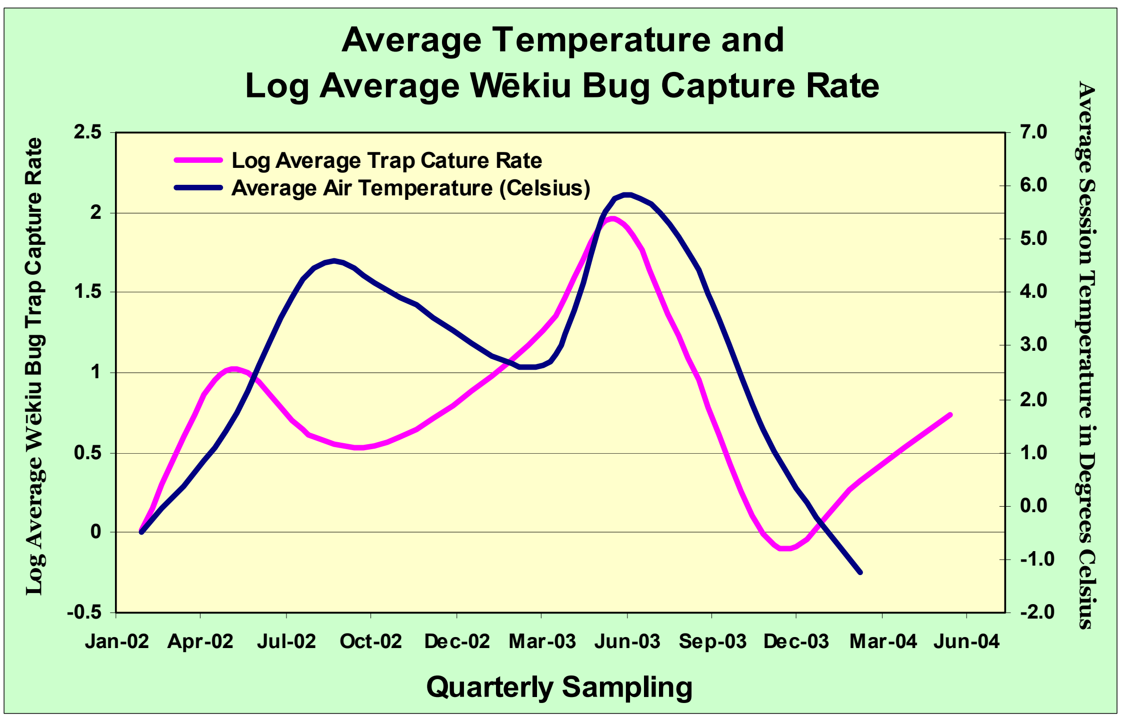


Figure 9. Plot of Baseline Monitoring Session Average Temperature (Celsius) and Natural Log Average Number of Wēkiu Bug Trap Capture Rate per Session on the Unnamed Pu‘u. **(Source Brenner 2006b)**

Research conducted in 2005 studied the composition of cinder in known Wēkiu bug habitat on summit cinder cones. This study found evidence of a correlation between the number of Wēkiu bugs captured at adjacent monitoring stations during concurrent sampling and the proportion of cinder less than ~2 inches and greater than ~ 0.5 inches. The study also found that the size distribution of cinder on Puʻu Wēkiu was not different from that on the unnamed puʻu (Brenner and Lockwood 2005).

The study concluded that "By placing 0.5 inch to 2 inch restoration cinder 12-inches to 18-inches deep and allowing it to size-sort over time, we feel that the resulting restoration will be similar to existing Wēkiu bug habitat where high numbers of these bugs have been found." The results of the study may be used for future habitat restoration activities.

Four reports of arthropod research were produced by the B.P. Bishop Museum from October, 2002 through April, 2007 (Englund and others 2002, Englund and others 2005, Englund and others 2006, Englund and others 2007) that give an account of the results of sampling over a large portion of the MKSR. The purpose of these studies was to gather information about the distribution of Wēkiu bugs throughout the MKSR.

These four studies found Wēkiu bugs on at least 15 cinder cones ranging in elevation from 11,715 feet to 13,796 feet. The studies generally conclude that Wēkiu bugs are restricted to rims and inner craters of cinder cones where loose cinders provide interstitial spaces large enough to allow movement through the cinder habitat.

The authors hypothesized that weather, abiotic factors, temperature, and substrate moisture all may influence Wēkiu bug activity. Trap efficiency of pitfall live-traps vs. glycol dead-traps was examined during these studies. It was reported that glycol dead-traps were about forty times more effective at capturing Wēkiu bugs. As a result of these tests, they conclude that there is no quantitative evidence of an actual decline in the population of Wēkiu bugs since 1982 (Englund and others 2002).

A fifth report (Porter and Englund 2006) details the accounts of a study on possible geologic factors that may influence Wēkiu bugs. This study found the Wēkiu bugs appear to prefer non-glaciated cinders and lava spatter in areas where glacial erratics are lacking. They concluded that "Because the [Wēkiu] bugs apparently do not like bedrock substrates, telescopes sited on the glacially modified lava flows in the summit region may have little or no local impact on the bugs" (Page 13 in Porter and Englund 2006).

There have been other studies of arthropods in the higher elevations of Maunakea but these studies are ongoing and their data are not complete or available (S. Nagata personal communication).

In summary, considering the information contained in all reports and published papers, at least 114 species of arthropods have been collected from the MKSR. Many of these species' identifications have not been determined or are undescribed species. Based on known generic distributions, thirty-one of the 114 species were identified as potentially endemic to Hawaiʻi.

As many as twelve indigenous Hawaiian species may be residents of the higher elevations of Maunakea, including Area E (Howarth and Stone 1982, Howarth and others 1999). This potential native resident fauna includes three species of spiders, three species of mites, three species of Collembola, a centipede, a moth, and a true bug. There are non-indigenous species thought to also be residents of this region, including mites, spiders, flies, true bugs, and barklice (Howarth and Stone 1982; Howarth and others 1999).

Some of the non-indigenous arthropods reported may pose a threat to the native Hawaiian arthropods that are residents of the higher elevations of the MKSR, as predators or competitors for food resources.

Current Study Results

<u>Findings</u>

During the Fall sampling period, twenty-two species of arthropods representing ten orders and eighteen families were collected from the Batch Plant Staging Area, Area E, and along the 4-wheel drive road. While as many as seven of these species collected may be endemic to Hawaiʻi, at most four found in Area E could be considered residents of the sites. These include two spiders, the wolf-spider (*Lycosa* sp.) and the sheetweb spider (*Erigone* sp.), the noctuid moth, and perhaps the unknown Collembola species. A fifth indigenous resident species, the Wēkiu bug (*Nysius wekiuicola*) was collected along the 4-wheel drive road.

Lycosid spiders live among rocks.

Despite intensive sampling (123 trap nights), no Wēkiu bugs were detected at the Batch Plant Staging Area, in Area E or along the 4-wheel drive road during the October 2008 sampling (Eiben 2008). Three Wēkiu bugs were detected at the two control sites, the unnamed puʻu and Puʻu Poliʻahu, indicating that this species was active in known habitats.

During the Spring sampling period, one hundred and forty-six Wēkiu bugs were observed in the baited live-traps and in the immediate vicinity of the traps (Eiben 2009). The counts comprise one hundred and two adult males, thirty-nine adult females, and five nymphs. No Wēkiu bugs were captured or observed in Area E or at the Batch Plant. Forty-one Wēkiu bugs were found in the six live-traps placed along the proposed Access Way Options 2 and 3. An additional one hundred and five Wēkiu bugs were observed in and near traps at the two control sites, sixty at the unnamed puʻu and forty-five at Puʻu Poliʻahu. Eighty-five percent of the Wēkiu bugs captured in the live-traps survived and were released into the habitat from which they were collected.

<u>Analysis</u>

The arthropod fauna of Area E, the 4-wheel drive road, and the Batch Plant Staging Area was found to be generally the same as that detected in historic collections. Resident native species detected during this study like the Lycosid spider and sheetweb spiders of the genus *Erigone*, are known from the Northern Plateau as well as being abundant over a large part of the MKSR (Howarth and Stone 1982, Howarth and others 1999). The native noctuid moth is also known from elsewhere in the MKSR and is always noted as being in low abundance (Howarth and Stone 1982, Howarth and others 1999, Pacific Analytics unpublished data). It is unlikely that disturbance and habitat loss due to construction of the Project would significantly impact these species.

The unidentified Collembola that was found at the Batch Plant Staging Area may or may not be endemic to Hawaiʻi. The fact that it was detected only at the Batch Plant Staging Area indicates that this species is able to survive a highly disturbed habitat. The cinder stored at the Batch Plant

Staging Area is used for road maintenance and is moved frequently. The rest of the area is used as parking and vehicles regularly move over the open ground. Therefore, it is unlikely that construction activity related to the Project would significantly impact this species.

The other native arthropods that were collected at these sites are not considered residents of the higher elevations of the MKSR and were likely blown into the area by strong winds where they may eventually become prey for the resident species. The Lygaeid bugs found feed on plants and the vegetation at these sites is generally sparse and lacks the host plants necessary to sustain a population of these insects.

The lack of Wēkiu bug detection during the September sampling should not be taken as evidence that this species does not use the areas as habitat. Wēkiu bugs were detected at low density along the 4-wheel drive road in 1982 (Howarth and Stone 1982). Wēkiu bug activity has been found to be seasonally variable and the late September sampling period was not optimal for Wēkiu bug detection (Howarth and others 1999, Brenner 2002a-2006b, Polhemus 2001, Englund and others 2002, Englund and others 2005, Englund and others 2006. Englund and others 2007, Eiben pers. com.). As expected, we observed much higher trap capture rates during the Spring sampling period. Wēkiu bugs have a seasonal occurrence and are usually much more abundant from March through June (Brenner 2006b, Englund et al. 2007).

The lava substrate in Area E is not considered to be ideal Wēkiu bug habitat (Howarth and Stone 1982, Howarth and others 1999, Brenner and Lockwood 2005). Wēkiu bugs have only been found in Area E during one study, and occurred during a particularly abundant year for the bugs (Howarth and Stone 1982). No Wēkiu bugs have detected at this locality since that study in 1982 until the current study. However, construction activities could potentially impact Wēkiu bugs within the Maunakea Summit Region. Dust generated during excavation and site preparation could drift into Wēkiu bug habitat. Trash and construction materials may also be blown off the site by the strong summit winds. Dust and wind-blown debris are believed to have an adverse impact on Wēkiu bug habitat, but impacts could be mitigated. It is not likely that construction activities within Area E would have a significant impact on the Wēkiu bug populations elsewhere within the MKSR if the recommendations in this report are followed (see Section 4.0 Recommendations).

The loose cinder adjacent to the existing 4 wheel-drive road is highly suitable as Wēkiu bug habitat, consisting of different sized cinders larger than ½ inch in a depth of 2 to 10 inches above the ash layer (Eiben 2009). Construction of the Access Way options 2 and 3 would disturb that habitat.

Wēkiu bugs have never been detected at the Batch Plant Staging Area and are not likely to use the area as habitat. The stockpiled cinder is disturbed regularly because of road maintenance and does not have structure suitable for Wēkiu bug habitat. The Batch Plant Staging Area is disturbed regularly and activity there has not appeared to impact Wēkiu bug populations elsewhere, therefore construction activities there would not likely have any significant impact. However precautions should be taken to prevent accidental habitat damage and the introduction of non-indigenous arthropods to ensure protection of the native arthropod species within the MKSR (see Section 4.0 Recommendations).

3.1.2 Lichens, Bryophytes, and Vegetation

Previous Studies

Early accounts of the high elevation flora of Maunakea began in 1826 (Goodrich 1826). Hartt and Neal (1940) provide an excellent review of the early expeditions to the summit of Maunakea. According to historic reports, few plants grew above 11,000 feet. The early botanists describe the flora as consisting of *māmane* (*Sophora chrysophylla*) extending to about 10,000 feet, and only *Dubautia*, silverswords, ferns, and grasses extending as high as Lake Waiau (Hartt and Neal 1940).

The first reported systematic survey of mosses and vascular plants from the higher elevations of Maunakea occurred in 1935 (Neal 1939). The investigators reported finding a total of 146 species and varieties from an altitudinal range of 5,800 feet to the summit. Only lichens, mosses, and one fern, *Asplenium adiantum nigrum*, were detected at the summit region. The report noted that the fern also was observed at many lower altitudes (Neal 1939, Hartt and Neal 1940).

Botanical surveys of the MKSR conducted for evaluating potential impacts due to construction of observatories started in 1982 (Smith and others 1982). The first of these surveys found six resident vascular plants; two indigenous ferns, two indigenous grasses, and two non-indigenous weeds. These species occur elsewhere in the Hawaiian Islands, and the two grasses (*Trisetum glomeratum* and *Agrostis sandwicensis*) are more common at lower elevations.

One of the ferns, the endemic *Cystopteris douglasii*, is designated as a Species of Concern by the U.S. Fish and Wildlife Service (USFWS) (1999). It is known from high elevations on Haleakalā and Maunakea and may also occur in moist forests on Kauai, Oahu, Lanai, and Maui (HBMP 2008, PBIN 2008). The other fern is the spleenwort, *ʻiwaʻiwa* (*Asplenium adiantum-nigrum*).

Rhizocarpon geographicum on rocks in Area E.

The bryophytes (mosses) from Maunakea were first described by Bartram (1939) and new notes were added in subsequent studies (Bartram 1952). Lichens were not treated systematically until Smith and others (1982) conducted a survey on Maunakea near the summit in their report to support the development of the MKSR Complex Development Plan (RCUH 1983). In this study, which covered the summit region above 13,000 feet, about twenty-five species of lichens and twelve species of mosses were found. Three areas of intense study were found to have a rich variety of lichens, including *Pseudephebe pubescens*, a lichen species never before collected in Hawaiʻi. The investigators concluded that suitable niches for mosses and lichens were dispersed over the summit area and that limited construction above 13,000 feet would not endanger habitats for these species, but recommended that the three areas of rich lichen variety be surveyed before development to determine if construction would remove any populations of *Pseudephebe pubescens*.

During development of the CSO, three species of lichens and two species of mosses were added to the summit list (Sohmer and others 1982). Later studies related to the development of the

Subaru Observatory confirmed the findings of the previous studies and added no new species to the list of plants that occur near the summit of Maunakea (Char 1990). The last study completed for observatory development was conducted in 1992 (Char 1992). The investigators mapped areas of high lichen concentrations; one of these concentrations falls within Area E.

Current Study

Findings

Three lichen/bryophyte habitat types were found to occur at Area E and along the 4-wheel drive road (Smith 2008).

Type 1 – Pahoehoe lave flows covered about 50 percent of the area. The general topography was essentially flat and smooth with many folds. In several areas small caves were found which ranged from about one foot to almost six feet deep.
Type 2 – Small islands of ash covered about 10 percent of Area E. The ash was typically covered with small stones or broken lava.
Type 3 - Rubble of shattered stones constituted about 40 percent of the habitat. Three different subtypes were found in Type 3 habitat;

1. with stones somewhat embedded in ash;
2. where stones rested on ash subsurface; and
3. where there was no evidence of ash between or below the stones.

Lichen colony found at Area E.

Ten species of lichens and two species of bryophytes were found within Area E (Appendix B). There is an extremely low cover (<1 percent) of lichens and bryophytes. They are confined to protected habitats almost always on the north-facing sides of rocks or the head of small collapsed lava tubes. In these sheltered, amenable habitats, lichens are locally common.

In 2 quantitative samples from each of these three subtypes, lichens were found only in the subtype b and c habitats. In subtype b, *Lecanora polytropa* was found under 2 of 50 rocks sampled. In subtype c, *Lecanura polytropa* was found under 22 of the 50 rocks sampled, and *Acarospora sp.* was under one of the 50 rocks. None of the *L. polytropa* had fertile thalli.

There is a marked difference in the distribution of the various lichens. The dark to black species (*Rhizocarpon ?hochstetteri, Pseudephebe miniscula, Umbilicaria aprina* and *U. hirsuta*) are found on the open face of northern facing rocks, (*Candelariella vitellina, Lecanora polytropa* and *Lecanora sp.*) at the base of northern facing rocks, and (*Lepraria ?incana*) on the roof of the small lava tubes in Type 1 habitat. The presence of the dark species in the most exposed inhabited areas is in keeping with McEvoy and others (2007) finding that melanic pigments play a photoprotective role in light acclimation. The other species do not have such protection though the apothecia and areoles of *L. polytropa* are often light to dark grey in more exposed situations. *Lepraria* species frequently grow in protected shaded and humid habitats.

It has been hypothesized that the resident native noctuid moth in the Maunakea Summit Region feeds on foliose lichens (Howarth and Stone 1982). This has not been confirmed. The foliose lichens found in Area E do not show evidence of feeding and therefore do not appear to be necessary to support any herbivore trophic level.

Umbilicaria **lichen on rocks in Area E show no sign of herbivore damage.**

None of the lichen species present contain cyanobacteria so if nitrogen fixation is taking place none of it comes from lichens.

Seven species of vascular plants were found in Area E, two native grass species, two introduced weeds and two native spleenwort ferns, and one bladder fern. Three of these species also occur at the Batch Plant Staging Area (Appendix C).

The spleenwort, *ʻiwaʻiwa* (*Asplenium adiantum-nigrum*), is a species indigenous to Hawaiʻi but found on all major islands in Hawaiʻi and elsewhere in the world (Clapham and others 1962, Wagner and others 1990, Palmer 2003). At higher elevations within the MKSR it grows in well protected areas at the base of rocks, between large boulders, or in rock crevices where water accumulates. Elsewhere in Hawaiʻi it grows on cinder plains, lava flows, and in dry forests in elevations ranging from 2,000 feet to approximately 13,000 feet (Valier 1995). This fern is uncommon in Area E and at the Batch Plant Staging Area, usually occurring as individual plants in protected areas that are sheltered from direct sun.

The spleenwort, *ʻoāliʻi* (*Asplenium trichomanes* subsp. *densum*), is an endemic species of fern. This delicate fern is uncommon in Area E, occurring in crevices of rocks. Also known from Haleakalā, this species is locally abundant in full sunlight in open areas on lava fields and in *kīpuka* from 3,936- 8,856 feet on East Maui and Hawaiʻi (Palmer 2003).

ʻiwaʻiwa **grows in rock crevices at Area E.**

The bladder fern, (*Cystopteris douglasii*), is a species endemic to Hawaiʻi. It occurs in Area E infrequently in open, exposed areas on weathered rock. It is also known from scattered locations throughout the summit (Smith and others 1982).

<u>Analysis</u>

There is a very low diversity and cover of plants in Area E, along the 4-wheel drive road, and at the Batch Plant Staging Area. The vascular plants appear to be confined to the western side of the larger pāhoehoe flows in Area E. The two endemic grasses found both occur throughout the Hawaiian Islands and are more abundant at lower elevations (Wagner and others 1990) and therefore not threatened by construction activities. The indigenous spleenwort ferns have a broad distribution and are more abundant at lower elevations (Palmer 2003), thus would not be significantly impacted by construction activities.

A few individual bladder ferns (*Cystopteris douglasii*) were detected at Area E during our survey. This fern is considered a Species of Concern (USFWS 1999). It occurs on five islands in Hawai‘i (Palmer 2003, HBMP 2008, PBIN 2008) and has been designated as a Priority Species-5 plant with more than 5,000 individuals and/or more than 40 populations remaining state wide (Evans and others 2006). On East Maui it grows between 1,500 and 3,000 feet in mesic forests and cave mouths (Palmer 2003). On the Island of Hawai‘i this species is found scattered throughout the higher elevations of the MKSR and on the eastern slopes of Maunaloa in the Pōhakuloa Training Area (USACE 2003). Thus, Area E does not provide unique habitat essential for its survival (Char 1990). Populations of this fern in habitats adjacent to Area E and the 4-wheel drive road could be impacted by excessive dust and wind-blown trash that cover these plants and block needed sunlight. Damage to these populations would be reduced by following the recommendations contained in this report (Section 4.0 Recommendations)

The two non-indigenous plant species, *Hypocaeris radicata*, and *Taraxacum officinale* are not abundant at the study sites and have not appeared to have spread since 1999.

Lichens and bryophytes were found to be generally confined to the northerly aspect of rocks or under overhangs and even then the abundance of species is much higher in those areas facing north.

There is a very low diversity and cover of lichens and mosses in Area E. All of the species detected are found at somewhat lower elevations at least on the southern side of the mountain, and none of the species are unique to Hawai‘i. Project construction activities would not likely have a significant impact on the plant, lichen, and moss species found at the surveyed sites.

3.1.3 Access Way Options

Option 1 – The terrain along this option is similar to that found in Area E, and is not considered to be ideal Wēkiu bug habitat (Howarth and Stone 1982, Howarth and others 1999, Brenner and Lockwood 2005). No sampling has been conducted here, but it is likely that Wēkiu bugs only occupy this area during extreme population explosions that push the insects into marginal habitats.

Option 2 – The terrain along this option has about a 15 percent slope and would require extensive fill to be functional. The ground here is a combination of loose cinder and lava and, like the terrain of Option 1, is not considered to be ideal Wēkiu bug habitat, however, ten Wēkiu bugs were detected in adjacent habitat during the Spring 2009 sampling session.

Option 3 – The terrain here is loose cinder and is contiguous with the unnamed pu‘u cinder cone. The cinder here is considered to be ideal Wēkiu bug habitat, although no Wēkiu bugs were collected here during the 2008 sampling, but thirty-one were collected during the Spring 2009 sampling. This option would require cutting into the cinder cone and Wēkiu bug habitat and adding a retaining wall to prevent cinder from encroaching on the newly paved road. The road would also bisect and isolate portions of habitat. While Wēkiu bugs have been observed crossing existing dirt and cinder roads, none have ever been observed on pavement. Because this option disturbs and displaces Wēkiu bug habitat, mitigation measures similar to those proposed for the Outrigger Telescope Project would likely have to be implemented (see Recommendations).

3.1.4 Summary

The results of this arthropod and botanical survey indicate there are no special concerns or legal constraints related to invertebrate and botanical resources in the project areas. No species listed as endangered or threatened were detected at the project construction areas (DLNR 1997, Federal Register 1999, 2005, 2005). One species currently proposed for federal listing, the Wēkiu bug (*Nysius wekiuicola*), was observed along the 4-wheel drive road. Some Wēkiu bug habitat could be disturbed if Option 2 or 3 are chosen for the proposed Access Way. The amount would be small compared to the amount of available habitat for this species and would likely not threaten its survival on Maunakea. One species of concern, Douglas' bladder fern (*Cystopteris douglasii*), was found in Area E, but this species also occurs on Maui and on the eastern slopes of Maunaloa, thus Area E does not provide unique habitat essential for its survival (Char 1990).

3.2 Construction Staging Area, Hale Pōhaku

3.2.1 Arthropods

Previous Studies

Several entomologists have collected in the *māmane* forest near Hale Pōhaku, but no one has published a systematic study of the arthropods found there. Swezey (1954) summarized early sampling and listed forty-one species from *māmane* (*Sophora chrysophylla*) and twenty different species from *naio* (*Myoporum sandwicense*) that occur on the Island of Hawai'i.

Honeybee foraging *māmane* blossoms.

A unpublished 1988 study conducted in the *māmane* near *Pu'u La'au* added forty-seven species of insects and spiders to the list of arthropods from the *māmane* forest on Maunakea (Gagne and Montgomery unpublished). These species could be expected to occur near Hale Pōhaku as well. There is no doubt that the subalpine forest arthropod fauna is larger than these studies indicate and that additional studies will likely expand the list.

A recent survey along the Saddle Road realignment route found 214 species of arthropods (USDOT 1997). This is the closest systematic survey to Hale Pōhaku that has been conducted. Many of the species collected during the study are likely to occur at or near Hale Pōhaku.

No endangered, threatened, or special status arthropod species were detected during any of the previous studies near Hale Pōhaku described above.

Current Study

Findings

Thirty-three species of arthropods and two snails were observed on or near the TMT Mid-Level Support Facility area within Hale Pōhaku. Fifteen of the species detected are endemic to Hawai‘i, seventeen are purposeful or adventives non-indigenous species, and three are of unknown origin. The endemic species include the difficult yellow-faced bee, *Hylaeus difficillis*, the yellow-footed yellow-faced bee, *Hylaeus flavipes*, a succineid snail, *Succinea konaensis*, and several common plant bugs and moths.

Analysis

The arthropod fauna at the TMT Mid-Level Support Facility area consists mostly of non-indigenous species and common endemic species that are abundant throughout the *māmane* forest, and occur on other islands. None of the species found are designated as serious pests, and no ants were detected during the sampling. Two endemic yellow-faced bees were detected; *Hylaeus difficillis*, and *H. flavipes*, both previously designated USFWS Species of Concern. Species of Concern is an informal term, and is not defined in the federal Endangered Species Act (ESA). The term commonly refers to species that are declining or appear to be in need of conservation. Many agencies and organizations maintain lists of at-risk species. These lists provide essential information for land management planning and conservation efforts, but the designation carries no special protection and is no longer used by the USFWS Pacific Region (USFWS personal communication). The difficult yellow-faced bee, *Hylaeus difficillis*, was observed only during the Spring sampling period and normally may forage at higher elevations during warmer weather. This species also occurs on Maui, Lanai, and Molokai and it is unlikely that disturbance due to construction and staging activities of the Project would significantly impact this species. The yellow-footed yellow-faced bee, *Hylaeus flavipes*, was observed during both sampling periods foraging on *māmane*. This species also occurs on Maui and Lanai and construction activities would not likely impact the species.

Little is known about the distribution of the succineid snail. It is known to occur near *Pu‘u La‘au* on the western slopes of Maunakea. The impact of construction activity on this species is unknown.

3.2.2 Botanical

Previous Studies

Many of the same botanists that explored the upper elevations of Maunakea also studied the vegetation of the subalpine *māmane* forest (Hartt and Neal 1940). The upper limits of this forest do not reach above 10,000 feet and many of these early botanists noted seeing sheep and cattle grazing in the area.

At least five botanical studies have taken place at Hale Pōhaku. The first complete study of the flora was conducted for the Hale Pōhaku Master Plan (Gerrish 1979). *Māmane* trees six to twenty-five feet tall were found to cover about 25 percent of the undisturbed area. The ground was covered by several common grasses, hairy horseweed (*Erigeron bonariensis*), common groundsel (*Senecio vulgaris*), and mullein (*Verbascum sp.*). In all, thirty-two plant species were identified, nine native to Hawai‘i. One endemic species, *Stenogyne microphylla*, a trailing perennial vine up to several feet long, with greenish yellow flowers, is considered rare and occurs only on two islands in Hawaiʻi.

The second botanical study was conducted in 1985 (Char 1985). In this study of the area twenty-six plant species, nine native to Hawaiʻi, were detected where temporary construction housing was built. A small population of the threatened species of Hawaiian catchfly (*Silene hawaiiensis*) was reported in rocky areas on the steep slopes adjacent to and above the maintenance area in the northern/upslope portion of Hale Pōhaku.

Wand mullein (Verbascum virgatum) is common at the Construction Staging Area.

The third botanical survey at Hale Pōhaku was conducted to assess the impacts of the new facilities built to support construction of the Subaru Observatory (Char 1990). A total of thirty-seven plant species were observed. The same nine Hawaiian native plants identified in 1979 could still be found at the site.

The fourth study was conducted as part of the MKSR Master Plan EIS (Char 1999). Fifty-three plant species were found to occur, sixteen native to Hawaiʻi.

Māmane tree (Sophora chrysophylla) just outside the boundary of Hale Pōhaku.

The most recent botanical survey at Hale Pōhaku was conducted at the Construction Staging Area to assess potential impacts on *palila* habitat due to use by the proposed Outrigger Telescopes Project (Brenner 2004e).

None of the plants identified in these studies that occur below the Visitors Center are listed as threatened and endangered species, nor are any candidates for listing (USFWS 2006).

Current Study

Findings

During the Fall sampling period, the entire Construction Staging Area (CSA) and the surrounding region within 100 feet of the area boundaries were surveyed for plants. No *māmane* trees were found within the existing construction staging area boundaries, but the area surrounding the existing CSA was found to contain twenty-five. The locations of the sixteen closest *māmane* trees surrounding the CSA were mapped (Figure 10).

The groundcover at the CSA and surrounding area is composed of mixture of low growing introduced plants and grasses. Besides the *māmane* trees, no other native plants were observed, except possibly some scattered bunches of native grasses outside the CSA boundaries.

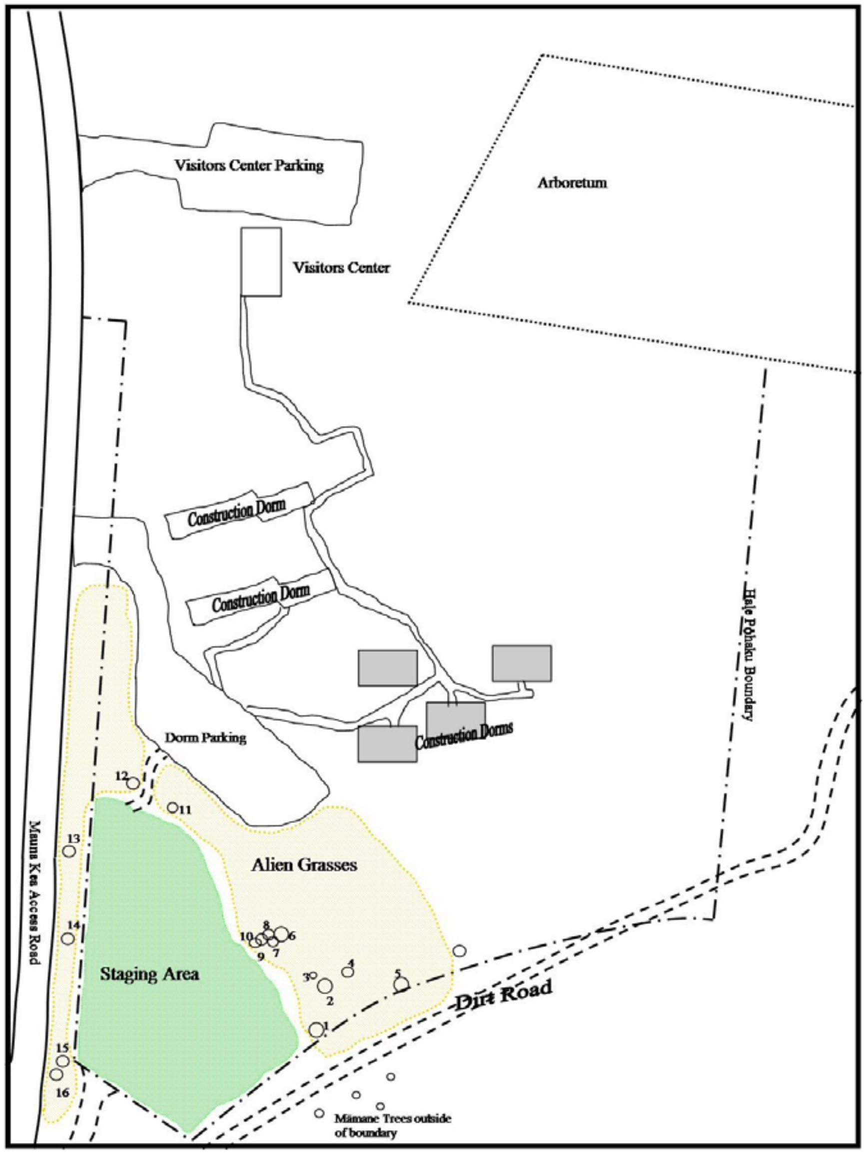


Figure 10. Map of Vegetation Surrounding Hale Pōhaku Construction Staging Area

The ground cover of the site and surrounding area consists of a mixture of grasses, dominated by needlegrass (*Nassella cernua*). The other plants that make up the ground cover include common groundsel (*Senecio vulgaris*), pin clover (*Erodium cicutarium*), woolly mullein (*Verbascum thapsus*), and evening primrose (*Oenothera stricta*).

The entire TMT Mid-Level Support Facility area was sampled during the 2009 sampling periods (see Figure 3). The area east of the existing dorms was found to have a moderate density of *māmane* trees with an understory of indigenous and nonindigenous grasses and shrubs. Indigenous plants include *māmane* trees (*Sophora chrysophylla*), *ʻaheahea* (*Chenopodium oahuense*), hinahina (*Geranium cuneatum*), *māʻohiʻohi* (*Stenogyne rugosa*), littleleaf stenogyne (*Stenogyne microphylla*), *ʻōāliʻi* (*Asplenium trichomanes* subsp. *densum*), Hawaiian bent grass

(*Agrostis sandwicensis*), pili grass (*Trisetum glomeratum*), and another grass (*Deschampsia australis*).

Analysis

The CSA is highly disturbed, mostly open ground with almost no vegetation. The few patches of plants consist of introduced weedy species. The vegetation surrounding the CSA is sparsely spaced *māmane* trees with grass and herbaceous groundcover. This surrounding vegetation may be susceptible to fire and care should be exercised to prevent such an occurrence.

Rabbitfoot clover (*Trifolium arvense*) is a low growing introduced weedy plant that occur at the CSA.

No *palila* were seen in *māmane* trees immediately adjacent to the CSA. The principal locality for *palila* is at *Pu'u La'au* and *palila* are rarely seen near Hale Pōhaku. Fire is a threat to the *māmane* forest and precautions should be taken to prevent it. It is unlikely *palila* would be significantly impacted by temporary use of the CSA if the recommendations contained in this report are followed.

The indigenous plants that grow within the TMT Mid-Level Support Facility boundary are common and all occur on other islands in Hawai'i. The proposed approximately 5 acre area studied represents a small fraction of the *māmane* subalpine forest habitat and Project use of the area would likely not substantially impact the vegetation surrounding the site.

Area Use Options

The area being considered for the TMT Mid-Level Support Facility (Figure 10) is located near the lowest reaches of the Hale Pōhaku boundary.

Primrose (*Oenothera stricta*) is one of the more abundant and showy, introduced weedy plants that occur at the CSA.

The area comprises three general areas; 1) the CSA described above; 2) the land around the Construction Dorms and Cabins; and 3) an area of open ground with scattered *māmane* trees above the existing dorms and east of the existing cabins. There are neither native Hawaiian species listed as threatened or endangered, nor any candidates for listing or are species of concern that were found within the entire 4.9 acres being considered. Nine native plant species occur within the area: *māmane* trees (*Sophora chrysophylla*), *'aheahea* (*Chenopodium oahuense*), hinahina (*Geranium cuneatum*), *mā'ohi'ohi* (*Stenogyne rugosa*), littleleaf stenogyne (*Stenogyne microphylla*), *'oali'i* (*Asplenium trichomanes* subsp. *densum*), Hawaiian bent grass (*Agrostis sandwicensis*), pili grass (*Trisetum glomeratum*), and another grass (*Deschampsia australis*). All of these species occur over a wide range and most on other islands in Hawai'i and none are considered rare or threatened.

To the east of the area is a forest reserve with native Hawaiian components, including those found within the area, and a fern (*Asplenium adiantum-nigrum*). The forest reserve is within the designated critical habitat for the federally listed endangered bird *palila* (*Loxioides bailleui*).

The only serious threats to the surrounding forest reserve that is posed by the use of this area for dormitory development and observatory construction activities are the potential for fire and the increased potential for introduction of non-indigenous plants and arthropods. Other impacts may also include wind-blown trash, construction debris and dust. All of these impacts can easily be mitigated or prevented by implementing sensible and well thought out management practices. Planning for development of the area should include considerations for protecting the surrounding forest reserve and *palila* critical habitat.

3.2.3 Summary

The results of this arthropod and botanical survey at the TMT Mid-Level Support Facility area indicate there are no special concerns or legal constraints related to invertebrate and botanical resources in the Project areas. No species listed as endangered, threatened, or that are currently proposed for listing under either federal or State of Hawaiʻi endangered species statutes were detected at the CSA or Area 1 (DLNR 1997, Federal Register 1999, 2005, 2006). The *māmane* forest that surrounds Hale Pōhaku is designated *palila* critical habitat. Care must be taken to reduce all threats to this habitat by use of the TMT Mid-Level Support Facility. By following the recommendations contained in this report those threats could be reduced. Three invertebrate formally designated Species of Concern occur within the TMT Mid-Level Support Facility boundary, the difficult yellow-faced bee (*Hylaeus difficillis*), the yellow-footed yellow-faced bee (*Hylaeus flavipes*), and the succineid snail (*Succinea konaensis*). The habitat for the two bees is extensive on Maunakea, and construction activity at the TMT Mid-Level Support Facility would likely not impact their populations. Little is known about the distribution of the succineid snail, other than that it is known to occur near *Puʻu Laʻau* on the western slopes of Maunakea. The impact of construction activities on this species is unknown.

4.0 RECOMMENDATIONS

4.1 Area E, Access Way, and Batch Plant Staging Area

Habitat Disturbance should be minimized - The rocks and cinder within Area E are home to lichens, mosses, and endemic arthropods, therefore disturbance should be minimized at the construction site and in the surrounding habitats.

Recommendation 1: Disturbance should be minimized. Construction activities should be limited to the footprint pad and road improvements, and no cinder or other materials should be side-cast into adjacent habitat.

Recommendation 2: Dust can impact lichens, mosses, and ferns and is believed to degrade Wēkiu bug habitat. Water should be applied to excavation sites and cinder stockpiles to minimize dust generation.

Recommendation 3: High winds can spread dust to surrounding habitat. It is recommended that dust-generating activities be suspended during high winds.

Recommendation 4: Soil-binding stabilizers such as DuraSoil are currently being used on unpaved roads within the MKSR. These compounds help reduce dust and road maintenance and their use is encouraged. However, soil-binding stabilizers should be used sparingly, and should never be applied to habitat adjacent to the roads or observatory use areas.

Recommendation 5: Oil spills and other contaminating events have occurred at observatories in the past. While these spills have always been contained immediately and have not resulted in serious ecological damage, care should be taken to avoid any spills. The Project staff and contractors should follow Federal guidelines specifying the use and disposal of oil, gasoline, dangerous chemicals, and other substances used during observatory construction and maintenance.

Recommendation 6: Contractors should minimize the amount of on-site paints, thinners, and solvents. Painting and construction equipment should not be cleaned on-site. Contractors should keep a log of hazardous materials brought on-site and report spills immediately to a designated Project representative and the proper authorities.

Recommendation 7: Construction trash containers should be tightly covered to prevent construction wastes from being dispersed by wind.

Recommendation 8: Construction materials stored at the site should be covered with tarps, or anchored in place, and not be susceptible to movement by wind.

Recommendation 9: If construction materials and trash are blown into habitat, they should be collected with a minimum of disturbance.

Recommendation 10: Option 3, developing the existing 4-wheel drive road as the Access Way, should be avoided because it disturbs, displaces, and isolates portions of Wēkiu bug habitat. It would likely require mitigation measures similar to those suggested for the Outrigger Telescopes project, such as habitat restoration in the unnamed puʻu. Option 2 crosses marginal Wēkiu bug habitat and would likely have no significant impact on Wēkiu bugs, but may entail some mitigation. The ideal option from a biological resources view is Option 1. It disturbs a minimal amount of only marginal habitat.

Introduction of non-indigenous arthropods and plants should be avoided – Non-indigenous arthropods can be a threat to native species that reside at or near the summit. Ants are especially threatening and their introduction should be strictly prevented. Introduced plants can change the microhabitat conditions if they become established, thereby facilitating the establishment of other non-indigenous species.

Recommendation 11: Earthmoving equipment should be free of large deposits of soil, dirt and vegetation debris that may harbor alien arthropods and weed seeds.

1. Pressure-wash and/or otherwise remove alien arthropods and weed seeds from equipment and materials before moving them from lower elevations and up the Maunakea Access Road. This cleaning should be done in baseyards in Hilo or Waimea before continuing up Saddle Road.
2. Inspect large trucks, tractors, and other heavy equipment before proceeding up Maunakea Access Road from Hale Pōhaku. Clean and wash as necessary prior to proceeding up to the summit area.

Recommendation 12: All construction materials, crates, shipping containers, packaging material, and observatory equipment should be free of alien arthropods when delivered to the summit.

1. Inspect shipping crates, containers, and packing materials before shipment to Hawaiʻi
2. Inspect construction materials before transport to the summit area

Recommendation 13: Outdoor trash receptacles should be provided for ready disposal of lunch bags and wrappers. These receptacles should be secured to the ground, have attached lids and plastic liners, and be collected frequently to reduce food availability for alien predators.

Recommendation 14: The construction site and staging areas should be monitored to detect new introductions of non-indigenous arthropod and plant species. New alien arthropod and plant introductions detected during monitoring should be eradicated immediately.

1. Ant eradication
2. Yellowjacket eradication
3. Alien spider eradication
4. Weed eradication

4.2 Construction Staging Area, Hale Pōhaku

Habitat Disturbance should be minimized – While the Construction Staging Area and the immediate surrounding area within Hale Pōhaku are highly disturbed, a native ecosystem exists nearby. Care should be taken to avoid disturbance of that ecosystem.

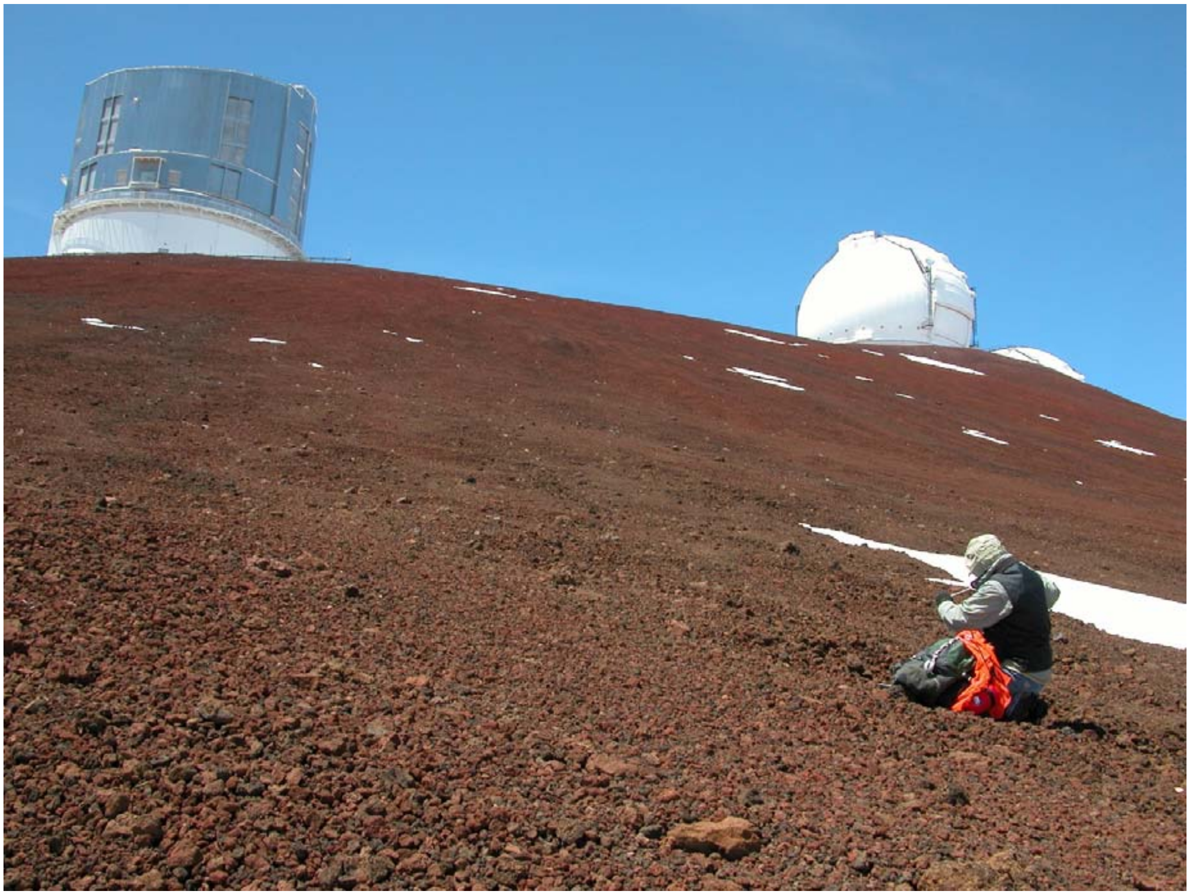
Recommendation 1: In previous botanical surveys conducted at this site it was recommended that efforts be directed to managing the natural resources on and around the site. The recommendations included plantings of native species and removing introduced species, such as mullein and the newly arrived Madagascar ragwort. These recommendations are still valid today.

