DRAFT ENVIRONMENTAL ASSESSMENT FOR THE HALEAKALĀ HIGH ALTITUDE OBSERVATORY SITE MAUI, HAWAI‘I MANAGEMENT PLAN

University of Hawai‘i
Institute for Astronomy

March 1, 2010

Prepared by

KC Environmental, Inc.
P.O. Box 1208
Makawao, Hawai‘i 96768

and

Tetra Tech, Inc.
737 Bishop Street, Suite 3020
Honolulu, Hawai‘i 96813

EXECUTIVE SUMMARY

Proposing/Approving Agency:	University of Hawai'i
Location of Proposed Action:	(2) 2-2-07-008, Waiakoa, Papa'anui, Makawao Maui, Hawai'i
Landowner:	University of Hawai'i
Project Summary:	Draft Environmental Assessment for a Management Plan for the Haleakalā High Altitude Observatory Site
Legal Authority:	Chapter 343, Hawai'i Revised Statutes
Applicable Environmental Assessment Review "trigger":	Use of State Lands or Funds Use of Conservation District Lands
Type of Document:	Draft Environmental Assessment for Implementation of a Management Plan
Anticipated Determination:	Based on the information contained in this Draft Environmental Assessment, UH has determined that the Proposed Action will not have a significant impact on the environment. accordingly, UH anticipates issuing a Finding of No Significant Impact (FONSI).
Consultant:	KC Environmental, Inc. P. O. Box 1208, Makawao, HI 96768 Charlie Fein, Ph.D., Vice President Direct: 808-281-7094

This Draft Environmental Assessment (DEA) evaluates a Management Plan (MP) for appropriate and reasonable activities that would be undertaken by the University of Hawai'i Institute for Astronomy (IfA) at the Haleakalā High Altitude Observatory Site (HO) in support of ongoing and future astronomical research activities, including those that would require a Conservation District Use Permit (CDUP), in accordance with Hawai'i Administrative Rules (HAR) 13-5-39. For this EA, the Proposed Action is defined as the implementation of a MP, which would regulate land use in the Conservation District for the purpose of conserving, protecting, and preserving the important natural resources of the State through appropriate management and use to promote their long term sustainability and the public health, safety, and welfare.

The implementation of the MP is intended to comply with Exhibit 3 of HAR 13-5 and is not intended to assess impacts from construction or operation of any new project at HO or to authorize construction of any Proposed Action. Any new proposed project within HO would require evaluation for potential impacts to resources within HO and any larger Region of Influence (ROI), as affected; and, relevant State agencies and the public would be informed of the environmental consequences.

This DEA has been developed in accordance with the Hawai'i Revised Statutes (HRS) Chapter 343, Environmental Impact Statements. The purpose of the DEA is to inform the relevant state agencies and the public of the likely environmental consequences of the MP on ongoing and future actions at HO in support of astronomical research.

Proposed Action and Alternative

The Proposed Action is defined as a MP for HO. Each new project proposing an action within HO would have to be evaluated for potential impacts to HO and any larger Region of Influence (ROI) as affected.

The Proposed Action includes monitoring and management strategies for astronomical and space surveillance experiments, requirements for new facility design, construction, and operation, and for replacing HO facilities in support of long-term science investigations. Future actions at HO may include developing the following:

- Facilities and experiments devoted to searching for and characterizing planets around the Sun and stars;
- Facilities and experiments dedicated to the study of oscillations and stellar activity in stars; and
- Experiments that study the Sun and its outer atmosphere.

No-Action Alternative

Under the No-Action Alternative, the MP would not be implemented and the integrated protection of natural and cultural resources in a single, comprehensive management plan would not be achieved.

Affected Environment

An overview is presented of baseline physical, cultural, biological, social, and economic conditions that occur within HO and expanded ROI where appropriate. The overview describes the resources, history, and current conditions for the property and expanded ROI where implementation of the MP would have an effect.

Summary of Impacts

Table ES-1 is a summary of impacts of the Proposed Action, the No-Action Alternative and cumulative impacts. Less than significant impacts were identified for most resource areas.

Table ES-1
Summary of Potential Impacts for
Proposed Action Alternative, No-Action Alternative, and Cumulative Actions

Impact Issues	Proposed Action	No-Action	Cumulative
Land use and existing activities	○	○	○
Cultural and historic resources	⊙	⊙	⊙
Archeological resources	+	○	⊙
Biological resources	+	⊙	⊙
Topography, geology, and soils	+	⊙	⊙
Visual resources and view plane	+	○	○
Hydrology	+	⊙	⊙
Infrastructure and utilities	○	○	○
Climatology and air quality	○	○	⊙
Public health and safety	+	○	⊙
Socioeconomics	○	○	⊙
Natural hazards	+	⊙	⊙

LEGEND:
⊗ = Significant impact
⃠ = Significant but mitigable to less than significant impact
⊙ = Less than significant impact
○ = No impact
\+ = Beneficial impact
N/A = Not applicable

Impacts for the Proposed Action

Under implementation of the MP, it is anticipated that no impacts would result to land use and existing activities, topography, geology and soils, infrastructure and utilities, climatology and air quality, and socioeconomics. Less than significant impacts would result for the following resource areas: cultural and historic resources. Other areas, such as archeological resources, biological resources; visual resources and view plane; hydrology; public health and safety; and natural hazards would benefit from implementation of the MP.

Although less than significant impacts can be expected for cultural resources and historic buildings and structures as a direct result of implementing the MP, there is potential at HO for projects to result in significant impacts to cultural and historic resources. Therefore, construction of new facilities that would affect those resources would require separate environmental documentation to be completed for each new proposed project, and the impacts of each project would be analyzed individually.

Archeological sites exist throughout the HO property. In some portions of the property, such as where the Maui Space Surveillance Complex (MSSC) was built, inspections indicate that parts of HO were previously affected by earthmoving associated with construction. Any archeological resources that may have existed before construction are no longer present. Under the MP, any future construction at HO would be conducted in accordance with the "Science City Preservation Plan" (Appendix D(2) approved by the State Historic Preservation Division (SHPD). The plan calls for passive preservation of sites during future activities, which would be a beneficial impact of the MP.

In the event that a burial site is uncovered under the Proposed Action, the requirements in HAR, Title 13, Subtitle 13, Chapter 300, Rules of Practice and Procedure Relating to Burial Sites and Human Remains would be followed.