Recommendation 2: Because of increased tourist traffic and resident recreational use of the surrounding area, it is possible that more non-indigenous species will be introduced. Construction vehicles and containers for the Project should be cleaned and inspected for alien species before proceeding up the Maunakea Access Road. These inspections are likely to intercept other alien species that may cause harm to the surrounding critical habitat at Hale Pōhaku.

Recommendation 3: Other habitat protection measures mentioned for Area E are also applicable at Hale Pōhaku. For example, control of trash, dust, and material is important to minimize disturbance to adjacent habitat. And, it is good practice to limit the amount of hazardous materials to decrease the potential for spills.

Recommendation 4: Another important habitat protection measure especially applicable at Hale Pōhaku is prevention of fire. The *māmane* forest surrounding the construction staging area is dry and susceptible to fire, and once started, a fire may be difficult to control. It is best to take precautions to prevent fire, such as advising personnel of the susceptibility of habitat to fire, limiting smoking to designated areas away from dry grass, and limiting the amount of activity that would cause sparks or fire that may spread to adjacent habitat. It is advisable to have fire extinguishers on hand and the construction staging area personnel should be trained in their use. These are practical measures that are usually applied at construction sites, but are especially important in natural areas where fire may have an impact on endangered species and their habitats.

Recommendation 5: The succineid snail (*Succinea konaensis*) occurs under fallen, dead trees. If dead trees are to be moved at the TMT Mid-Level Support Facility area, they should be placed outside the disturbance area. It may be preferred to have a qualified biologist present to search for and remove individual snails and relocate them with the dead trees.



Jesse Eiben checking Wēkiu bug traps on the unnamed pu‘u in April 2009.

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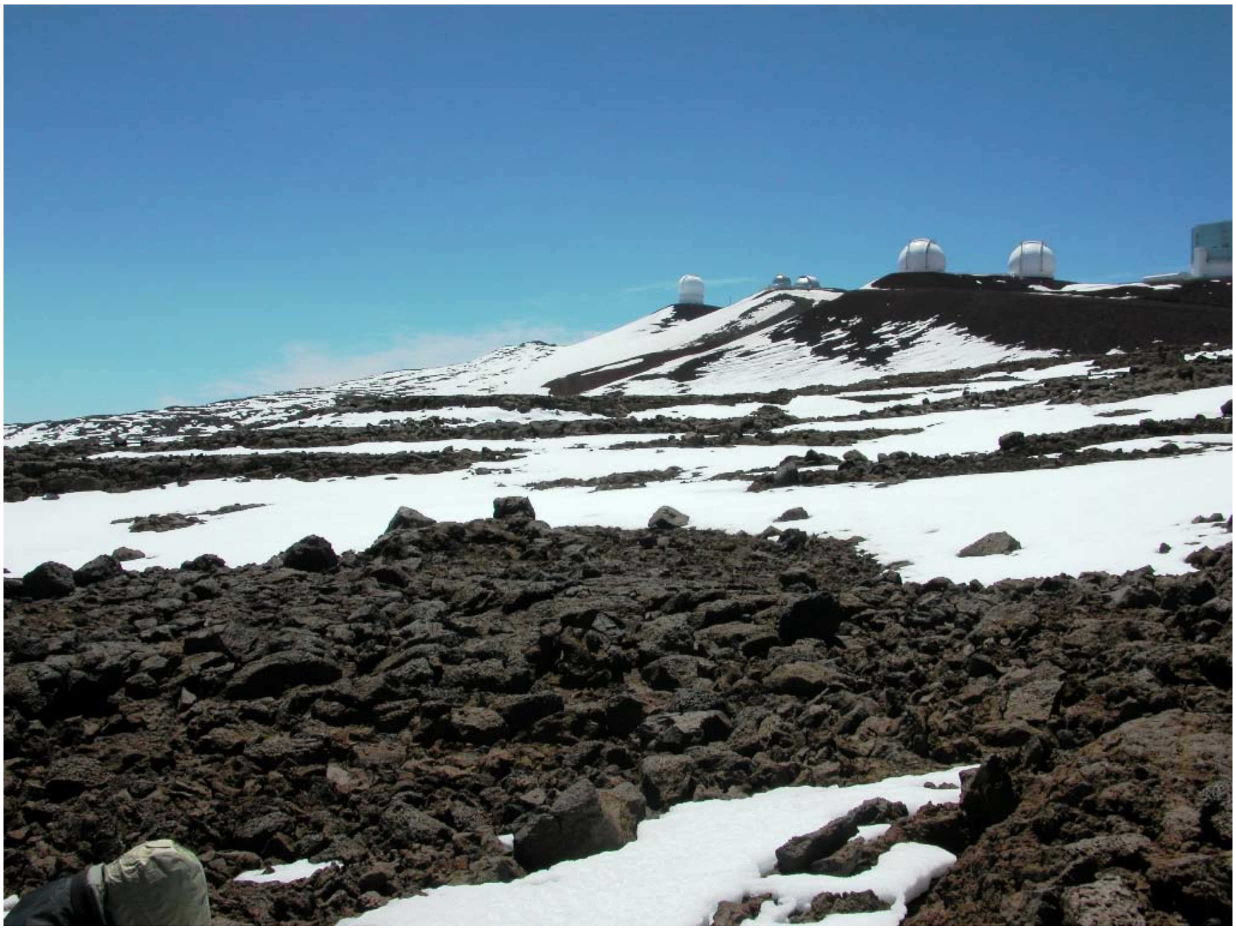

Looking towards the summit observatories from Area E in April 2009.

APPENDIX A

Results of the Thirty Meter Telescope Proposed Site Evaluation for the
Wekiu Bug (*Nysius wekiuicola*): Fall 2008.

Technical Report prepared by Jesse Eiben, M.S.

Results of the Thirty Meter Telescope Proposed Site Evaluation for the Wekiu Bug (*Nysius wekiuicola*): Fall 2008

Prepared for:
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Summary
A four day sampling regime with the use of 45 baited attractant live traps designed for monitoring the presence and absence of the Wekiu bug (*Nysius wekiuicola* Ashlock and Gagné) was used to create part of the biological assessment of a proposed site for the Thirty Meter Telescope on Maunakea, Hawaiʻi. Three Wekiu bugs were captured and counted before being released at the end of the sampling period on September 28, 2008. No Wekiu bugs were found in the area purported to be directly physically impacted by any possible observatory construction activity. The fall season is not the best time to look for the presence or absence of the Wekiu bug anywhere in its range, so there can be only limited conclusions drawn from this sampling period. However, there is broad accord among scientists that the type of rock substrate in the Northern Plateau is not known to regularly harbor large numbers of Wekiu bugs.

Introduction
As part of a project by Pacific Analytics, LLC for the Thirty Meter Telescope Project, I have been contracted to sample for the Wekiu bug in areas selected as possible sites for Project construction on the Northern Plateau of Maunakea. This project is different from, yet is informed by, scientific research I am conducting for my PhD in entomology at the University of Hawaiʻi at Manoa involving the life history and population genetics of the Wekiu bug.

The Wekiu bug, *Nysius wekiuicola* Ashlock and Gagné, on the Island of Hawaiʻi has been the focus of much attention in its native range on and near the summit of Hawaiʻi's tallest mountain, Maunakea. Since the bug's formal description in 1983 by Ashlock and Gagné, the bug's habitat and life history has been of great interest to scientists, conservationists, and the public as a whole. The specialized life history allowing the Wekiu bug to survive the extremes of temperature, solar radiation, and water and food availability make this insect a true marvel of adaptation. Due to its limited range, specialized habitat requirements, isolated populations, and habitat destruction, the Wekiu bug was is currently a candidate for listing priority 8 under the Endangered Species Act (Endangered, 2006). Explorations of the summit area over the past 10 years by entomologists representing the Bishop Museum, Pacific Analytics, LLC, and the University of Hawaiʻi at Manoa have greatly enhanced our knowledge of the types of areas Wekiu bugs inhabit, their behaviors and life history (Pacific Analytics, 2006, Englund et al. 2007, Eiben, unpublished).

The objectives for this study are to provide presence and absence data of the Wekiu bug in a subset of its range on and near the summit of Maunakea as part of the biological assessment of a potential site for a new observatory in the Astronomy Precinct being prepared by Pacific Analytics, LLC.

Materials and Methods

Study Area:

The area of Maunakea being sampled for Wekiu bugs is known as Area E on the Northern Plateau of the mountain. In practical terms, the area encompasses a part of the west and northwest zone of the Astronomy Precinct on the summit of Maunakea. Specific locations for wekiu bug live-trap placements were haphazardly selected in Area E, along the 4-wheel drive road to Area E, around the Batch Plant, and in two control locations not in the expected construction disturbance areas where Wekiu bugs have been found multiple times in 2007 and 2008 (Eiben, unpublished).

Trapping Methods:

A live pitfall trap design very similar to those described by Englund et al. (2002) and Pacific Analytics (2002) was used to attract Wekiu bugs. The modifications in design are as follows. Two 10oz clear plastic cups were used for each trap. The upper cup was punctured with one small hole in the bottom center through which a small absorbent wick made of tissue (Kimtech Science) was pushed. A small amount of water was poured into the bottom of the lower reservoir cup. The attractant shrimp paste was placed in the upper cup contacting the wick, on a few small pieces of rock in the cup, smeared on the side of the cup, and on a cap rock. The traps were dug into the available ground substrate attempting to achieve a depth where moisture was present in the ash layer. The lip of the cup was not necessarily placed flush with ash layer, and there was no wire mesh surround to provide structure surrounding the cups. This cup design has been successful for attracting and capturing Wekiu bugs during 2007 and 2008 (Eiben, unpublished). Most sites selected for sampling used a pair of traps within 16.4 feet of each other in different microhabitat types (ex. large rock jumble vs. ash layer near the surface) to attempt to sample the true diversity of the habitat (see Tables 1 and 2). The traps were checked daily and bugs captured were removed for the duration of the sampling period to prevent recounts. Bugs were held for up to three days in captivity with food and water sources.

Results

No Wekiu bugs were observed while hiking through the trapping areas, nor were any Wekiu bugs observed while emplacing the traps. Forty-five traps were placed for three or four days from September 25-28. Three Wekiu bugs were captured in two locations over the sampling period (see Table 1, Table 2, and Figure 1). One adult female and one 5th instar nymph Wekiu bug were captured in the control area near the SE base of Puu Hau Oki on September 26, 2008. One 5th instar nymph Wekiu bug was found in the control area on the E base area of Puu Poliahu on September 28, 2008. All three Wekiu bugs found in the traps were alive and were released alive in good condition where they were captured on September 28, 2008.

Discussion

Though the sampling effort (number of traps) for Wekiu bugs during this sampling period was quite intense given the area surveyed, there can be little information drawn from the lack of bugs found in Area E. During the fall season, the number of Wekiu bugs found on Maunakea throughout its range are much less than during other times of the year. The reason for this is unknown. Wekiu bugs are found in much higher numbers during the late spring and early summer, and these areas are correlated to lasting snow pack (Englund et al. 2007). The duration and availability of moisture sources may indeed be a limiting factor for the year-round distribution of the Wekiu bug within its range. The spring sampling period of Area E should be much more informative for determining the presence or absence of the Wekiu bug in the possible construction zone for the Project.

Acknowledgements

I would like to thank Greg Brenner of Pacific Analytics, LLC for his help in the field and valuable insights about the Wekiu bug and its habitat. Betsy Gagné at DLNR has proven

instrumental in obtaining permits for all work relating to the genus Nysius in Hawai‘i. The support of Stephanie Nagata at OMKM is crucial to all work involving the Wekiu bug and is always most helpful.

Table 1. Detail of baited shrimp trap locations and wekiu bug captures during September, 2008

Site Description	Trap Name	Paired traps	GPS Coordinates (NAD83)		Wekiu Bug Captures			
					25-Sep-08	26-Sep-08	27-Sep-08	28-Sep-08
Site 1 footprint	TMT1A	Yes	19°49'57.22"N	155°28'52.93"W	Install	0	0	0
Site 1 footprint	TMT1B	Yes			Install	0	0	0
Site 1 footprint	TMT2A	Yes	19°49'57.90"N	155°28'53.69"W	Install	0	0	0
Site 1 footprint	TMT2B	Yes			Install	0	0	0
Site 1 footprint	TMT3A	Yes	19°49'56.35"N	155°28'53.65"W	Install	0	0	0
Site 1 footprint	TMT3B	Yes			Install	0	0	0
Site 1 footprint	TMT4A	Yes	19°49'55.42"N	155°28'53.08"W	Install	0	0	0
Site 1 footprint	TMT4B	Yes			Install	0	0	0
Site 1 footprint	TMT5A	Yes	19°49'53.80"N	155°28'52.97"W	Install	0	0	0
Site 1 footprint	TMT5B	Yes			Install	0	0	0
Road	TMT6A	Yes	19°49'52.46"N	155°28'53.04"W	Install	0	0	0
Road	TMT6B	Yes			Install	0	0	0
Road	TMT7A	Yes	19°49'51.67"N	155°28'50.74"W	Install	0	0	0
Road	TMT7B	Yes			Install	0	0	0
Site area	TMT8A	Yes	19°49'52.10"N	155°28'49.69"W	Install	0	0	0
Site area	TMT8B	Yes			Install	0	0	0
Site area	TMT9A	Yes	19°49'52.68"N	155°28'48.22"W	Install	0	0	0
Site area	TMT9B	Yes			Install	0	0	0
Site 2 footprint	TMT10A	Yes	19°49'41.02"N	155°28'46.45"W	Install	0	0	0
Site 2 footprint	TMT10B	Yes			Install	0	0	0
Site 2 footprint	TMT11A	Yes	19°49'41.84"N	155°28'45.01"W	Install	0	0	0
Site 2 footprint	TMT11B	Yes			Install	0	0	0
Site 2 footprint	TMT12A	Yes	19°49'43.10"N	155°28'44.08"W	Install	0	0	0
Site 2 footprint	TMT12B	Yes			Install	0	0	0

Table 2. Detail of baited shrimp trap locations and wekiu bug captures during September, 2008

Site Description	Trap Name	Paired traps	GPS Coordinates (NAD83)	Wekiu Bug Captures 25-Sep-08	26-Sep-08	27-Sep-08	28-Sep-08
Site 2 footprint	TMT13A	Yes	19°49'43.61"N 155°28'45.84"W	Install	0	0	0
Site 2 footprint	TMT13B	Yes		Install	0	0	0
Site 2 footprint	TMT14A	Yes	19°49'46.49"N 155°28'47.39"W	Install	0	0	0
Site 2 footprint	TMT14B	Yes		Install	0	0	0
Site Area	TMT15A	Yes	19°49'43.79"N 155°28'51.78"W	Install	0	0	0
Site Area	TMT15B	Yes		Install	0	0	0
Site Area	TMT16A	Yes	19°49'45.55"N 155°28'53.47"W	Install	0	0	0
Site Area	TMT16B	Yes		Install	0	0	0
Road	TMT road1	No	19°49'28.63"N 155°28'40.01"W	N/A	Install	0	0
Road	TMT road2	No	19°49'32.48"N 155°28'41.26"W	N/A	Install	0	0
Road	TMT road3	No	19°49'38.27"N 155°28'44.31"W	N/A	Install	0	0
Road	TMT road4	No	19°49'43.75"N 155°28'48.79"W	N/A	Install	0	0
Batch plant	TMTbatch1A	Yes	19°49'12.65"N 155°28'27.44"W	N/A	Install	0	0
Batch plant	TMT batch1B	Yes		N/A	Install	0	0
Batch plant	TMT batch2A	Yes	19°49'12.72"N 155°28'29.82"W	N/A	Install	0	0
Batch plant	TMT batch2B	Yes		N/A	Install	0	0
Batch plant	TMT batch3	No	19°49'11.04"N 155°28'30.52"W	N/A	Install	0	0
Non-construction	TMT Pol contA	Yes	19°49'26.54"N 155°28'48.36"W	N/A	Install	0	1*
Non-construction	TMT Pol contB	Yes		N/A	Install	0	0
Non-construction	TMT Oki contA	Yes	19°49'25.72"N 155°28'31.66"W	Install	2**	0	0
Non-construction	TMT Oki contB	Yes		Install	0	0	0

*one fifth instar nymph captured
**one adult female and one fifth instar nymph captured

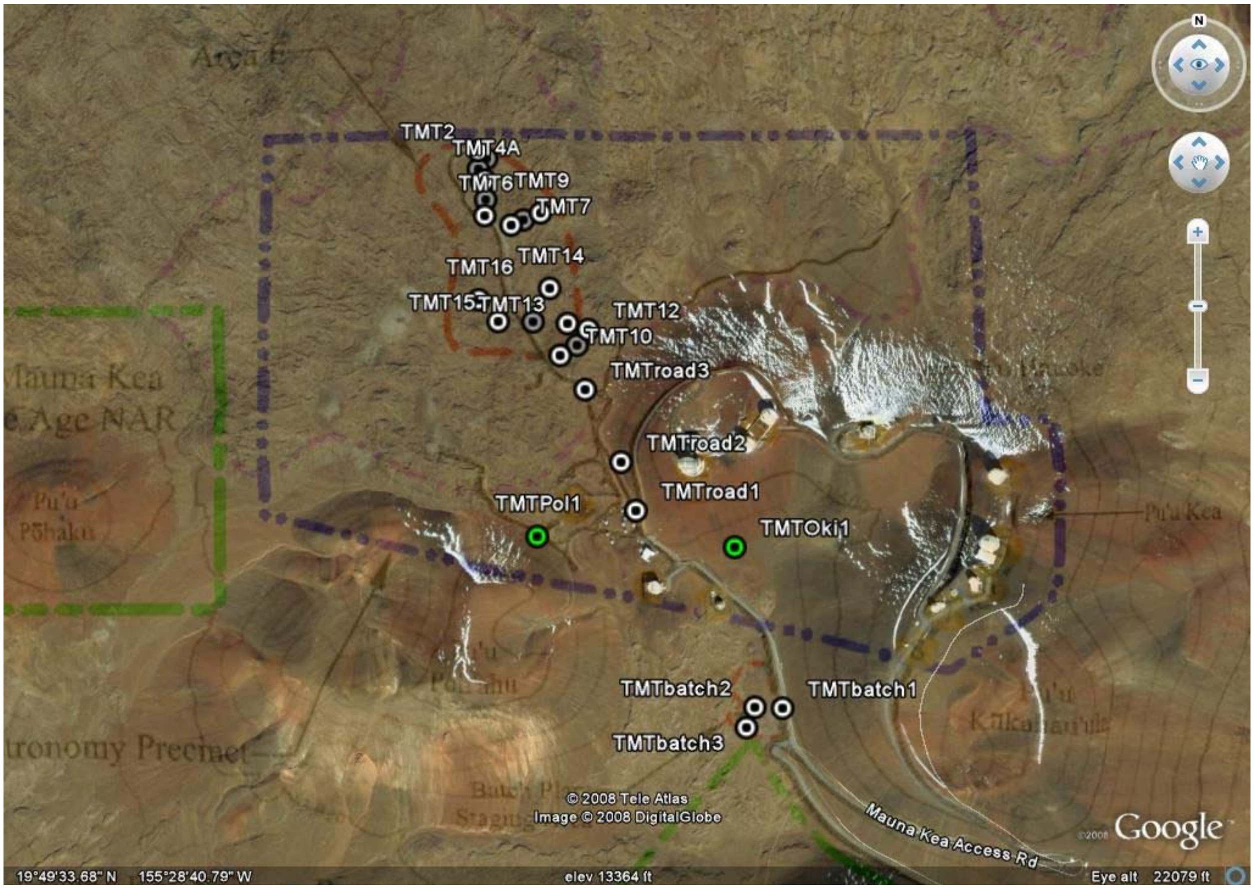

Figure 1. Overview map of study site sample locations within the Astronomy Precinct on Maunakea, Hawaiʻi

*Astronomy Precinct outlined in purple

**Green dots indicate Wekiu bug capture locations

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APPENDIX B

Results of the Thirty Meter Telescope Proposed Site Evaluation for the
Wekiu Bug (*Nysius wekiuicola*): Spring 2009.

Technical Report prepared by Jesse Eiben, M.S.

Results of the Thirty Meter Telescope Proposed Site Evaluation for the Wekiu Bug (*Nysius wekiuicola*): Spring 2009

Prepared for:
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Summary
A four day sampling regime with the use of 24 baited attractant live traps designed for monitoring the presence and absence of the Wekiu bug (*Nysius wekiuicola* Ashlock and Gagné) was used to create part of the biological assessment of a proposed site for the Thirty Meter Telescope on Maunakea, Hawai‘i. A total of 146 wekiu bugs were observed and/or captured between April 20 and 23, 2009. In the past, Wekiu bugs have often been captured in greater numbers during late March, April and May than during the summer and fall (Eiben pers. obs.). This cycle of Wekiu bug activity was confirmed during the two sampling periods for the proposed TMT site. Wekiu bugs were found in areas impacted previously by construction and in areas that are considered unaltered habitat. No Wekiu bugs were found in the area of the proposed construction footprint of the Project construction, however there were many Wekiu bugs found along the currently closed unpaved 4-wheel drive road north of the SMA array. This road may be impacted by Project construction, and Wekiu bug habitat and populations will need to be taken into consideration in the event of the road reopening. There is still broad accord among scientists that the type of rock substrate in the Northern Plateau is not known to regularly harbor large numbers of Wekiu bugs, and this was confirmed during the spring 2009 sampling session.

Introduction
As part of a project by Pacific Analytics, LLC for the Thirty Meter Telescope, I have been contracted to sample for the Wekiu bug in areas selected as possible sites for observatory facility construction on the Northern Plateau of Maunakea. This project is different from, yet is informed by, scientific research I am conducting for my PhD in entomology at the University of Hawai‘i at Manoa involving the life history and population genetics of the Wekiu bug.

The Wekiu bug, *Nysius wekiuicola* Ashlock and Gagné, on the Island of Hawai‘i has been the focus of much attention in its native range on and near the summit of Hawai‘i’s tallest mountain, Maunakea. Since the bug’s formal description in 1983 by Ashlock and Gagné, the bug’s habitat and life history has been of great interest to scientists, conservationists, and the public as a whole. The specialized life history allowing the Wekiu bug to survive the extremes of temperature, solar radiation, and water and food availability make this insect a true marvel of adaptation. Due to its limited range, specialized habitat requirements, isolated populations, and habitat destruction, the Wekiu bug is currently a candidate for listing priority 8 under the Endangered Species Act (Endangered, 2006). Explorations of the summit area over the past 10 years by entomologists representing the Bishop Museum, Pacific Analytics, LLC, and the University of Hawai‘i at Manoa have greatly enhanced our knowledge of the types of areas Wekiu bugs inhabit, their behaviors and life history (Pacific Analytics, 2006, Englund et al. 2007, Eiben, unpub.).

The objectives for this study are to provide presence and absence data of the Wekiu bug in a subset of its range on and near the summit of Maunakea as part of the biological assessment of a potential site for a new observatory in the Astronomy Precinct being prepared by Pacific Analytics, LLC.

Materials and Methods

Study Area:

The area of Maunakea being sampled for Wekiu bugs is known as Area E on the Northern Plateau of the mountain. In practical terms, the area encompasses a part of the west and northwest zone of the Astronomy Precinct on the summit of Maunakea. Specific locations for Wekiu bug live-trap placements were haphazardly selected in Area E in the proposed footprint sites of the TMT Project, along the 4-wheel drive road to Area E, around the Batch Plant, and in two control locations not in the expected construction disturbance areas where Wekiu bugs have been found multiple times in 2007 and 2008 (Eiben, unpublished).

Trapping Methods:

A live pitfall trap design very similar to those described by Englund et al. (2002) and Pacific Analytics (2002) was used to attract Wekiu bugs. The modifications in design are as follows. Two 10oz clear plastic cups were used for each trap. The upper cup was punctured with one small hole in the bottom center through which a small absorbent wick made of tissue (Kimtech Science) was pushed. A small amount of water was poured into the bottom of the lower reservoir cup. The attractant shrimp paste was placed in the upper cup contacting the wick, on a few small pieces of rock in the cup, smeared on the side of the cup, and on a cap rock. The traps were dug into the available ground substrate attempting to achieve a depth where moisture was present in the ash layer. The lip of the cup was not necessarily placed flush with ash layer, and there was no wire mesh surround to provide structure surrounding the cups. This cup design has been successful for attracting and capturing Wekiu bugs during 2007 and 2008 (Eiben, unpublished). Most sites selected for sampling used a pair of traps within 5 meters of each other in different microhabitat types (ex. large rock jumble vs. ash layer near the surface) to attempt to sample the true diversity of the habitat (see Table 1). The traps were checked daily and bugs captured were removed for the duration of the sampling period to prevent recounts. Bugs were held for up to three days in captivity with food and water sources.

Results

A total of 146 Wekiu bugs were observed in the baited traps and in the immediate vicinity of the traps. Twenty four traps were placed for three full days starting on April 20 and removed on April 23. No Wekiu bugs were captured or observed in the area known as Area E on the Northern Plateau (12 traps), nor near the Batch Plant area (2 traps), 41 Wekiu bugs were found in 6 traps along the dirt road that is currently closed adjacent to the SMA array, and 105 Wekiu bugs were captured in four traps in two control locations not in areas with any planned direct impacts by construction activities of the Project (see Table 1, and Figure 1). Five nymph, 102 adult male, and 39 adult female Wekiu bugs were captured in total. Twenty seven live Wekiu bugs captured in the two "Poi Bowl, Pu'u Hau 'Oki" control trap sites were collected and moved to the University of Hawaiʻi lab colony by myself, Jesse Eiben, as per my permit allowances for the life history study of the Wekiu bug. There was an 85 percent survivorship rate of Wekiu bugs trapped in this sampling period with eighteen Wekiu bugs found dead in the traps, and four Wekiu bugs dying in captivity.

Discussion

The sampling effort during the spring sampling session was less intense (24 traps vs. 45 traps) than the fall sampling period because the spring is typically the active season for adult Wekiu bugs. As expected, we observed much higher trapping rates than in the fall of 2008 when Wekiu bugs are scarce and/or not attracted to traps. The weather at the summit during the sampling period of April 20-23, 2009 was quite cold and windy with the daytime high air temperature hovering only slightly above freezing at 34-41ºF and wind gusts up to 94 mph with ~45mph constant wind speeds. The lower trap catches on April 22 could be correlated to the overcast sky the previous day. Wekiu bugs were less likely to be active during the time between the traps were checked because they were simply too cold to be attracted and move in high numbers toward the baited traps on April 21st. Important to note is the complete lack of any recent wind deposited insect food sources for the Wekiu bugs. Virtually no by-catch of other insects was found in the traps, and the snow-covered areas of the mountain observed were bereft of insects.

Wekiu bugs were captured in places characterized as having large areas with an assemblage of different sized rock cinder scoria in a depth of approximately 2-10 inches before the ash layer was reached. This mixed rock tephra is found on the slopes of cinder cones. The areas where Wekiu bugs are found show a constant state of flux, with the scoria slowly moving down slope by the force of gravity and undergoing frost-heaves that continually 'sift' dust and ash down in depth thereby creating a natural and very slow sorting of rock scoria with larger rocks nearer the surface and smaller cinders being closer to the ash layer. This habitat type is apparently highly suitable for supporting populations of Wekiu bugs. There are many interconnected reasons why Wekiu bugs are associated with specific type of habitat. Wekiu bugs can use this depth of different sized cinder to thermoregulate by moving through the innumerable crevices that the assortment of rocks create. These crevices also provide paths for escape from predators (most likely the endemic lycosid spider). Temperature and humidity data show the incredible variation found in these few inches of rock, with humidity and temperature being oppositely correlated. Near the ash layer, the temperature is cool with high humidity, and at the surface where Wekiu bugs can bask in the sun, the temperature can be very high (up to 114º F) with extremely low humidity (10 percent) (Eiben unpublished). These microhabitats are necessary for the Wekiu bug physiologically, but can also create areas that hold and preserve prey items on which Wekiu bugs feed. As insects drop from the wind column and sift through the scoria, they can become protected from the intense desiccating conditions found at the surface. Of the traps that attracted Wekiu bugs, some traps were placed in areas with very little depth of this type of cinder tephra, however, since the effective range of these traps is unknown, the bugs could be attracted from adjacent deep cinder zones.

It has previously been shown that Wekiu bugs are found in much higher numbers during the late spring and early summer, and these areas are correlated to lasting snow pack (Englund et al. 2007). During this trapping session and others (Eiben, unpublished), it is apparent that Wekiu bugs are often found in areas that have no current adjacent snow pack (along the dirt road north of SMA, and at the lower trap sites on Pu'u Poliahu and Pu'u Hau 'Oki). The duration and availability of moisture sources may indeed be a limiting factor for the year-round distribution of the Wekiu bug within its range. When discussing insect populations and habitats, it essential to be cognizant that the individual organism does not seek out and use habitat on a very large scale. Population growth in an area will be at the whim of the food and climate (microclimate) available. This is especially true on Maunakea, where weather events can drastically change the time and duration of activity possible and availability of fresh prey items for Wekiu bugs.

Acknowledgements
I would like to thank Greg Brenner of Pacific Analytics, LLC for his help in the field and valuable insights about the Wekiu bug and its habitat. Betsy Gagné at DLNR has proven instrumental in obtaining permits for all work relating to the genus Nysius in Hawai‘i. The support of Stephanie Nagata at OMKM is crucial to all work involving the Wekiu bug and is always most helpful.

Table 1. Detail of baited shrimp trap locations and wekiu bug captures during April, 2009

Site Description	Trap Name	Paired traps	GPS Coordinates (NAD83)	Wekiu Bug Captures				
				20-Apr-09	21-Apr-09	22-Apr-09	23-Apr-09	TOTALS
SMA Access Road	STMTR1-A	No	N19 49.482 W155 28.648	Install	9	0	3	= 12
SMA Access Road	STMTR1-B	No	N19 49.481 W155 28.653	Install	3	0	7	= 10
SMA Access Road	STMTR2-A	No	N19 49.505 W155 28.659	Install	2	0	5	= 7
SMA Access Road	STMTR2-B	No	N19 49.503 W155 28.656	Install	1	1	2	= 4
SMA Access Road	STMTR3-A	No	N19 49.549 W155 28.679	Install	1	0	6	= 7
SMA Access Road	STMTR3-B	No	N19 49.549 W155 28.686	Install	0	0	1	= 1
Site 1 Footprint	STMTF1-A	Yes	N19 49.968 W155 28.880	Install	0	0	0	0
Site 1 Footprint	STMTF1-A			Install	0	0	0	0
Site 1 Footprint	STMTF1-B	Yes	N19 49.975 W155 28.895	Install	0	0	0	0
Site 1 Footprint	STMTF1-B			Install	0	0	0	0
Site 1 Footprint	STMTF1-C	Yes	N19 49.932 W155 28.898	Install	0	0	0	0
Site 1 Footprint	STMTF1-C			Install	0	0	0	0
Site 2 Footprint	STMTF2-A	Yes	N19 49.903 W155 28.887	Install	0	0	0	0
Site 2 Footprint	STMTF2-A			Install	0	0	0	0
Site 2 Footprint	STMTF2-B	Yes	N19 49.908 W155 28.853	Install	0	0	0	0
Site 2 Footprint	STMTF2-B			Install	0	0	0	0
Site 2 Footprint	STMTF2-C	Yes	N19 49.885 W155 28.849	Install	0	0	0	0
Site 2 Footprint	STMTF2-C			Install	0	0	0	0
Batch Plant	STMTbatch	Yes	N19 49.175 W155 28.492	Install	0	0	0	0
Batch Plant	STMTbatch			Install	0	0	0	0
Non-Construction	STMTPol-A	Yes	N19 49.448 W155 28.802	Install - 1	14	6	21	= 42
Non-Construction	STMTPol-B			Install	2	0	1	= 3
Non-Construction	STMTPoi-A	Yes	N19 49.429 W155 28.517	Install	6	13	16	= 35
Non-Construction	STMTPoi-B			Install	3	5	17	= 25

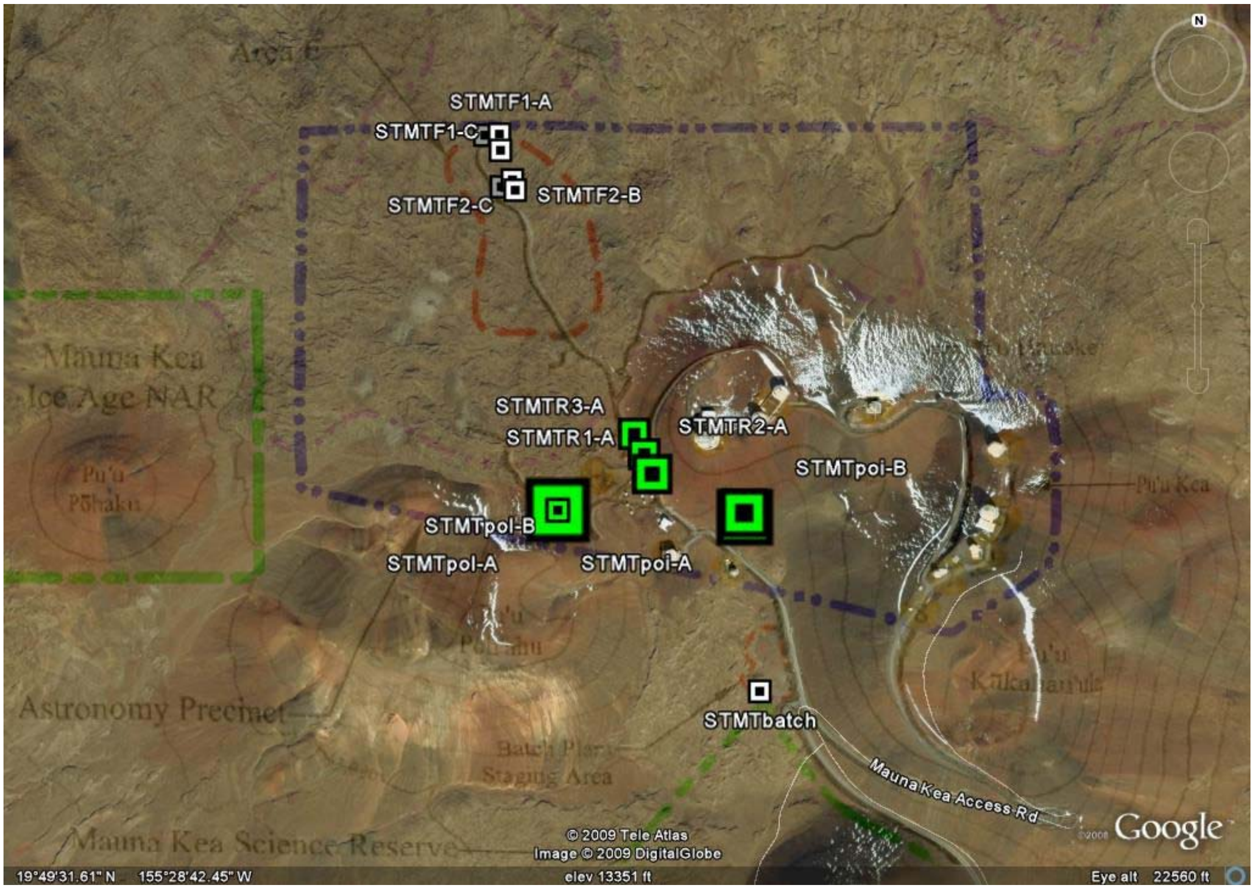

Figure 1. Overview map of study site sample locations within the Astronomy Precinct on Maunakea, Hawaiʻi

*Astronomy Precinct outlined in purple
**Green squares indicate Wekiu bug capture locations, size correlated to trap captures

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APPENDIX C

MAUNAKEA REPORT
The lichens and bryophytes in the proposed Thirty Meter Telescope sites at the summit of Maunakea, Hawai‘i

Technical Report prepared by Clifford Smith, Emeritus Professor in Botany, University of Hawai‘i at Manoa.

MAUNAKEA REPORT
The lichens and bryophytes in the proposed Thirty Meter Telescope sites at the summit of Maunakea, Hawai‘i.

Clifford W. Smith, Emeritus Professor in Botany, University of Hawai‘i at Manoa, 3190 Maile Way #410, Honolulu HI 96822. (Email: cliff@hawaii.edu).

INTRODUCTION

The summit area of Maunakea is barren land of massive cinder cones above andesite lava flows that erupted during the last period of glaciation; the lava flows erupting below the glacier cooled without crystallizing creating a particularly dense rock (Anon xxxx). The average daytime maximum air temperature is 50.1ºF and the low 24.8ºF; it freezes almost every night of the year (NOAA 2008). Such fluctuations are often referred to as ‘summer every day, winter every night.’ The average annual rainfall is 74 inches/year principally from November through April with little rain during June and July. Snow accumulates during the winter months sufficient for skiing but accumulation records have not been kept. UV radiation is intense; records from the Mauna Loa Observatory at 11,135 foot elevation are much higher than at sea level and will be higher still on the summit area of Maunakea (Bodhaine et al. 1997). Winds at the summit can reach 100 mph sufficient to abrade vegetation from rock surfaces (Anon xxxx).

In a general botanical survey of the summit area above 12,992 feet, Smith et al. (1982) recorded one species of algae, no hornworts or liverworts, possibly 12 species of moss, possibly 25 species of lichen, one fern and five flowering plants. All species occurred in very low abundance though there were very small, highly protected pockets where the lichens and mosses were common.

This survey was confined to a much smaller 40-acre area of the North Plateau.

STUDY SITE

The study site was the area being considered for the Thirty Meter Telescope just below the summit of Maunakea, Island of Hawai‘i. The area surveyed is called Area E, a 34-acre zone near the 13N Site located on the North Plateau of the Mauna Kea Science Reserve (MKSR).

METHODOLOGY

We spent two days in the area walking through the whole site recording all lichens and bryophytes observed. We search all four principal habitat types and spent some extra time investigating the small caves taking particular care not to disturb anything that looked of archaeological significance. We replaced all rocks that were picked up for examination as precisely as possible. We did disturb some of the rocks on the ground as we slide into the caves. We walked as much as possible on the large rocks and flows to prevent disturbance as well as for safety reasons.

The undersurface of 25 rocks of varying size were examined for lichens in rubble habitats. Counts were made of lichens present on the undersurface of rocks in the rubble areas to quantify abundance in these areas.

We removed small samples of all species found. Voucher specimens will be deposited in the B. P. Bishop Museum in Honolulu, Hawai‘i. Larger specimens were collected of species of whose identity we were uncertain so they could be sent to other lichen experts for confirmation of their identity.

HABITAT DESCRIPTION

Substrate types

- Pahoehoe.- About 50% of the habitat was of this type. The general topography was essentially flat and smooth with many folds. The edges of the folds were steep and rounded. There were several areas where the flow had shattered, fallen away creating small cliff-like faces. In several areas particularly at the head of small draws that typically radiated away from the mountain top in a northerly direction, small caves were found which ranged from about one foot to almost six feet deep.
- Aa.- No aa was found in the study area.
- Ash.- Small areas of ash was found in about 10% of the area.
- Rubble of shattered stones - This environment constituted about 40% of the habitat. Because lichens can grow on the undersurface of rocks we counted the number of rocks on their undersurface. We selected three different situations; stones with somewhat embedded in ash, stones where ash subsurface stones rested on ash, stones where there was no evident between or below the stones. Twenty five stones were overturned and examined for lichens and then replaced in their original position, Stones of various sizes were examined. Lichens were found only in the group where ash was not evident. In all but one instance the only lichen found was *Lecanora polytropa* and none of the thalli were fertile.

Rock surface

There are two apparent rock types in the study area a dense bluish coloured rock that breaks with a smooth surface with very few cracks or bubble cavities and a brown rock with a rougher surface and numerous bubble cavities. Both are andesite rock formed under the ancient summit glacier. The rocks are acidic and low in calcium.

Topography

The overall topography is approximately 10º slope with a sharp decline to a lower plateau on the eastern side. The slope increases at the northern edge of the study.

- Site 1 has less andesite rock, at least there is less exposed smooth, blue rock, there are also several small 'draws' leading down the mountain. They do not appear to be drainage channels. They are important habitat because it is at the head of these draws that one finds good lichen habitat on the rock face and in the small caves underneath.
- Site 2 has large areas of andesite rock with many clean faces of the smooth, blue andesite rock. The draws are much wider here and do not support as good lichen communities.

Temperature

The average monthly temperatures at the summit range from -5 to 13ºC (NOAA 2008).

Average Maximum Temperature (1971-2000).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Av.
(ºF)	42.0	42.5	40.3	41.4	47.5	49.3	50.9	49.9	50.5	48.3	45.1	42.7	46.0
(ºC)	5.6	5.8	4.6	5.2	8.6	9.6	10.5	9.9	10.3	9.1	7.3	5.9	7.8
Average Minimum Temperature													
(ºF)	26.3	26.1	24.9	26.2	29.0	29.4	30.3	30.9	31.3	29.5	27.8	27.6	28.4
(ºC)	-3.2	-3.3	-3.9	-3.2	-1.7	-1.4	-0.9	-0.6	-0.4	-1.4	-2.3	-2.4	-2.0

There is a notable, as yet unmeasured, difference in the temperature of exposed (hot) and shaded (cold) areas of rock faces. The difference is quite abrupt particularly where the aspect of the rock face changes abruptly.

Rainfall (NOAA 2008)

Average Precipitation (1971-2000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Av.
(in.)	0.85	0.15	1.07	0.48	0.97	0.12	0.20	0.75	0.62	0.53	1.26	0.42	7.41
(mm)	216	38	272	122	246	30	51	190	157	135	320	107	1882

SPECIES LIST

Lichens

Acarospora c.f. depressa.
Small light brown areoles (<3 mm diam.). Not fertile.
On the underside of a 15 × 7 cm piece or rubble.
Probably much more common lower down.

Candelariella cf. vitellina
Orange crust rarely more than 1 cm diam. of compact rounded areoles or isolated apothecia. Not fertile.
On consolidated ash or *Grimmia* tussocks in well-sheltered situations exposed to light but not in positions where it is exposed to full sunlight for long periods.
A cosmopolitan species on siliceous and non-calcareous rock.
The size and clumped, almost erect, nature of the areoles and their separation from the apothecia might suggest that this is a different species. However, the K- staining reaction clearly excludes the possibility that it is a species of *Caloplaca*. The somewhat unusual growth form may be a

consequence of the unfavorable environment where the squamules rarely divide but continue to grow.

Lecanora polytropa
Thallus of small, often indistinct areoles to somewhat continuous yellow-green crusts with frequent apothecia. The apothecia sessile, the margin the same color as the thallus, the disc paler with a somewhat greasy appearance, often partly or completely grayish to black, frequently completely overlapping the areole.
On rock in cracks or on *Grimmia* tussocks in open situations and at the mouth of overhangs. It is also found on the undersurface of rocks in the rubble areas.
A cosmopolitan species on siliceous rock.
The most widely distributed species in the study area.

Lecanora sp.
One small (1 cm diam.) thallus of compact white squamules most covered with large apothecia with concolorous margins and 1 mm diam., light buff discs.
On a small rock chip among consolidated ash amongst Grimmia.

Lepraria ?incana
A thin crust of small gray to blue-gray granules with a delicate intervening web of white hyphae.
In deep shade of small caves. Generally on the floor but toward the cave mouth also on the roof.
The species prefers shaded habitats and is not tolerant of direct rainfall. It requires the very humid conditions found in the protected caves and can absorbed moisture when the relative humidity is higher than 70 percent.
Cosmopolitan.
Confirmation awaiting chemistry.

Pseudephebe minuscula
Colonies up to 5 cm diam., black, richly branched, prostrate, closely appressed to the rock face, thread-like, wiry. Not fertile.
On exposed, N-facing, vertical or almost so, rock faces. It was only found on the smooth rock face of exposed andesite rock. Common on sheer north-facing rocks at the head of the small draws and occasionally more open areas.
Arctic-alpine, circumboreal.

Rhizocarpon geographicum
An immediately recognizable species of small yellow areoles surrounded by a black hypothallus, with occasional apothecia in the middle or to the edge of the areoles.
On exposed, N-facing, vertical or almost so, rock faces. It was only found on the smooth rock face of exposed andesite rock.
Cosmopolitan. Arctic-alpine, montane in the tropics.
Not common.

Rhizocarpon sp.
Small colonies (1-2 cm diam.) of brown, shiny areoles <0.5 mm diam., interspersed with a black hypothallus.
On exposed, N-facing, vertical or almost so, rock faces. It was only found on the smooth rock face of exposed andesite rock.
Reminiscent of *R. hochstetteri* but no apothecia were found.

Umbilicaria aprina
Small (1-2 cm diam.), gray to black thalli generally closely appressed to the rock face but with ascending edges where crowded, the upper surface with large white crystals particularly along ridges. Attached at one point only (umbilicate). Not fertile.
On exposed, N-facing, vertical or almost so, rock faces. It was only found on the smooth rock face of exposed andesite rock.
Abundant in a few areas. Also known in greater abundance and size particularly where protected from continuous insolation in the summit area down to at least 3660m.
Found on high tropical mountain in Africa and also in Scandinavia and Greenland.
The thalli are attached along cracks or in a few small gas pockets on the rock surface.

Umbilicaria hirsuta
Very similar to *U. aprina* but the upper surface is brown and there are no crystals on the upper surface.
Only one colony was found mixed in with *U. aprina*
A cosmopolitan species found in greater abundance at lower elevations.

Lichen Abundance Estimates:

Counts of lichens present on the undersurface of 25 rocks in the rubble areas.
<u>Embedded rocks</u>. No lichens in two separate situations.
<u>Rocks over ash</u>. *Lecanora polytropa* under two rocks in one sample, 0 in the other.
<u>Rocks not over apparent ash</u>. *Lecanora polytropa* under ten or 12 rocks in the two samples as well as being on rocks under the rocks examined. *Acarospora sp*. under one rock.

<u>Bryophytes</u>

Grimmia ?pulvinatum
Small tussocks of grayish moss with black leaves and a fine white terminal hair.
On consolidated ash in well-sheltered situations exposed to light but not in positions where it is exposed to full sunlight for long periods.

Pohlia cruda
Small tussocks of green moss often with an orange tinge.
On consolidated ash in well-sheltered situations exposed to light but not in positions where it is exposed to full sunlight for long periods.

GENERAL COMMENTS

- The lichens and bryophytes are confined to protected habitats almost always on the north-facing sides of rocks or the head of small collapsed lava tubes.
- There is an extremely low cover (<1 percent) and diversity of lichens (10 species out of a currently known 612 species in the islands) and bryophytes (2 species out of a currently known 273 species in the islands) in the area. In sheltered, amenable habitats, lichens are locally common.
- The distribution of the different lichens is thought to reflect their ability to tolerate UV irradiation, overall light intensity and the availability of water, both liquid and gaseous.
- There is a marked difference in the distribution of the various lichens. The dark to black species (*Rhizocarpon ?hochstetteri, Pseudephebe miniscula, Umbilicaria aprina and U. hirsuta*) are found on the open face of northern facing rocks, (*Candelariella vitellina, Lecanora polytropa* and *Lecanora sp.*) at the base of northern facing rocks and (*Lepraria ?incana*) on the roof of the small lava tubes or deeper inside the tube). The presence of the dark species in the most exposed inhabited areas is in keeping with McEvoy, M., Gauslaa, Y. & Solhaug, K.A. (2007) finding that melanic pigments play a photoprotective role in light acclimation. The other species do not have such protection though the apothecia and areoles of *L. polytropa* are often light to dark grey in more exposed situations. *Lepraria* species frequently grow in protected shaded and humid habitats.
- Concise determinations of some species is not possible under the time constraints of this study even though fruiting bodies may be present. Species growing in such severe habitats, particularly those growing on rocks, produce spores only during favorable conditions. The only sure way of finding good specimens would be to conduct monthly collections for at least one year.
- None of the plants show evidence of feeding and there do not appear to be any obligate herbivores present. Therefore, the plants present do not appear to be necessary to support any herbivore trophic level.
- None of the lichen species present contain cyanobacteria so if nitrogen fixation is taking place up there none of it comes from lichens. Lichens on lava flows down below contribute to the nitrogen budget particularly the very common *Stereocaulon vulcani*.

RECOMMENDATIONS

- Site E2, the upper, more southerly footprint site being considered for Project construction is the preferred site from a cryptogamic point of view. The number of species is lower and the abundance of those present is lower. There is less sheltered habitat present.
- There is a greater abundance of lichens at the same elevation adjacent to the proposed sites where there are mounds of rocks rather than the solid flows present in the proposed sites.

CONCLUSIONS

- There is a very low diversity and cover of plants in the study area.
- All of the species are found at somewhat lower elevations at least on the southern side of the mountain. None of the species are unique to Hawai‘i.
- Lichens and bryophytes are generally confined to the northerly aspect of rocks or under overhangs and even then the abundance of species is much higher in those facing north.
- The vascular plants appear to be confined to the western side of the larger pahoehoe flows.
- It was gratifying to note that much of the rubbish that was seen in the 1982 Survey of the summit area had been removed.

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Respectfully submitted,

Clifford W. Smith

Mauna Loa Observatory (11,135 ft)													
Average Max. Temperature (ºF)	49.8	49.6	50.2	51.8	53.9	57.2	56.4	56.3	55.8	54.7	52.6	50.6	53.2
Average Min. Temperature (ºF)	33.3	32.9	33.2	34.6	36.6	39.4	38.8	38.9	38.5	37.8	36.2	34.3	36.2
Average Total Precipitation (in.)	2.39	1.53	1.73	1.28	1.01	0.49	1.16	1.49	1.34	1.14	1.74	1.98	17.30
Average Total SnowFall (in.)	0.0	1.0	0.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.7
Average Snow Depth (in.)	0	0	0	0	0	0	0	0	0	0	0	0	0

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Abstract

A UV spectroradiometer was installed at Mauna Loa Observatory (MLO), Hawai‘i, in July 1995. This instrument, based on a commercially available double monochromator, uses a diffuser mounted as a horizontal receptor inside a quartz dome and views the whole sky. The instrument scans over the 290–450 nm spectral range with a band pass of about 1 nm for each 5° of solar zenith angle (SZA). The UV irradiances measured at MLO are much more intense than at low-altitude midlatitude locations. For observations at SZA 45° the erythemally weighted UV irradiances can exceed 21 µW cm^{-2}, which is approximately 15–20% greater than that seen at Lauder, New Zealand, for similar ozone amounts. The difference is primarily due to the higher altitude at MLO (3.4 km). For overhead Sun conditions at MLO the largest value of erythemal UV was 51.3 ± 3.1 µW cm^{-2}, which to our knowledge is the highest recorded any-where at the Earth's surface. UV irradiance is strongly correlated (inversely) with Dobson spectrophotometer total ozone measurements at MLO, with higher correlations at shorter wavelengths. The radiative amplification factor (RAF) for erythema at MLO is about 1.33 ± 0.2 at SZA 45°.

McEvoy, M., Gauslaa, Y. & Solhaug, K.A. (2007). Changes in pools of depsidones and melanins, and their function, during growth and acclimation under contrasting natural light in the lichen Lobaria pulmonaria. New Phytologist **175(2)**: 271-282.

Abstract

["In conclusion, the highly responsive melanic pigments play a photoprotective role in light acclimation, whereas the constant amount of depsidones across a wide spectrum of growth ranges and irradiances is consistent with herbivore defense functions."]

DRAFT ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2 – APPENDIX H: GEOLOGICAL TECHNICAL REPORT

Thirty Meter Telescope Project

Island of Hawai‘i

Proposing Agency:
University of Hawai‘i at Hilo

GEOLOGIC TECHNICAL REPORT

Thirty Meter Telescope Project

Island of Hawai‘i

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April 2009

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1.0 Maunakea Summit Region

Geohazards Consultants International, Inc. was requested to prepare a geologic study to evaluate the geologic substrate underlying the proposed sites for the Thirty Meter Telescope (TMT) Project. The principal focus of this report is to describe the geologically unique structures present within the areas being considered for the site of the TMT Observatory on Maunakea, and to evaluate their uniqueness relative to other similar areas on this great volcano.

We were also asked to evaluate the stability of the ground and any soils present as to suitability for construction activities, as well as to discuss geologic hazards that could impact facilities. This report is based on four days of field investigation at the sites, literature research, and inspection of available stereographic aerial photography and satellite imagery. A geologic field evaluation of comparable geologically unique features on Maunakea's south summit area was also undertaken. Geologic perspectives relative to proposed TMT Mid-Level Facility in the Hale Pōhaku area are also given as an Addendum at the end of this report.

1.1 Regional Setting

Maunakea is one of five volcanoes comprising the Island of Hawaiʻi. This dormant shield volcano is the highest of the five, and the highest mountain in the interior Pacific basin. Because of its elevation, Maunakea's summit has been repeatedly glaciated during the past few hundred thousand years, and preserves the best glacial record of any oceanic volcano on Earth. Maunakea has erupted 12 times within the last 10,000 years, and though it has been at least 4,600 years since its last eruption, it is anticipated that the volcano will erupt again at some time in the future; such an eruption would likely occur on the flanks of the volcano, below the summit and astronomical facilities. The geologic history of Maunakea was thoroughly discussed by Wolfe and others (1997) and in more general terms focusing on unique geologic features by Lockwood (2000).

1.1.1 Glacial History

Maunakea's glacial history was recognized early by Wentworth and Powers (1941) and has been well documented by Porter (1979a, 1979b, 1979c, 1987), and by Porter and others (1977). Although periods of abnormal cold and extensive glacial activity have characterized much of the past two million years on Earth, known as the Pleistocene Epoch, Maunakea only grew high enough to have been glaciated beginning a half million years ago. If present, however, glacial deposits of such older times are buried by younger volcanic rocks, and the earliest glacial deposits exposed are no older than 200,000 years (Wolfe and others, 1997), based on revised radiocarbon dating. The lava flow underlying Area E was erupted during the youngest period of glaciation, known as Mākanaka time. The Mākanaka ice cap completely covered the summit area down to about 12,000 feet between approximately 40,000 and 13,000 years ago, according to the latest radiocarbon-dating of glacial deposits (Wolfe and others, *ibid.*). The ice cap had an estimated area of around 27 square miles (Porter, 1979c), and was relatively thin at no more than 300 feet thick. The cinder cones of Maunakea's summit likely projected above the glacier, although they were doubtless snow-covered most of the year. Porter believed that an ice-free interglacial period separated Mākanaka time into an upper and lower period, but Wolfe and others dispute that conclusion and feel that glacial ice was always present during this period. Regardless, surface features of the flow surface in Area E show convincingly that these lavas were emplaced beneath glacial ice or snow.

1.1.2 Geologic Hazards

The potential for renewed volcanic activity in this region is extremely remote. Maunakea last erupted about 4,600 years ago, and the volcano is considered to be dormant (Lockwood, 2000; Mullineux and others, 1987). Although Wolfe and others (1997) mapped a dozen separate post-glacial (post- 10,000 year old) eruptive vents on Maunakea's middle flanks, none younger than 40,000 years occur in the summit area, and future eruptions will likely occur well below the summit and will not pose any direct threat to astronomical facilities.

The most significant geologic hazards that would potentially impact the TMT Observatory are related to seismic activity. Hawai‘i Island is one of the most seismically active areas on Earth, and about two dozen earthquakes with Magnitude 6 or greater have been documented on Hawai‘i since the devastating earthquakes of 1868; those that caused damage are listed in Table 1. Four major earthquakes have occurred on Hawai‘i since the first astronomical facilities were constructed on Maunakea (1975 – M=7.2; 1983 – M=6.7; 1989 – M=6.1; 2006 – M=6.7). The first three of these only caused minor impact to then existing astronomical facilities, but the epicenter of the M=6.7 earthquake in 2006 was closer to the Maunakea summit than the others (Robertson and others, 2006), involved Peak Ground Acceleration forces of up to 0.26 g, and caused minor to significant damages to the Keck, Subaru, UH 88 and CFHT observatories. The Keck observatories were not fully operational for more than three months after this earthquake. Earthquake impacts on these observatories and engineering recommendations to mitigate future damage were discussed in detail at the "*Mauna Kea Observatories Earthquake Workshop*" held in Kailua-Kona on March 23, 2007 – results reported at http://www.gemini.edu/node/227.

Future earthquakes will impact the Maunakea summit area repeatedly in the future, and any future construction must include design for significant seismic forces. The summit of Maunakea is susceptible to seismic intensities of up to VII on the Modified Mercalli Intensity Scale (Wyss and Koyanagi, 1992; Figure 1).

Table 1: Summary of Damage Causing Earthquakes

Date	Epicenter Location	Maximum Intensity Mag	Magnitude	No. of Deaths	Damage	Repair Cost
03 28 1868	Southern Hawai`i	IX	7.0	0	Extensive-Southern Hawai`i	Unknown
04 02 1868	Southern Hawai`i	XII	7.9	81	>100 houses destroyed in tsunami	Unknown
10 05 1929	Hualālai	VIII	6.5	0	Extensive-Kona	Unknown
08 21 1951	Kona	VIII	6.9	0	Extensive-Kona	Unknown
04 26 1973	North of Hilo	VIII	6.2	0	Extensive-Hilo	$5.6M
11 29 1975	Kalapana	VIII	7.2	2	Extensive-Hilo	$4.1M
11 16 1983	Ka`oiki	IX	6.7	0	Extensive-Southern Hawai`i	>$6M
06 25 1989	Kalapana	VII	6.2	0	Southeast Hawai`i	almost $1M
10 15 2006	Kiholo Bay	VIII	6.7&6.0	0	NW Hawai`i	>$100M

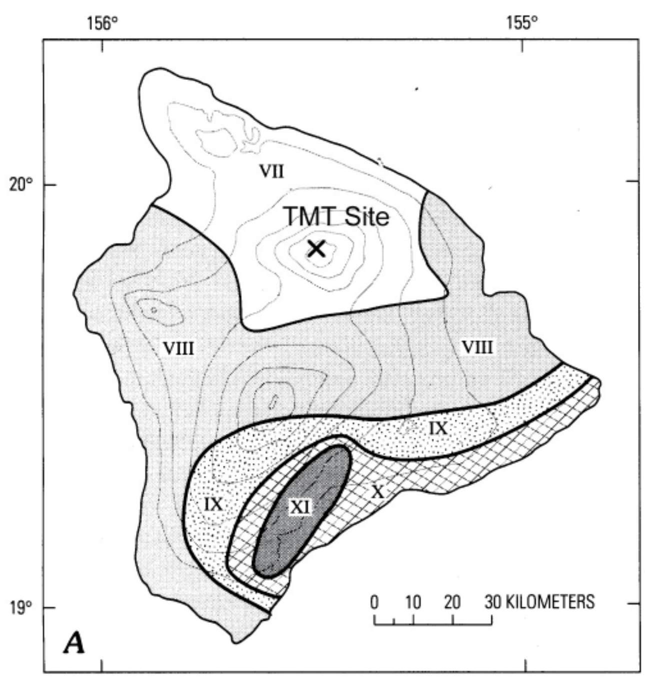

Figure 1: Map showing expected highest Mercalli Intensities for earthquakes expected on the Island of Hawai'i (modified from Wyss and Koyanagi, 1992).

1.2 Geologic Description of Area E

Area E (Figure 2) was designated in the 2000 Master Plan as a location for future facilities development. This area bounds the general limits of sites being considered for the location of the TMT Observatory. It is entirely underlain by a single lava flow, erupted between 30,000 and 40,000 years ago[1] from a vent located on the saddle between Pu‘u Poli‘ahu and the unnamed cinder cone west of Pu‘u Hau‘oki on which the Subaru Telescope is situated (Figure 2). The flow consists of uniformly dense, fine-grained lavas characterized by abundant microcrystalline plagioclase feldspar platelets. These give the rocks a silvery sheen on fresh-broken surfaces. The flow was emplaced as viscous pāhoehoe, although some ‘a‘a fragmental material may have originally overlain the surface. The eruption that produced this overall flow generated multiple flow lobes that overrode one another as the eruption progressed. An older lobe trends to the northwest, and is overlain by a younger lobe that traveled more northerly (Figure 2). It is probable that growth of each of these major lobes was caused by both vertical inflation of ice-quenched surfaces from subsurface injection of molten material, as well as by surface breakouts that fed short flows above solidified crust. Multiple complex flow lobes may be found at depth during excavation.

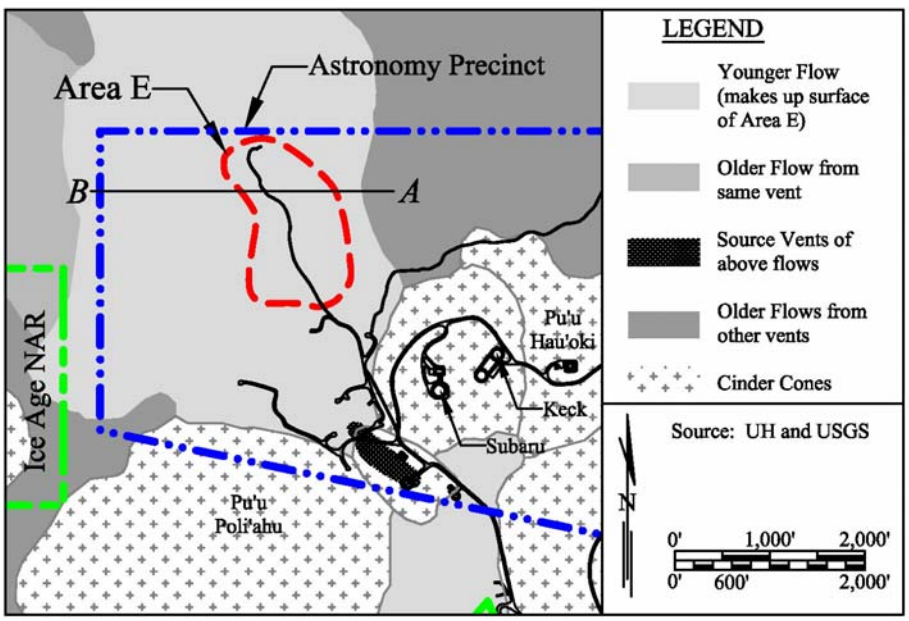

Figure 2: Geologic sketch map of the Area E region. The two flows are of identical composition and have similar surface characteristics. They were both derived from a linear vent system between Pu‘u Poli‘ahu and Hau‘oki.

Although the lavas at the surface in Area E are of a uniformly medium-gray color internally, flow surfaces are everywhere weathered, from yellow-brown to orange ochre colors (Figure 3).

[1] Two K-Ar radiometric ages have been determined for this flow: 33+/- 12 Ka; 41+/-8 Ka (Wolfe and others (1997).

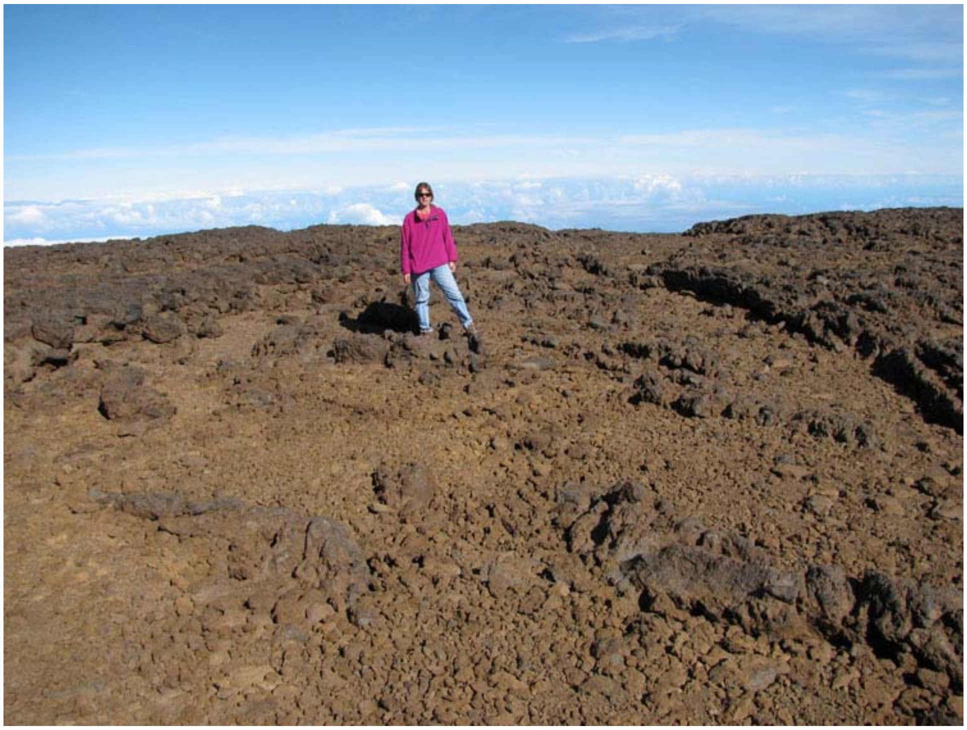

Figure 3: Typical surface of the flow present at surface in Area E. High-standing ground has been eroded by glacial action; low-standing areas are covered by fragmental debris up to a foot thick. Flow surfaces are much more irregular in the northern parts of Area E.

Surficial surface features indicate that most of this flow was emplaced beneath glacial ice or snow. In contrast, the source vent for this flow (Figure 2 and Figure 4) shows no evidence of interaction with water, and fire fountains must have melted through overlying ice during the eruption so that lava fountaining took place and made contact with the air, producing numerous air-cooled volcanic bombs (Figure 5). The flows from this vent traveled down slope to the northwest, beneath a pre-existing thin glacier; the flows preserve many features that document sub-glacial origin. Lava flowage beneath the ice was concentrated in irregular lava channels typically 3-8 feet deep and beneath elongate constructional ridges that are oriented in fan shapes roughly radial to the principal axis of the flow.

Figure 4: Spatter cone at the southern end of the flow present at the surface in Area E. This 20' high structure was formed by fire fountains that projected above surrounding ice and snow.

Figure 5: Aerodynamically-shaped fusiform bomb from the source vent. Such bombs show that the vent erupted into the air.

A single chemical analysis of this lava flow (Table 2) shows the flow to be of typical hawaiite composition, which is a type of alkali-rich basalt. The petrologic evolution of Maunakea, with perspectives on the prospect of future volcanism is given by Frey and others (1990) as well as by Wolfe and others (*ibid.*).

Table 2: Chemical analysis of the lava flow underlying Area E (Sample HR-76 - Wolfe and others, 1997). Values in weight percent.

SiO_2	Al_2O_3	FeO_x	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5	MnO	Total
50.60	17.00	11.50	4.01	6.97	4.68	1.94	2.70	0.95	.22	100.57

1.2.1 Glacial Features

The features described below are unique to glaciated terrains, and are found at no other oceanic volcano in the Pacific. However, the features in Area E are not unique on Maunakea, and better examples are widely distributed in other areas in the summit above the elevation of about 12,000 feet (Lockwood, 2000, Figure 2). The degree of glacial polishing is related to the thickness of the overlying ice that was present; because the glacial ice cap that overlaid Area E was less thick than the glacier overlying lower elevations southeast of the summit, glacial polishing and striations are less developed on the lava flow surface exposed in Area E.

Features associated with sub glacial eruptive activity

Because the flow no present at the surface in Area E was entirely emplaced beneath ice or snow, the actual interface between “fire and ice” was always marked by a zone of melt water, and this water served to very rapidly quench the surface of the flow. Where open channels of molten lava existed at the surface, the margins of those flows repeatedly quenched, narrowing the width of the channels and forming unique structures we term quenching ripples (Figure 6). Such features are common over the top of the flow in most places, within and beyond Area E.

Figure 6: Quenching ripples, formed along the margin of a lava channel in the southern part of Area E. These structures indicate the rapidity of cooling of lava channels overlain by ice.

Most molten lava was supplied by flowage beneath a solidified carapace of frozen lava, but where this carapace was breached, especially at flow margins south and east of Area E, bulbous lava protrusions formed rounded structures, termed mega-pillows after the smaller structures commonly formed by submarine lava flows. These unique structures (Figure 7) consist of especially fine-grained, flinty lava with interstitial glass on marginal surfaces. These flinty rocks are similar in texture to the materials quarried by Hawaiian toolmakers at sites near Puʻu Kokoʻolau on Maunakea's south flank (Cleghorn, 1982; Mills and others, 2008), but were likely obscured by snow during the cooler weather of the past, and would not have been exposed for possible use during the period of active quarrying at lower elevations.

Figure 7: Mega-pillow formed as bulbous protrusions of molten lava grew upward into glacial melt water during flow emplacement. The rapidly quenched lava contains volcanic glass indicative of its rapid cooling.

Features associated with post-eruptive glacial erosion

Following emplacement and cooling of the flow no present on the surface in Area E, ice continued to cover the Maunakea summit, and down slope movement of these glaciers modified lava flow surfaces though the erosive power of entrained rock debris and flowing melt water. Any fragmental material originally at the surface was eroded away by torrents of sub-glacial melt water (Figure 8), leaving typically irregular surfaces that reveal the structures of underlying dense lava. Where moving ice directly overlaid lava, hard surfaces were scoured by entrained rock debris, polishing high-standing areas and leaving glacial striations (Figure 9). Glacial polish is not generally well-developed, and is best seen in low-angle incident sunlight. Some of the lava channels may have been roofed during the eruption to form small pyroducts, or lava tubes, but if once present, these thin roofs have generally been removed by glacial erosion.

Figure 8: Glacially-eroded surface of the flow near the Alternative E2 site. High-standing areas are glacially polished; low-standing areas probably represent weak areas that were eroded by torrents of glacial meltwater.

Figure 9: Glacially-polished rock outcrop near the Project 13N site. The striations are aligned with the direction of ice transport.

As the last glaciers melted in the area 10,000-13,000 years ago, boulders once entrained in the ice were left standing on high places. These boulders, called glacial erratics, give testament to the carrying power of the ice that once flowed above Area E (Figure 10). Such glacial erratics and other debris form extensive deposits of glacial till about a mile down slope, but the glaciers were never extensive enough to form spectacular glacial moraines, of the sorts so well preserved on Maunakea's south flank.

Figure 10: Glacial erratic near the Project 13N site. This boulder, about 2 feet high, was carried by glaciers to its resting spot, and left behind as the glacier melted away about 10,000-13,000 years ago.

1.2.2 Geologic Cross-Section

A geologic cross-section across Area E along the southern edge of the Project 13N site (Figure 11) was constructed to provide an estimate of the thickness of the flow that was emplaced during the eruption event in this area which created the lava no exposed on the surface in Area E, and to show surface terrain variations. From this cross-section it is estimated that the aggregate thickness of all flow layers combined is at least 75 feet; based on the exposed thickness at flow margins. Because lava flows tend to travel along pre-existing depressions, it is likely that most of the flow is thicker than this, especially in the center, and more likely is over 100 feet thick. The pre-existing ground surface in this area evidently sloped locally to the northwest, so that the flow surface slopes in this direction, as well as to the north. Judging from older rocks exposed down slope from Area E, it is possible that this flow overlies a rubbly surface consisting of loose lava fragments and windblown cinders from summit cones, although such material may have been eroded away by glacial activity before the flow was emplaced.

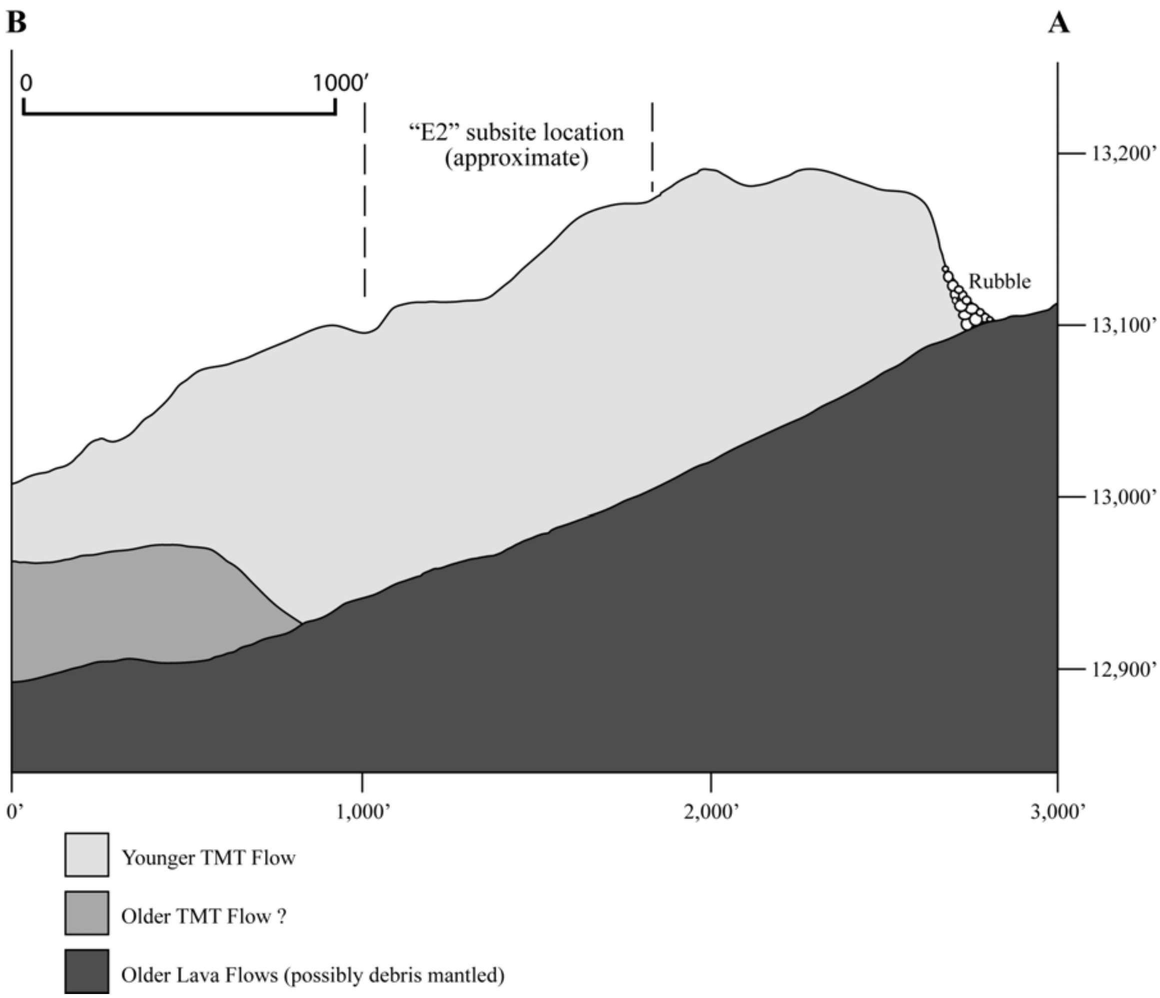

Figure 11: Geological cross-section along line A-B in the area of the Alternative E2 site (location shown on Figure 2). Topographic profile from unpublished University of Hawai'i five foot contour map. The land slopes both to the north and west, and is similar to terrain near the Project 13N site. Vertical exaggeration 5:1.

1.2.3 Soils, Slope Stability, and Construction Perspectives

No soils in a conventional sense are present in Area E as the only fragmental material present has not had sufficient time for soil weathering in this arid, alpine environment. Fragmental material is present in most low-lying areas, however, and could be classified as a non-weathered soil. This material consists of unconsolidated debris derived from glacial erosion and mechanical weathering of the adjacent lavas, and is nowhere more than a foot or two in thickness. This material is subject to down slope movement and internal sorting by the periglacial, or non-glacial alpine, processes known as solifluction (Matsuoka, 2001). Because these materials have no internal strength, they must be removed before being overlain by heavy structures.

The flow present at the surface in Area E is composed of dense, fine-grained lava of exceptional strength, and slope stability will not be a problem for well-anchored structures. There are typically few vesicles (gas bubbles) in these lavas, except in the uppermost sections of flows. During flow emplacement, most lava was supplied by subterranean conduits (pyroducts, or lava tubes- Figure 12), but these structures appear to have mostly been filled during late eruption stages. Some pyroduct voids might be encountered at depth within the lavas during excavation, but these structures will likely be small and not laterally extensive. Separate individual flow units will likely be encountered at depth, with vesicular sections at their tops, but the probable absence of any loose debris at flow contacts will not cause any excavation problems. The estimated combined thickness of over 100 feet, of these flows should allow basement foundations to rest on solid lava and not on the more fragmental materials that might lie at greater depths.

Figure 12: Subglacial pyroduct (lava tube) opening in central part of Area E. Such structures transported lava beneath glacier cover during emplacement of the flow, but were mostly filled by late-stage lavas.

1.2.4 Descriptions of TMT Observatory Sites

Project 13N Site

The 13N site near the northern boundary of Area E is characterized by irregular terrain, with local relief of 15-20 feet. No geologically unique features were observed within this area, and much of the original surface has been degraded by road-building and site testing activity. The overall slope of the site is about 5-6 degrees to the north.

Alternative E2 Site

The E2 site is characterized by irregular terrain and relatively deep lava channels that trend northerly across the site. The overall ground slopes steeply to the north at 12-15 degrees, which might cause design problems for structures. A strange east-west-oriented lineament crosses Area E directly south of the E2 site (Figure 13). This linear feature, prominent on aerial photographs (Figure 13), is of uncertain origin and is difficult to identify on the ground. It was initially suspected that this feature might represent a fault or ground fracture, but no indications of any tectonic affinities were observed.

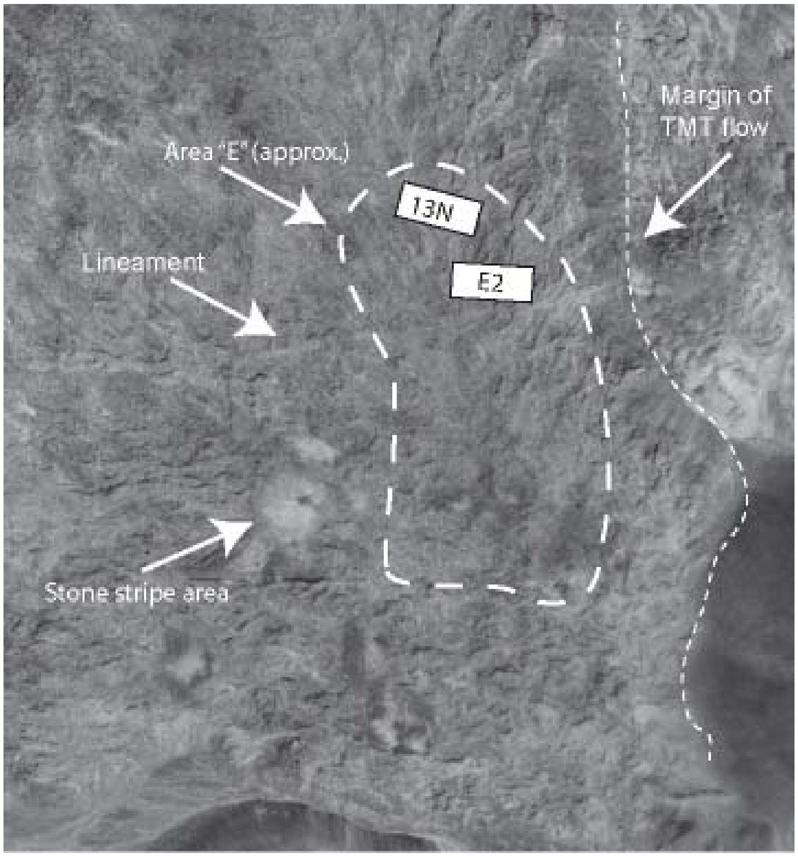

Figure 13: Aerial photo of the flow, showing the flow's irregular surface morphology and an anomalous east-west-trending lineament immediately south of the Alternative E2 site. An area of stone stripes lies west of Area E. USN photo HAI 11 017 (10 October, 1954), obtained before any road development in the Maunakea summit area.

1.2.5 Summary Perspectives on Potential TMT Observatory Construction Sites

The two sites within Area E that are being considered as potential sites for the TMT Observatory are both located on a stable lava flow that would provide a solid substrate for the envisioned construction activities. This lava flow was emplaced during a period of extensive glaciation on Maunakea, and unique geologic features record the interaction with glacial ice, both during and following eruption. Although such features are unique to Maunakea volcano in the Pacific region, they are common and better preserved elsewhere on the mountain. The Alternative E2 site lies in an area of steep regional terrain slope, and perhaps would involve the most difficult construction design factors of the two sites. The Project 13N site has been previously degraded by prior construction activity, and may be the most appropriate for consideration.

1.3 Geologic Description of Area Surrounding Area E

The area in the 500 meter-wide zone surrounding Area E includes numerous geologically unique structures, including portions of the Pu‘u Poli‘ahu and Pu‘u Hau‘oki cinder cones to the south and southeast. The northern and western areas of this border zone are mostly underlain by the same lava flow that is present on the surface in Area E, and are characterized by the same sorts of glacial features described in Area E. None of these features are unique to this area or Maunakea, although a small area of stone stripes located about 300 feet west of Area E (Figure 14) deserves mention. These features, formed by periglacial process and studied elsewhere on Maunakea by Werner and Hallet (1993) are uncommon, although more extensive examples are also found to the south, on the slopes of Pu‘u Poli‘ahu and Pu‘u Waiau. However, because of their rarity care should be taken not to impact this small area, shown on Figure 2.

Figure 14: Well-developed stone stripes about 300 feet west of Area E (location shown on Figure 13). These structures are formed by self-sorting during periglacial solifluction transport.

1.4 Potential Environmental Impact

Any construction activity associated with the construction of the Access Way or clearing of the footprint for the TMT Observatory would unavoidably remove any surface geologic structures present, such as lava flow morphology and glacial features. However, such geologic features are not unique on Maunakea and are better developed at many other areas – especially on the south summit area adjacent to the Maunakea Access Road.

1.5 Mitigation Measures

The areas of glacial polish and striations are highly vulnerable to damage by tracked vehicles, and movement of such construction equipment should be limited to the bounds of the Access Way and the TMT Observatory construction site. Exceptionally noteworthy examples of glacial features near the proposed Access Way would be identified prior to the start of construction, and buffer zones established around them so they would be preserved where alternate routing of the road is feasible. Such features are presently unappreciated, and might be identified along the Access Way to enhance public interpretation efforts.

2.0 Hale Pōhaku TMT Mid-Level Facility Area

2.1 Introduction

Geohazards Consultants International, Inc. was requested to conduct a geologic inspection of proposed sites for the TMT Mid-Level Facility at Hale Pōhaku on the south flank of Maunakea, focusing on the identification and evaluation of any geologically unique features or construction hazards within this area. This brief report summarizes field observations made on 16 February, 2009 at the two separate areas under consideration.

2.2 Site Descriptions

The Hale Pōhaku area is underlain by loose volcanic colluvium (admixed sand, gravel, and cobbles deposited by surface water and wind), extensively impacted by frost action and overlain by soil alteration zones where not disturbed. Because this material is unconsolidated, it is subject to erosion and gullying by flowing surface water during heavy rainfall. The regional geologic structure of the area is shown on a geologic map by Wolfe and others (1997). Note: *All notations of surface slope are given in geometric, not engineering degrees.*

2.2.1 Area within Hale Pōhaku

This 3.2 acre area has been extensively modified by construction around buildings, and is impacted by minor gullying, especially in upper portions where water runoff is concentrated from parking areas and roof drainage. The undisturbed surfaces are covered with loose volcanic cobbles overlying fine grained sand of volcanic origin. Clumps of vegetation have trapped high mounds of aeolian (wind-blown) sand. Slopes are as steep as 8 degrees southward in upper parts, but less than 2 degrees on the south margin of this area. This latter area is presently used as a parking lot for ATV activities.

2.2.2 HELCO Transformer Site

The transformer station is located within a fenced enclosure located in a natural saddle between Puʻu Kalepeamoa to the south and a cinder cone and crater associated with Puʻu Kilohana to the north. The enclosure is mostly sited on a thick layer of imported gravel fill, and has had no impact on surrounding geologic structures. The surface underlying this fill consists of unconsolidated colluvial sand and gravel that has been unaffected by surface water runoff as have lower areas in other sites. The adjoining cinder cone slopes are covered with angular pyroclastic debris - principally broken volcanic bombs.

2.3 Summary

The areas being considered for the TMT Mid-Level Facility are entirely underlain by unexceptional volcanic colluvial materials that characterize much of the lower slopes of Maunakea volcano. There are no geologically unique features in these areas. The HELCO transformer site can presumably be expanded to accommodate the increased power needs of the Project without impact on surrounding areas.