Implementation of the MP would address biological resources, and in particular potential impacts to endangered species. Measures are presented in the MP that would not only minimize potential impacts but would be beneficial to proliferation of at least one of those species. Introduction and proliferation of alien invasive species (AIS) at HO continues to be possible and beneficial measures are presented in the MP for prevention of AIS introduction.

Under an approved MP, there would be no impacts on topography and geology and a positive impact on soils. Measures in the MP are intended to reduce the risk of erosion and soil loss, and therefore would result in beneficial effects on this resource.

With respect to visual resources, the intention of IfA is to have facilities that are as appropriate as possible on a mountain summit that has rich natural, cultural, and historic resources. Rules and design criteria to be implemented in the MP were developed in keeping with that intention. The construction and operation of facilities and structures at HO that do not replace existing facilities and structures of similar size, scale, dimension, and appearance would require further analysis of potential adverse impacts on visual resources.

The MP would result in beneficial impacts on groundwater resources and less than significant impacts on surface water. While a new individual wastewater treatment system may be installed for any new facilities, the existing cesspools would continue to be used. During construction of any future facilities, there would be an increased potential for water quality degradation due to sediment runoff from disturbed areas at the site. This potential would require separate analysis for any proposed project.

If implemented, the MP would result in a beneficial impact on the stormwater and drainage system, domestic wastewater, solid waste disposal, electrical systems, and roadways and traffic within the ROI. The construction and operation of new facilities would increase the demand on the electrical distribution and communication systems, increase the amount of impermeable surfaces and the potential for more runoff associated with construction, and place higher demand on the domestic wastewater system. There would also be a potential increase in vehicles on HO roadways. Again, under the MP, these potential impacts would have to be evaluated for any new proposed projects.

The MP would not likely have any adverse impacts on climatology and air quality from conducting astronomical or space surveillance experiments; the low levels of emissions from HO operations would continue. If construction and operation of new facilities were considered, further analysis would be needed.

The MP would have beneficial impacts on public health and safety. Any adverse effects would be related to future activities. Such actions as the operation of future proposed facilities could result in an increase in hazardous materials and waste streams. However, the MP defines how these materials are to be handled, and therefore no appreciable effect on public health and safety would be expected. Future construction could result in noise emissions that would increase the ambient noise levels at the summit and would need to be evaluated for impacts within HO and for areas outside of HO, in which such noise could be heard. Standard operational processes for future proposed facilities would not likely emit significant nuisance noises or vibrations to the surrounding research environment.

Under an approved MP, there would be no impact on staff to perform new research experiments, on population and housing, or on employment and income from hiring staff for research experiments and construction. The MP would not impact new experiments and research that would result in beneficial impacts on education and outreach.

The implementation of the MP would have a beneficial on the safety of the public and the impacts on the environment where future actions would have more comprehensive provisions to protect personnel and structures from natural hazards that could cause damage, destruction, or loss of life.

Impacts for the No-Action Alternative

The impact evaluation for the No-Action Alternative is based on a comparison to the baseline effects. The No-Action Alternative would impose no new impacts on land use and existing activities. However, biological resources, archeological resources, topography, geology, and soils; visual resources and view plane; hydrology; infrastructure and utilities; and natural hazards would likely experience less than significant impacts without the Proposed Action.

Impacts from the No-Action Alternative are similar to impacts for the Proposed Action for cultural, historic, climatology and air quality. Less than significant impacts are expected even if the MP is not implemented.

Cumulative Impacts

Cumulative impacts are the direct and indirect effects of a proposed project's incremental impacts when they are added to other past, present, and reasonably foreseeable future actions, regardless of who carries out the action (HRS 343). For the purposes of this DEA, the temporal boundary of analysis is from approximately 2000 to 2015. Implementation of the MP would result in beneficial, less than significant cumulative impacts, or no impacts for all resource areas.

Based on the analyses in this DEA, the University has determined that the Proposed Action will either have beneficial, less than significant, or no impacts on the environment. Accordingly, it anticipates that it will issue a Finding of No Significant Impact (FONSI) for the Proposed Action. This anticipated determination will be reviewed after all comments on the DEA are received. At that time, the University will either issue a FONSI or will proceed with an Environmental Impact Statement (EIS).

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While some of the surveys and assessments were conducted for specific projects within HO, they are discussed and provided in this Draft Environmental Assessment for their environmental resources information content.

ACRONYMS, ABBREVIATIONS, AND TERMINOLOGY

AEOS	Advanced Electro-Optical System
AERL	AVCO Everett Research Laboratory
AFI	Air Force Instruction
AFRL	Air Force Research Laboratory
AGN	active galactic nuclei
‘ahinahina	Haleakalā silversword
ahu	altar or shrine
AIS	Alien Invasive Species
AMOS	ARPA Maui Optical Station
ASL	above sea level
ATST	Advanced Technology Solar Telescope
BLNR	Board of Land and Natural Resources
BMP	Best Management Practice
CAA	Clean Air Act
CDUA	Conservation District Use Application
CDUP	Conservation District Use Permit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CfAO	Center for Adaptive Optics
CRE	Cultural Resources Evaluation
CSH	Cultural Surveys Hawai‘i, Inc.
DARPA	Defense Advanced Research Projects Agency
dBA	“A-weighted” decibel scale
DEA	Draft Environmental Assessment
DLNR	Department of Land and Natural Resources
DOD	Department of Defense
DOE	Department of Energy
DOFAW	Division of Forestry and Wildlife
DOT	Department of Transportation
DS3	Digital Signal 3
EHSO	Environmental Health and Safety Office
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FDA	Food and Drug Administration
FHWA	Federal Highway Administration
FTF	Faulkes Telescope Facility
GEODSS	Ground-Based Electro-Optical Deep Space Surveillance System
GPAC	General Plan Advisory Committee
GPS	Global Positioning System