The unconsolidated nature of the underlying colluvium at the TMT Mid-Level Facility would require attention during construction to avoid undue erosion. Disturbance of the soil surfaces would expose loose material that is highly vulnerable to erosion by heavy rainfall episodes that can occur very infrequently in this region during thunderstorms. Parking areas should be covered by thick but permeable gravel materials rather than paved in order to reduce water runoff. Permanent facilities should be built above grade on raised foundations to protect against potential flooding.

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DRAFT
ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2 – APPENDIX I:
VISUAL IMPACT ASSESSMENT TECHNICAL REPORT

Thirty Meter Telescope Project

Island of Hawai‘i

Proposing Agency:
University of Hawai‘i at Hilo

VISUAL IMPACT ASSESSMENT TECHNICAL REPORT

Thirty Meter Telescope Project

Maunakea Northern Plateau and Hale Pōhaku,
Island of Hawai'i
TMK 4-4-15: 9 and 12

Proposing Agency:
University of Hawai'i at Hilo

This document was prepared to support the Environmental Impact Statement for the project, which was prepared pursuant to Hawai'i Revised Statutes, Chapter 343, Environmental Impact Statement Law and Chapter 200 of Title 11, Hawai'i Administrative Rules, Department of Health, Environmental Impact Statement Rules

May 2009

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Acronyms and Abbreviations

3D	Three dimensional
BLNR	Board of Land and Natural Resources
CFHT	Canada France Hawai'i Telescope

CMP	Comprehensive Management Plan
CSO	California Institute of Technology Submillimeter Observatory
DEM	Digital Elevation Model
DHHL	Department of Hawaiian Home Lands
EA	Environmental Assessment
EIS	Environmental Impact Statement
EISPN	Environmental Impact Statement Preparation Notice
FEIS	Final Environmental Impact Statement
GIS	Geographic Information Systems
HAR	Hawai‘i Administrative Rules
HRS	Hawai‘i Revised Statutes
IRTF	NASA Infrared Telescope Facility
LUC	Land Use Commission
NED	National Elevation Dataset
NGLT	Next Generation Large Telescope
NPDES	National Pollutant Discharge Elimination System Permit
OMKM	Office of Mauna Kea Management
SMA	Submillimeter Array
TMT	Thirty Meter Telescope
UH	University of Hawai‘i
IfA	University of Hawai‘i Institute for Astronomy
UKIRT	United Kingdom Infrared Telescope
USGS	United States Geologic Services

1.0 Introduction and Background

1.1 Introduction

The TMT Observatory Project, referred to as the Project, would consist of the construction and operation of an optical/infrared telescope observatory below the summit of Maunakea[1] and the associated permanent and temporary ancillary facilities. The permanent ancillary facilities would include a Headquarters in Hilo to manage operation of the observatory, a Satellite Office in Waimea to support operation of the observatory, and housing and support facilities at the mid-elevation Hale Pōhaku facility for visiting scientists and others working near the summit. Temporary construction facilities would also include worker housing at Hale Pōhaku and construction yards near the summit, at Hale Pōhaku, and near the port where the telescope components would be received.

The purpose of this document is to describe the existing visual conditions, discuss and quantify the visual impacts the Project would have, and identify how the Project mitigates its potential visual impact. The information contained in this discipline report will be used to support the Project's Environmental Impact Statement (EIS).

1.2 Policy Documents and Previous Studies

The following is a summary of the discussion of existing visual conditions of Maunakea and the guidance for new projects contained in existing policy documents and recent environmental studies prepared for the Mauna Kea Astronomy Precinct.

1.2.1 Mauna Kea Comprehensive Management Plan, 2009

The Mauna Kea Comprehensive Management Plan for UH Management Areas (CMP) provides a management framework for the University of Hawai‘i (UH) to address existing and future activities in the UH management areas. The CMP generally discusses the existing views of Maunakea from around the Island of Hawai‘i and notes "when skies are clear, the summit region and observatories can be seen from Hilo, Honoka‘a, Waimea, the summit of Kīlauea, sections of the Maunakea Access Road and much of Puna". The CMP also generally discusses the views available from the summit of Maunakea and the physical characteristics that make it a good location for astronomical viewing.

[1] Maunakea is spelled as one word in this document because it is considered the traditional Hawaiian spelling (Ka Wai Ola, Vos. 25 No. 11). The common "Mauna Kea" spelling is considered an English spelling and is only used in this document where Mauna Kea is used in a proper name, such as the "Mauna Kea Science Reserve."

The CMP also recommends actions to address environmental impacts related to the visual environment. One of the recommended actions is to require new observatories to prepare a site restoration plan to be followed upon their decommissioning. In addition, the CMP includes an action that allows the leaving of traditional offerings to continue unrestricted, while implementing culturally appropriate guidelines for removing offerings to protect the visual landscape. The CMP also prohibits off-road vehicle use to protect visual resources by reducing the associated scarring of the landscape. The CMP also recommends developing and implementing consistent interpretive signage for the observatories.

1.2.2 Mauna Kea Science Reserve Master Plan, 2000

The 2000 Mauna Kea Science Reserve Master Plan is an update of the 1983 plan and addresses issues and concerns that arose during the 30 years of development on Maunakea. The 2000 Master Plan provides guidance relative to the physical development of the summit area, such as the location of facilities, character, size, mass, color, and other physical attributes.

The 2000 Master Plan states that new facilities will be located within the Astronomy Precinct because it would "limit visual impact and scattering of facilities by clustering within the existing development area, recognizing that facilities have already been built in this area." Within the Astronomy Precinct, Areas D, E, and F were identified as new areas to locate observatories because they would have minimal visual impacts. The 2000 Master Plan limits future telescope redevelopment on the summit ridge to a maximum height and diameter of approximately 130 feet.

The 2000 Master Plan includes a discussion of a Next Generation Large Telescope (NGLT), which it describes as a telescope with a mirror of 82 to 164 feet (25 to 50 meters) in diameter that may be proposed for the summit of Maunakea. The 2000 Master Plan recognizes that the large scale of a NGLT makes the visual impact considerations very important, and recommends siting such a facility within Area E of the Astronomy Precinct because it would minimize its visibility. The 2000 Master Plan also recommends implementing strict design guidelines for the size and color of the NGLT, and recommends that the observatory be built below grade to minimize its apparent height and mass.

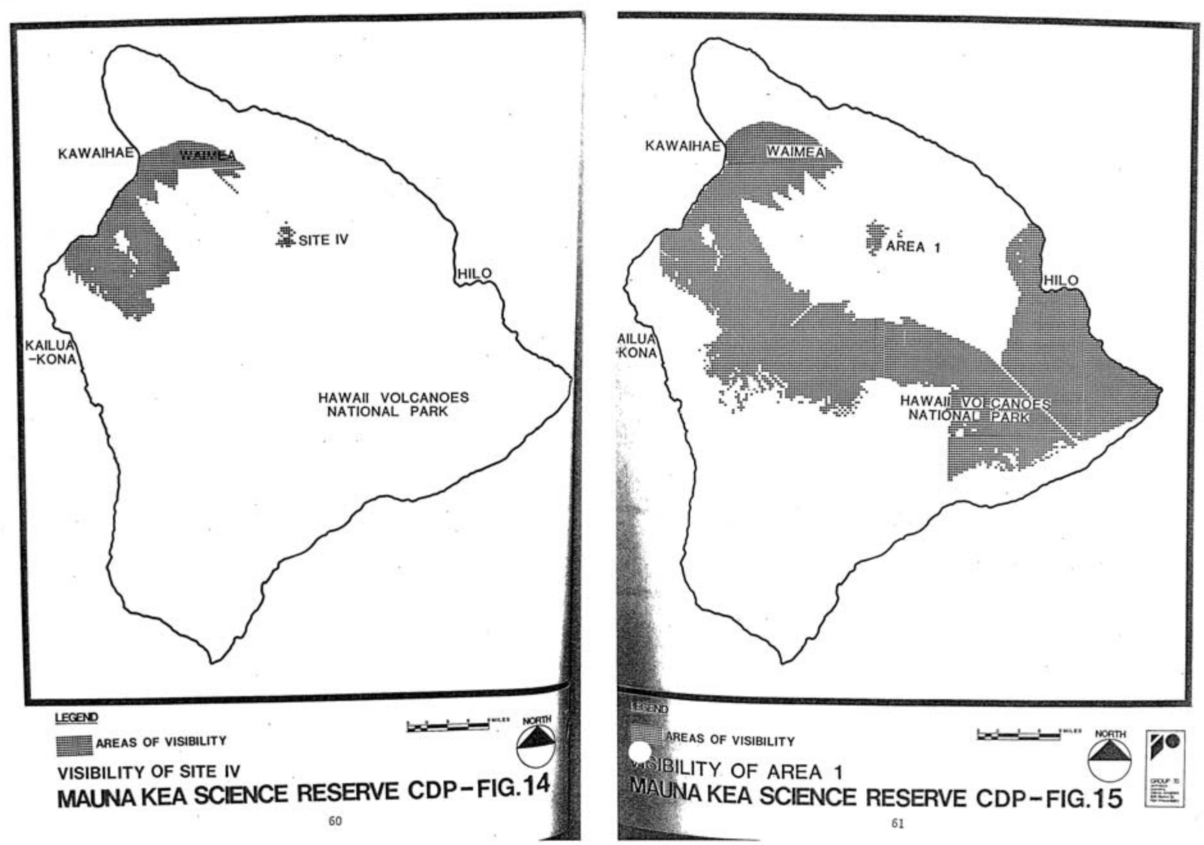
1.2.3 Mauna Kea Science Reserve Development Plan, 1983

The 1983 Mauna Kea Science Reserve Development Plan included a visibility analysis for two areas on the summit of Maunakea where future observatories may be proposed. This visibility analysis identified areas on the island where the future observatories could be seen. These figures are shown in Figure 1-1.

1.2.4 Conservation District, 1961

In 1961 the Hawaiian State Land Use Law (Act 187), granted the State Land Use Commission (LUC) the power to zone all lands in Hawaiʻi into three districts: Agriculture, Conservation and Urban. The Conservation District has five subzones: Protective, Limited, Resource, General, and Special; Maunakea is designated as Conservation District land, within the Resource subzone. Because the UH Management Areas consist of lands owned by the State, land uses within these areas are regulated by the Board of Land and Natural Resources (BLNR), and all activities must be in compliance with the laws and regulations applicable to Conservation District Lands.

Figure 1-1. Visibility Analysis from the 1983 Mauna Kea Science Reserve Development Plan



1.2.5 Outrigger Final EIS, 2005

The EIS prepared for the Outrigger Telescopes provided a brief description of the existing visual conditions within the Astronomy Precinct and of places on the island where the existing observatories are visible. This EIS stated that the proposed Outrigger Telescopes would be visible from within the Astronomy Precinct and from areas below the summit such as Waimea and Honokaʻa. The EIS for the Outrigger Telescopes also stated that the visual impact of the proposed telescopes would have a "small impact on visual/aesthetic" resources, but stated that the cumulative visual impact would continue to be substantial[2].

[2] NASA, 2005.

2.0 Methods

This section applies to the methods used during the visual analysis of the proposed TMT Observatory on Maunakea.

2.1 Coordination

The following plans were reviewed and consulted:

- Mauna Kea Science Reserve Development Plan, 1983
- Mauna Kea Science Reserve Master Plan, 2000
- Outrigger Final Environmental Impact Statement (FEIS), 2005
- County of Hawaiʻi General Plan, 2005
- South Kohala Community Development Plan, 2008
- Final Mauna Kea Comprehensive Management Plan (CMP), 2009

Site visits were conducted from October 6 through 9, 2008. The purpose of these visits was to document existing views. Additional visits were made thereafter to take photographs of the summit from various viewpoints.

2.2 Establishing the Affected Environment

2.2.1 Viewer Groups

The potential visual impact of the proposed TMT Observatory at the proposed13N site and the alternative E2 site depends on the type, or group, of people at a location, their activity, and their expectation of their experience. An assessment of the various viewer groups and their expectations was made.

2.2.2 Viewpoints

Seventeen representative viewpoints were selected to analyze the potential visual impact of locating the TMT Observatory on Maunakea. These viewpoints are locations such as population centers, resorts, Department of Hawaiian Home Lands (DHHL) land, and culturally important locations where various activities occur and where the identified viewer groups would visit. The viewpoints are all located in the northern portion of the island because both the proposed 13N site and the alternative E2 site for the TMT Observatory are north of and below the summit of Maunakea, within Area E as designated in the 2000 Master Plan and would not be visible from the southern portion of the island.

For the purpose of this report the primary view from a viewpoint is the orientation of the most visually prominent feature. The direction of the primary view from a viewpoint was determined by considering the viewer group and the activities at that location. For example, at a beach viewpoint where the main activity is sightseeing and swimming, the primary view would be toward the ocean. For those viewpoints where the panoramic view is important to the viewer group and the activity at that location, no primary view has been specified.

2.3 Visual Consequences

The analysis of potential visual impacts from the TMT Observatory at the proposed 13N site and the alternative E2 site includes four elements: 1) a viewshed analysis, including quantifying the area of the island and the island's population that could see it; 2) whether it would be visible within the direction of the primary view; 3) whether it would be in silhouette; and 4) photo simulations from select viewpoints where the TMT Observatory would be visible.

2.3.1 Viewshed Analysis

The first step in the analysis of visual consequences is a viewshed analysis. The viewshed of the TMT Observatory was calculated in terms of the percent of the area of the island where it could be visible, and the percent of the island's population that could see it.

The viewshed for the TMT Observatory was calculated using specific latitude and longitude points and a height for the facility of 180 feet above grade. Topographic data from the U.S. Geological Survey (USGS) was used; specifically the National Elevation Dataset (NED)[3]. Geographic Information Systems (GIS) software was used to determine areas on the island where at least the top of the TMT Observatory could be visible. The NED is used as a three dimensional (3D) surface in GIS. The topographical changes were calculated using Environmental Science Research Institute's ArcGIS software package and the associated 3D analyst extension. The viewshed analysis does not take into consideration existing vegetation or structures, which may further obstruct views. Therefore, the viewshed analysis can be considered a worst case scenario.

Once the viewshed was established, 2000 U.S. Census data for the County of Hawai‘i was used to determine the population within the viewshed. Population data was taken at the block level, the smallest area in which census data is collected.

2.3.2 Primary View

If the viewshed analysis determined that the TMT Observatory would be visible from a viewpoint it was then determined whether it would be visible within the direction of the primary

[3] The USGS National Elevation Dataset (NED) has been developed by merging the highest-resolution, best quality elevation data available across the United States into a seamless raster format. NED is the result of the USGS effort to provide 1:24,000-scale Digital Elevation Model (DEM) data for the conterminous US and 1:63,360-scale DEM data for Alaska. The dataset provides seamless coverage of the United States, HI, AK, and the island territories. NED has a consistent projection (Geographic), resolution (1 arc second), and elevation units (meters). The horizontal datum is NAD83, except for AK, which is NAD27. The vertical datum is NAVD88, except for AK, which is NAVD29. NED is a living dataset that is updated bimonthly to incorporate the "best available" DEM data. As more 1/3 arc second (10m) data covers the US, then this will also be a seamless dataset.

view. This criterion is not applicable to viewpoints where the panoramic view is important to the viewer group and the activity at the location.

2.3.3 Silhouette View

If the viewshed analysis determined that the TMT Observatory could be visible from a viewpoint it was then determined whether the view of the facility would be a prominent silhouette against the sky, or whether it would be seen against the backdrop of Maunakea or one of the existing observatories. The silhouette analysis consists of a profile of the topography between a viewpoint and the TMT Observatory and a line of sight extended from a representative viewer (with a height of 6 feet) at a viewpoint to the top of the proposed TMT Observatory and beyond. If the line of sight extended into the mountainside the view of the TMT Observatory would be against the backdrop of Maunakea; if the line of sight extended into air the view would be either a full or partial silhouette view.

To determine the amount of the TMT Observatory that would be in partial silhouette, a line was drawn from the viewer and tangent to the top of the first rise of Maunakea either in front of or behind the TMT Observatory. If the line is tangent to a rise of Maunakea that is behind the TMT Observatory, the portion between the two lines is the amount that would be in silhouette. If the line is tangent to a rise of Maunakea that is in front of the TMT Observatory the portion below that line would not be visible from that viewpoint; the portion between the two lines is the amount that would be visible and in silhouette.

2.3.4 Photo Simulations

Photo simulations of the TMT Observatory at the proposed 13N site were done for select viewpoints. These simulations help to evaluate the potential visual impact of the TMT Observatory in the context of its proposed setting. To evaluate the visual impact of the color and material of the dome enclosure, simulations of the TMT Observatory were prepared with the dome covered in different exterior finishes and set against the bare summit as well as the summit covered in snow.

To create these simulations, photos of the summit of Maunakea were acquired from the Canada–France- Hawai‘i Telescope (CFHT) with accompanying information such as camera type, lens and frame size, and the latitude and longitude locations of where the photos were taken. The photos used in the simulation were taken with a 600 millimeter (mm)/5.6 telephoto lens that shows the summit of Maunakea and the observatories as if a viewer was looking through binoculars. For a “naked eye” perspective, Project personnel took photos from the representative viewpoints using a 50mm focal length, which best approximates what the human eye sees. While in the field, Project personnel also held a ruler at arms length and measured the distance between the existing observatories. This provided an example of the scale of the existing observatories within the view of a typical viewer. For example, the distance between the Keck and Subaru Observatories is 1 mm.

Terrain data, or DEM (Digital Elevation Model), was acquired from the USGS Seamless Data Distribution Center. The Project’s architect provided a 3D model of the TMT Observatory along with the latitude, longitude and elevation for the location of the proposed structure. Latitude, longitude and elevation data was also acquired for the existing observatories on Maunakea.

Using the above information a 3D model of the summit of Maunakea and the proposed TMT Observatory was created. Within the 3D model a “camera” was created and positioned based on imported location points, and the lens and frame size of the camera used in the original photo. The 3D camera position was further refined by camera matching, a technique where the 3D camera view is slightly modified to allow for the 3D structures to align with coinciding objects seen in the original photograph. 3D lighting was approximated based on the time of day seen in the photograph. Finally, a composite image was created from a 2D rendering of the TMT Observatory and the original photograph.

2.4 Mitigation

The visual impact of the TMT Observatory is due to its proposed size and location on Maunakea, as well as its proposed design and exterior coating of the dome; these aspects of the TMT Observatory were examined to assess how the Project could mitigate its potential visual impacts.

3.0 Affected Environment

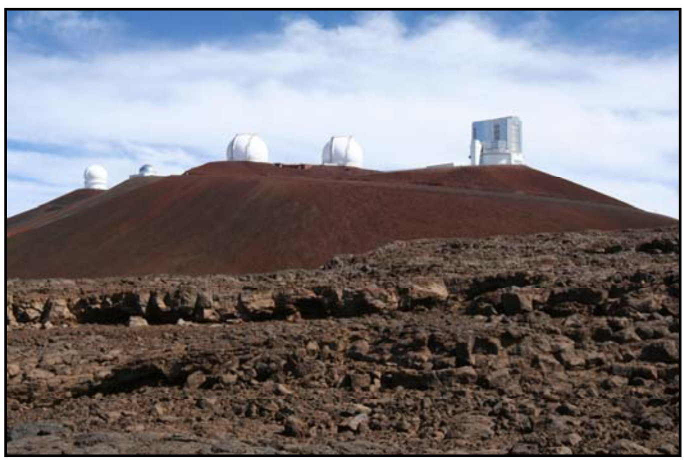
This section describes the existing visual environment related to Maunakea.

3.1 Maunakea

The Island of Hawai‘i’s landscape and visual resources are varied. On the northern tip the coast is rugged, covered in dense vegetation and dotted with waterfalls and rivers. Inland, around the town of Waimea (at an elevation of 4,000 feet), the landscape is comprised of rolling pastures used for cattle ranching. The west side of the island consists of popular resorts and beaches but lacks vegetation. The southern and southeastern portions of the island receive lots of rainfall and are covered with lush vegetation; Volcanoes National Park is located in this area. The eastern portion of the island consists of steep terrain with dramatic views of the rain forest and cliffs along the coast.

Maunakea is the highest peak on the island, with an elevation of 13,796 feet above sea level. In contrast to the lush coastal areas, the summit of Maunakea is an alpine ecosystem. Above the tree line at roughly 9,500 feet, there is little more than low shrubs and above 12,800 feet the vegetation consists mainly of lichens, mosses and small ferns that grow in the cracks and crevices of the cinder cones that comprise the mountain’s dome. A small alpine lake, Lake Waiau, is situated on the upper southern flank of the mountain. The summit of Maunakea is often obscured by vog, which is volcanic smog that is formed when sulfur dioxide and other volcanic gases emitted from Kīlauea mix with oxygen, moisture and sunlight. The vog has been especially thick since February 2008 when gas emissions from Kīlauea dramatically increased.

Maunakea is one of the best locations in the world for ground-based astronomical observations. The first telescope on the summit of Maunakea was constructed in 1964. Today, there are 11 observatories on Maunakea within the designated Astronomy Precinct and a twelfth located at a lower elevation. The existing facilities are visible from locations as around the island including Hilo, Honoka‘a and Waimea. On the west coast of the island the existing telescopes appear most visible at sunset, when they are lit by the setting sun; on the east coast the existing telescopes appear most visible at sunrise.



Existing telescopes on Maunakea as seen from Area E.

3.1.1 Scenic Vistas and Viewplanes

The State of Hawai‘i Administrative Rules (HAR) Title 11, Chapter 200, § 11-200-12, lists the significance criteria for a State EIS. A proposed action is judged against these criteria to determine whether it would have a significant effect on the environment or not. A significant adverse impact on the visual setting would occur, according to Significance Criteria 12, if an action:

> *"Substantially affects scenic vistas and viewplanes identified in county or state plans or studies"*

The County of Hawai‘i's 2005 General Plan includes a chapter on Natural Beauty that recognizes the importance of preserving the island's natural and scenic beauty. The chapter includes goals, policies and standards to identify and protect scenic vistas and viewplanes. Goal 7.2(b) is to "Protect scenic vistas and view planes from becoming obstructed." Section 7.4 also provides guidelines for designating sites and vistas of extraordinary natural beauty to be protected, and includes the standard "Distinctive and identifiable landforms distinguished as landmarks, e.g. Mauna Kea, Waipio Valley."

Around the island, the following natural beauty sites have been identified that include Maunakea:

- View of Maunakea and Maunaloa from Pāhoa-Kea'au, Volcano-Kea'au Roads, and various Puna subdivisions
- Viewpoint of Hilo Bay with Maunakea in background
- Mauna Kea State Park area

In addition, the South Kohala Development Plan (County of Hawai‘i, 2008) includes a policy to preserve Waimea's sense of place. The plan recommends the strategy to "protect the pu'u of Waimea that have cultural, historical and visual importance" and which have "grand views of Mauna Kea".

3.1.2 Viewer Groups

According to 2000 U.S. Census data, the Island of Hawai‘i is home to roughly 148,000 people. The largest cities are Hilo on the east coast (with about 41,000 residents) and Kailua-Kona on the west side (with about 10,000 residents). There are also several smaller towns such as Waimea, Honoka‘a and Hāwī.

Tourism is an important industry for the State of Hawai‘i, and the Island of Hawai‘i is famous for its volcanoes, namely Kīlauea, which has been active for more than two decades. The island is also popular for its beaches and recreational opportunities, including snorkeling, scuba diving, and golf.

In Hawaiian culture Maunakea is recognized as a sacred place. Similar to other Polynesian cultures, Native Hawaiians believed the highest points of their land were most sacred. Maunakea was host to early Hawaiian traditions including religious practices, study of the heavens, and tool making in the Keanakako'i adze quarry. Lake Waiau was believed to contain pure water which was used in healing and worship practices. Today, there are still Hawaiians who go to Maunakea for prayer and restoration.

The people that view the island, and more specifically Maunakea, can be categorized into three groups, each with a different expectation of their visual experience:

Existing shrine on the summit of Mauna Kea.

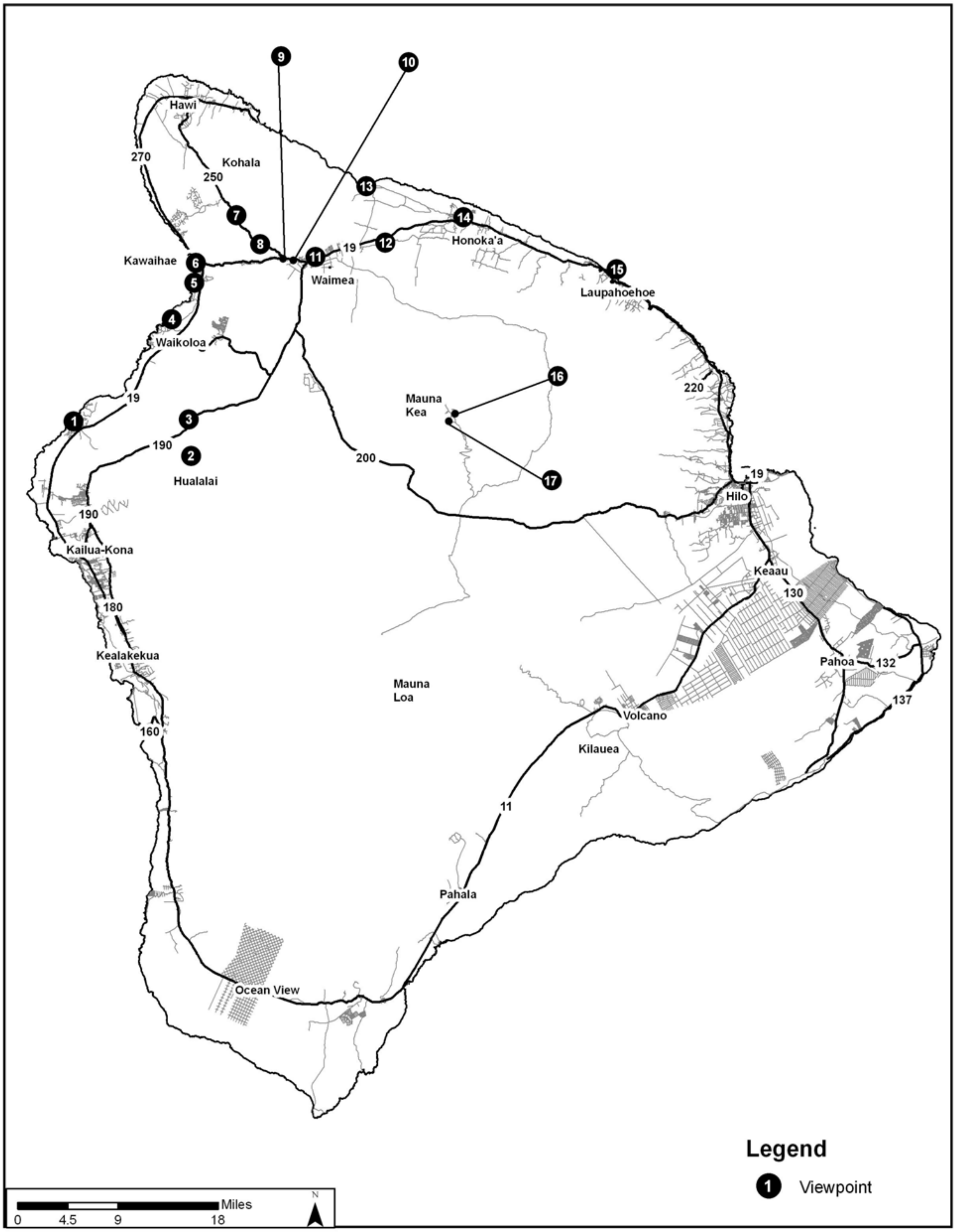
- *Residents* – Residents place value on the existing condition of the surrounding landscape, particularly as viewed from their homes. Residents would also have views of the island and Maunakea from public places such as commercial centers, beaches and state parks. Residents experience the island's visual resources, including Maunakea, frequently and for a long duration.
- *Sightseers* – Sightseers visit the island to view the landscape, including the beaches and volcanoes, and to enjoy recreational activities. Sightseers would visit the larger cities of Kailua-Kona and Hilo for shopping, dining, and touring activities, and would take scenic drives along the island stopping at scenic overlooks. Sightseers may also be interested in astronomy and visit the observatories on Maunakea. Sightseers would have a temporary experience of Maunakea and the island's visual resources.
- *Cultural Practitioners*[4] – Cultural Practitioners are Native Hawaiians who, as individuals or groups, may visit Maunakea for worship on special occasions or on a regular basis[5]. Cultural Practitioners may also visit other important sites on the island with views of Maunakea. Cultural Practitioners place a high value on the island's visual resources, and particularly on pristine views of Maunakea.

3.1.3 Viewpoints

Seventeen representative viewpoints within the northern portion of the island have been identified as places that are of visual significance to the island's three viewer groups. The viewpoints are all located in the northern portion of the island because the proposed 13N site and the alternative E2 site for the TMT Observatory are north of and below the summit of Maunakea and would not be visible from the southern portion of the island. Figure 3-1 maps the locations of the 17 representative viewpoints.

[4] This report only discusses the project's potential visual impact. For more information on impacts to cultural sites or practices please see Appendix D of the TMT Project Draft EIS, the Cultural Impact Assessment.
[5] OMKM, 2000.

Figure 3-1. Viewpoints Used for the Visual Analysis



Primary view from Viewpoint # 13 – Waipio Valley Lookout

Table 3-1 provides the name and description of each viewpoint, including the main activity that occurs at that location, and states the primary viewer group at the viewpoint. For example, at the Waipio Valley Lookout the primary viewer group is Sightseers. For the Hualālai Resort, Big Island Country Club, Hāpuna Beach and Puukohola Heiau State Park, both Residents and Sightseers have been listed as the primary viewer group because of the range of activities that occur at these locations.

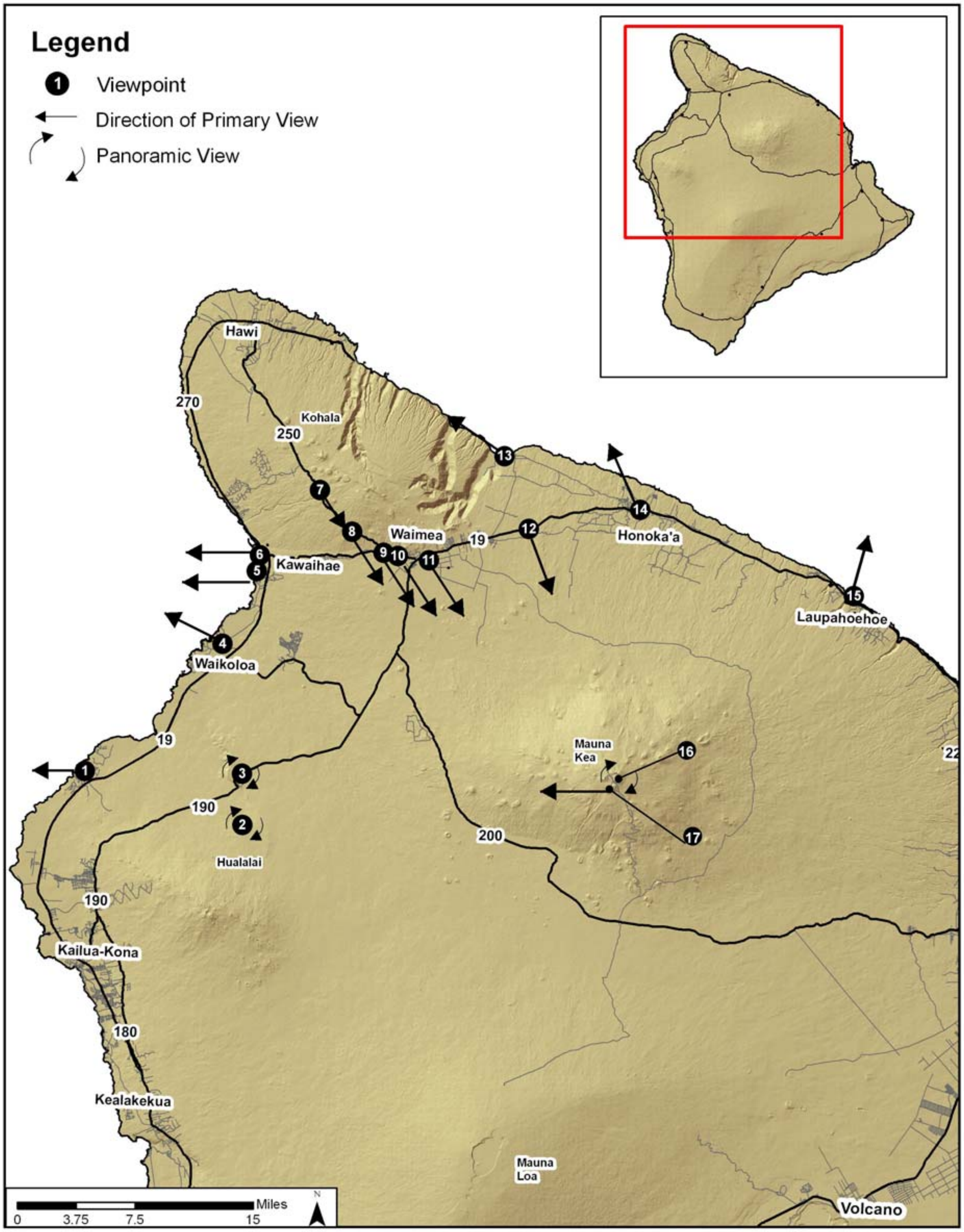
Finally, Table 3-1 states the direction of the primary view from each viewpoint; the orientation of the most visually prominent feature. The primary view has been determined relative to the viewer group and the activities at the viewpoint. The primary view for viewpoints near the coast, such as Hāpuna Beach and Laupāhoehoe Point, is toward the ocean (makai). For viewpoints that are more inland, such as the Route 250 Puu overlook and Waimea Park, the primary view is towards Maunakea (mauka). At the Big Island Country Club, the panoramic view is important to the viewer group and the location's use. The direction of the primary view from each viewpoint is mapped in Figure 3-2.

Appendix A includes a photograph of or from the viewpoints. It has been noted if the photograph is of the primary view from the viewpoint.

Table 3-1. Description of Viewpoint, Viewer Group and Primary View Direction

Viewpoint	Location	Description	Viewer Group	Primary View
1	Hualālai Resort	Exclusive, luxury residential community and hotel.	Residents / Sightseers	West toward the ocean (makai)
2	Pu'u Waawaa	Summit of cinder cone that is of cultural importance to Native Hawaiians.	Cultural Practitioners	Panoramic
3	Big Island Country Club	Independent (non-resort affiliated) daily-fee golf course. The club includes views of the coastline and of Maunakea.	Residents / Sightseers	Panoramic
4	Waikoloa/Mauna Lani	Resort development.	Sightseers	West makai
5	Hāpuna Beach	Public beach near a resort.	Sightseers / Residents	West makai
6	Puukohola Heiau	National historic site and Spencer Beach Park, which includes camping and picnic areas along a beach.	Residents / Sightseers	West makai
7	DHHL Kawaihae at Route 250	Summit of Highway 250 between Waimea and Hāwī.	Residents	Southeast toward Maunakea (mauka)
8	Route 250 Pu'u overlook	Gravel shoulder where cars can pull off of the highway and view Maunakea and North Kona/South Kohala.	Sightseers	Southeast mauka
9	DHHL Lalamilo	Residential neighborhood within Waimea.	Residents	Southeast mauka
10	Waimea Park	Athletic facilities for sports such as baseball and tennis, near a school.	Residents	Southeast mauka
11	DHHL Pu'u Kapu	Residential neighborhood within Waimea.	Residents	Southeast mauka
12	DHHL Waikoloa-Waialeale	Along Old Mamahaloa Highway through ranch lands.	Residents	South mauka
13	Waipio Valley Lookout	Formal lookout with parking lot and trail to scenic view.	Sightseers	Northwest along the coast
14	Honoka'a	Main road into town.	Residents	Northwest up the coast
15	Laupāhoehoe Point	State park with parking lot and picnic facilities along the coast.	Sightseers	Northeast makai
16	Maunakea Summit	Highest point on Maunakea, recognized as a sacred place to Native Hawaiians.	Cultural Practitioners	Panoramic
17	Lake Waiau	Small lake near the summit of Maunakea, accessible by a trail. Waters used for healing and worship practices in Hawaiian culture.	Cultural Practitioners	West over the lake

Figure 3-2. Primary View from Viewpoints



3.1.4 Existing Telescopes on Maunakea

There are 11 existing observatories near the summit of Maunakea, eight of which are optical/infrared and three of which are submillimeter/radio observatories. The heights of these existing observatories range from a little over 20 feet to 150 feet. The names, elevation and approximate heights of the existing observatories are listed in Table 3-2. The locations of these observatories within the Astronomy Precinct are shown in Figure 3-3.

Table 3-2. Existing Observatories on Maunakea

Map Number	Observatory	Elevation (feet)	Estimated Max Dome Height from Ground (feet)
Submillimeter/Radio Observatories			
1	California Institute of Technology Submillimeter Observatory (CSO)	13,362	62.5
2	James Clerk Maxwell Telescope (JCMT)	13,466	100
3	Submillimeter Array (SMA)	13,366	32
Optical/Infrared Observatories			
4	Subaru Observatory	13,704	141
5a, 5b	W. M. Keck Observatory (telescopes I and II)	Keck 1: 13,714, Keck 2: 13,659	111
6	NASA Infrared Telescope Facility (IRTF)	13,622	53
7	Canada-France- Hawai‘i Telescope (CFHT)	13,788	124.75
8	Gemini Northern Observatory	13,881	150
9	University of Hawai‘i (2.2m)	13,858	80
10	United Kingdom Infrared Telescope (UKIRT)	13,813	61
11	University of Hawai‘i – Hilo (0.6m)	13,743	20.25

For each individual observatory, Table 3-3 lists the percent of the area of the island where it would and would not be visible, assuming no vegetative or structural obstructions and a clear sky. Figure 3-4 shows the combined visibility of the existing 11 observatories near the summit where the top of at least one of the existing observatories is visible. Individual viewshed maps are included in Appendix B. Based on this analysis, from approximately 43 percent of the island area a viewer would be able to see at least one existing observatory. According to 2000 U.S. Census data, 72 percent of the island’s population (roughly 107,000 people) is within the viewshed of the existing observatories.

Table 3-3. Visibility of Existing Observatories on Maunakea

Observatory		Island Land Area Visibility	Island Land Area without Visibility
Optical/Infrared Observatories			
University of Hawai‘i at Hilo 0.9 m		15%	85%
University of Hawai‘i (2.2 m)		36%	64%
Canada-France-Hawai‘i Telescope (CFHT)		35%	65%
United Kingdom Infrared Telescope (UKIRT)		26%	74%
Gemini Northern Observatory		39%	61%
NASA Infrared Telescope Facility (IRTF)		14%	86%
W. M. Keck Observatory	Keck 1	17%	83%
	Keck 2	16%	84%
Subaru Observatory		20%	80%
Submillimeter/Radio Observatories			

Observatory	Island Land Area Visibility	Island Land Area without Visibility
California Institute of Technology Submillimeter Observatory (CSO)	5%	95%
James Clerk Maxwell Telescope (JCMT)	7%	93%
Submillimeter Array (SMA)	2%	98%

Figure 3-3. Map of Existing Observatories on Maunakea

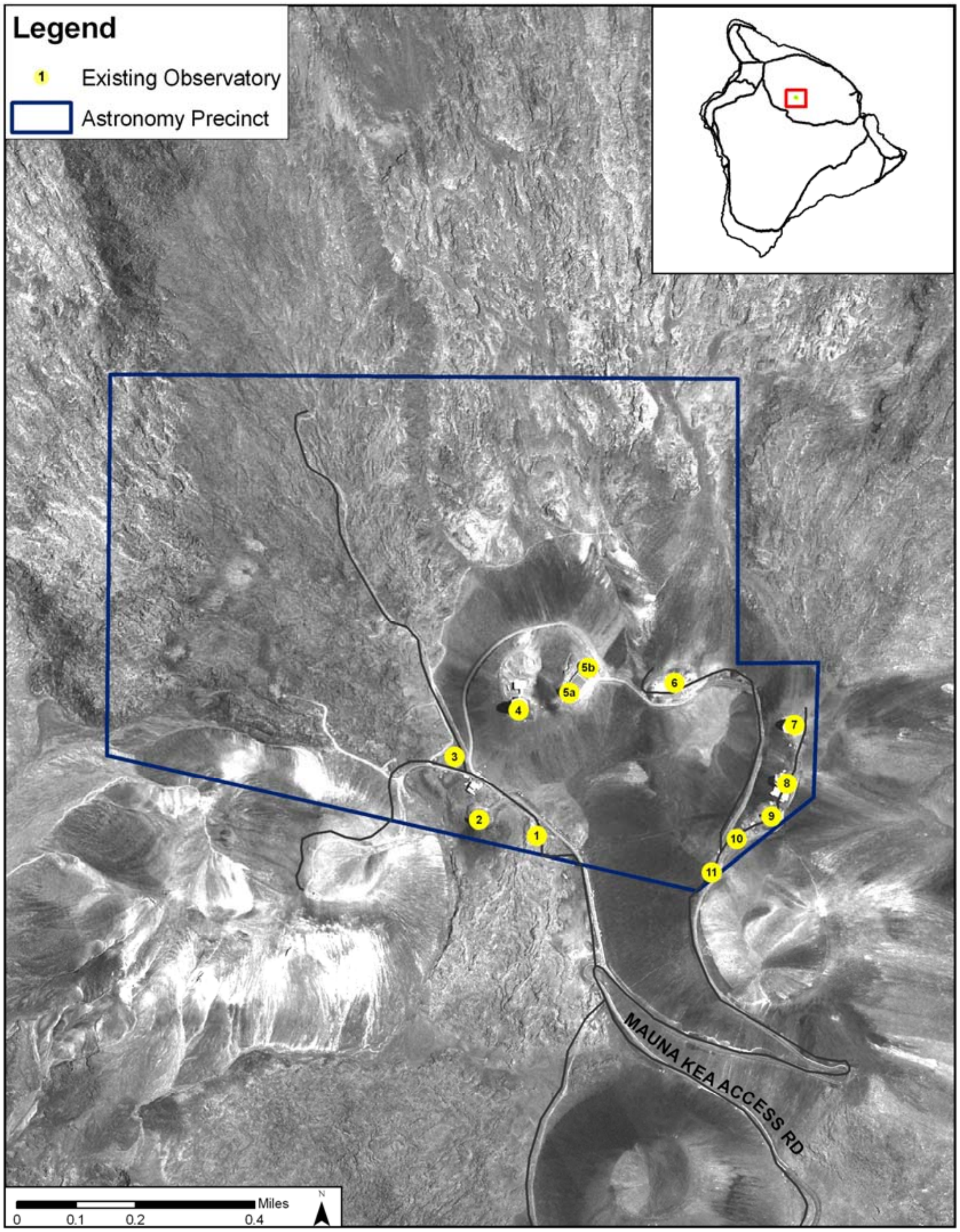
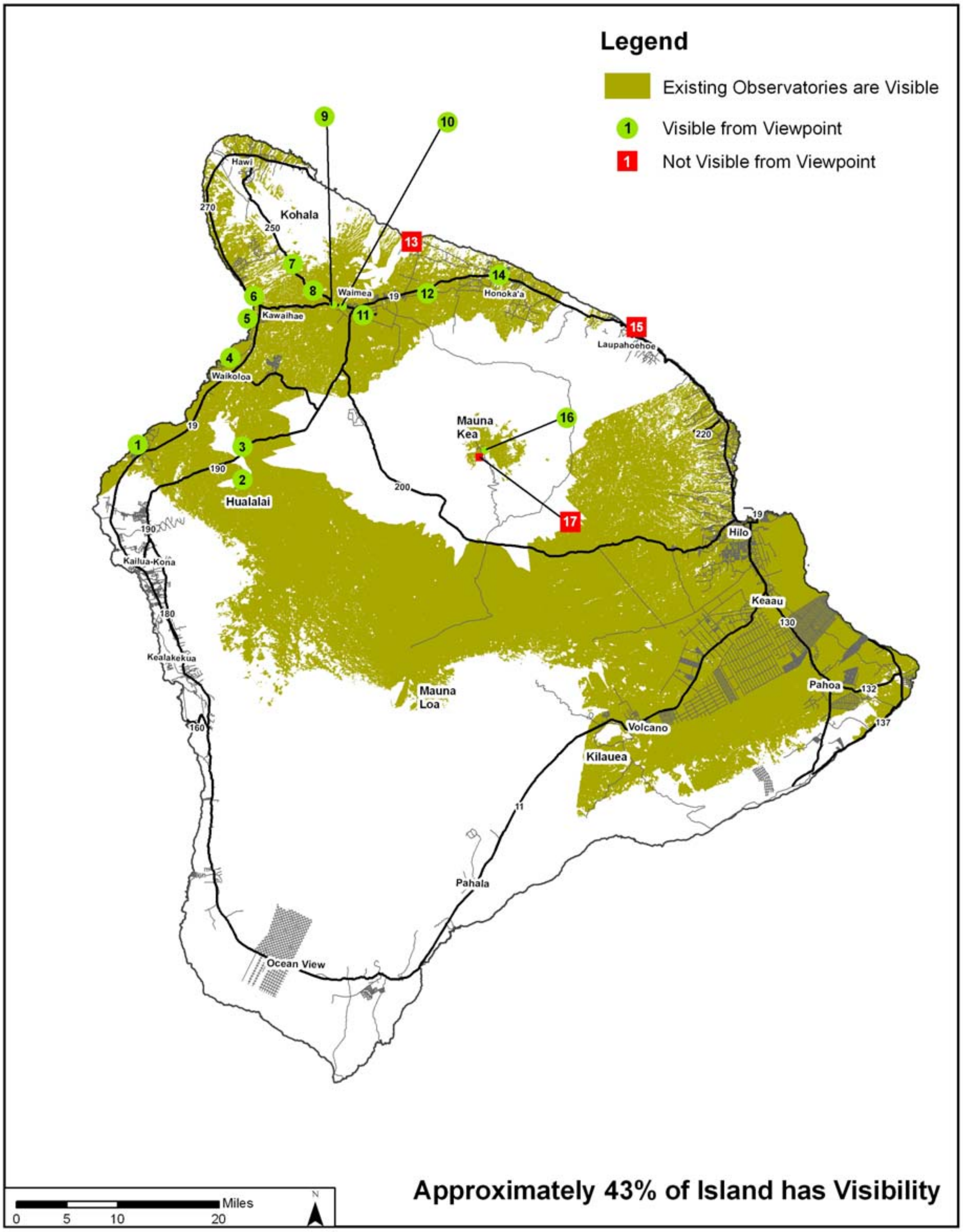


Figure 3-4. Combined Visibility of Existing Observatories on Maunakea



4.0 Consequences

This section presents the potential visual impacts that would occur due to locating the TMT Observatory at the proposed 13N site and the alternative E2 site on Maunakea.