ACRONYMS, ABBREVIATIONS, AND TERMINOLOGY

HALE	Haleakalā National Park
HAR	Hawai'i Administrative Rules
HAZMAT	hazardous materials
Hinala'anui	West-facing ahu
HO	Haleakalā High Altitude Observatory Site
Ho'omahanahana	dedication or "warming" offering
Ho'oponopono	to "make right"
HRS	Hawai'i Revised Statutes
HVAC	heating ventilation and air conditioning
IfA	University of Hawai'i Institute for Astronomy
Kahu	clergyman, caretaker
kāhuna	priest
kāhuna Po'o	head priest
Kanaka Maoli	indigenous Hawaiian people
Kinolau	supernatural forms taken by Pele
ko'a	ceremonial rock formations
Kumu Hula	hula master
kupuna	elders
kVA	kilo Volt Ampere
LCOGT	Las Cumbres Observatory Global Telescope Network, Inc.
LRDP	Long Range Development Plan
LUC	Land Use Commission
LURE	Lunar Ranging Experiment
MAGNUM	Multi-color Active Galactic Nuclei Monitor Project
mana	spirit
Maui Nui O Kama	the greater Maui
MECO	Maui Electric Co., Inc.
MEDB	Maui Economic Development Board, Inc.
mo'olelo	stories
MOTIF	Maui Optical Tracking and Identification Facility
MSSC	Maui Space Surveillance Complex
MSSS	Maui Space Surveillance System
MSTEE	Maui Science and Technology Education Exchange
MSO	Mees Solar Observatory
na poāo kāhuna	priest
nēnē	Hawaiian goose
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
OCCL	Office of Conservation and Coastal Lands
OEQC	Office of Environmental Quality Control

ACRONYMS, ABBREVIATIONS, AND TERMINOLOGY

ODS	ozone-depleting substance
oli	chants
‘ope‘ape‘a	Hawaiian hoary bat
Pā‘ele Kū Ai I Ka Moku	East-facing ahu
Pan-STARRS	Panoramic-Survey Telescope and Rapid Response System
PDW	Professional Development Workshop
Pele	Goddess of the Volcano
piko	navel
pu‘u	hill
Pu‘u Ula‘ula	Red Hill
RCAG	Remote Communications Air/Ground
RCRA	Resource Conservation and Recovery Act
ROI	Region of Influence
SCIA	Supplemental Cultural Impact Assessment
SHPD	State Historic Preservation Division
SIHP	State Inventory of Historic Places
SOLAR-C	Scatter-free Observatory for Limb Active Regions and Coronae
SQG	small quantity generator
SUP	Special Use Permit
SWMP	Stormwater Management Plan
TCP	Traditional Cultural Property
TMK	tax key map
TLRS	Transportable Laser Ranging System
‘ua‘u	Hawaiian Petrel
UK	United Kingdom
UH	University of Hawai‘i
URM	under-represented minorities
USAF	U.S. Air Force
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey
Wahi Pana	a legendary place

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

This Draft Environmental Assessment (DEA) evaluates a Management Plan (MP) for appropriate and reasonable activities that would be undertaken by the University of Hawaiʻi Institute for Astronomy (IfA) at the Haleakalā High Altitude Observatory Site (HO) in support of ongoing and future astronomical research activities, including those that would require a Conservation District Use Permit (CDUP), in accordance with HAR 13-5-39. For this DEA, the Proposed Action is defined as the implementation of the MP, which would regulate land use in the Conservation District for the purpose of conserving, protecting, and preserving the important natural resources of the State through appropriate management and use to promote their long term sustainability and the public health, safety, and welfare. The MP is included in this DEA as Appendix K.

The implementation of the MP is intended to comply with Exhibit 3 of HAR 13-5, and is not intended to assess impacts from construction or operation of any new Proposed Action at HO or to authorize construction. Any new proposed project within HO would have to be evaluated for potential impacts to resources within HO and any larger Region of Influence (ROI), as affected; and, relevant State agencies and the public would be informed of the environmental consequences.

In 1961, Executive Order 1987 (EO) signed by State of Hawaiʻi Governor Quinn set aside 18.166 acres on the summit of Haleakalā for observatory site purposes. HO is located within the Conservation District and General Subzone, on Puʻu Kolekole, and the University of Hawaiʻi (UH) is the owner of the parcel, with IfA responsible for managing and developing the site for scientific purposes.

Hawaiʻi Administrative Rules (HAR) Title 13: Department of Land and Natural Resources (DLNR), Subtitle 1: Administration, Chapter 5: Conservation District, regulates land use in the Conservation District for conserving, protecting, and preserving the important natural resources of the state through appropriate management and use to promote their long-term sustainability and the public health, safety, and welfare. The current activities within HO are permitted under Conservation District and General Subzone land use requirements of HAR 13-5.

This EA has been developed in accordance with the Hawaiʻi Revised Statutes (HRS) Chapter 343, Environmental Impact Statements (EIS). The purpose of the DEA is to inform the relevant State agencies and the public of the likely environmental consequences of the MP prepared for HO in accordance with HAR 13-5-39.

1.2 PURPOSE AND NEED

HO is important as it is one of the prime sites in the world for astronomical and space surveillance. In accordance with the requirements of Chapter 13-5-39, IfA has prepared an MP for HO, to serve as the guiding framework that enables IfA to effectively and efficiently manage HO for scientific purposes. The MP provides an overview of the resources within HO, a description of the proposed land use on the parcel, and a discussion of managing and monitoring strategies, some of which were first presented in the IfA's Long Range Development Plan (LRDP) for HO. Section 1.8.2 provides details about the LRDP.

1.3 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

This DEA evaluates the effects of the Proposed Action and the No-Action Alternative. The analysis of the Proposed Action is limited to the MP. Any proposed future actions would be evaluated on a case-by-case basis to determine whether additional environmental analysis is needed. The No-Action Alternative serves as the benchmark against which the Proposed Action can be evaluated.

1.3.1 Proposed Action

The Proposed Action includes monitoring and management strategies for implementing astronomical experiments, replacing HO facilities in support of long-term science investigations and as guidance for design and construction of new facilities. Future actions, which are not the subject of this MP, may include developing the following:

- Facilities and experiments devoted to searching for and characterizing planets around the sun and other stars;
- Facilities and experiments dedicated to the study of oscillations and stellar activity in other stars; and
- Experiments that study the Sun and its outer atmosphere.

1.3.2 No-Action Alternative

Under the No-Action Alternative, the MP would not be implemented and the integrated protection of natural and cultural resources in a single, comprehensive management plan would not be achieved.

1.4 AGENCY IDENTIFICATION

The UH is the agency assuming responsibility for the DEA in accordance with Chapter 343 of the HRS. The primary contact is the Office of the Director, University of Hawaiʻi

Institute for Astronomy, 2680 Woodlawn Drive, Honolulu, HI 96822-1897; telephone (808) 956-8566, fax (808) 946-3467.

The IfA was founded at the University of Hawai'i in 1967 to manage Haleakalā and Mauna Kea Observatories and to carry out its own program of fundamental research into the stars, planets, and galaxies that make up our Universe. One of eleven research institutes within the UH, it has a total staff of over 200, including about 45 faculty members.

The UH IfA is the steward of the 18.166 acres designated as HO and is responsible for managing and developing the property. HO is a preeminent state, national, and international resource for astronomical and related studies. In order to continue in the forefront of astronomy, UH must provide high-quality research and training facilities and place special emphasis on programs that have distinctive attributes, while maximizing both the educational and scientific benefits for UH and the State of Hawai'i. It is just as important that these goals be achieved while preserving, protecting, integrating, and balancing significant and unique cultural and natural resources and education/research values on Haleakalā.

Presently, facilities within HO are used for the following purposes:

- To observe the Sun;
- To provide a world-class telescope for education and research outreach to students all over the world;
- To provide lasers to measure the distance to satellites;
- To track and catalogue man-made objects, asteroids, and other natural potential space threats; and,
- To obtain detailed images of spacecraft.

It is a principal site for optical and infrared surveillance, inventory and tracking of space debris, and active laser illumination of objects launched into Earth's orbit, activities that are all crucial to the nation's space program.

1.5 LOCATION

HO is 18.166 acres on State of Hawai'i land within the Conservation District on Pu'u (hill) Kolekole, near the summit of Haleakalā, on the island of Maui. Pu'u Kolekole is about a third of a mile from the highest point, Pu'u Ula'ula (Red Hill) Overlook, which is in Haleakalā National Park (HALE). At an elevation of 10,023 feet, the summit of Haleakalā is one of the prime sites in the world for astronomical and space surveillance. The Kolekole cinder cone lies near the apex of the southwest rift zone of the mountain. The rift zone forms a spine separating the Kula Forest Reserve from the Kahikinui Forest Reserve, both of which are pristine lands along the rift zone. Figure 1-1 shows the location of HO.

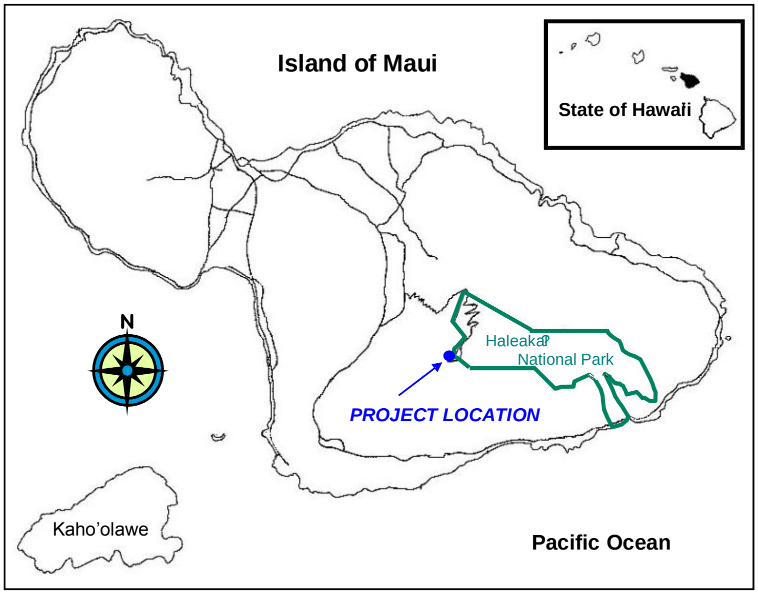


Figure 1-1 Location of HO on Maui, Hawai'i

1.6 LAND OWNERSHIP

In 1961, Governor William Francis Quinn signed an EO to set aside 18.166 acres on the summit of Haleakalā in a place known as Kolekole to be under the control and management of the UH for observatory site purposes. HO is the only property on Haleakalā specifically designated for such purposes. UH is the owner of the parcel identified as Tax Map Key (TMK) (2) 2-2-07-008. Figure 1-2 shows the TMK and general location of HO. The IfA is responsible for managing and developing the land. Other agencies established adjacent facilities through EOs during the same period.

Figure 1-3 shows HO and the surrounding properties. Immediately east of HO is the former General Broadcasting Area. The Federal Aviation Administration (FAA) air traffic Remote Communications Air to Ground (RCAG) facilities and the U.S. Dept. of Energy (DOE) research facility are immediately to the west of HO. Other land bordering HO is owned by the State of Hawai'i and controlled by the DLNR. The road leading up to HO crosses HALE. Figure 1-4 is a contour map of the HO, DOE, and FAA properties that are adjacent to HO. Figure 1-5 is an aerial photograph showing facilities within the HO complex.