4.1 No Action Alternative

The No Action Alternative considers existing conditions and what would be reasonably expected to occur in the foreseeable future, absent the proposed Project.

Under this alternative, the existing CSO facility on Maunakea would be decommissioned and the SMA would add one more antenna and two more pads in Areas C and D of the Astronomy Precinct. The other existing observatories would remain. These observatories can be seen from 43 percent of the area of the Island of Hawai‘i, as shown in Figure 3-4; approximately 72 percent of the population (roughly 106,000 people) is within this existing viewshed.

TMT would not fund construction, installation, or future operation of the TMT Observatory and its supporting facilities at either Maunakea or Cerro Armazonas. The Pan-STARRS project, a telescope consisting of four mirrors each with a diameter of 6 feet, similar to what is constructed on Haleakala, would occur at the current location of the UH 2.2 Observatory. Also, in the absence of the proposed TMT Observatory, it is possible that in the future another observatory would be developed within Area E pursuant to the CMP.

4.2 Maunakea

The proposed 13N site, and the alternative E2 site, for the TMT Observatory are within the Astronomy Precinct on Maunakea in an area northwest of the summit that was identified in the 2000 Master Plan as Area E. These two sites are shown in Figure 4-1. The 2000 Master Plan for Maunakea identified the Area E location as a potential site for a Next Generation Large Telescope (NGLT), similar to the TMT Observatory, primarily because it minimizes visual impacts.

In addition to the observatory within the Mauna Kea Astronomy Precinct the project would also require a Mid-Level Support Facility that would be located at Hale Pōhaku, at an elevation of 9,300 feet, a Headquarters in Hilo, and a Satellite Office in Waimea. The Mid-Level Support Facility, Headquarters, and Satellite Office are not anticipated to have a visual impact due to their limited visibility and because their design would be similar to other developments in these areas.

Figure 4-1. Proposed 13N Site and Alternative E2 Site

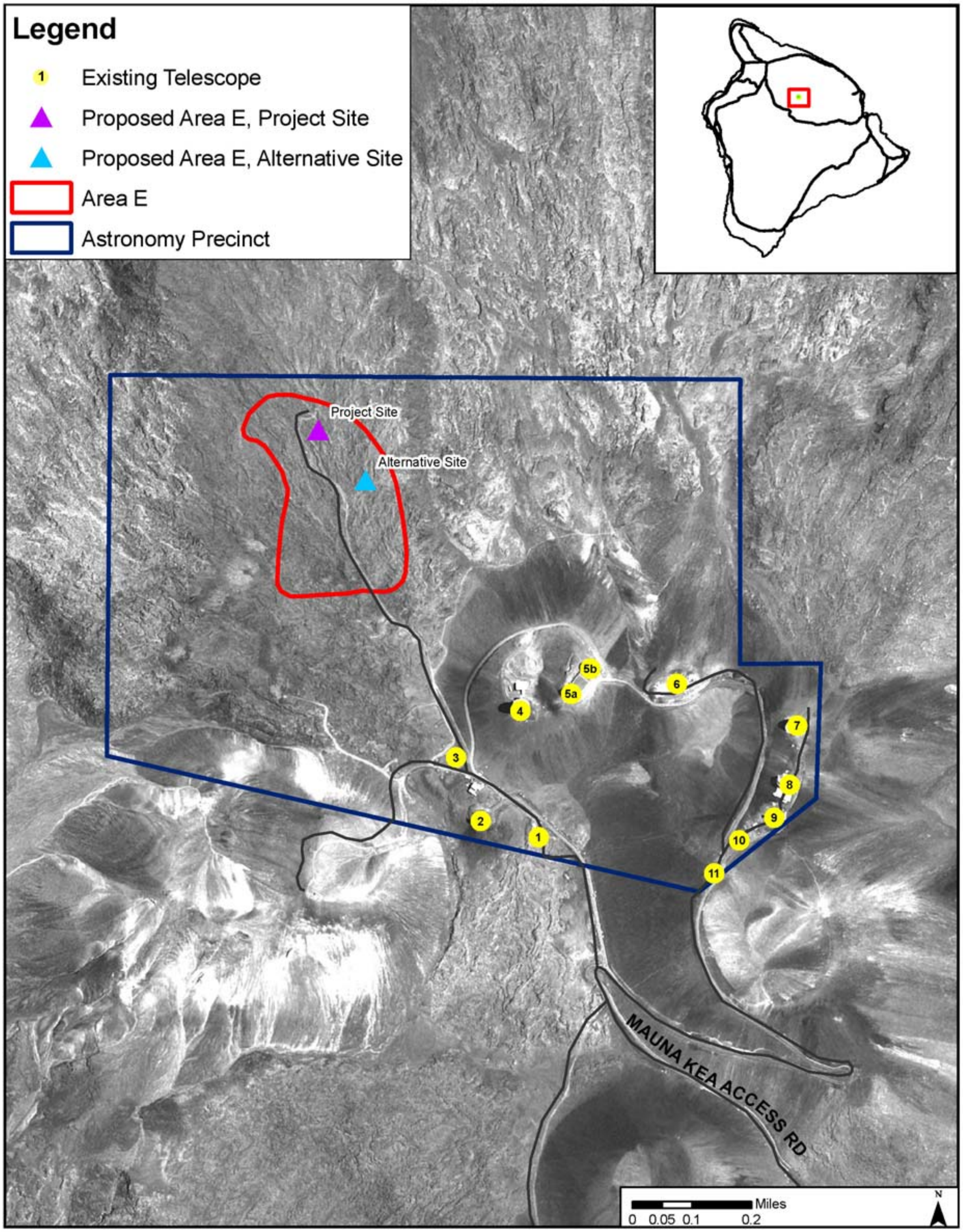


Figure 4-2 provides a simulation and cross section of the proposed design of the TMT Observatory, including the proposed dome enclosure for the telescope and the administrative facilities. In addition to the 13N and E2 sites being below the summit of Maunakea, the cross section shows that part of the TMT Observatory would be below the existing grade, which would further minimize the potential visual impact. The proposed maximum height of the dome enclosure is approximately 180 feet above existing grade; the proposed diameter to the exterior of the structure is 216 feet. To put this height into perspective, the TMT Observatory would be similar to the Ilikai Hotel in Honolulu.

As shown in Figure 4-2, natural colors that blend into the landscape would be used for the exterior of the fixed enclosure and the administrative facilities. The proposed coating of the rotating dome enclosure is a reflective or non-reflective metallic coating similar to that used by the Gemini Observatory. The coating on the outer surface of an observatory dome is important to the function of the telescope. If the telescope and inner structure of the enclosure heat up during the day, or cool below the night air temperature, it causes local air turbulence inside the enclosure that would degrade the telescope image quality. To maintain a consistent temperature inside the dome the TMT Observatory would be constructed with thick insulation and use air conditioning. The proposed metallic exterior coating on the dome would reduce the amount of energy needed to regulate the temperature.

In general, the existing observatories on Maunakea with a metallic coating, such as Gemini, IRTF, and Subaru, reflect the morning sunrise and evening sunset light and stand out during these periods. However, during the majority of the day the metallic coating reflects the sky, which helps reduce the visibility of the observatory.

Visibility of the Adaptive Optics Laser

The proposed TMT Observatory would use an adaptive optics (AO) system on the telescope to correct distortions in the view resulting from atmospheric affects. This greatly improves the image that can be obtained from the telescope. The TMT Observatory would be the first astronomical telescope of its size designed from conception to use AO. The AO system uses a laser pointed into the sky, which could be visible to the naked eye on moonless nights for a distance of 4.5 to 9 miles. Figure 4-3 shows a circle with a 9 mile radius around the proposed location of the TMT Observatory, outlining the maximum potential area where the AO laser may be visible. The area where the laser may be visible consists primarily of ranchlands and forest reserve which are unpopulated. Therefore, the laser used in the AO system is expected to have a less than significant visual impact.

Figure 4-2. Proposed TMT Observatory Design

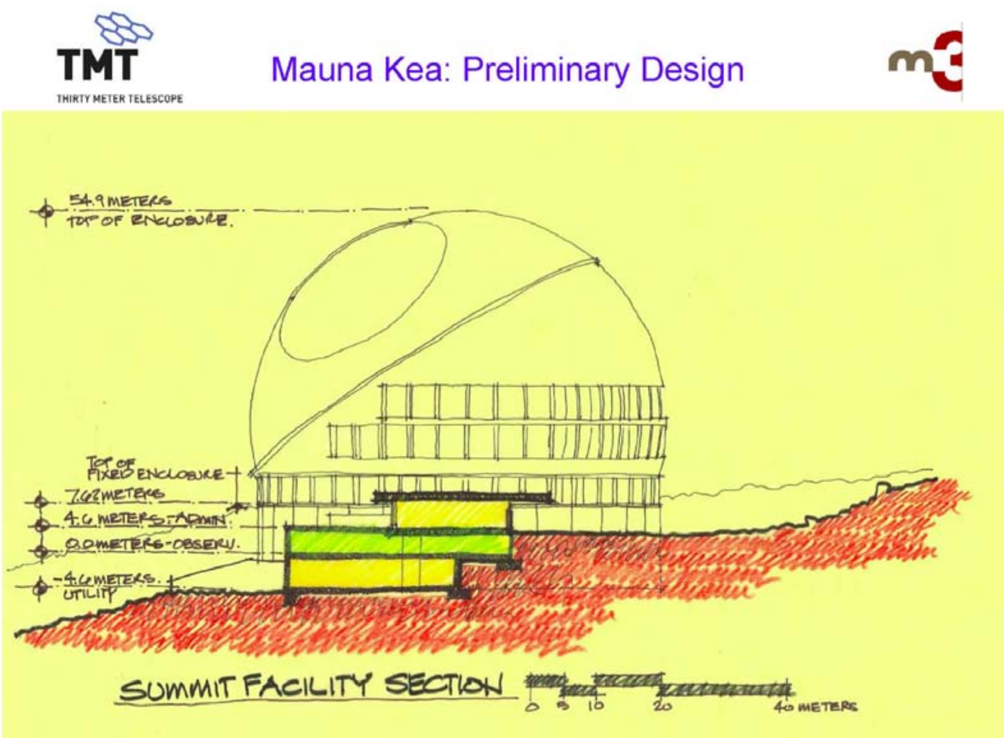
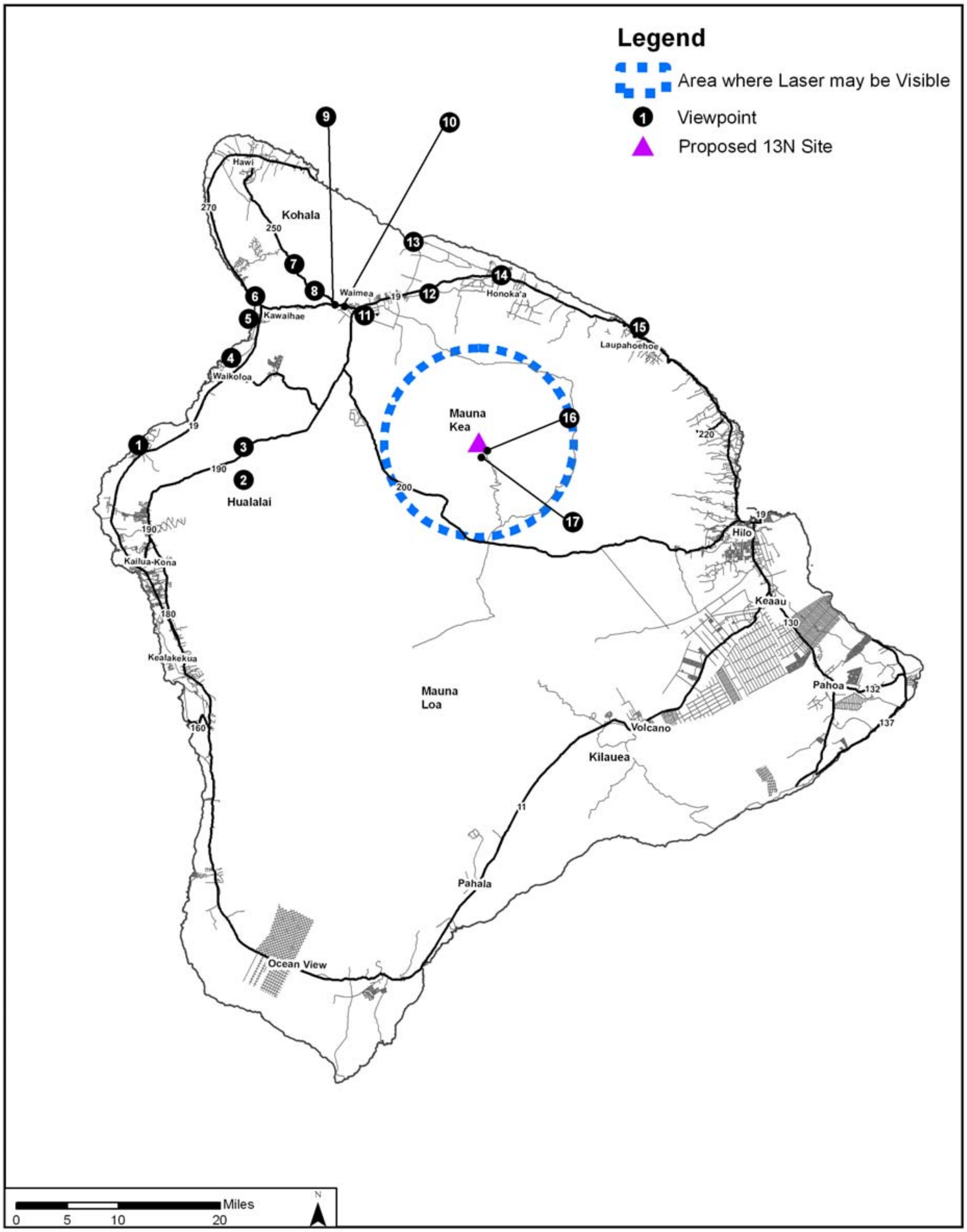


Figure 4-3. Potential Visibility of the TMT Observatory's Adaptive Optics Laser



4.2.1 13N Site

Temporary Impacts

Construction and Decommissioning

Temporary visual impacts from the proposed construction, and the associated future decommissioning, of the TMT Observatory would be due to the presence of construction equipment and workers, material stockpiles, debris and staging areas. Most of the construction staging and material storage would occur in the area around Hale Pōhaku, at an elevation of 9,300 feet, which would not be visible from other areas of the island. Dust, light, and glare emanating from construction activities would also have a temporary visual impact. These temporary impacts would be less than significant.

Long-Term Impacts

Scenic Vistas and Viewplanes

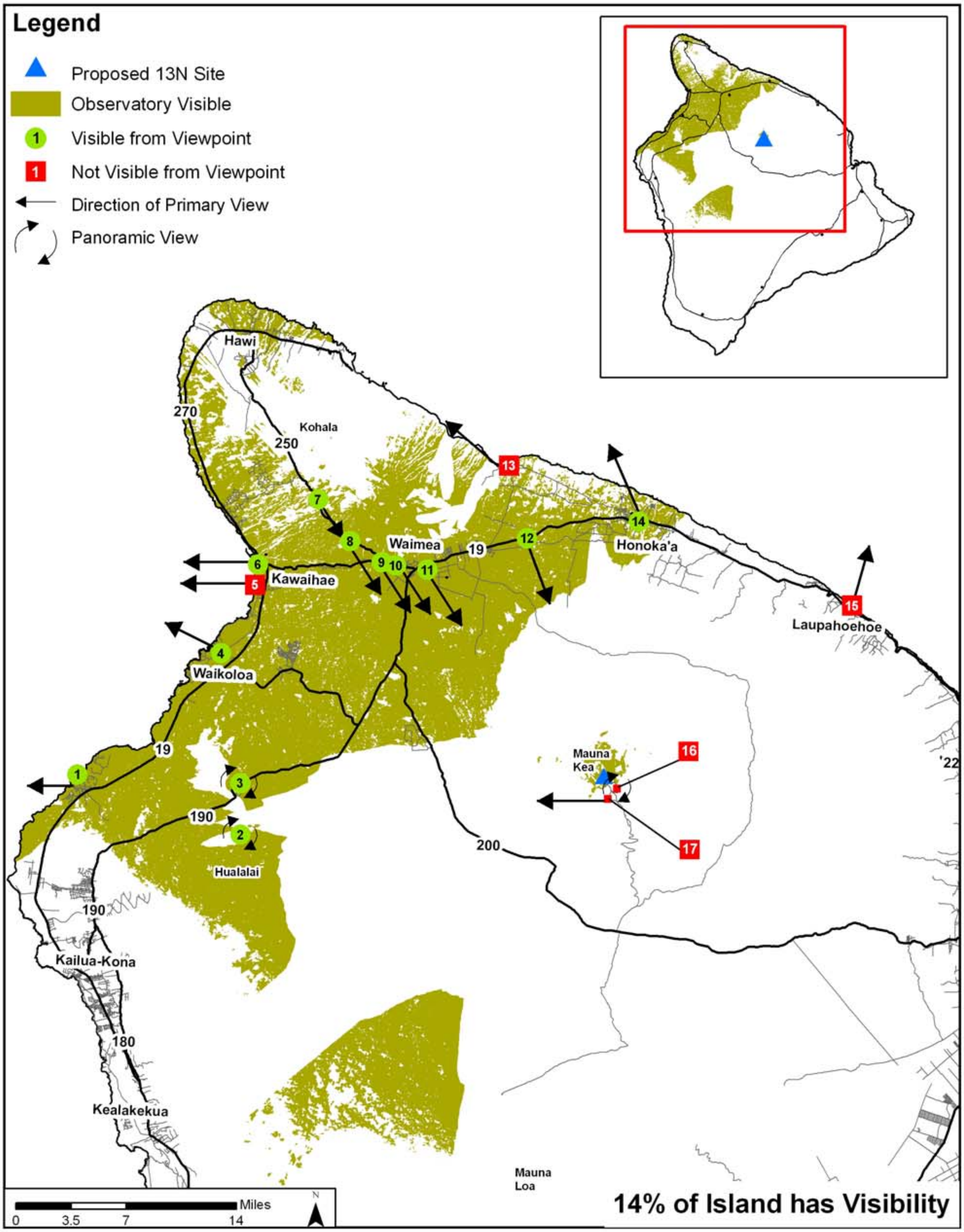
Locating the TMT Observatory at the proposed 13N site would not substantially affect scenic vistas and viewplanes identified in the County of Hawai‘i’s General Plan or the South Kohala Development Plan. The TMT Observatory would not be visible in the view from Hilo Bay with Maunakea in the background. In addition, although the TMT Observatory may be visible in the view of Maunakea from portions of the South Kohala district and the area around Waimea, it would not block the views and viewplanes of the mountain. Therefore, the project would not exceed significance criteria 12 as stated in HAR §11-200-12.

Viewshed Analysis

A viewshed analysis was conducted to assess which areas of the island may have a view of the TMT Observatory at the proposed 13N site. The viewshed analysis is based on topographic information, and it does not include existing vegetation or structures which may further obstruct views of the TMT Observatory. Therefore, the viewshed analysis can be considered a worst case scenario.

The results of this analysis are shown in Figure 4-4. In this figure the shaded portions of the island are areas where at least the top of the TMT Observatory would be visible. For the 17 representative viewpoints, a green circle shows that the TMT Observatory would be visible and a red square means it would not be visible. The TMT Observatory could be visible from viewpoints 1-4, 6-12, and 14. The TMT Observatory would not be visible from viewpoints 5, 13 and 15-17.

Figure 4-4. Proposed 13N Site - Viewshed and Primary View Analysis



The viewshed analysis confirms that, because it would be located north of and below the summit of Maunakea, the TMT Observatory would not be visible in the southern portion of the island, including the larger cities of Hilo and Kailua-Kona. According to the viewshed analysis the TMT Observatory would be visible from 14 percent of the area of the island (see Table 4-1). According to 2000 U.S. Census data, approximately 15.4 percent of the island's population (approximately 23,000 people) would live within the viewshed of the TMT Observatory at the proposed 13N site.

Table 4-1. Visibility of the Proposed 13N Site

Visibility	Area of Island (%)	Hawai'i's Population	
		%	People
Visible	14%	15.4%	23,000
Not Visible	86%	84.6%	125,000

Table 4-2 divides the viewshed, and the population within the viewshed, into five areas: Waimea, Honoka'a, Hāwī, Waikoloa and Kawaihae, and Hualālai. Of these areas, the TMT Observatory would be visible in the primary view direction only from the area around Waimea. For the other four areas the primary view direction is makai. Of the island's population, 5.5 percent (approximately 8,100 people) are within the area around Waimea and may be able to see the TMT Observatory.

Table 4-2. Visibility of the Proposed 13N Site within the Primary View Direction

Location	Hawai'i's Population		Primary View Direction?
	%	People	
Waimea	5.5%	8,100	Yes
Honoka'a	2.8%	4,200	No
Hāwī	2.6%	3,900	No
Waikoloa and Kawaihae	4.3%	6,400	No
Hualālai	0.2%	303	No

Primary View

Of the 12 viewpoints where the TMT Observatory may be visible, it would not be within the primary view of four: the Hualālai Resort (1), Waikoloa/Mauna Lani (4), Puukohola Heiau (6) and Honoka'a (13). At these coastal locations, the primary view is makai.

The TMT Observatory could be visible and in the primary view direction from viewpoints along Highway 250 (7 and 8) and around the town of Waimea (9, 10, 11 and 12). The TMT Observatory could also be visible from the Big Island Country Club (3) and from the summit of Pu'u Waawaa (2), where the panoramic view of the water, the surrounding area, and Maunakea would be important to the viewer.

Silhouette View

For the 12 representative viewpoints where the TMT Observatory may be visible, an analysis of the line of sight from the viewpoint to the TMT Observatory was conducted to determine whether the view of the facility would be a full or partial silhouette against the sky, or whether it would be seen against the backdrop of Maunakea. For some of these 12 viewpoints the silhouette analysis showed that the view of the TMT Observatory would be partially obstructed from a rise between the viewer and the viewpoint. Table 4-3 summarizes the silhouette analysis for the TMT Observatory at the proposed 13N site. The results of the silhouette analysis are in Appendix C.

Table 4-3. Proposed 13N Site - Silhouette Analysis

Viewpoint	Location	Portion of TMT Observatory in Silhouette		
		None	Partial	Full
1	Hualālai Resort	--	164 feet (50 m)	--
2	Pu'u Waawaa	--	58 feet (17 m)	--
3	Big Island Country Club	--	82 feet (25 m)	--
4	Waikoloa/Mauna Lani	--	164 feet (50 m)	--
5	Hāpuna Beach	Not Visible		
6	Puukohola Heiau	--	164 feet (50 m)	--
7	DHHL Kawaihae at Rt. 250	X	--	--
8	Route 250 Pu'u overlook	X	--	--
9	DHHL Lalamilo	--	49 feet (15 m)	--
10	Waimea Park	--	89 feet (27 m)	--
11	DHHL Pu'u Kapu	--	98 feet (30 m)	--
12	DHHL Waikoloa-Waialeale	--	164 feet (50 m)	--
13	Waipio Valley Lookout	Not Visible		
14	Honoka'a	--	82 feet (25 m)	--
15	Laupāhoehoe Point	Not Visible		
16	Maunakea Summit	Not Visible		
17	Lake Wai'au	Not Visible		

From the two viewpoints along Highway 250 (7 and 8), the view of the TMT Observatory would not be in silhouette; it would be visible against the backdrop of Maunakea. This may reduce the prominence of the TMT Observatory in the view from these locations, particularly during sunset when Maunakea would be back-lit by the setting sun. None of the other 10 viewpoints would have a full silhouette view of the TMT Observatory.

From the coastal locations of Hualālai Resort (1), Waikoloa/Mauna Lani (4) and Puukohola Heiau (6), approximately 165 feet of the TMT Observatory would be in silhouette. From the town of Honoka'a (14), approximately 80 feet of the TMT Observatory would be in silhouette. However, from these viewpoints the TMT Observatory would not be located within the direction of the primary view, which is makai.

In the area around Waimea (viewpoints 9 through 12), where the TMT Observatory would be visible within the direction of the primary view, the amount of the partial silhouette would range from 50 feet to 165 feet. The silhouette analysis also showed that from the Big Island Country Club (3) and Pu'u Waawaa (2) the view of the TMT Observatory would be partially obstructed by a rise of Maunakea between the viewer and the observatory. From portions of the Big Island Country Club (2) the top 80 feet of the TMT Observatory would be visible and in silhouette; from the summit of Pu'u Waawaa (3) the top 55 feet would be visible and in silhouette.

The existing observatories on the summit of Maunakea can also affect the silhouette view. From some areas on Hawai'i, the view of the TMT Observatory would be in front of Keck I, Keck II, or Subaru. These areas are shown in Figure 4-5.

Figure 4-5. Area where TMT would be Viewed in front of an Existing Observatory

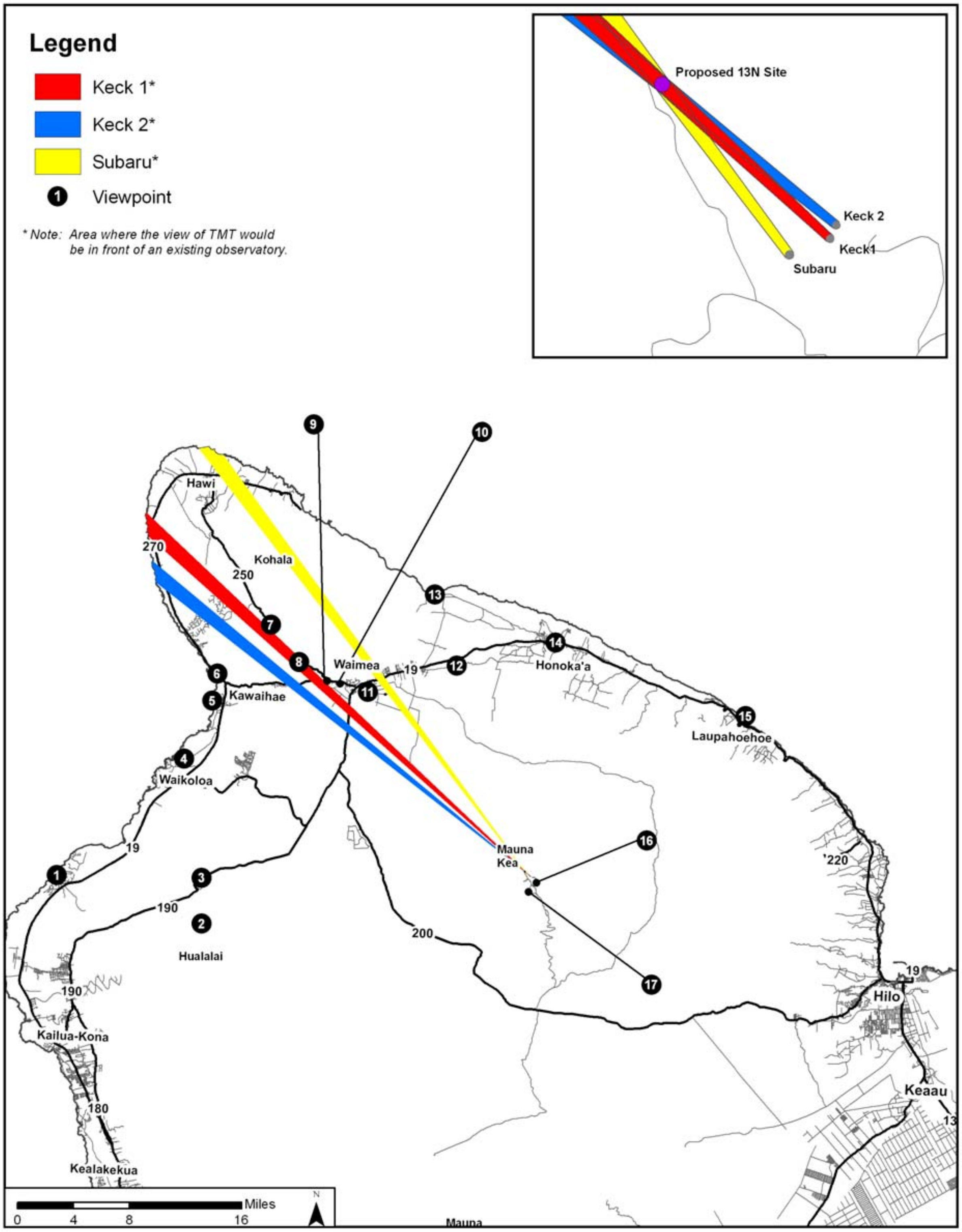


Photo Simulations

Photo simulations of the TMT Observatory at the proposed 13N site were created using views from Waimea, Honoka‘a (in the area around viewpoint 12), and Waikoloa. The photos used in these simulations were taken with a 600 mm/5.6 telephoto lens, creating a binocular view. For comparison purposes a naked eye view, without the aid of binoculars or a telephoto lens, from Waimea, Honoka‘a and Waikoloa are also provided. These naked eye photos show how, from these locations that are approximately 19 miles from the summit of Maunakea, the existing observatories appear quite small and do not occupy much of the total view. The naked eye view of the TMT Observatory on Maunakea would be similar. Because the size and design of the TMT Observatory would not be discernable from the naked eye perspective, simulations at this scale were not prepared.

An example of the naked eye view of Maunakea from Waimea is shown in Figure 4-6. Figure 4-7 is a binocular view simulation of the TMT Observatory in the proposed 13N site from Waimea. This simulation shows how the location of the TMT Observatory would be below the summit of Maunakea and the existing observatories. In this view the lower portion of the TMT Observatory would be obscured behind a rise of Maunakea and it would be located in front of one of the existing domes of the Keck Observatory.

In Figure 4-7 the TMT Observatory is shown with a metallic coating on the dome enclosure. In Figure 4-8 the TMT Observatory is shown with a white exterior finish and in Figure 4-9 it is shown in a brown finish. The visual impact of the dome’s exterior finish partly depends on the colors in the landscape of the summit of Maunakea. For much of the year the summit of Maunakea has a reddish-brown color from the volcanic rock, while in the winter months the summit is white from snow cover. Figure 4-10 throughPhoto Credit: Charles R. West Photography

Figure 4-12 provide a photo simulation of the TMT Observatory, as viewed from Waimea, with the three proposed exterior finishes when Maunakea is covered with snow.

Figure 4-13 shows the naked eye view from Honoka‘a. Figure 4-14 through

Figure 4-16 are binocular view simulations of the TMT Observatory, in the proposed 13N site, near Honoka‘a (in the area around Waikoloa-Waialeale, viewpoint 12) with the metallic, white, and brown exterior finishes when Maunakea is covered in snow.

Figure 4-17 shows the naked eye view from Waikoloa in the northwest portion of the island. Figure 4-18 shows a binocular view simulation of the TMT Observatory, in the proposed 13N site with a metallic finish, as seen from Waikoloa. Figure 4-19 throughFigure 4-21 are binocular view simulations of the TMT Observatory, as seen from Waikoloa when Maunakea is covered in snow, with the metallic, white, and brown exterior finishes.

As shown in these simulations while the white finish visually blends in with Maunakea when it is snow covered, it would be more visually prominent when the summit is bare. Conversely, the brown finish may blend better with the bare volcanic rock at the summit, but would stand out more during the snow covered months. The metallic exterior finish reflects the colors of the sky and ground, which would better reflect its setting and have a reduced visual impact year round.

Figure 4-6. Naked Eye View of Maunakea from Waimea

Figure 4-7. Simulation of TMT Observatory, Metallic Finish – Binocular View from Waimea

Photo Credit: CFHT

Figure 4-8. Simulation of the TMT Observatory, White Finish – Binocular View from Waimea

Photo Credit: CFHT

Figure 4-9. Simulation of the TMT Observatory, Brown Finish – Binocular View from Waimea

Photo Credit: CFHT

Figure 4-10. Simulation of the TMT Observatory, Metallic Finish – Binocular view from Waimea with Maunakea in Snow

Photo Credit: Charles R. West Photography

Figure 4-11. Simulation of the TMT Observatory, White Finish – Binocular view from Waimea with Maunakea in Snow

Photo Credit: Charles R. West Photography

Figure 4-12. Simulation of the TMT Observatory, Brown Finish – Binocular view from Waimea with Maunakea in Snow

Photo Credit: Charles R. West Photography

Figure 4-13. Naked Eye View of Maunakea near Honoka'a

Figure 4-14. Simulation of the TMT Observatory, Metallic Finish – Binocular view from Honoka‘a with Maunakea in Snow

Figure 4-15. Simulation of the TMT Observatory, White Finish – Binocular view from Honoka‘a with Maunakea in Snow

Figure 4-16. Simulation of the TMT Observatory, Brown Finish – Binocular view from Honoka‘a with Maunakea in Snow

Figure 4-17. Naked Eye View of Maunakea from Waikoloa

Figure 4-18. Simulation of the TMT Observatory, Metallic Finish – Binocular View from Waikoloa

Photo Credit: Charles R. West Photography

Figure 4-19. Simulation of the TMT Observatory, Metallic Finish – Binocular view from Waikoloa with Maunakea in Snow

Photo Credit: Charles R. West Photography

Figure 4-20. Simulation of the TMT Observatory, White Finish – Binocular view from Waikoloa with Maunakea in Snow

Figure 4-21. Simulation of the TMT Observatory, Brown Finish – Binocular view from Waikoloa with Maunakea in Snow

Photo Credit: Charles R. West Photography

Summary

The potential long-term visual impacts from the proposed 13N site for the TMT Observatory are summarized in Table 4-4.

Table 4-4. Proposed 13N Site - Summary of Potential Visual Impacts

Viewpoint	Location	Visual Impact				
		Is the TMT visible?	Visible in primary view?	Visible in silhouette?		
				No	Partial	Full
1	Hualālai Resort	Yes	No	--	164 feet (50 m)	--
2	Pu'u Waawaa	Yes	N/A[1]	--	58 feet (17 m)	--
3	Big Island Country Club	Yes	N/A[1]	--	82 feet (25 m)	--
4	Waikoloa/Mauna Lani	Yes	No	--	164 feet (50 m)	--
5	Hāpuna Beach	No	No	N/A		
6	Puukohola Heiau	Yes	No	--	164 feet (50 m)	--
7	DHHL Kawaihae at Route 250	Yes	Yes	X	--	--
8	Route 250 Pu'u Overlook	Yes	Yes	X	--	--
9	DHHL Lalamilo	Yes	Yes	--	49 feet (15 m)	--
10	Waimea Park	Yes	Yes	--	89 feet (27 m)	--
11	DHHL Pu'u Kapu	Yes	Yes	--	98 feet (30 m)	--
12	DHHL Waikoloa-Waialeale	Yes	Yes	--	164 feet (50 m)	--
13	Waipio Valley Lookout	No	N/A	N/A		
14	Honoka'a	Yes	No	--	82 feet (25 m)	--
15	Laupāhoehoe Point	No	N/A	N/A		
16	Maunakea Summit	No	N/A	N/A		
17	Lake Waiau	No	N/A	N/A		

[1] The primary view criterion is not applicable because at these viewpoints the panoramic view is important.

Visual Impact on Viewer Groups

Based on the above analysis, the following is a summary of the potential visual impacts on the three viewer groups due to locating the TMT Observatory at the proposed 13N site.

Residents

Most residents of Hawai'i would not be able to see the TMT Observatory from their homes or public gathering places. From the viewshed analysis approximately 15 percent of the population (23,000 people) would be able to see at least the top of the TMT Observatory. Of this percentage, it would only be within the direction of the primary view of 5.5 percent of the population (8,100 people) in the area around Waimea.

The TMT Observatory could have a visual impact on residents in towns such as Waimea, Waikoloa and the area around Honoka'a. Within these towns the views of Maunakea that residents may have from their homes or gathering places, such as the Waimea Park (10), may be altered. The views from these viewpoints would be in partial silhouette, which could make the view more prominent, particularly in the morning when the facility would be back lit by the sun. The extent of the visual impact would be somewhat reduced by the times when the summit of Maunakea would be obscured by vog, clouds, or other causes of limited visibility. In general, the visual impact to the resident viewer group of Hawai'i would be less than significant. The impact to residents of Waimea, while slightly higher, would still be less than significant.

Sightseers

The visual experience for the sightseer viewer group would not be impacted by the TMT Observatory. This is because it would not be visible from the majority of the island including: the larger cities of Kona and Hilo, Volcanoes National Park, or from scenic viewpoints such as Waipio Valley Lookout (13) and Laupāhoehoe Point (15). From viewpoints, such as the Hualālai Resort (1), where the TMT Observatory could be visible, it would not be within the primary view and would not be expected to impact the visual experience. In addition, sightseers may be interested in astronomy, may plan on visiting the Astronomy Precinct and enjoy views of the TMT Observatory. The visual impact to sightseers on the island would be less than significant.

Cultural Practitioners

Finally, as stated in Section 3.1.2, cultural practitioners on the island place a high value on pristine views of Maunakea. Of the three representative viewpoints that are from culturally important locations, the TMT Observatory would not be visible from two: the summit of Maunakea (17) and Lake Waiau (18). The TMT Observatory could be visible from the summit of Pu'u Waawaa (2), where cultural practitioners may experience a visual impact. The silhouette analysis showed that from Pu'u Waawaa the view of the TMT Observatory would be partially obstructed from a rise of Maunakea between the viewer and the observatory and that only the top 56 feet would be visible and in silhouette. The extent of the visual impact would be somewhat reduced at the times when the summit of Maunakea would be obscured by vog, clouds, or other causes of limited visibility. The visual impact of the TMT Observatory on cultural practitioners would be less than significant.

Visual impacts are only a component of the Project's potential cultural impact. For information on the project's impacts to cultural practices see Section 3.2 of the Draft EIS and the Cultural Impact Assessment in Appendix D of the Draft EIS for the Thirty Meter Telescope Project.

Overall Visual Impact

As discussed above, while the TMT Observatory would be a new visual element within the views of Maunakea for approximately 14 percent of the island area and could be seen by approximately 15.4 percent of the population (roughly 23,000 people), it would not obstruct or block existing views of Maunakea from around the island. Therefore, the Project would not exceed the applicable significance criteria in HAR §11-200-12 and would be expected to have a less than significant visual impact.

4.2.2 E2 Site

Temporary Impacts

Construction and Decommissioning

At the alternative E2 site the temporary visual impacts from the proposed construction of the TMT Observatory and the associated future decommissioning of the TMT Observatory, would be the same as described in Section 4.2.1 for the proposed 13N site. These include the presence of construction equipment and workers, dust, and light and glare. These temporary impacts would be less than significant.

Long-Term Impacts

The long-term impacts from the alternative E2 site would be similar to the long-term impacts of the proposed 13N site.

Scenic Vistas and Viewplanes

Locating the TMT Observatory at the alternative E2 site would not substantially affect scenic vistas and viewplanes identified in the County of Hawai‘i’s General Plan or the South Kohala Development Plan. The TMT Observatory would not be visible in the view from Hilo Bay with Maunakea in the background. In addition, although the TMT Observatory may be visible in the view of Maunakea from portions of the South Kohala district and the area around Waimea, it would not block the views and viewplanes of the mountain. Therefore, the project would not exceed significance criteria 12 as stated in HAR §11-200-12.