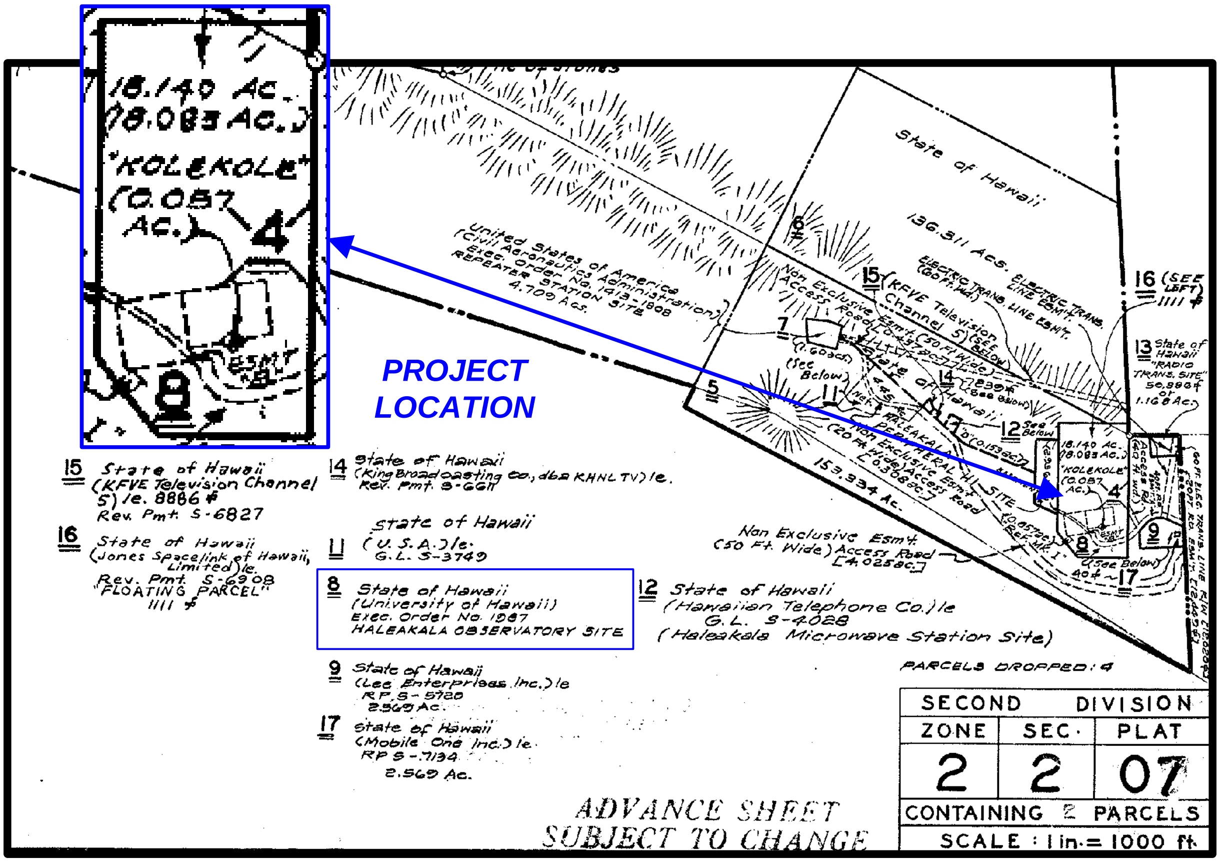
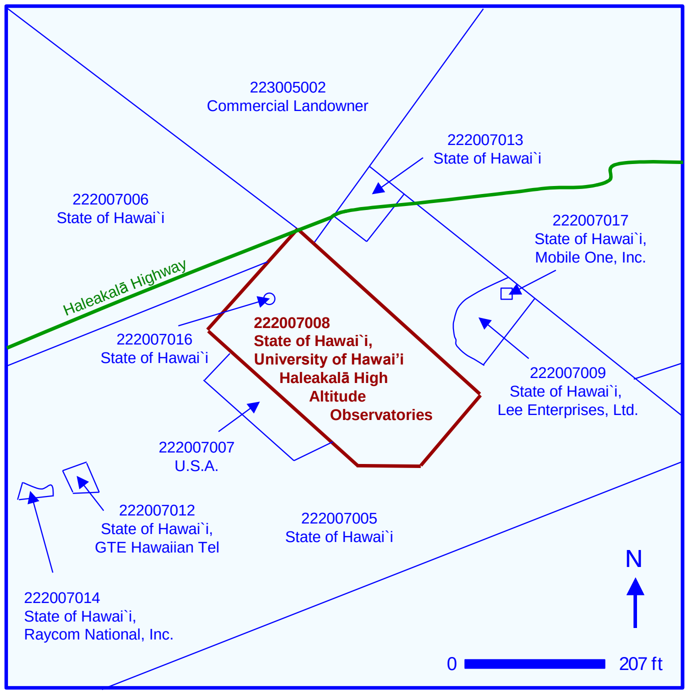


Figure 1-2 Tax Map Key Showing HO



Internet website: http://kivanetext.co.maui.hi.us/kivanet/2/permit/index.cfm

Figure 1-3 HO and Surrounding Properties

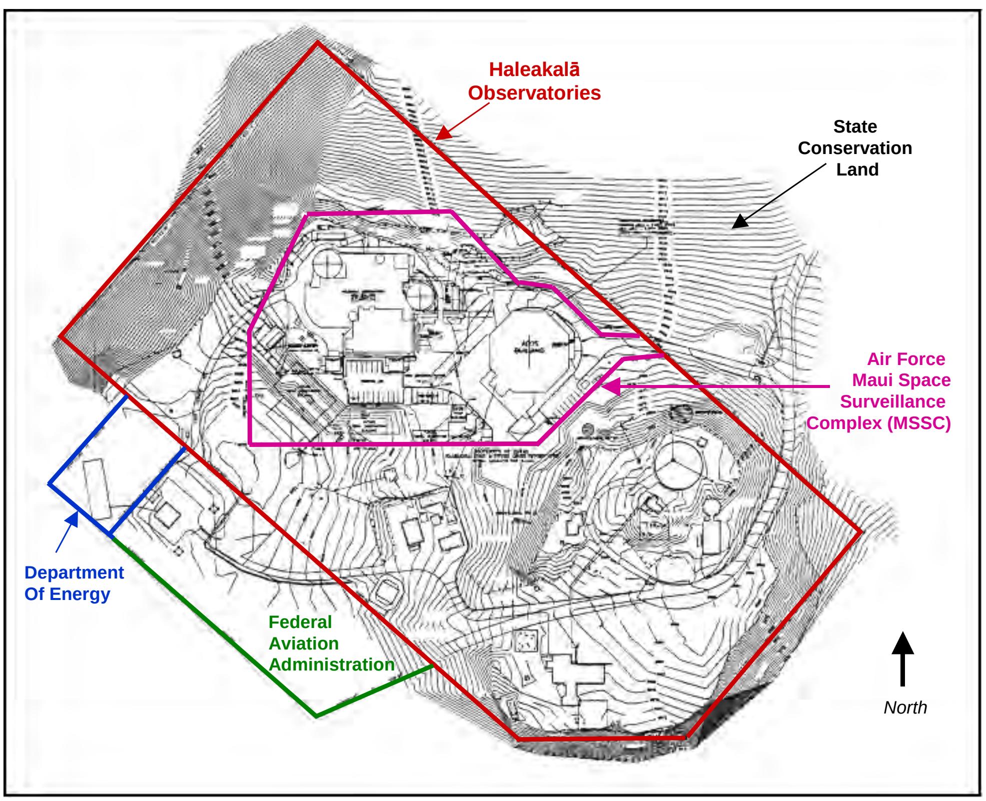


Figure 1-4 Contour Map of HO and Adjacent Properties

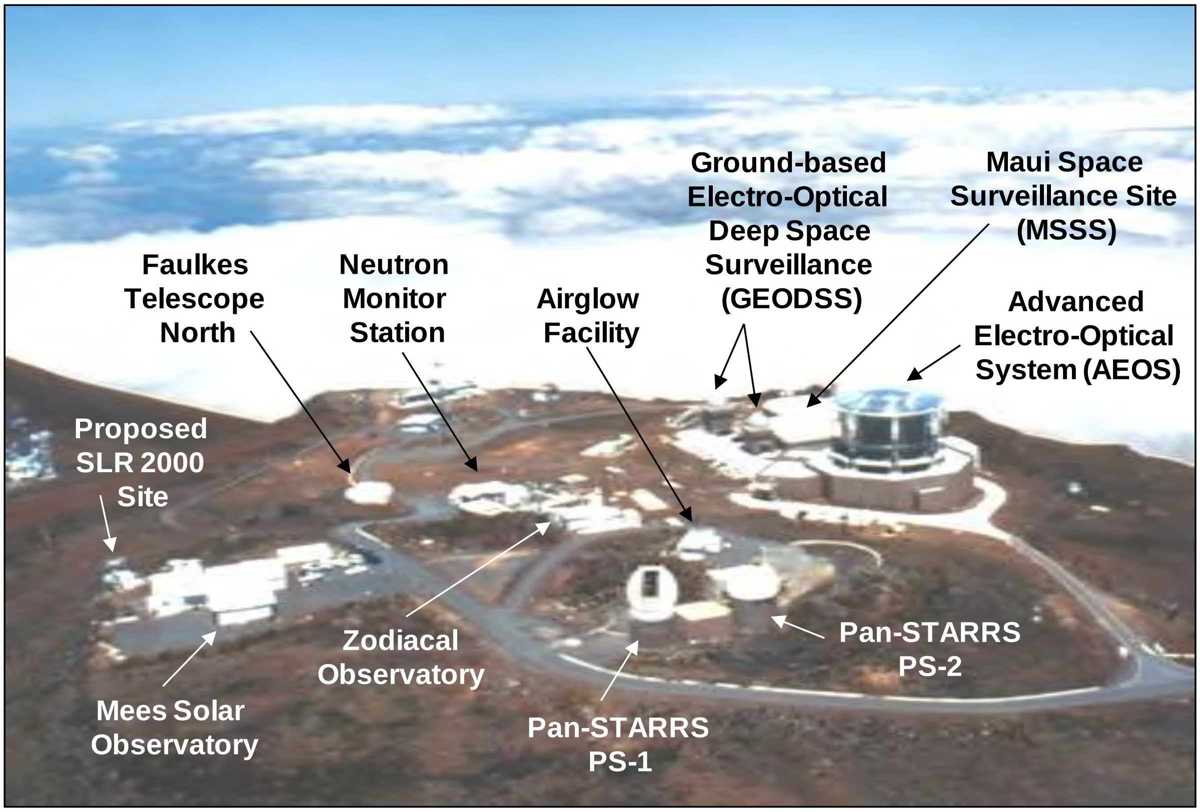


Figure 1-5 Aerial of HO Facilities

1.7 HISTORY OF HO

The summit of Haleakalā has hosted astronomical research for almost half a century. In the early 1950s, Grote Reber, one of the pioneers of radio astronomy, experimented with radio interferometry using a large steel and wood truss antenna. Site testing for a solar observatory began in 1955. In preparation for the International Geophysical Year (1957-1958), the Smithsonian Astrophysical Observatory, assisted by Dr. C. E. Kenneth Mees, a retired vice president of Eastman Kodak, approached UH to locate a Baker-Nunn satellite-tracking telescope on the mountain, a facility that remained operational until 1976. Another early astronomy program on Haleakalā was night-sky photometry, including measurements of the airglow (weak emission of light from Earth's atmosphere) and zodiacal light (sunlight reflected off dust in the solar system). In 1961, EO 1987 set aside 18.166 acres of land on the summit of Haleakalā to establish HO. Other Federal agencies established nearby facilities through other EOs during the same period.

Planning for a much-anticipated solar observatory began in earnest in 1961 with the founding of the Hawai'i Institute for Geophysics at UH. Funding for the observatory was obtained from the National Science Foundation (NSF), and ground was broken for the facility in February 1962. The facility was dedicated in January 1964 and was named the C. E. Kenneth Mees Solar Observatory (MSO) to honor the man who did much to help UH begin its astronomical programs on Haleakalā.

Haleakalā has also been the home of the Air Force Maui Space Surveillance System (MSSS) for more than four decades. Ground was broken for the Advanced Research Projects Agency [ARPA, now referred to as Defense Advanced Research Projects Agency (DARPA)] telescope facility in 1963, and first light, or the first time the telescope took an astronomical image, was achieved in 1965. In 1967, ARPA designated the site for Western Test Range midcourse observations, under the auspices of the University of Michigan, Ann Arbor. The ARPA Midcourse Optical Station, as it was known, began routine missile tracking operations in 1969 under contractors AVCO Everett Research Laboratory (AERL) and Lockheed Missiles and Space Company. In 1975, the site became the ARPA Maui Optical Station (AMOS), and ultimately the MSSS. Daily routine satellite tracking operations were inaugurated in 1977 as the Maui Optical Tracking and Identification Facility (MOTIF). In addition to MSSS, the Air Force has located three smaller telescopes for deep space surveillance as well as support facilities on Haleakalā. The entire Air Force site, known as the Maui Space Surveillance Complex (MSSC), comprises the largest single user area on the mountain.

Table 1-1 lists a facility history for scientific events, beginning in the spring of 1951 when Grote Reber conducted radio astronomy experiments at Haleakalā.