Viewshed Analysis

The results of the viewshed analysis for the alternative E2 site are shown in Figure 4-22. The viewshed analysis confirms that, because it would be located north of and below the summit of Maunakea, the TMT Observatory would not be visible in the southern portion of the island; this includes the large cities of Hilo and Kailua-Kona. According to the viewshed analysis the TMT Observatory would be visible from about 13 percent of the area of the island (see Table 4-5). According to U.S. Census data, approximately 15.1 percent of the island’s population (approximately 22,500 people) would be within the viewshed of the TMT Observatory at the alternative E2 site. Of the representative viewpoints, the TMT Observatory could be visible from viewpoints 1 through 12; the TMT Observatory would not be visible from viewpoints 13 through 17.

Figure 4-22. E2 Alternative Site – Viewshed and Primary View Analysis

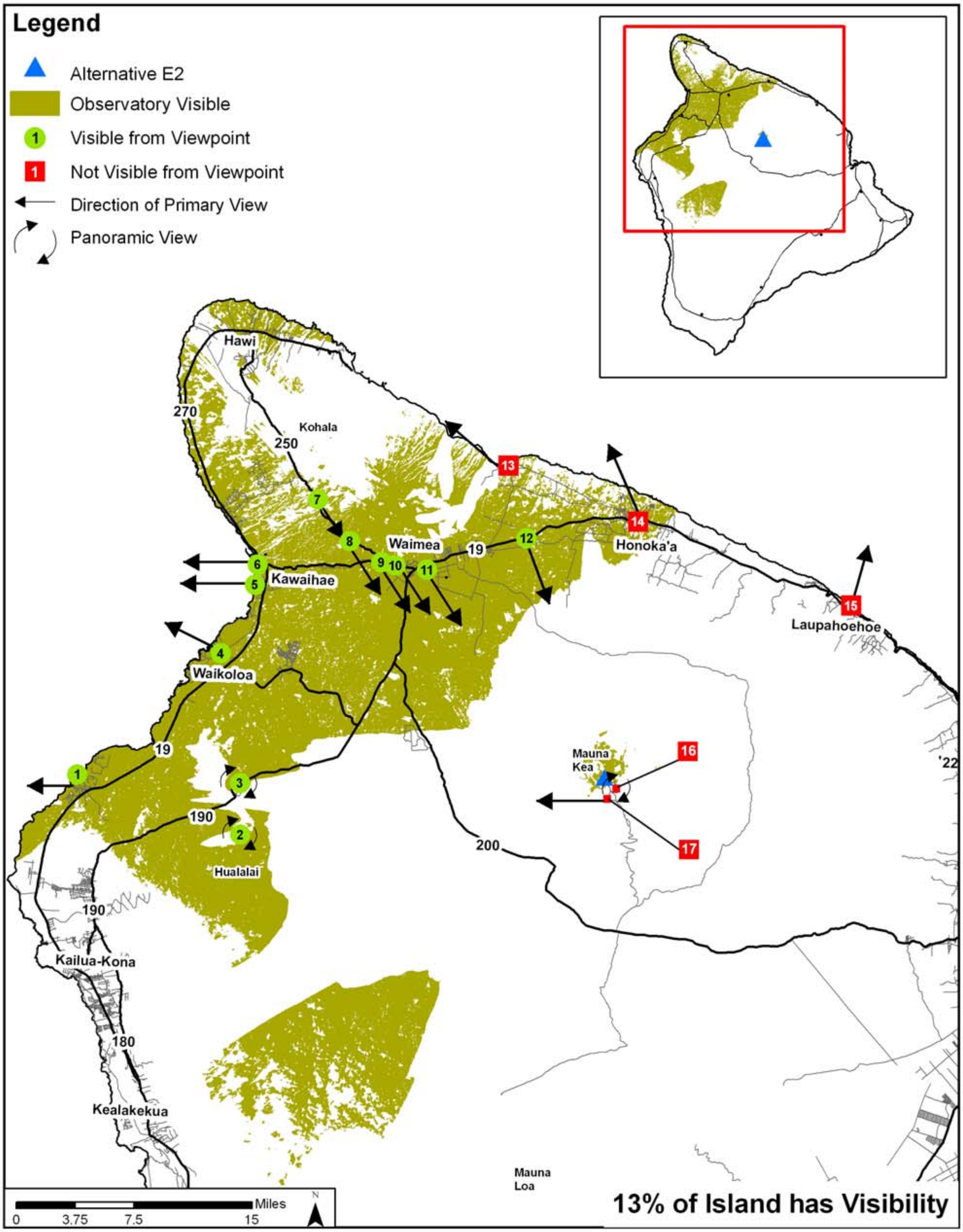


Table 4-5. Visibility of Alternative E2 Site

Visibility	Area of Island (%)	Hawai‘i's Population	
		%	People
Visible	13%	15.1%	22,500
Not Visible	87%	84.9%	126,200

Table 4-6 divides the viewshed, and the population within the viewshed, into five areas: Waimea, Honoka‘a, Hāwī, Waikoloa and Kawaihae, and Hualālai. Of these areas, the TMT Observatory would be visible in the primary view direction only from the area around Waimea. For the other four areas the primary view direction is toward the ocean. Of the island's population, 5.4 percent (approximately 8,000 people) are within the area around Waimea and may be able to see the TMT Observatory.

Table 4-6. Visibility of the Alternative E2 Site within the Primary View Direction

Location	Hawai‘i's Population		Primary View Direction?
	%	People	
Waimea	5.4%	8,000	Yes
Honoka‘a	2.8%	4,200	No
Hāwī	2.6%	3,900	No
Waikoloa and Kawaihae	4.3%	6,400	No
Hualālai	0.04%	66	No

Primary View

Of the 12 viewpoints where the TMT Observatory may be visible, it would not be within the primary view of four: the Hualālai Resort (1), Waikoloa/Mauna Lani (4), Hāpuna Beach (5), and Puukohola Heiau (6). At these coastal locations, the primary view is westward makai.

The TMT Observatory could be visible and in the primary view direction from viewpoints along Highway 250 (7 and 8) and around the town of Waimea (9, 10, 11 and 12). The TMT Observatory could also be visible from the Big Island Country Club (3) and from the summit of Pu'u Waawaa (2), where the panoramic view of the water, the surrounding area, and Maunakea would be important to the viewer.

Silhouette View

With the alternative E2 site the TMT Observatory would be in partial silhouette from all 12 of the viewpoints where it would be visible. Table 4-7 summarizes the silhouette analysis for the TMT Observatory at the alternative E2 site. The results of the silhouette analysis are shown in Appendix C.

Table 4-7. Alternative E2 Site - Silhouette Analysis

Viewpoint	Location	Portion of TMT Observatory in Silhouette		
		None	Partial	Full
1	Hualālai Resort	--	141 feet	--
2	Pu'u Waawaa	--	43 feet	--
3	Big Island Country Club	--	17 feet	--
4	Waikoloa/Mauna Lani	--	148 feet	--
5	Hāpuna Beach	--	144 feet	--
6	Puukohola Heiau	--	105 feet	--
7	DHHL Kawaihae at Route 250	X	--	--
8	Route 250 Pu'u Overlook	X	--	--
9	DHHL Lalamilo	--	40 feet	--
10	Waimea Park	--	62 feet	--
11	DHHL Pu'u Kapu	--	105 feet	--
12	DHHL Waikoloa-Waialeale	--	128 feet	--
13	Waipio Valley Lookout	Not Visible		
14	Honoka'a	Not Visible		
15	Laupāhoehoe Point	Not Visible		
16	Maunakea Summit	Not Visible		
17	Lake Waiau	Not Visible		

From the two viewpoints along Highway 250 (7 and 8) the view of the TMT Observatory would not be in silhouette; the observatory would be visible against the backdrop of Maunakea. This may reduce the prominence of the TMT Observatory in the view from these locations, particularly during sunset when Maunakea would be back-lit by the setting sun. From the coastal locations of Hualālai Resort (1), Waikoloa/Mauna Lani (4), Hāpuna Beach (5), and Puukohola Heiau (6) between 105 feet and 148 feet of the TMT Observatory would be in silhouette. From these viewpoints the TMT Observatory would not be located within the direction of the primary view, which is toward the ocean.

In the area around Waimea (viewpoints 9 through 12), where the TMT Observatory would be visible within the direction of the primary view, the amount of the partial silhouette would range from 40 feet to 128 feet. The silhouette analysis showed that from the Big Island Country Club (3) and Pu'u Waawaa (2) the view of the TMT Observatory would be partially obstructed from a rise of Maunakea between the viewer and the observatory. From portions of the Big Island Country Club only the top 16 feet of the TMT Observatory would be visible and in silhouette. From the summit of Pu'u Waawaa the top 43 feet would be visible and in silhouette.

In addition to the topography of Maunakea limiting the silhouette of the TMT Observatory, the existing observatories can also affect the silhouette view. The areas where the view of the TMT Observatory would be in front of one of the existing observatories would be similar to what is shown in Figure 4-5.

Photo Simulations

Photo simulations specific to the alternative E2 site were not created. Because the E2 site is located less than 1,000 feet south of the proposed 13N site the visual representations of the TMT

Observatory shown in Figure 4-7 throughFigure 4-21 for the 13N site would be very similar for the alternative E2 site.

Summary

The potential long term visual impacts of the alternative E2 site for the TMT Observatory are summarized in Table 4-8.

Table 4-8. E2 Alternative Site - Summary of Potential Visual Impacts

Viewpoint	Location	Visual Impact				
		Is the TMT visible?	Visible in primary view?	Visible in silhouette?		
				No	Partial	Full
1	Hualālai Resort	Yes	No	--	141 feet	--
2	Pu'u Waawaa	Yes	N/A[1]	--	43 feet	--
3	Big Island Country Club	Yes	N/A[1]	--	17 feet	--
4	Waikoloa/Mauna Lani	Yes	No	--	148 feet	--
5	Hāpuna Beach	Yes	No	--	144 feet	--
6	Puukohola Heiau	Yes	No	--	105 feet	--
7	DHHL Kawaihae at Route 250	Yes	Yes	X	--	--
8	Route 250 Pu'u Overlook	Yes	Yes	X	--	--
9	DHHL Lalamilo	Yes	Yes	--	40 feet	--
10	Waimea Park	Yes	Yes	--	62 feet	--
11	DHHL Pu'u Kapu	Yes	Yes	--	105 feet	--
12	DHHL Waikoloa-Waialeale	Yes	Yes	--	128 feet	--
13	Waipio Valley Lookout	No	N/A	N/A		
14	Honokaʻa	No[2]	N/A	N/A		
15	Laupāhoehoe Point	No	N/A	N/A		
16	Maunakea Summit	No	N/A	N/A		
17	Lake Wai'au	No	N/A	N/A		

[1] The primary view criterion is not applicable because at these viewpoints the panoramic view is important.
[2] At the specific location for Honokaʻa used in the visual analysis the TMT Observatory was not visible. However, there are portions of Honokaʻa where the TMT Observatory would be visible.

Visual Impact on Viewer Groups

Based on the above analysis, the following is a summary of the potential visual impacts on the three viewer groups from locating the TMT Observatory at the proposed alternative E2 site.

Residents

Most residents of the island would not be able to see the TMT Observatory in the alternative E2 site. From the viewshed analysis 15.1 percent of the population (approximately 22,500 residents) would be able to see at least the top of the TMT Observatory. Of this percentage, it would only be within the primary view direction of 5.4 percent of the population (approximately 8,000 residents).

The TMT Observatory could have a visual impact on residents in towns such as Waimea, Waikoloa and the area around Honokaʻa. These residents may have their views of Maunakea from their homes or gathering places altered by the facility. The views from these viewpoints would be in partial silhouette, which could make the view more prominent, particularly in the morning when the facility would be back lit by the sun. The extent of the visual impact would be somewhat reduced by the times when the summit of Maunakea would be obscured by vog, clouds, or other causes of limited visibility. In general, the visual impact to the resident viewer group would be less than significant. The impact to residents of Waimea, while slightly higher, would still be less than significant.

Sightseers

The visual experience for the sightseer viewer group would not be impacted by the TMT Observatory. This is because it would not be visible from the majority of the island. From viewpoints, such as Hāpuna Beach (5), where the TMT Observatory could be visible, it would not be within the primary view and would not be expected to impact their visual experience. In addition, some sightseers may be interested in astronomy, may plan on visiting the astronomy precinct and enjoy views of the facility. The visual impact to sightseers would be less than significant.

Cultural Practitioners

Finally, as stated in 3.1.2, cultural practitioners place a high value on pristine views of Maunakea. Of the three representative viewpoints that are from culturally important locations, the TMT Observatory would not be visible from two; the summit of Maunakea (17) and Lake Waiau (18). The TMT Observatory could be visible from the summit of Pu'u Waawaa (2), where cultural practitioners may experience a visual impact. The silhouette analysis showed that from Pu'u Waawaa, the view of the TMT Observatory would be partially obstructed from a rise of Maunakea between the viewer and the observatory and that only the top 43 feet would be visible and in silhouette. The extent of the visual impact would be somewhat reduced by the times when the summit of Maunakea would be obscured by vog, clouds, or other causes of limited visibility. The visual impact of the TMT Observatory on cultural practitioners would be less than significant.

Visual impacts are only a component of the Project's potential cultural impact. For information on the Project's impacts to cultural practices see the Appendix D of the TMT Project Draft EIS.

Overall Visual Impact

As discussed above, while the TMT Observatory would be a new visual element within the views of Maunakea for approximately 13 percent of the island area and could be seen by approximately 15.1 percent of the population (roughly 22,500 people), it would not obstruct or block existing views of Maunakea from around the island. Therefore, the Project would not exceed the applicable significance criteria in HAR §11-200-12 and would be expected to have a less than significant visual impact.

4.2.3 Indirect and Cumulative

Indirect Impacts

The TMT Observatory is not expected to have any indirect visual impacts.

Cumulative Impacts

A cumulative impact is the incremental impact of a proposed project together with other past, present and reasonably foreseeable future actions. For cumulative visual impacts, the analysis for the TMT Observatory looks at the following two components:

- Would the TMT Observatory be visible in an area of the island where currently no telescopes are visible?
- Which areas of the island would the TMT Observatory be visible in addition to the existing telescopes?

Proposed 13N Site

Table 4-9 summarizes the cumulative visual impact of the TMT Observatory at the proposed 13N site.

Table 4-9. Cumulative Visibility of Proposed 13N Site

Visibility	Area of Island (%)	Hawai‘i’s Population	
		%	People
Existing	43%	72%	107,000
New (TMT)	1.2%	Less than 1%	72

Figure 4-23 shows the visibility/viewshed of the existing summit observatories on Maunakea (see Section 3.1.4) combined with the viewshed of the TMT Observatory at the proposed 13N site. The green shaded area indicates where the existing summit observatories on Maunakea are visible; this area is approximately 43 percent of the island and is home to approximately 72 percent of the population. The portions of the island that are shaded in red are areas where the TMT Observatory would be visible where currently none of the existing telescopes can be seen. The new area where a telescope would be visible is roughly 1.2 percent of the area of the island and the majority of this new area is ranch land south of Waimea. Off of Saddle Road there is a residential area, Waiki‘i Ranch, which would be within the area where the TMT Observatory would be the only visible observatory. Using the 2000 U.S. Census average household size of 2.75 people for the County of Hawai‘i, the estimated number of people living in this area is 72 (substantially less than 1 percent of the island’s population).

Figure 4-23. Proposed 13N Site – Cumulative Visibility Analysis

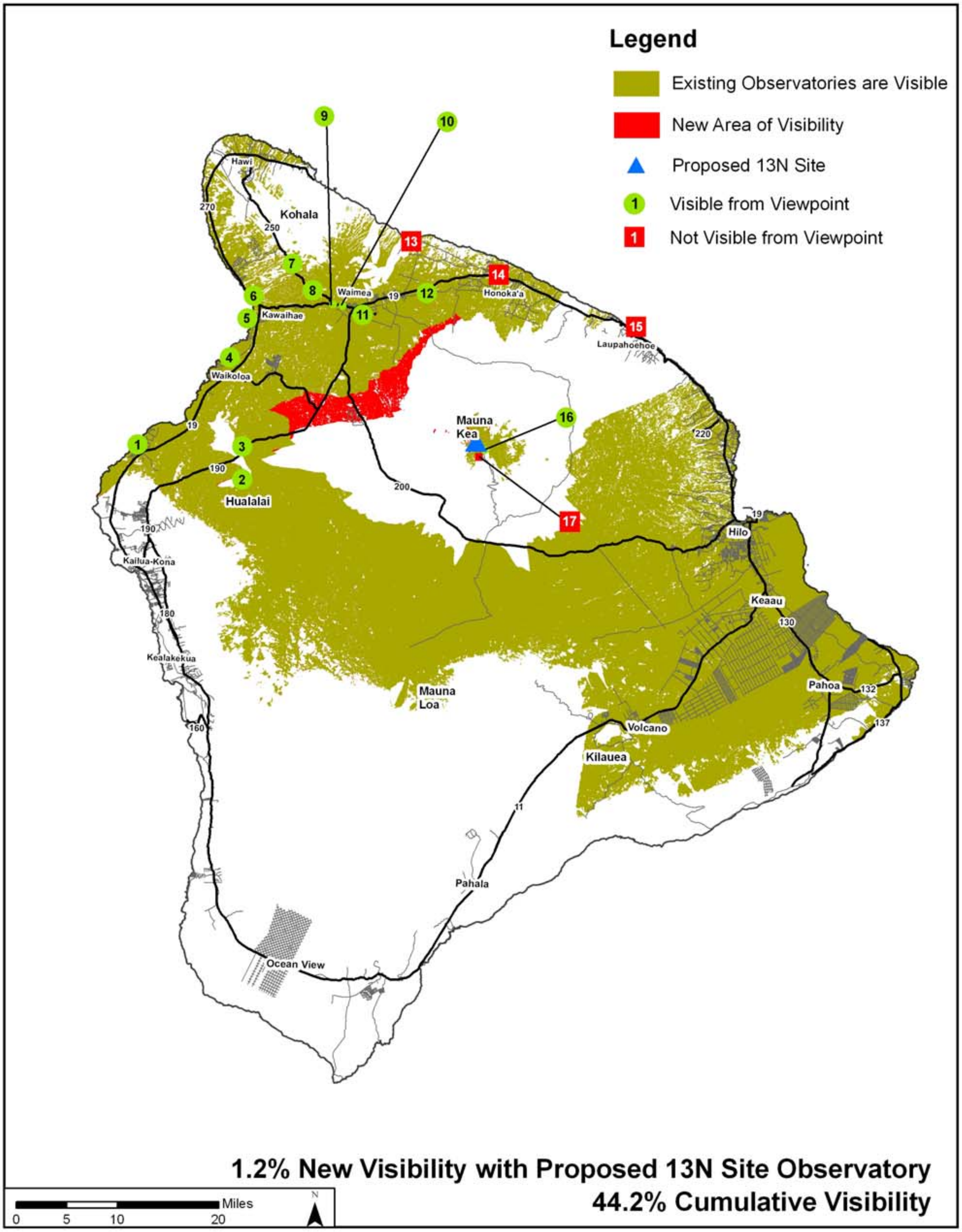


Table B-1, in Appendix B, shows which of the existing observatories are visible at the 17 representative viewpoints. At the viewpoints where the TMT Observatory would be visible, six to eight of the existing 11 summit observatories are currently visible.

The visual impact of the existing observatories on Maunakea is significant, particularly when considering the visual sensitivity of the cultural practitioner viewer group. The visual impact of the TMT Observatory at the proposed 13N site would be less than significant. Nonetheless, when combined with the past, present, and reasonably foreseeable future actions the cumulative visual impact of development on and near the summit of Maunakea would continue to be significant.

E2 Alternative Site

The cumulative visual impact of the TMT Observatory at the alternative E2 site would be similar to the proposed 13N site.

Table 4-10 summarizes the cumulative visual impact. Figure 4-24 shows the visibility/viewshed of the existing observatories combined with the viewshed of the TMT Observatory at the alternative E2 site. The new area where a telescope would be visible is roughly 0.9 percent of the area of the island and the majority of this new area is ranch land south of Waimea. Off of Saddle Road there is a residential area that would be within the area where the TMT Observatory would be the only telescope visible. Using the 2000 U.S. Census average household size of 2.75 people for the County of Hawaiʻi, the estimated number of people living in this area is 28 (substantially less than 1 percent of the island's population).

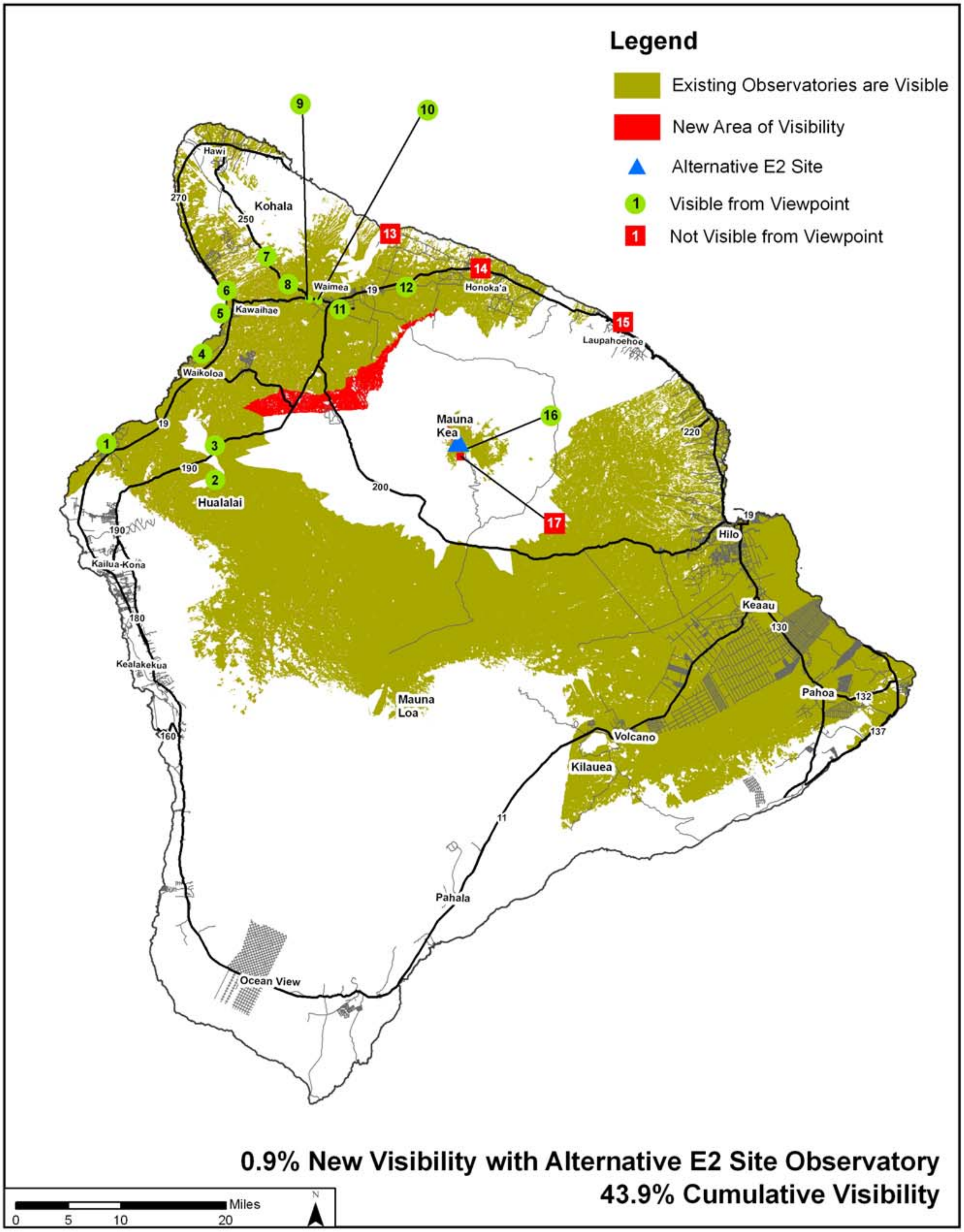
Table 4-10. Cumulative Visibility of Alternative E2 Site

Visibility	Area of Island (%)	Hawaiʻi's Population	
		%	People
Existing	43%	72%	107,000
New (TMT)	0.9%	Less than 1%	28

Table B-1, in Appendix B, shows which of the existing observatories are visible at the 17 representative viewpoints. At the viewpoints where the TMT Observatory would be visible, six to eight of the existing 11 summit observatories are currently visible.

The visual impact of the existing observatories on Maunakea is significant, particularly when considering the visual sensitivity of the cultural practitioner viewer group. The visual impact of the TMT Observatory at the alternative E2 site would be less than significant. Nonetheless, when combined with the past, present, and reasonably foreseeable future actions the cumulative visual impact of development on and near the summit of Maunakea continues to be significant.

Figure 4-24. E2 Alternative Site – Cumulative Visibility Analysis



5.0 Mitigation

5.1 No Build Alternative

There are no Project visual impacts from the No Build Alternative, therefore mitigation is not proposed.

5.2 Maunakea

The proposed location for the TMT Observatory is the primary mitigation for the Project’s potential visual impacts. As shown in Section 4.2 because the proposed location of the TMT Observatory is north of and below the summit of Maunakea it would be visible to roughly 14 percent of the island and to approximately 15 percent of the population (23,000 people). This is significantly different than if the TMT Observatory were to be placed in a more visible location, such as the summit ridge or on a pu’u.

The visual impacts of the TMT Observatory are also due to the size of the dome enclosure; the proposed diameter of the TMT dome is 216 feet. Because the center of the dome would be placed only 36 feet off the ground surface the TMT Observatory would have a height of approximately 180 feet above grade level, and would be the tallest observatory on Maunakea. However, the TMT telescope and the dome enclosure have been designed to minimize the height of the structure, which in turn minimizes the visual impacts (Figure 25). The TMT telescope itself has been designed to be much shorter to allow for a much smaller dome. In addition, the enclosure has been designed to fit very tightly around the telescope, leaving only about 20 inches between the telescope and the dome.

For comparison purposes, the Keck Observatory consists of two telescopes each with mirrors 33 feet in diameter, and the diameter of each Keck dome is 121 feet. Using this ratio of mirror to dome size the TMT telescope would result in a dome with a diameter of 364 feet, almost twice what is proposed (Figure 26).

Finally, the color, or coating, of the dome enclosure has visual impacts. As discussed in Section 4.2 the fixed enclosure and support facilities would be painted with colors that would blend into the landscape. The proposed coating of the dome enclosure is a reflective or non-reflective metallic coating, similar to the Gemini Observatory. In general, the visual impacts of the existing observatories on Maunakea with a metallic coating are that they reflect the morning sunrise and evening sunset light and stand out during this period. However, during most of the day the coating reflects the sky, which helps reduce the visibility of the observatory.

Figure 25: Overview of TMT Telescope and Dome Design

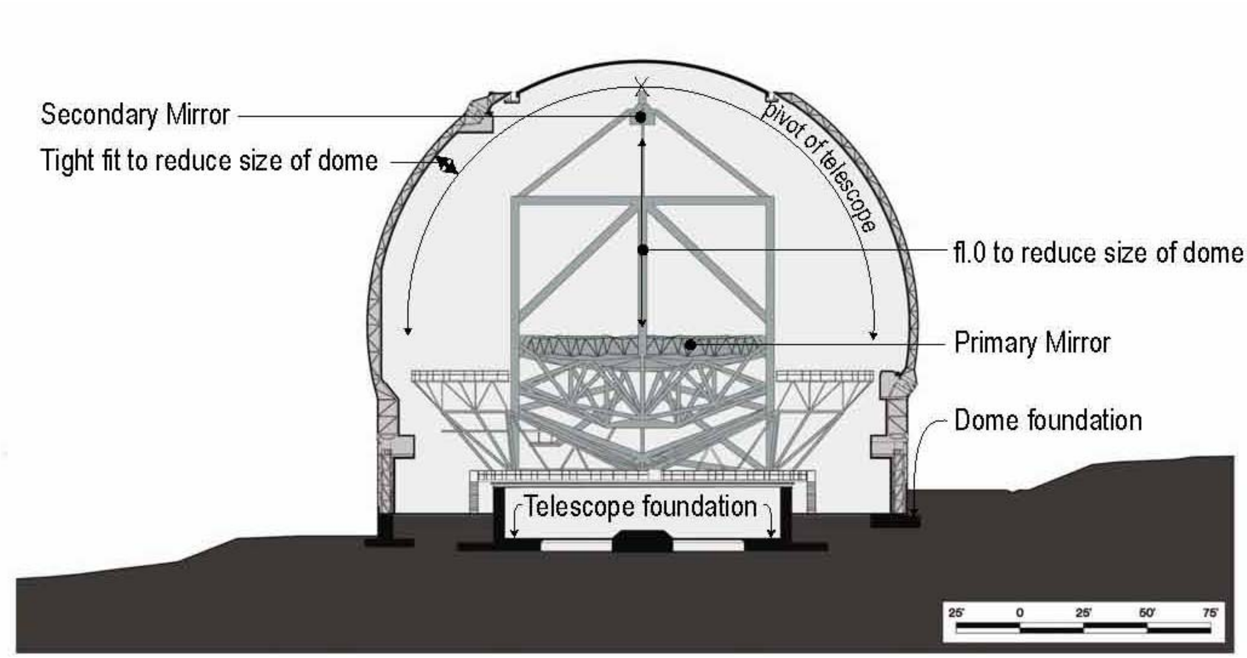
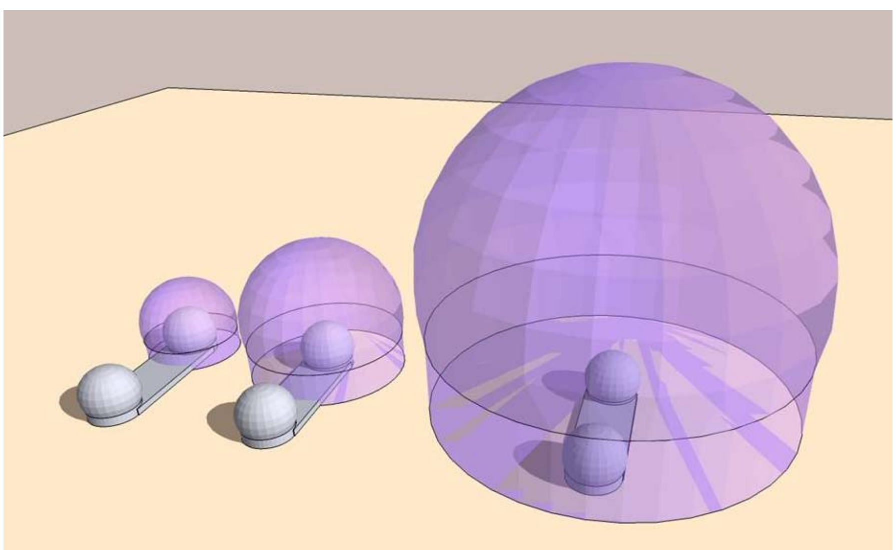


Figure 26: Comparison of Observatory Dome Sizes to Telescope Focal Ratios



In summary, the location and design of the TMT Observatory incorporate measures that mitigate for the potential visual impacts. No further visual mitigation measures are proposed.

6.0 References

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Appendix A: Photographs of or from the Representative Viewpoints

Viewpoint 1: Hualālai Resort

Photo not available.

Viewpoint 2: Pu'u Waawaa

Photo not available.

Viewpoint 3: Big Island Country Club

Viewpoint 4: Waikoloa/Mauna Lani (View toward Maunakea)

Viewpoint 5: Hāpuna Beach (Primary View)

Viewpoint 6: Puukohola Heiau (Primary View)

Viewpoint 7: DHHL Kawaihae at Rt. 250 (In the direction of Maunakea)

Viewpoint 8: Route 250 Pu'u Overlook (Primary View)

Viewpoint 9: DHHL Lalamilo (Primary View)

Viewpoint 10: Waimea Park (Primary View)

Viewpoint 11: DHHL Pu'u Kapu (Primary View)

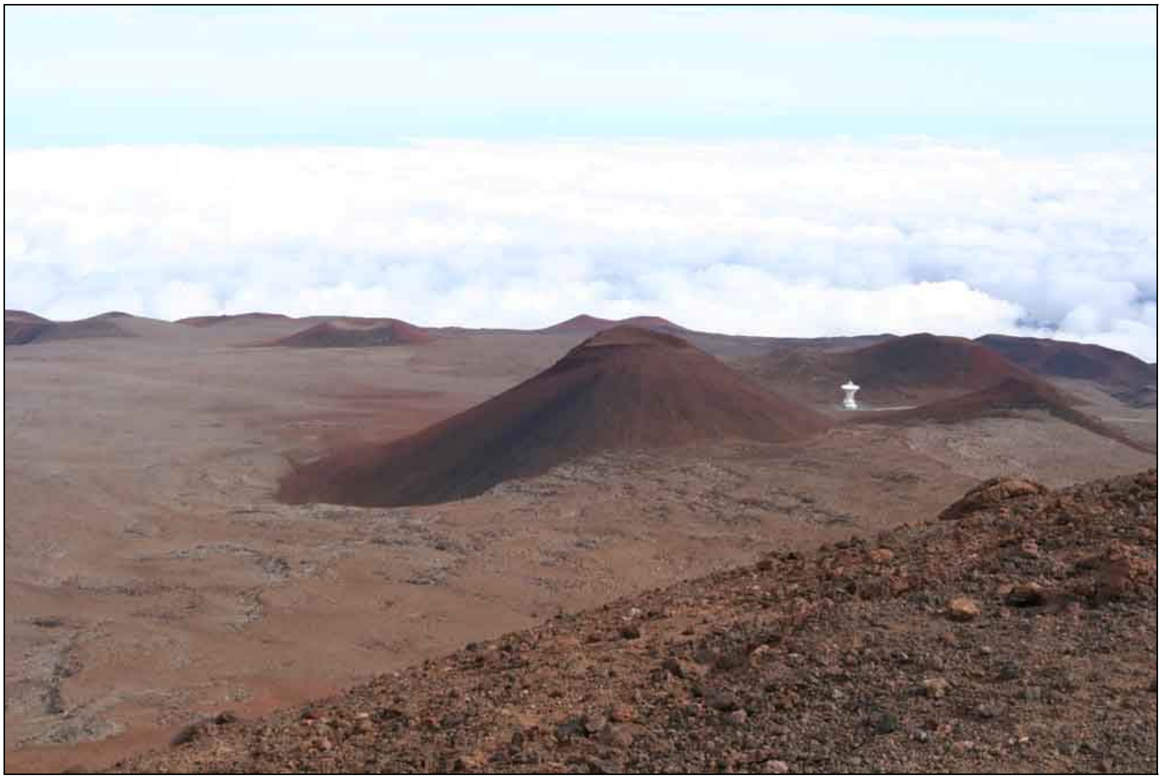
Viewpoint 12: DHHL Waikoloa-Waialeale (Primary View)

Viewpoint 13: Waipio Valley Lookout (Primary View)

Viewpoint 14: Honokaʻa (Primary View)

Viewpoint 15: Laupāhoehoe Point (Primary View, Top Photo)

Viewpoint 16: Maunakea Summit



Viewpoint 17: Lake Waiau (Primary View)

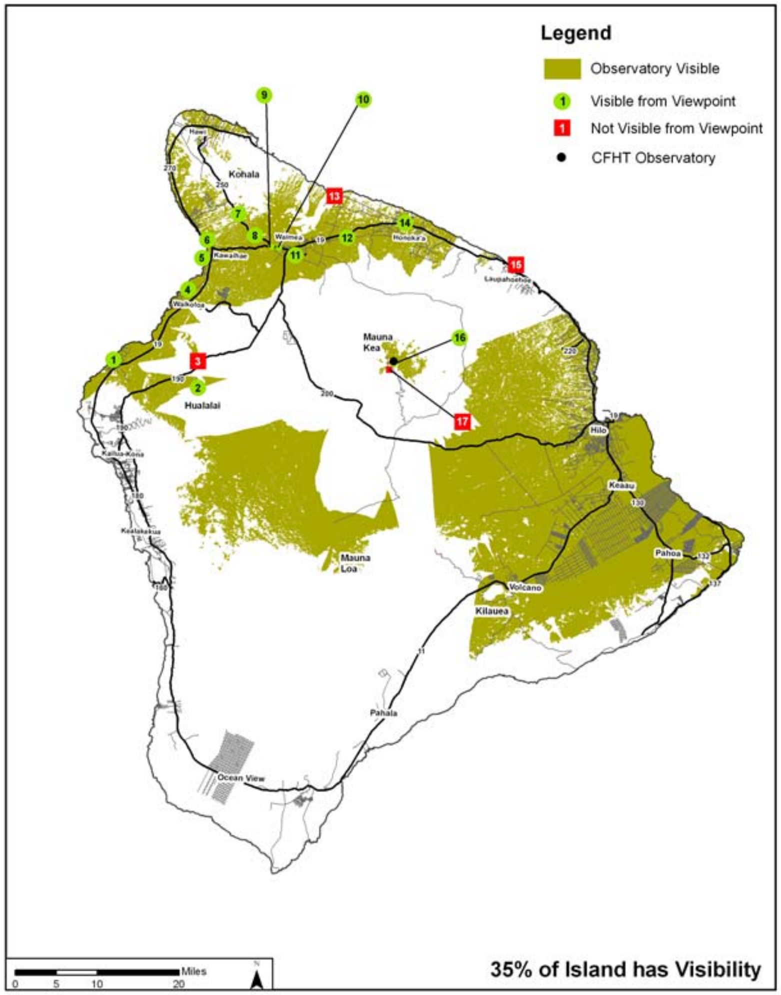
Appendix B: Viewsheds of Existing Observatories

Table B-1. Visibility of the TMT Observatory and the Existing Observatories from the Representative Viewpoints

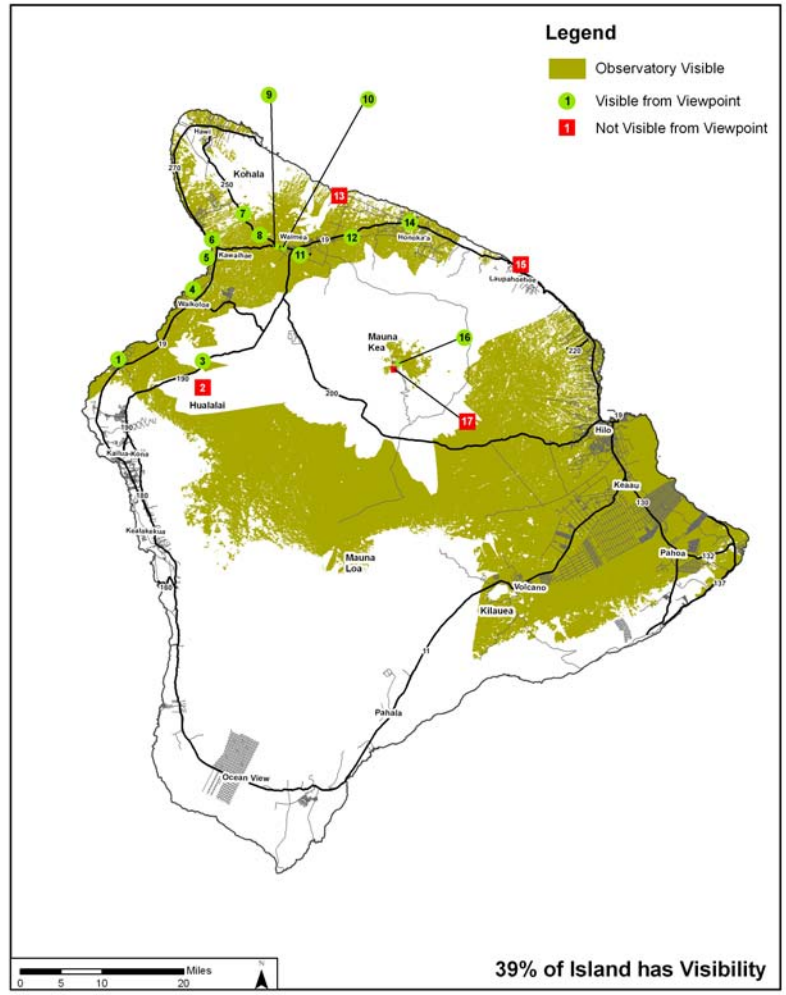
Viewpoint Number	Viewpoint Name	TMT Proposed 13N Site	TMT Alternative E2 Site	CFHT	Gemini	UH 2.2 M	IRTF	Keck	UKIRT	Subaru	Hilo	CSO	JCMT	SMA
1	Hualālai Resort	X	X	X	X	X	X	X		X				
2	Pu'u Waawaa	X	X	X			X	X		X				
3	Big Island Country Club	X	X		X			X		X				
4	Waikoloa/Mauna Lani	X	X	X	X	X	X	X	X	X				
5	Hāpuna Beach		X	X	X	X	X	X	X	X	X			
6	Puukohola Heiau	X	X	X	X	X	X	X	X	X	X			
7	DHHL Kawaihae at Route 250	X	X	X	X	X	X	X	X	X	X		X	X
8	Route 250 Pu'u Overlook	X	X	X	X	X	X	X	X	X				X
9	DHHL Lalamilo	X	X	X	X	X	X	X		X				
10	Waimea Park	X	X	X	X	X	X	X		X				
11	DHHL Pu'u Kapu	X	X	X	X	X	X	X		X				
12	DHHL Waikoloa-Waialeale	X	X	X	X	X	X	X	X	X				
13	Waipio Valley Lookout													
14	Honoka'a	X		X	X	X	X	X	X					
15	Laupāhoehoe Point													
16	Maunakea Summit			X	X	X			X	X	X			
17	Lake Waiau													

CFHT = Canada France Hawai'i Telescope Gemini = Gemini Northern Observatory UH 2.2M = University of Hawai'i 2.2 m IRTF = NASA Infrared Telescope Facility Keck = W.M. Keck Observatory UKIRT = United Kingdom Infrared Telescope Subaru = Subaru Observatory CSO = California Institute of Technology Submillimeter Observatory Hilo = University of Hawai'i 0.9 m JCMT = James Clerk Maxwell Telescope SMA = Submillimeter Array

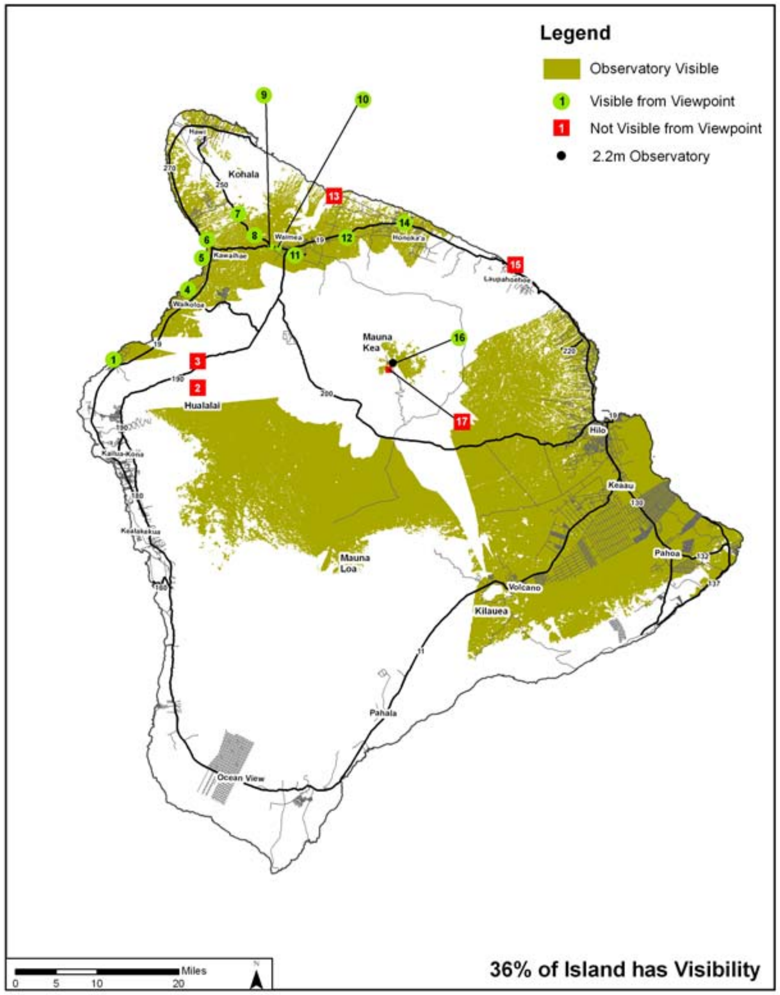
1) Canada-France-Hawai'i Telescope (CFHT)



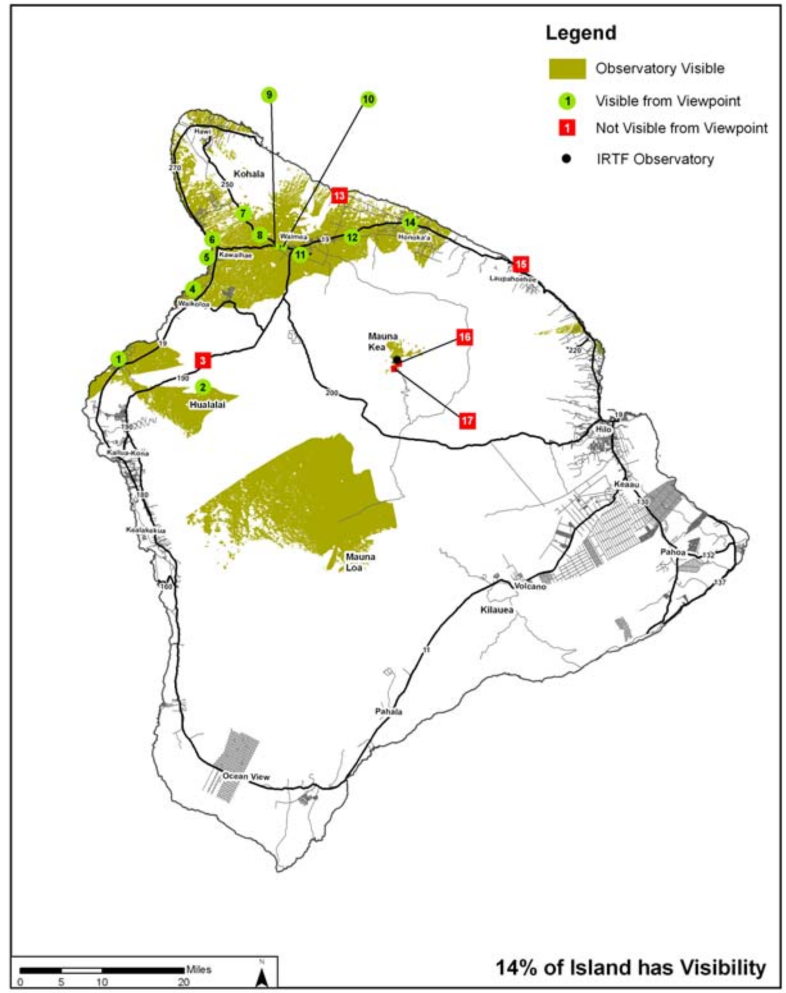
2) Gemini Northern Observatory



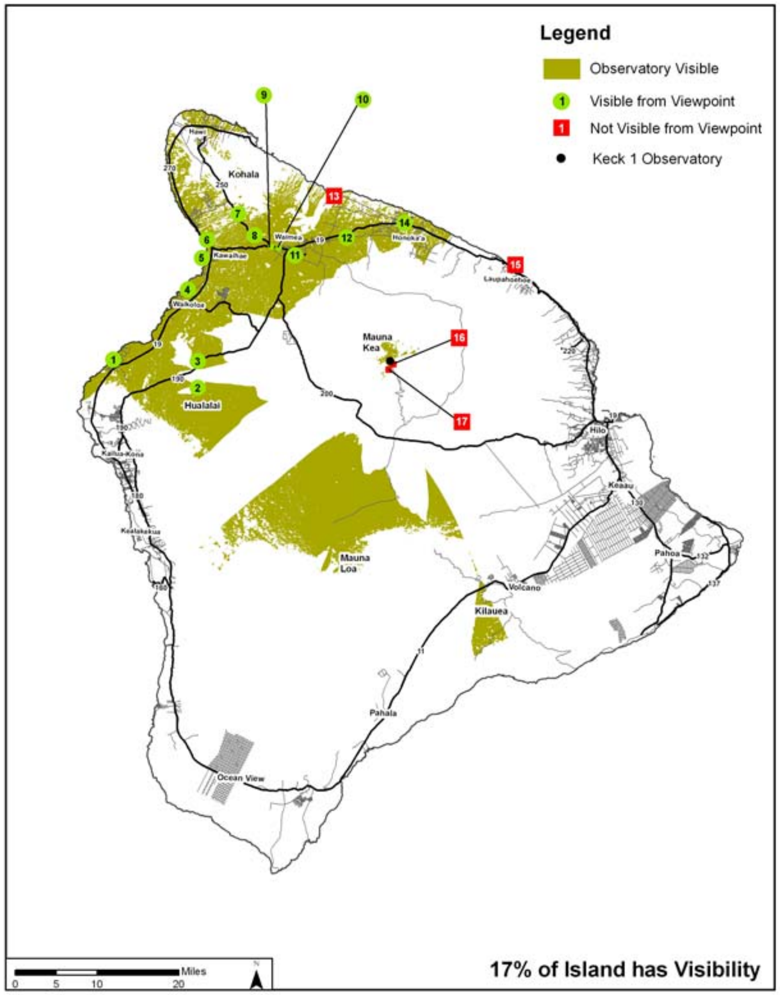
3) University of Hawai‘i 2.2 m Observatory

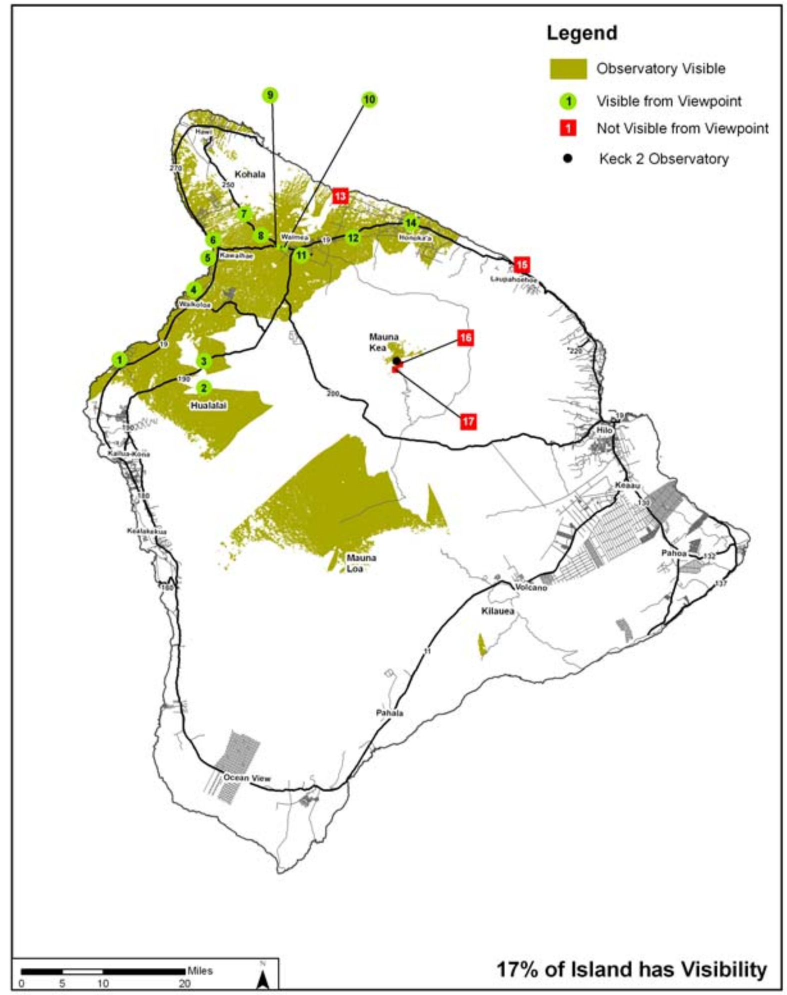


4) NASA Infrared Telescope (IRTF)

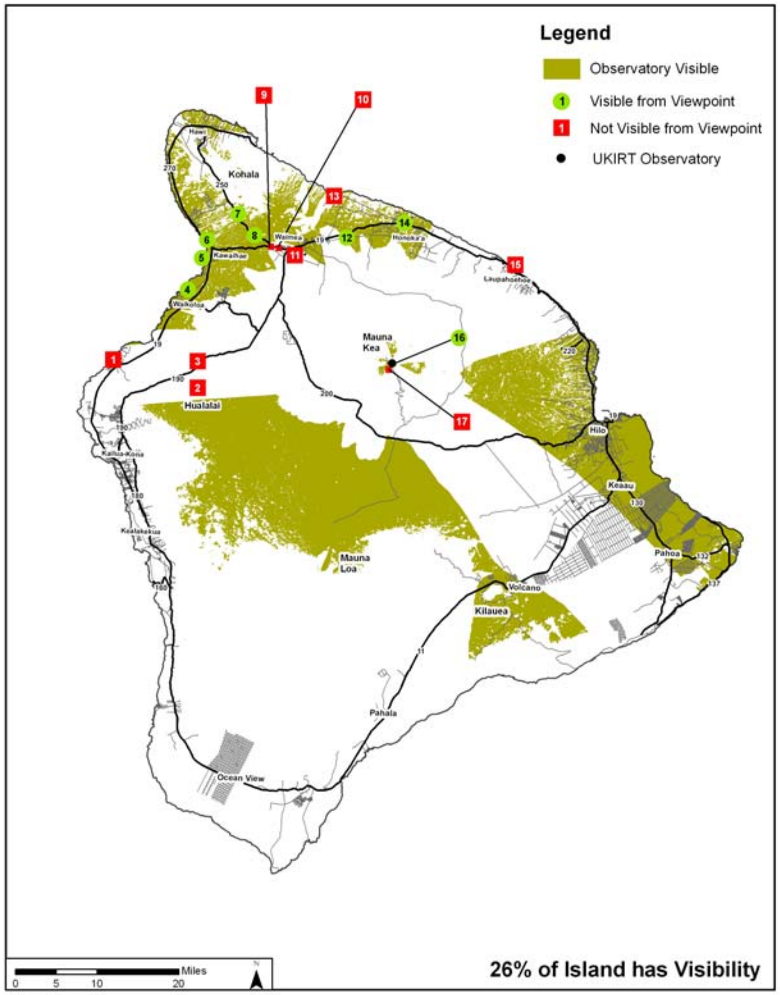


5) Keck 1 and Keck 2

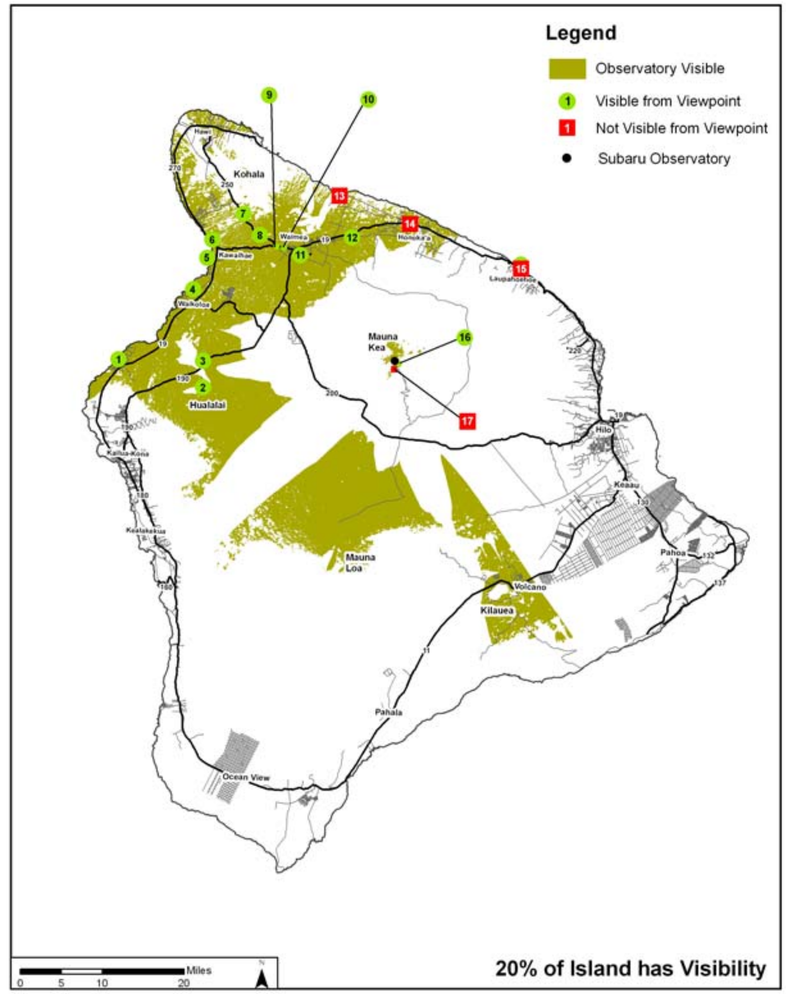




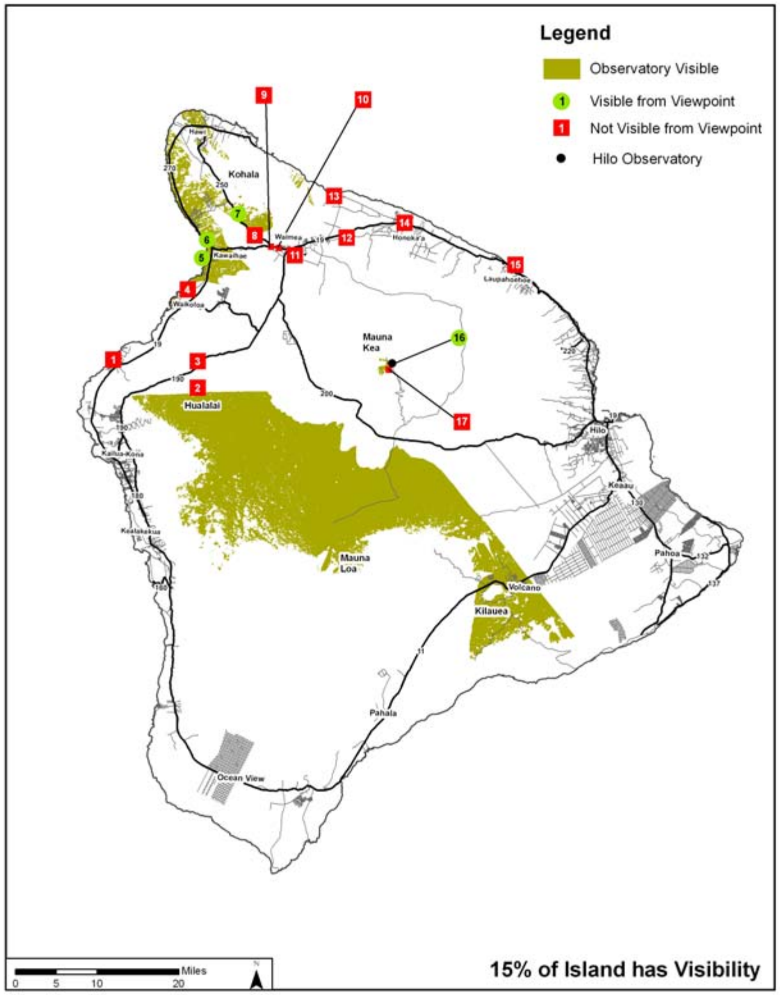
6) United Kingdom Infrared Telescope (UKIRT)



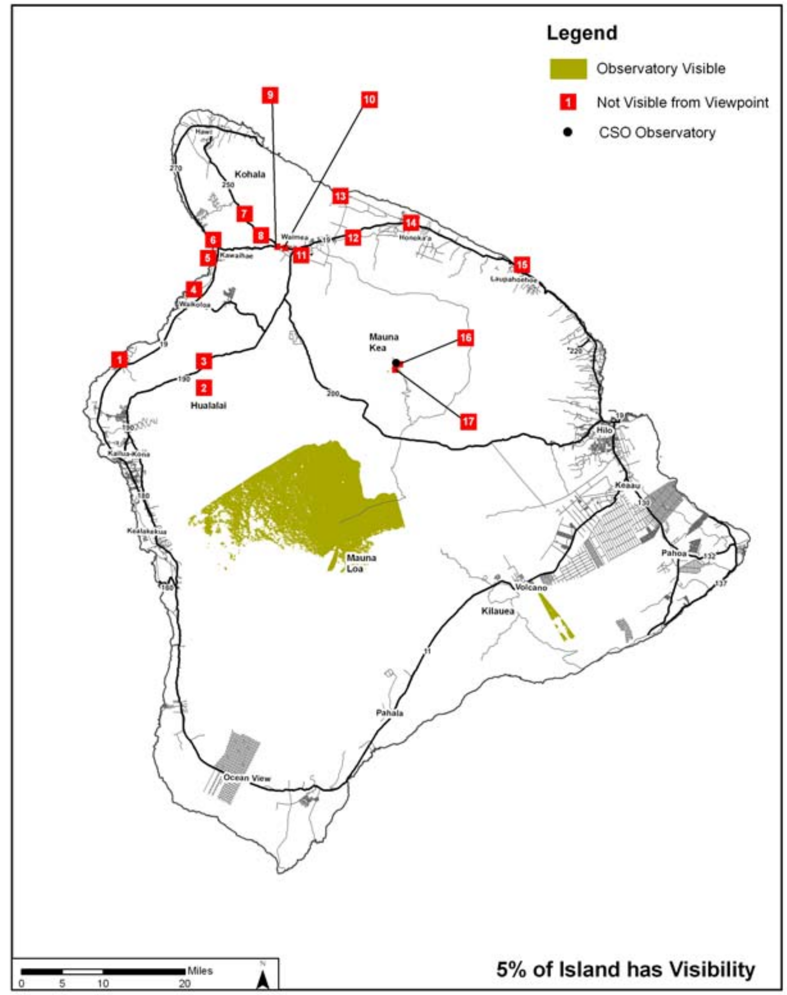
7) Subaru Observatory



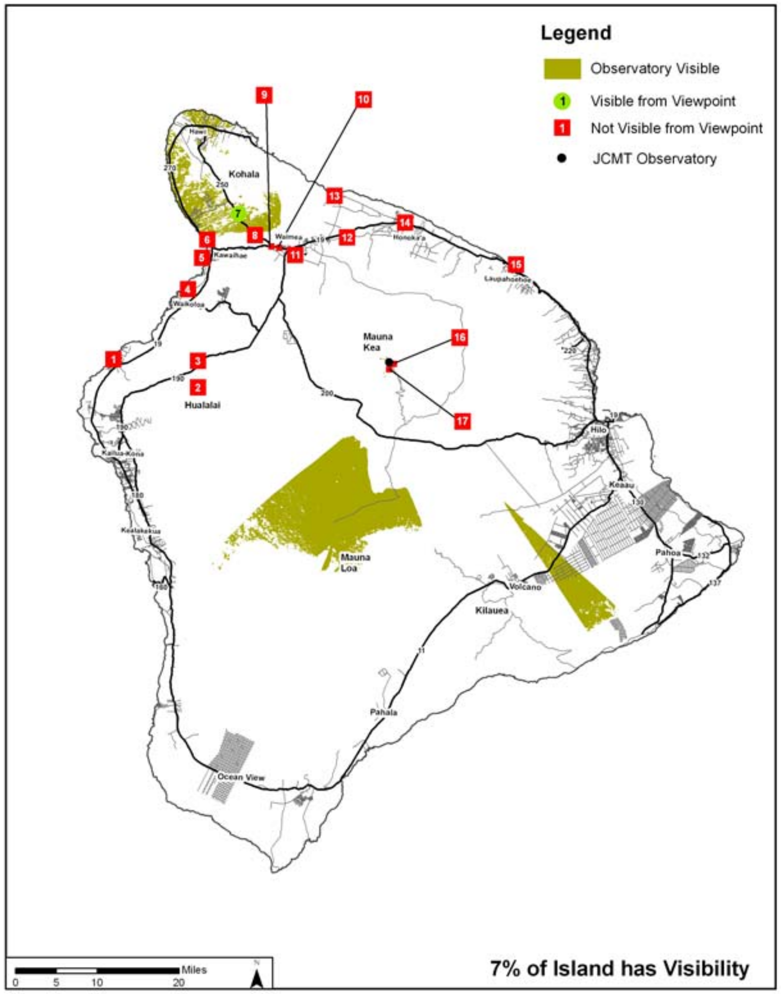
8) University of Hawai‘i 0.9 m Telescope (Hilo)



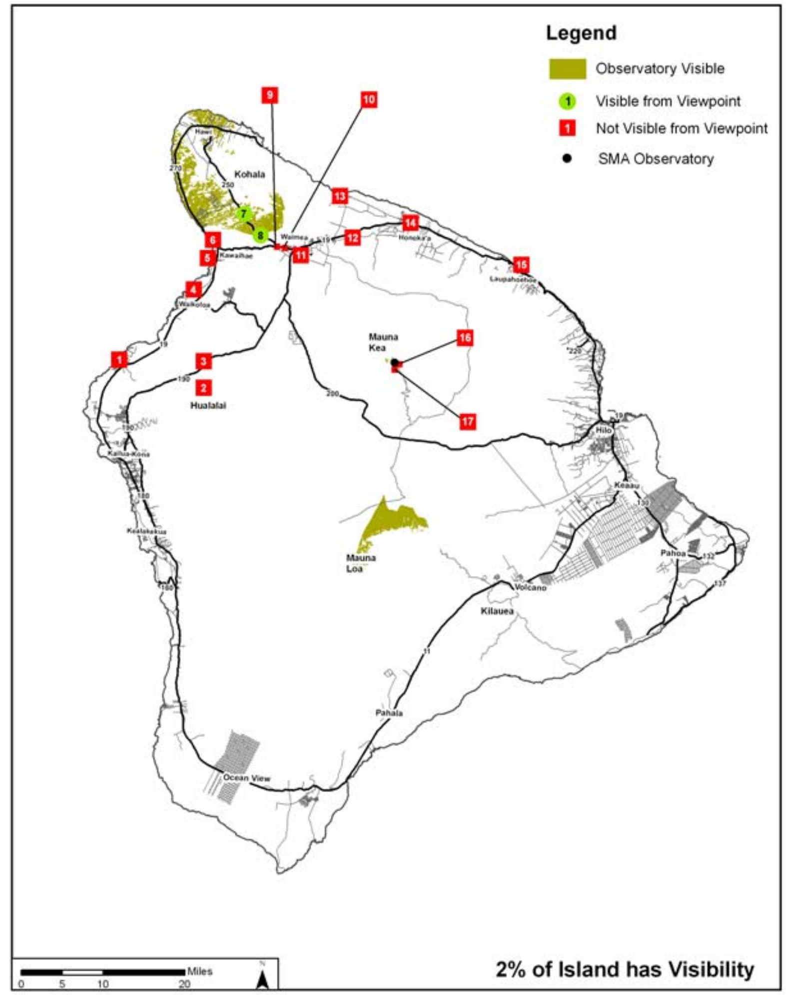
9) Caltech Submillimeter Telescope (CSO)



10) James Clerk Maxwell Telescope (JCMT)

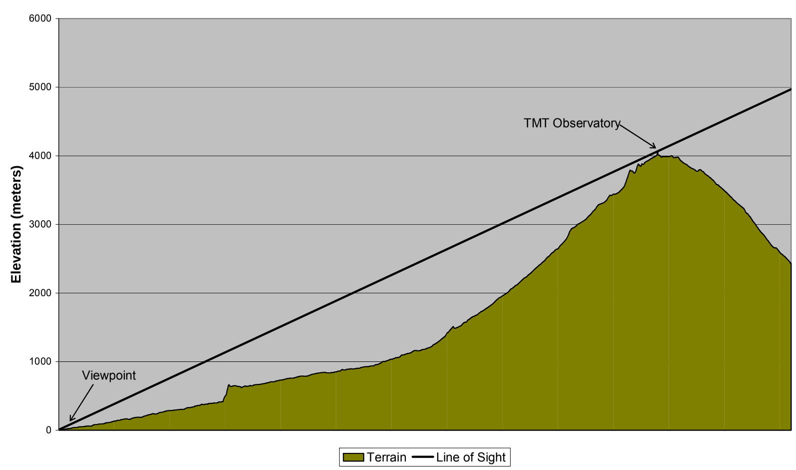


11) Submillimeter Array (SMA)

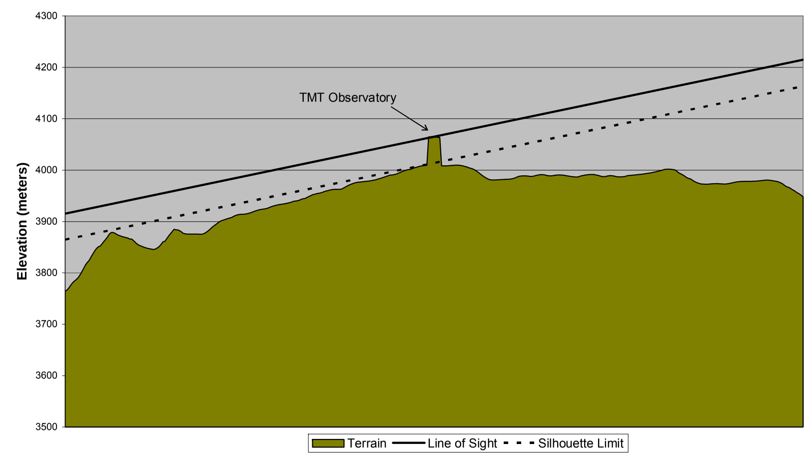


Appendix C: Silhouette Analysis by Viewpoint

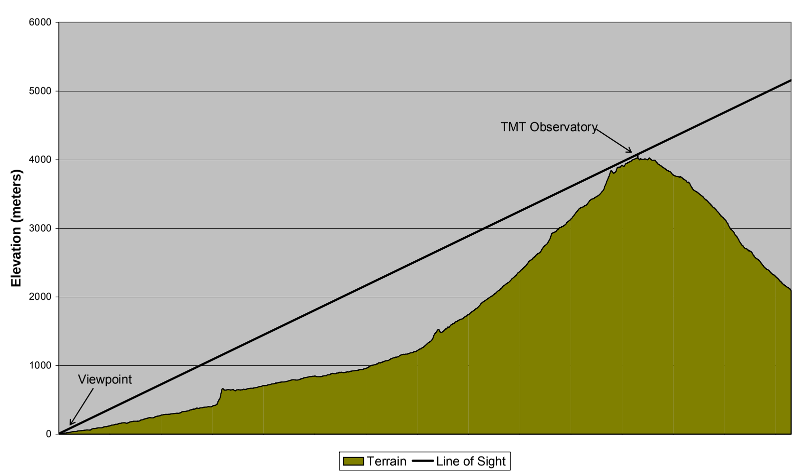
Hualalai Resort - TMT Proposed 13N Site



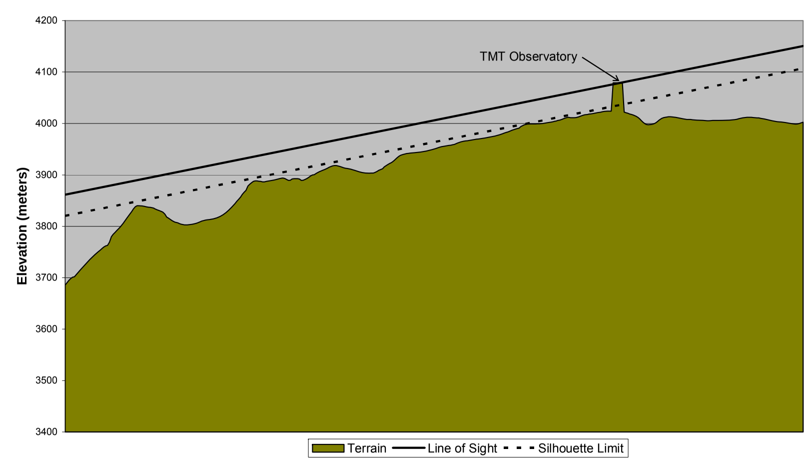
Hualalai Resort - Near TMT Proposed 13N Site

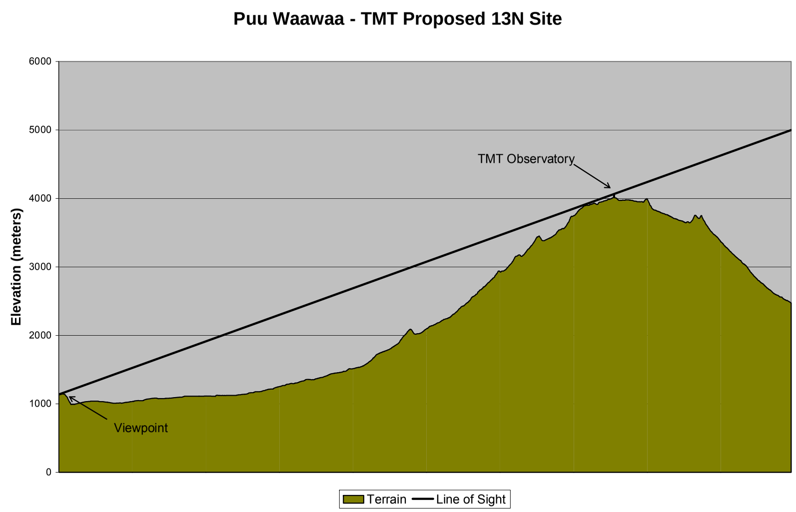


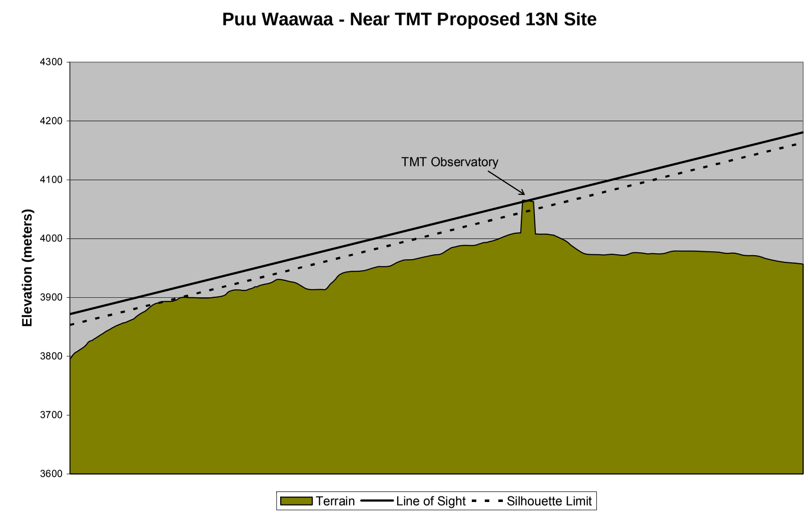
Hualalai Resort - TMT Alternative E2 Site

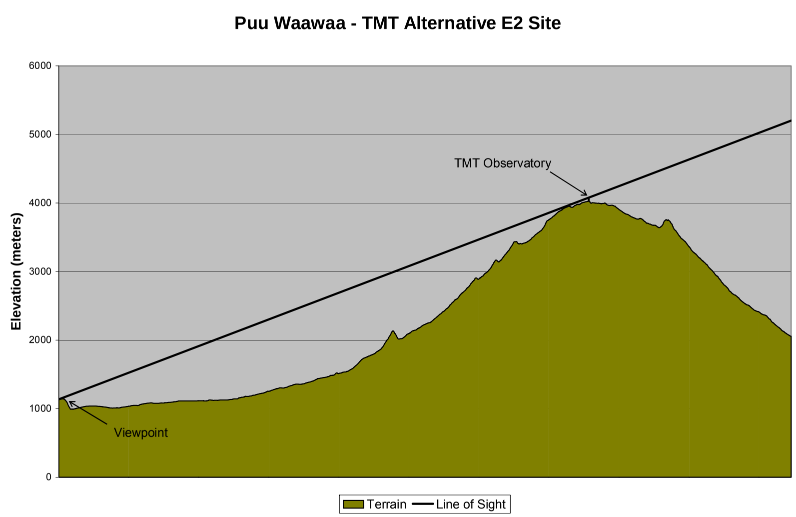


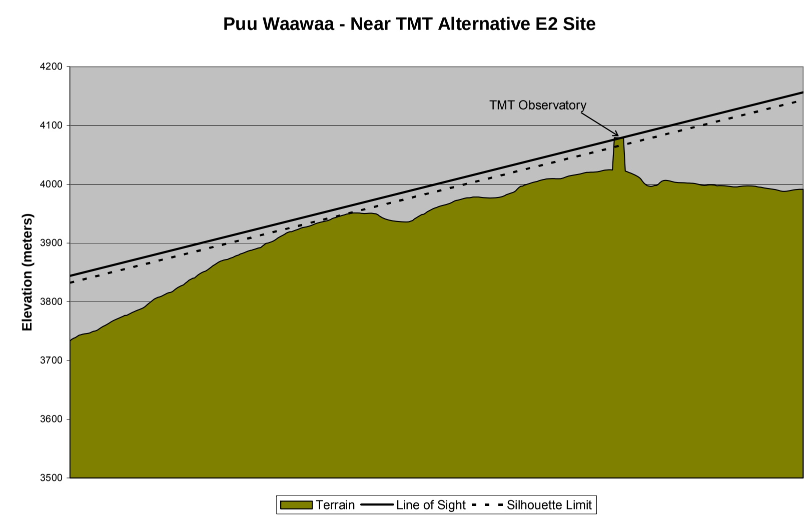
Hualalai Resort - Near TMT Alternative E2 Site



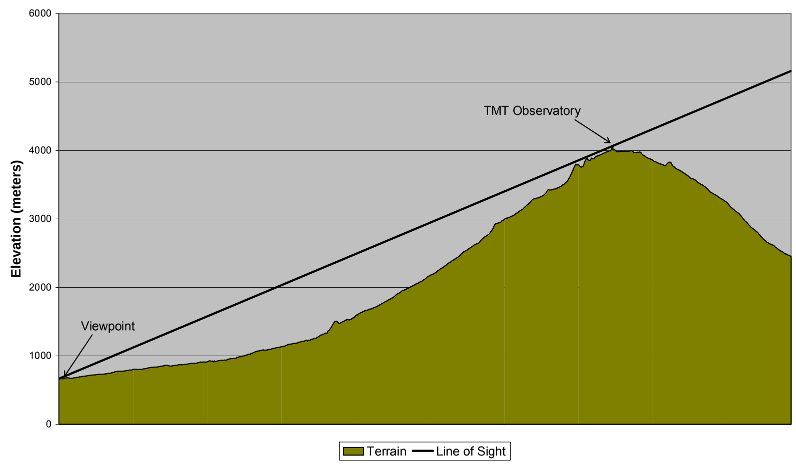

Puu Waawaa - TMT Proposed 13N Site
Elevation (meters)
6000
5000
4000
3000
2000
1000
0
TMT Observatory
Viewpoint
Terrain
Line of Sight


Puu Waawaa - Near TMT Proposed 13N Site
Elevation (meters)
4300
4200
4100
4000
3900
3800
3700
3600
TMT Observatory
Terrain
Line of Sight
Silhouette Limit

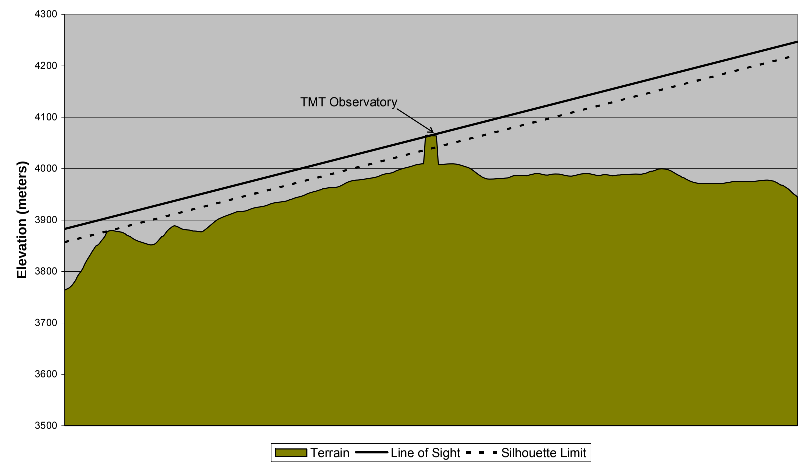

Puu Waawaa - TMT Alternative E2 Site
Elevation (meters)
6000
5000
4000
3000
2000
1000
0
TMT Observatory
Viewpoint
Terrain
Line of Sight


Puu Waawaa - Near TMT Alternative E2 Site
Elevation (meters)
4200
4100
4000
3900
3800
3700
3600
3500
TMT Observatory
Terrain
Line of Sight
Silhouette Limit

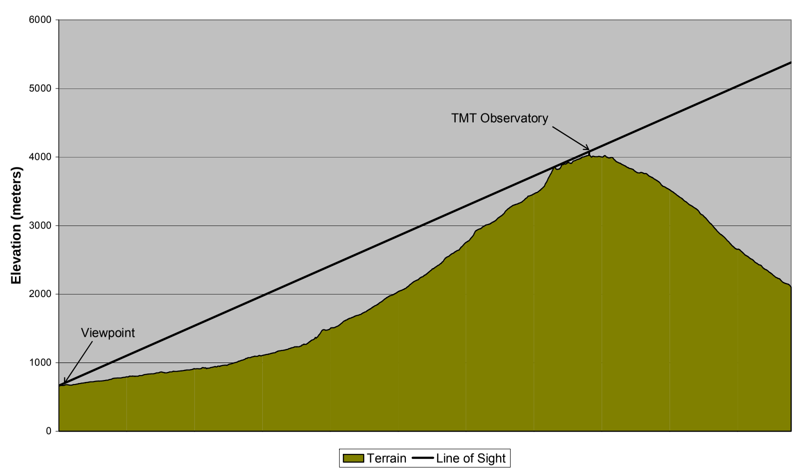
Big Island Country Club - TMT Proposed 13N Site



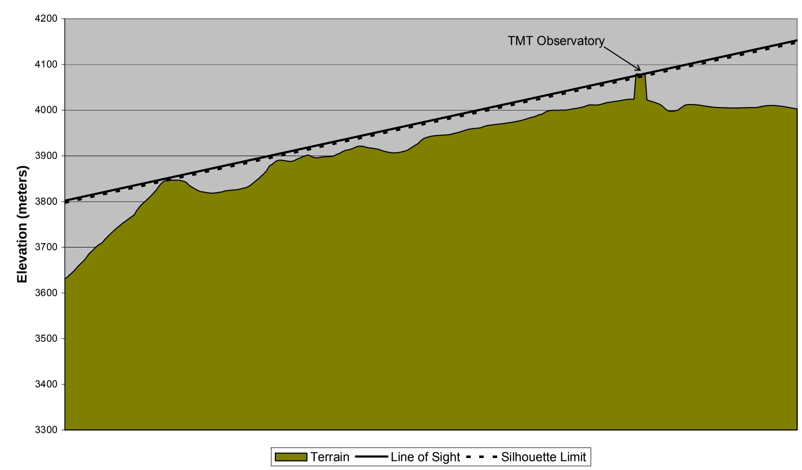
Big Island Country Club - Near TMT Proposed 13N Site



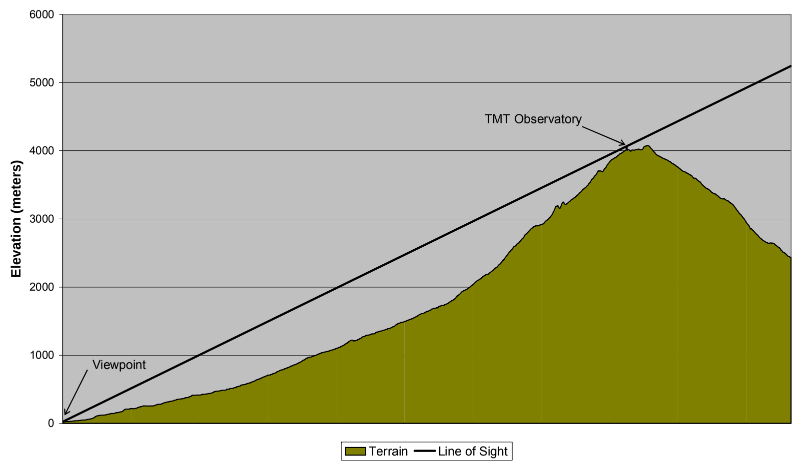
Big Island Country Club - TMT Alternative E2 Site



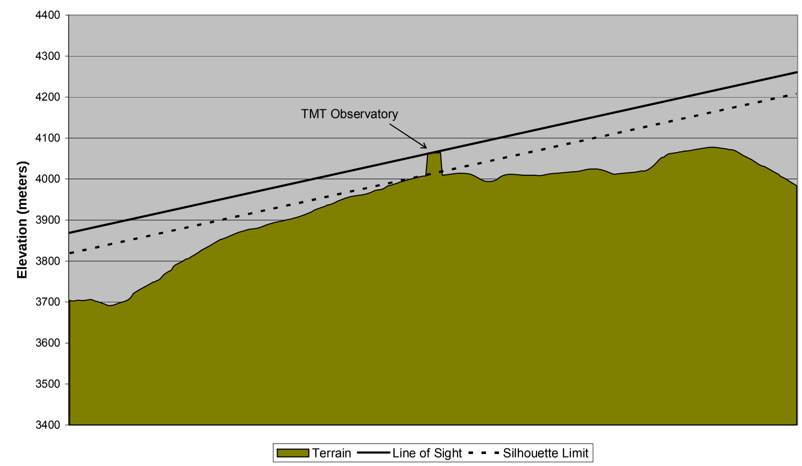
Big Island Country Club - Near TMT Alternative E2 Site



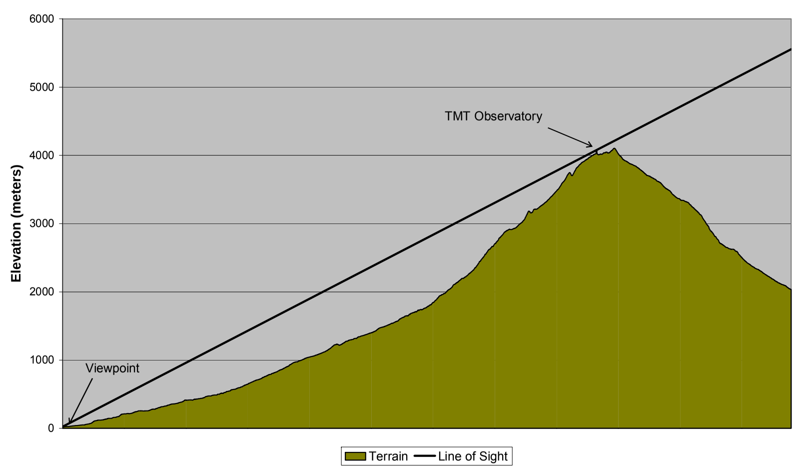
Waikoloa/Mauna Lani - TMT Proposed 13N Site



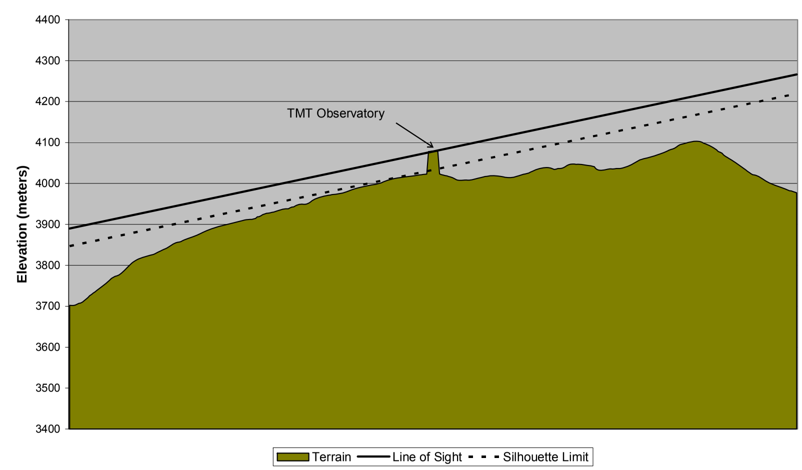
Waikoloa/Mauna Lani - Near TMT Proposed 13N Site



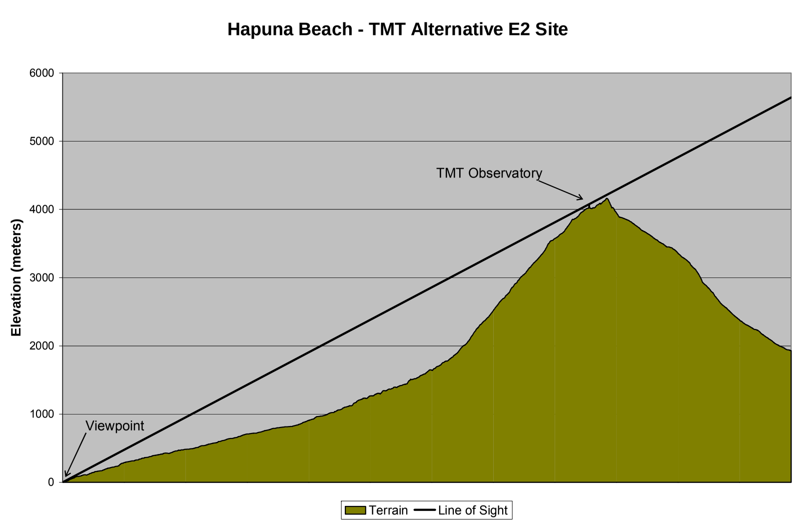
Waikoloa/Mauna Lani - TMT Alternative E2 Site

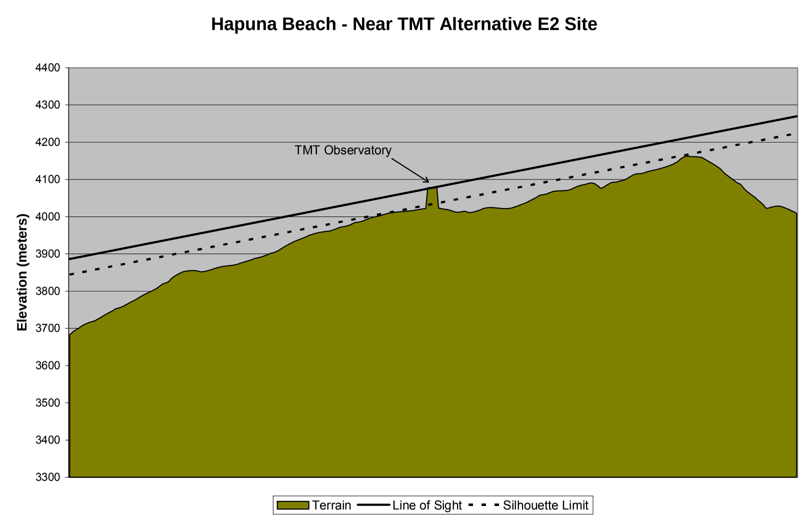


Waikoloa/Mauna Lani - Near TMT Alternative E2 Site

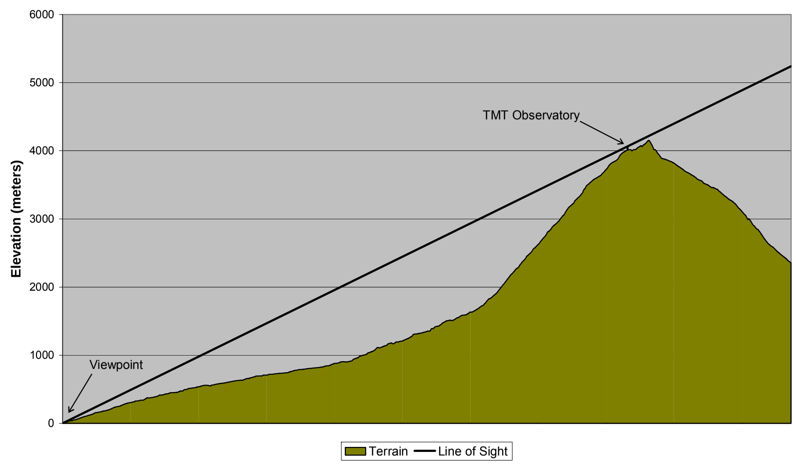


At site 13N the TMT Observatory would not be visible from Hapuna Beach.