Table 1-1
Facility History at HO

Facility	Date	Event
"Reber Circle"	1951	Grote Reber, one of the pioneers of radio astronomy, experimented with radio interferometry using a large steel and wood truss antenna. Site abandoned approximately one year later.
None	1955	Dr. Walter R. Steiger of the UH Department of Physics conducted a site survey near the summit of Haleakalā to determine the suitability of the location for a solar observatory.
None	1961	EO 1987 from Hawaii's Governor Quinn to UH set aside 18+ acres of land on the summit of Haleakalā to establish HO. UH responsible for managing and developing land.
Mees Solar Observatory (MSO)	1957 to 1976	In preparation for the International Geophysical Year, the UH was approached by Dr. C. Kenneth Mees of Eastman Kodak to locate and operate a Baker-Nunn satellite-tracking facility on Haleakalā. In 1964, the MSO facility was named for Dr. C. Kenneth Mees.
	1964 to Present	National Science Foundation initially funded [and in later years National Aeronautics and Space Administration (NASA) funded] the C. E. Kenneth Mees Solar Observatory, which began studying the solar corona and chromosphere.
Airglow and Zodiacal Light Programs	1962	Airglow and Zodiacal Light Programs initiated in the old blockhouse, where Grote Reber had once housed his equipment.
University of Hawai'i IfA	1967	The University of Hawai'i founded the IfA, whose primary research includes the study of galaxies, cosmology, stars, planets, and the sun. At this point, the IfA's assets included the Waiakoa Laboratory in Kula, the MSO, and the newly constructed Zodiacal Light Observatory at the summit.
Airglow Facility	1972	Airglow program equipment moved to new facility.

Table 1-1
Facility History at HO

Facility	Date	Event
Lunar and Satellite Ranging Observatory (LURE)	1974 to 2004	LURE, which was operated by IfA under contract to the NASA Goddard Space Flight Center, supported the NASA Space Geodesy and Altimetry Projects, has provided NASA with highly accurate measurements of the distance between LURE and satellites in orbit about the Earth, and which was involved in the NASA Crustal Dynamics Project. This project was replaced by the Pan-STARRS test-bed (PS-1) in 2006.
Cosmic Ray Neutron Monitor Station	1991	The only such station in the world, operated in association with the University of Chicago Enrico Fermi Institute and the Faulkes Telescope Facility (FTF).
Multi-Color Active Galactic Nuclei Monitor Project (MAGNUM)	1998 to 2008	The University of Tokyo, the National Astronomical Observatory of Japan, and the Australian National University have installed a two-meter telescope in the 9-meter north dome of the LURE complex to support the MAGNUM project.
FTF	2004	The FTF at HO houses the largest educational outreach optical telescope in the world in support of astronomy research and education for grades K through college in Hawai'i and the United Kingdom. The FTF on Maui is known as the FTF North, and its twin in Australia is known as FTF South.
Presently known as the Maui Space Surveillance Complex (MSSC)	1963	Construction begins on the AMOS, designated in 1977 as MSSS.
	1965	AMOS satellite tracking facility achieves first light.
	1967	ARPA designated MSSS site for Western Test Range midcourse observations, with the University of Michigan conducting operations and maintenance at the site. About 40 scientists, engineers, and technicians worked for University of Michigan, about half traveling to the summit on any given day.
	1969	Routine missile tracking operations began under new contractors AERL and Lockheed Missiles and Space Company. AERL adds about 40 additional personnel for research and development, about half at the summit at any given time.
	1977	The twin 1.2-meter telescope at AMOS is dedicated to the MOTIF, known now as the MSSC, for daily routine satellite tracking operations. No new personnel were required.
	1980	Construction begins at MSSS on Ground-Based Electro-Optical Deep Space Surveillance System (GEODSS). Three new domes were built, along with approximately 10,000 square feet of office and laboratory space on the south side of MSSS.
	1982	The GEODSS, with three one-meter telescopes becomes one of three operational sites in the world performing ground-based optical tracking of space objects. It employs about 15 operations and maintenance personnel.
	1995 to Present	One part of the MSSC is the MSSS, a facility combining operational satellite tracking facilities with a research and development facility. This also includes the DoD's largest telescopes, the Advanced Electro-Optical System (AEOS). Over the years the Air Force operation has grown to include approximately 125 civilian and military personnel housed at the Kihei Research and Technology Park and approximately 115 more based at MSSS.
Panoramic-Survey Telescope and Rapid Response System (Pan-STARRS)	2006	PS-1 South — These facilities house a 1.8-meter wide-field optical imaging system equipped with a 1.44-billion-pixel charge-coupled device camera. This unique combination of sensitivity and field-of-view will address a wide range of time-domain astronomy and astrophysical problems in the solar system, the galaxy, and the universe.
	2010	PS-2 North

1.8 RELATED DOCUMENTS

1.8.1 Existing Conservation District Use Permits

Table 1-2
Conservation District Use Permits for HO

CDUP No.	Date	Project
MA-386	1973	Lunar Ranging Experiment
MA-386	1998	Site Plan Approval LURE Accessory Trailers
98-164	1999	Accessory Structure Zodiacal Light Observatory/Exempt class
MA-3201	11/04/04	Pan-STARRS (PS-1)
MA-3032B	04/29/04	Faulkes Telescope Facility
MA-0516	02/11/05	Site Plan Approval for ATST Geotechnical Soil Coring
MA-2705	07/31/06	Advanced Electro-optical System
MA-3308	08/07/06	Transportable Laser Ranging System (TLRS)
MA-3032	11/12/08	Site Plan Approval for Faulkes Telescope Facility Site Improvements
MA-3308	08/06/09	Accessory Trailer TLRS/Exempt class

1.8.2 Long Range Development Plan

The IfA LRDP for HO (www.ifa.hawaii.edu/haleakala/LRDP/) is a publicly vetted document that includes discussion of possible locations for future development within the HO property. Following the review process used for environmental documents, the LRDP was distributed to State of Hawai‘i and County of Maui entities, the National Park Service (NPS), the U.S. Air Force, community associations, individuals, and to Maui public libraries. Notice of release of the draft LRDP was also published in the *Maui News*. The draft LRDP had an extended, nine-month, public comment period. Therefore, one intention for the LRDP has been to provide a vehicle for consulting with the greater Maui community, Upcountry organizations, and individuals concerned about development, as well as Native Hawaiian interests.