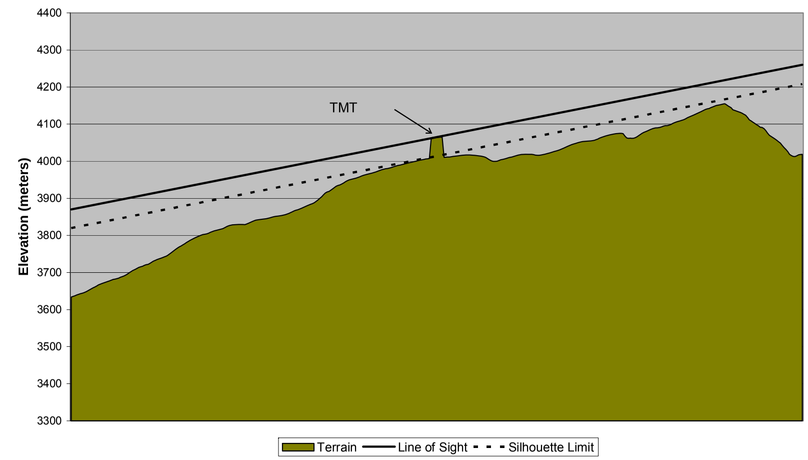




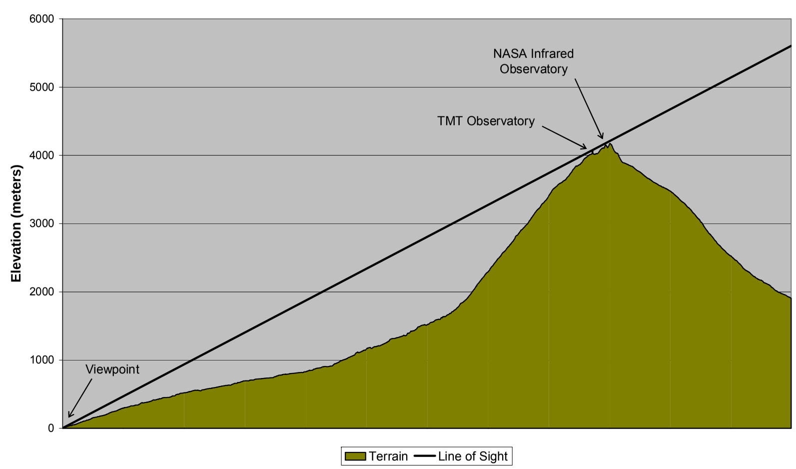
Puukohola Heiau - TMT Proposed 13N Site



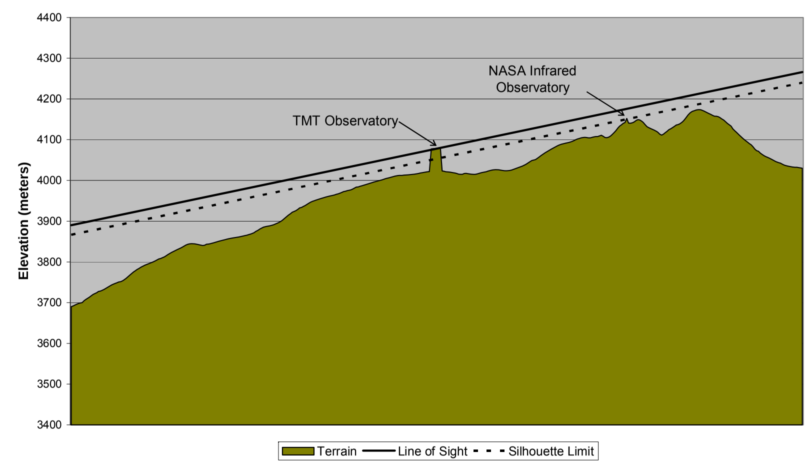
Puukohola Heiau - Near TMT Proposed 13N Site



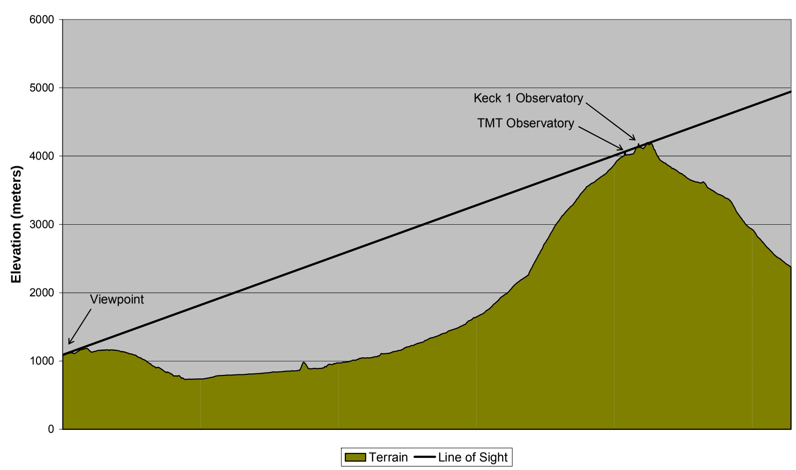
Puukohola Heiau - TMT Alternative E2 Site



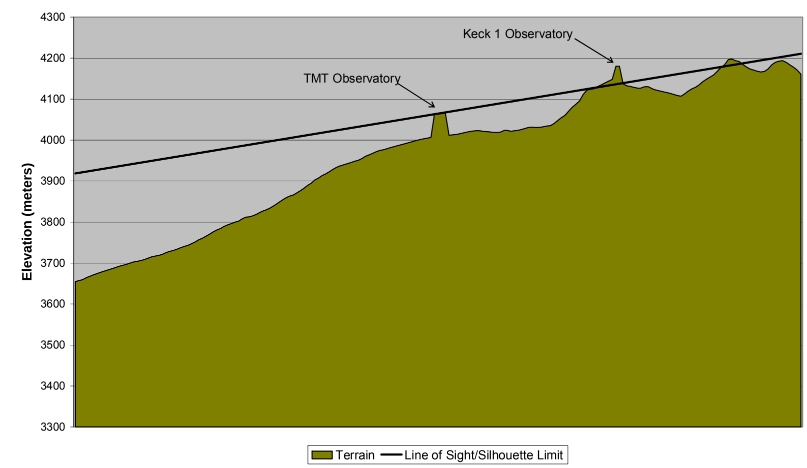
Puukohola Heiau - Near TMT Alternative E2 Site



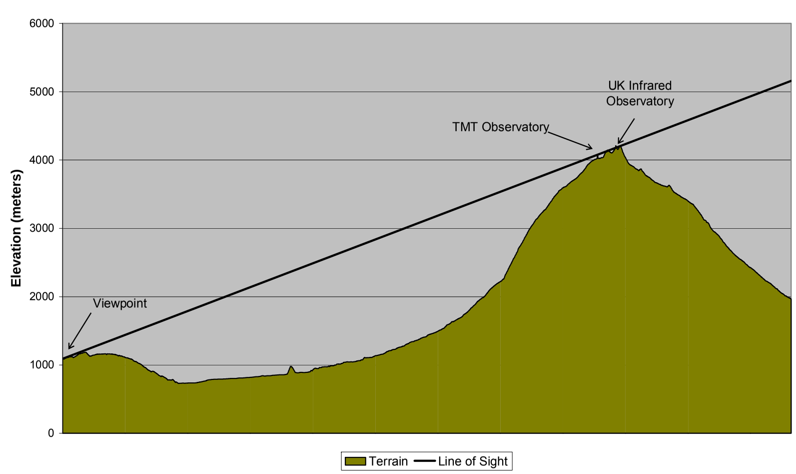
DHHL Kawaihae at Rt. 250 - TMT Proposed 13N Site



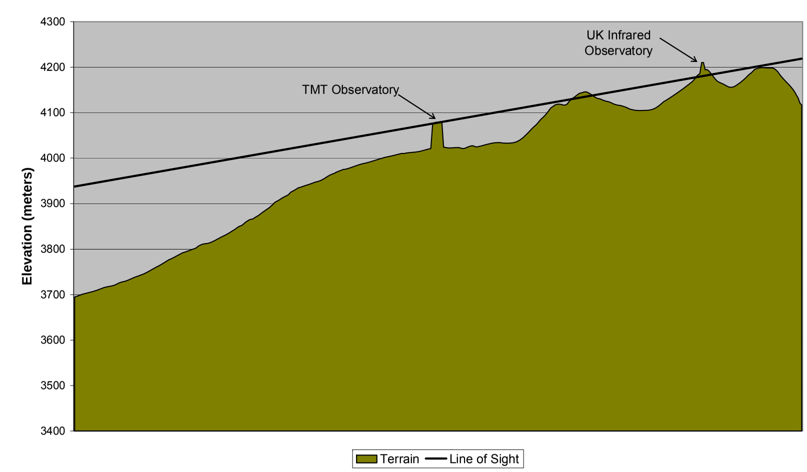
DHHL Kawaihae at Rt. 250 - Near TMT Proposed 13N Site



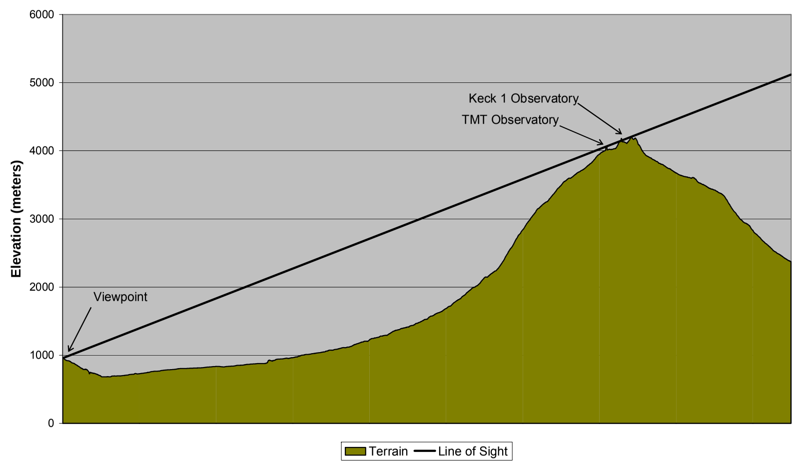
DHHL Kawaihae at Rt. 250 - TMT Alternative E2 Site



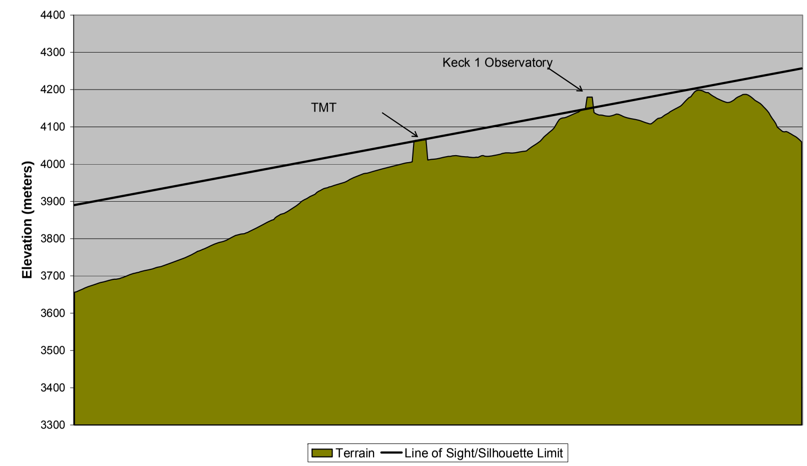
DHHL Kawaihae at Rt. 250 - Near TMT Alternative E2 Site



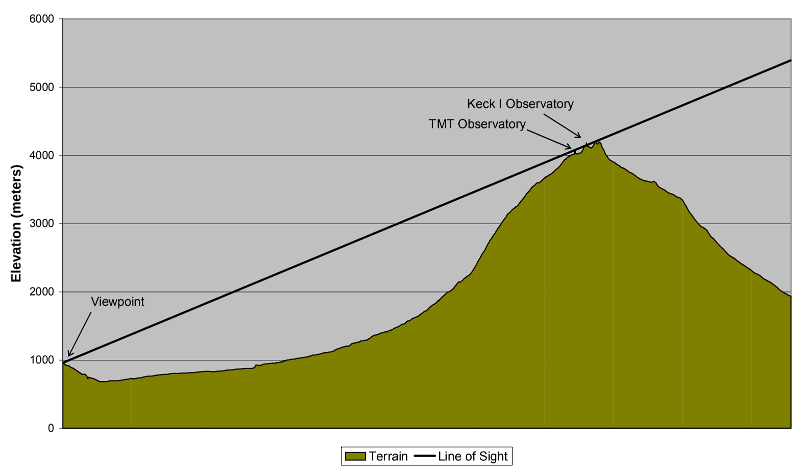
Route 250 Puu overlook - TMT Proposed 13N Site



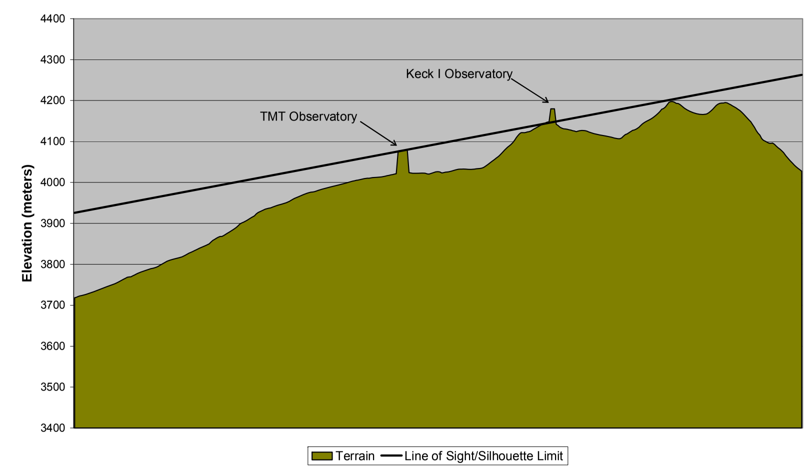
Route 250 Puu overlook - Near TMT Proposed 13N Site



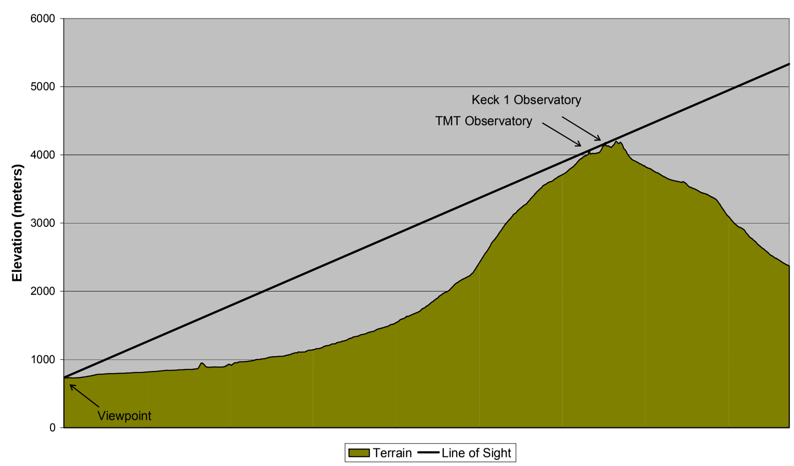
Route 250 Puu overlook - TMT Alternative E2 Site



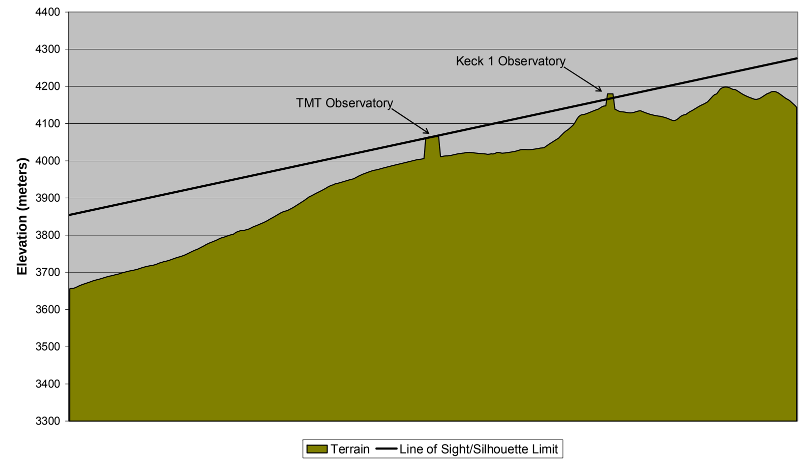
Route 250 Puu overlook - Near TMT Alternative E2 Site



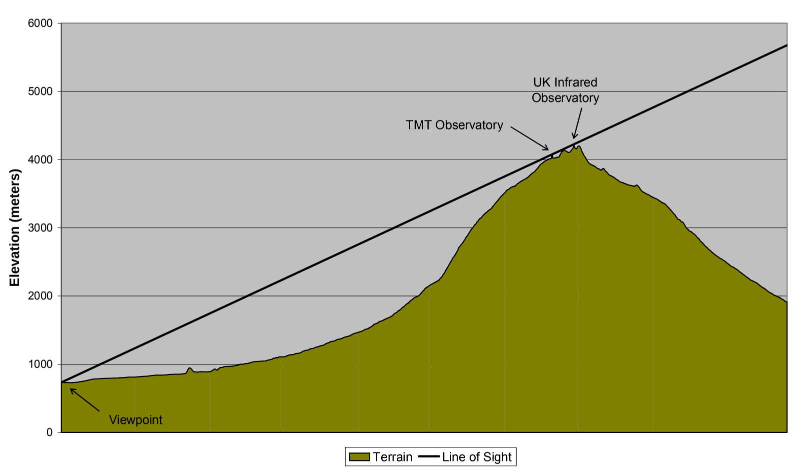
DHHL Lalamilo - TMT Proposed 13N Site



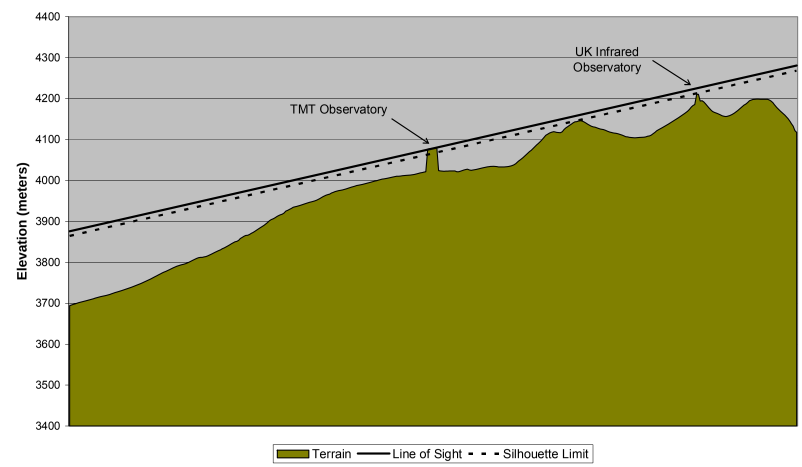
DHHL Lalamilo - Near TMT Proposed 13N Site



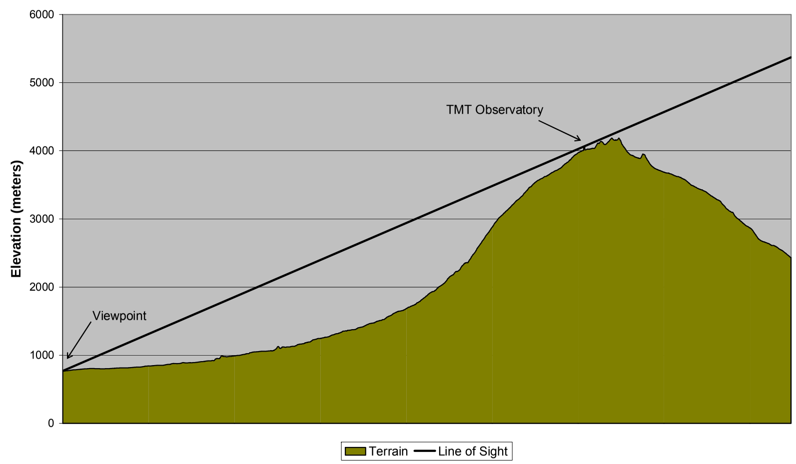
DHHL Lalamilo - TMT Alternative E2 Site



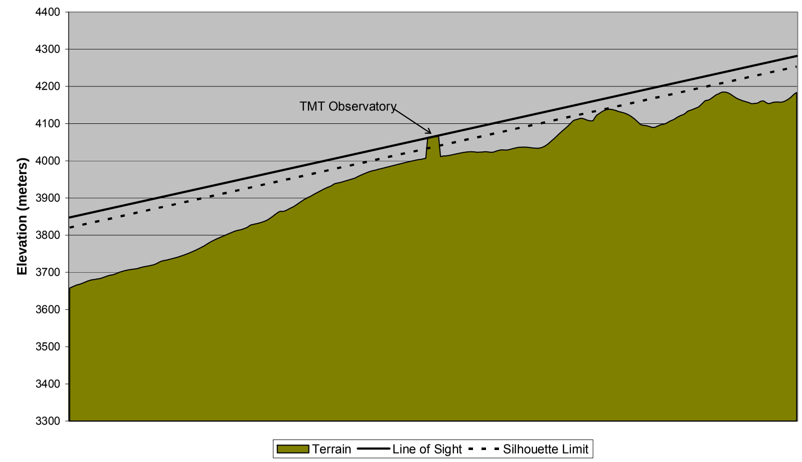
DHHL Lalamilo - Near TMT Alternative E2 Site



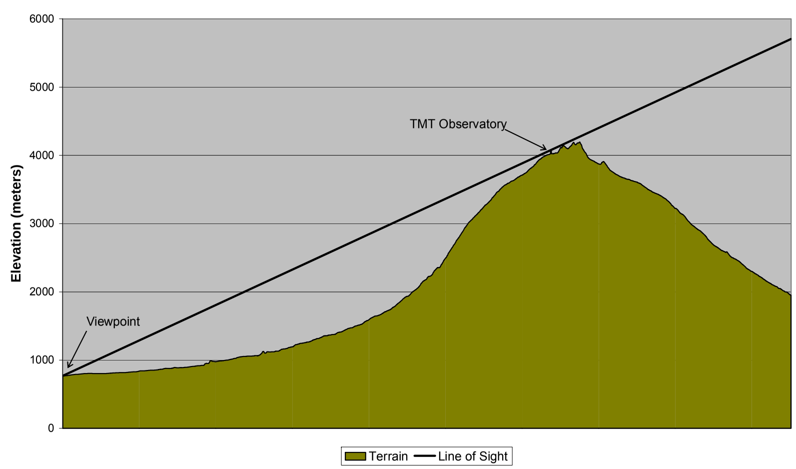
Waimea Park - TMT Proposed 13N Site



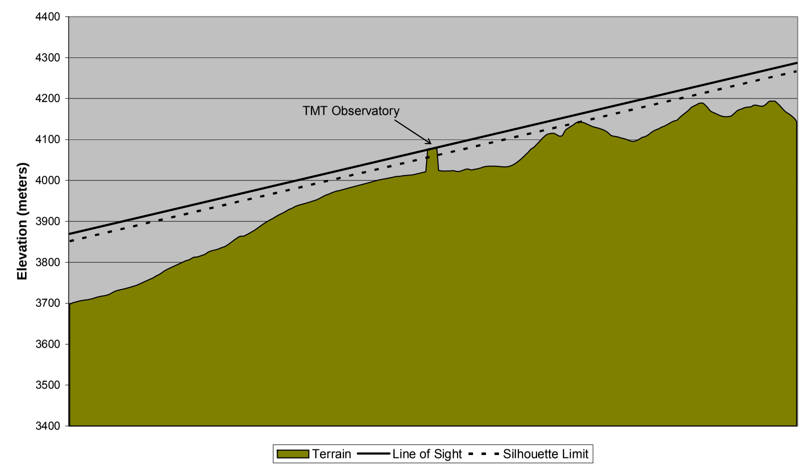
Waimea Park - Near TMT Proposed 13N Site



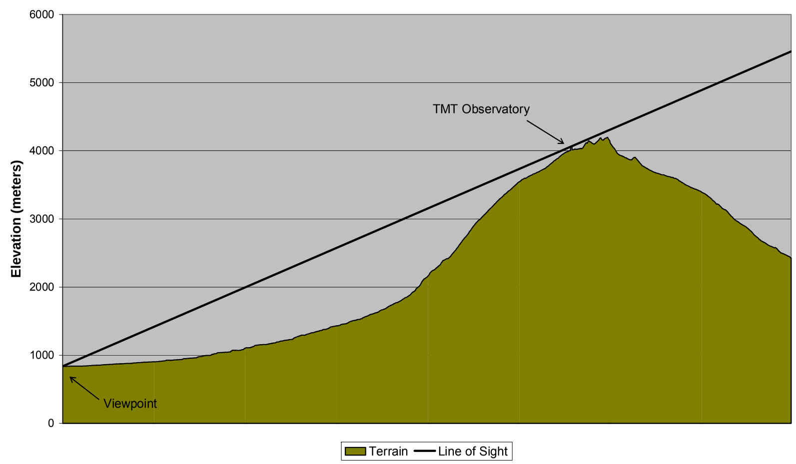
Waimea Park - TMT Alternative E2 Site



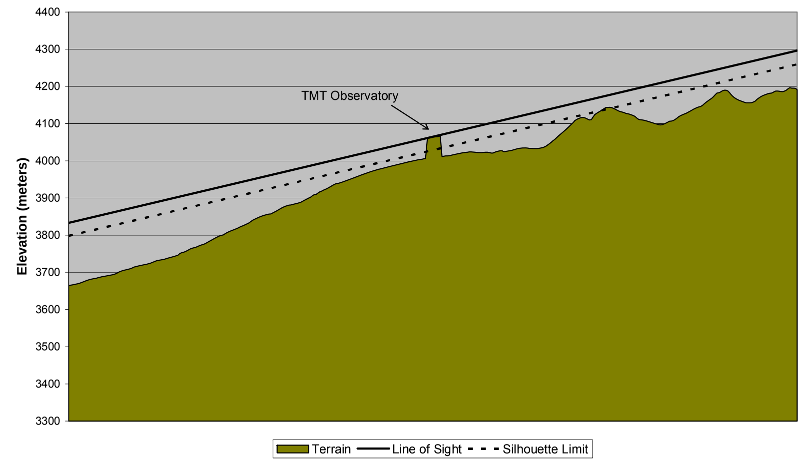
Waimea Park - Near TMT Alternative 13N Site



DHHL Puu Kapu - TMT Proposed 13N Site



DHHL Puu Kapu - Near TMT Proposed 13N Site



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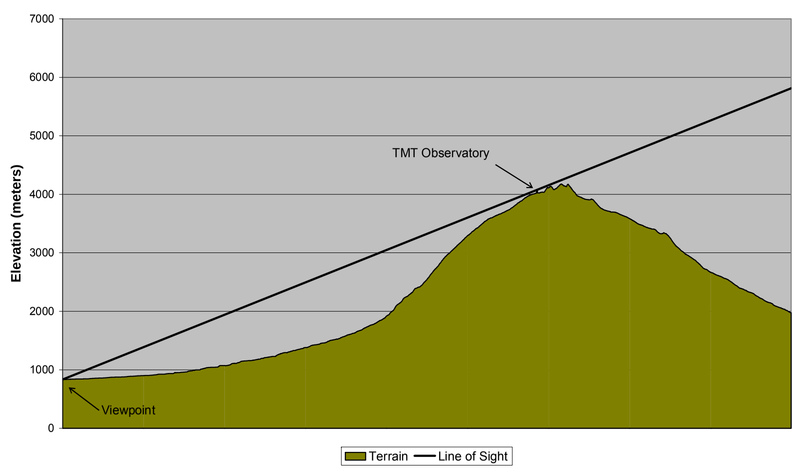
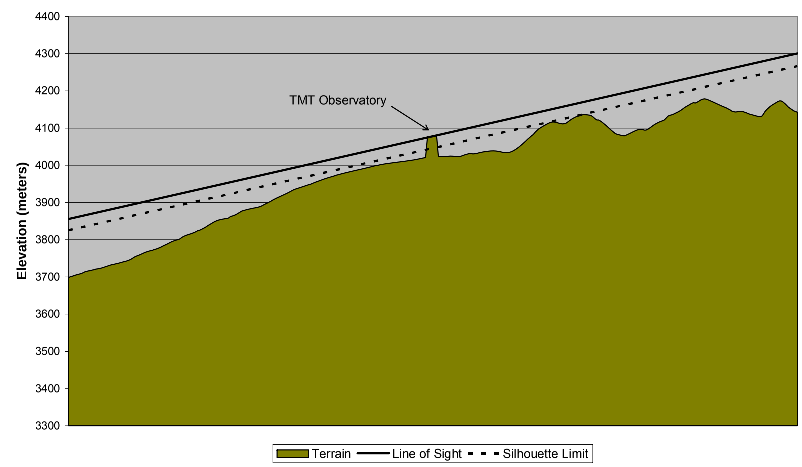
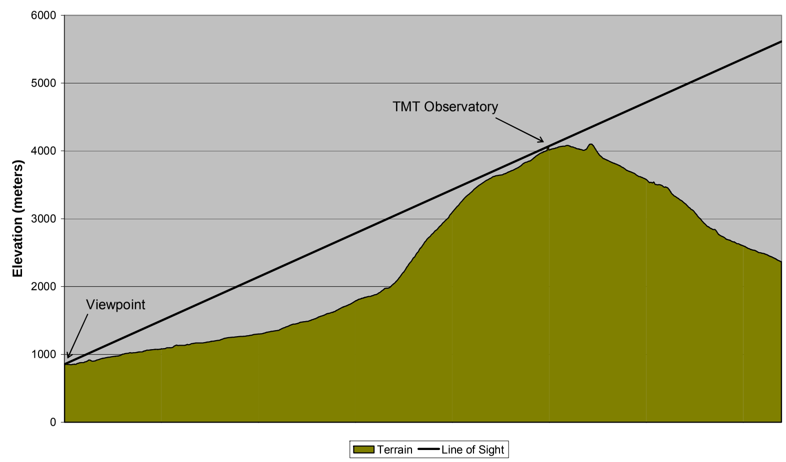


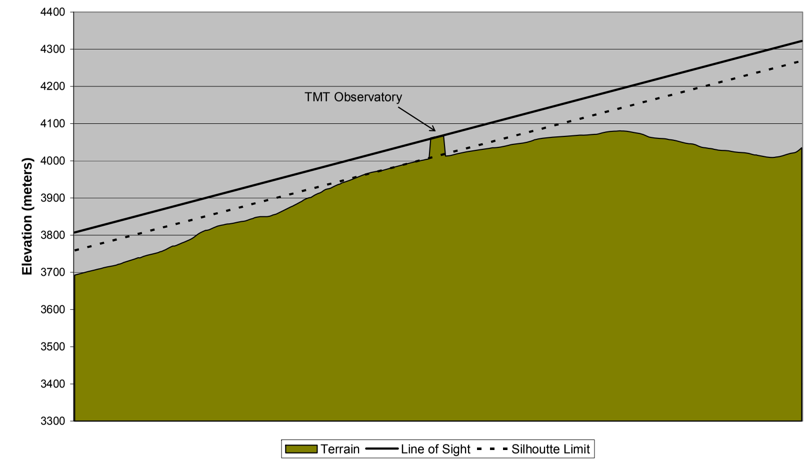
DHHL Puu Kapu - Near TMT Alternative E2 Site



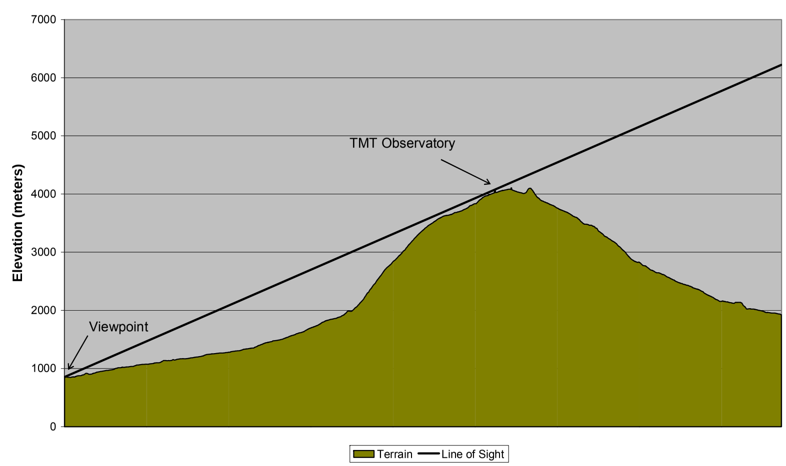
DHHL Waikoloa-Waialeale - TMT Proposed 13N Site



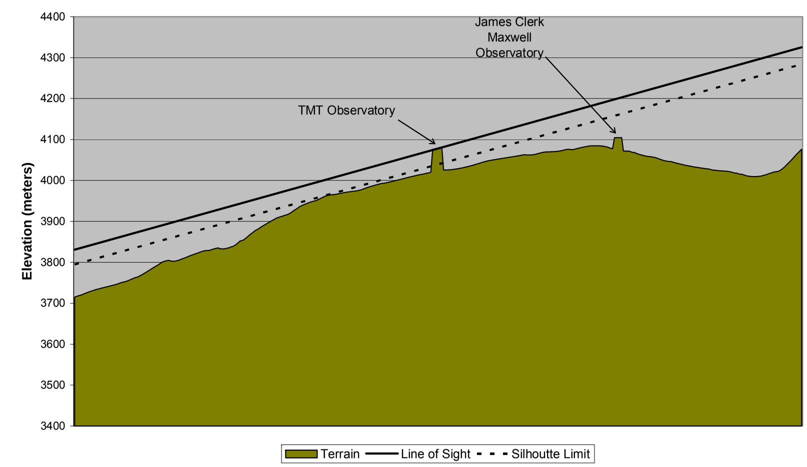
DHHL Waikoloa-Waialeale - Near TMT Proposed 13N Site

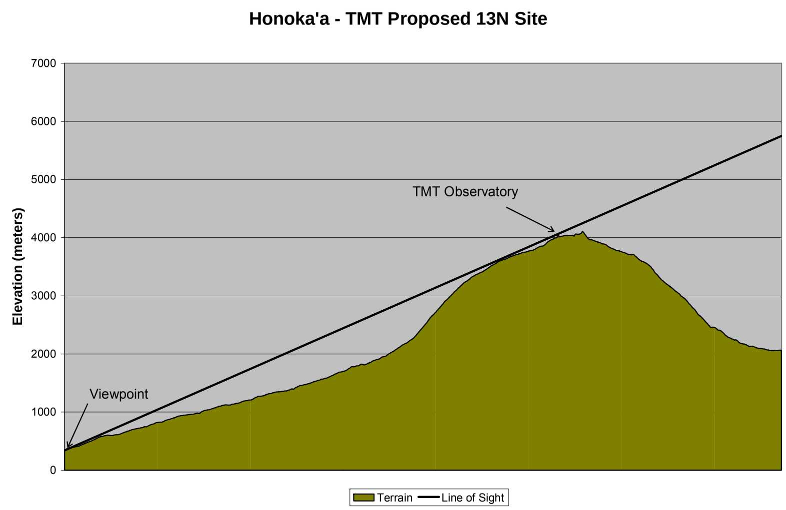


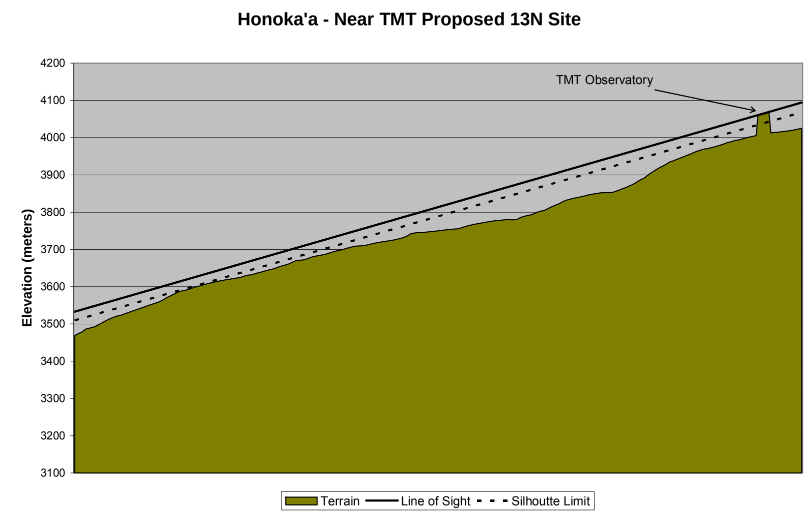
DHHL Waikoloa-Waialeale - TMT Alternative E2 Site



DHHL Waikoloa-Waialeale - Near TMT Alternative E2 Site







At site E2 the TMT Observatory would not be visible from Honoka‘a.