In broad terms, the LRDP describes the general environmental, cultural, and historic conditions and the site characteristics that guide future development. It also describes the principles that define the scientific programs that the UH strives to maintain and develop at HO and the potential new facility developments that will keep the UH in the forefront of astronomy into the next decade. In order to describe and to protect this resource, while accommodating the growing need for public scrutiny and partnering in its astronomical planning, the IfA planning process for long-range development takes into consideration the environmental, cultural, and historic importance of Haleakalā.

While the long range planning aspect of the LRDP is still current, the management plans for HO that were included in the LRDP would be superseded by those in an approved MP.

CHAPTER 2
AFFECTED ENVIRONMENT

This chapter is an overview of the baseline physical, cultural, biological, social, and economic conditions that occur within HO and is organized by resource. These baseline conditions are referred to as the affected environment because the activities associated within HO could affect them.

The affected environment of HO is within the 18.166 acres assigned to UH on State of Hawai'i land within a Conservation District. The property boundaries for HO are wholly within Pu'u Kolekole near the summit of Haleakalā. The HO land designated through the EO is about one-third of a mile from the highest point in HALE, which is known as Pu'u 'Ula'ula (Red Hill) Overlook. The Kolekole cinder cone lies just to the southwest of the topographic apex of the southwest rift zone of Haleakalā. The rift zone forms a spine separating the Kula Forest Reserve from the Kahikinui Forest Reserve, both of which are pristine lands along the rift zone. The environment at Kolekole has been extensively studied for many years and has been well characterized.

2.1 LAND USE AND EXISTING ACTIVITIES

2.1.1 Introduction/Region of Influence

The region of influence (ROI) for determining the affected environment for this section includes all areas within the boundaries of HO. HO is in the area of the State of Hawai'i Conservation District. Act 187 vested the DLNR with jurisdiction over the Conservation District, who then divided the Conservation District to subzones in order to better regulate land uses and activities therein. Since 1964, the Board of Land and Natural Resources (BLNR) has adopted and administered land use regulations for the Conservation District and made major changes to the regulations in 1978 and 1994.

The objective of the Conservation District is to conserve, protect, and preserve the important natural resources of the state through appropriate management and use in order to promote their long-term sustainability and the public health, safety, and welfare. The potential uses of Conservation District lands are numerous. During the past few years, the

DLNR Office of Conservation and Coastal Lands (OCCL) has administered Conservation District Use Applications (CDUAs) for open ocean aquaculture projects, telescopes on top of Haleakalā and Mauna Kea, major power line projects on scenic ridges, telecommunication facility projects, single-family residences, parks and commercial forestry projects.

The Conservation District has five subzones: Protective, Limited, Resource, General and Special. Omitting the Special Subzone, the four subzones are arranged in a hierarchy of environmental sensitivity, ranging from the most environmentally sensitive (Protective) to the least sensitive (General); the Special Subzone is applied in special cases to allow a unique land use on a specific site. "Subzone" means a zone established within the Conservation District, which is identified by boundaries and resource characteristics (HAR 13-5-2). The objectives of the General Subzone are to designate open space where specific conservation uses may not be defined but where urban uses would be premature.

These subzones define a set of "identified land uses" that may be allowed by discretionary permit. The OCCL can accept a permit application only for an identified land use listed under the particular subzone covering the subject property. Most of the identified land uses require a discretionary permit or some sort of approval from the DLNR or BLNR. Major permits are required for land uses that have the greatest potential impact. Major permits also require an EA or an EIS, possibly a public hearing, and decision making by the BLNR. Minor permits are required for land uses that may have fewer impacts. Minor permits may be approved by the BLNR chairperson (and may not require a public hearing) or by the OCCL administrator (for certain minor uses within the Conservation District).

2.1.2 Resources Overview

Land Use

In accordance with Title 13 Chapter 5, HAR, HO is in the State of Hawai'i Conservation District with an identified use in the General Subzone and is consistent with the objectives of the General Subzone of the land. The Proposed Action would be consistent with Conservation District land use requirements requiring a CDUA. Any land use pursuant to HAR 13-5-30 must be an identified land use and require that a CDUA be filed with the DLNR and approved by BLNR beforehand. The objectives of the General Subzone (HAR Chapter 13-5-14) are to designate open space where specific conservation uses may not be defined but where urban uses would be premature.

This area of the Conservation District has been set aside for "…Haleakalā High Altitude Observatory Site purposes only" under EO 1987. HAR 13-5-25 identifies land uses for HO as General Subzone, which is applicable for astronomy facilities (HAR 13-5-25, R-3) under an approved management plan (HAR 13-5-25, D-1).

Conditions of Executive Order 1987

In 1961, Hawaii's Governor Quinn set aside 18.166 acres on the summit of Haleakalā to establish HO in EO 1987. This EO is subject to the following conditions:

1. "That the lands herein set aside shall be used for the Haleakalā High Altitude Observatory Site purposes only;

2. Should the lands herein described be abandoned for a period of one year or used for purposes other than those permitted herein, this Executive Order shall automatically terminate and the lands herein described shall forthwith be forfeited and revert to the state, resuming the status of public lands."

HO is composed of previously developed facilities for astronomy and advanced space surveillance. Land cannot be subdivided to increase the intensity of land use within this Conservation District (Fig. 2-1).

Existing Activities

Roadway Access

Haleakalā Highway (State Route 37) is a 37-mile road that begins at the Kahului Airport in central Maui and continues as Haleakalā Highway at the Kula Highway junction, becoming State Route 377 until the junction with Kekaulike Avenue in upper Kula. At the Kekaulike Avenue junction it becomes Haleakalā Crater Road (State Route 378) until the entrance to HALE (DOT website). The HALE road corridor is a 10.6 mile stretch of road that begins at the entrance to HALE and ends at the summit of Haleakalā.

The HALE road corridor is owned and managed by the NPS. It begins at the boundary at the northwestern corner of the HALE and ascends the northwest slopes of the Haleakalā Crater with a series of switchbacks. Hosmer Grove, Park Headquarters Visitor Center, Halemau'u Trailhead, Leleiwi Overlook, Kalahaku Overlook, Haleakalā Visitor Center (or Pa Ka'oao Observation Station), and Pu'u 'Ula'ula Overlook are all accessed from the road. A significant number of vehicles and buses traverse the HALE road each year. In 2007, there were 248,224 vehicles and approximately 3,650 buses that traversed the HALE road; in 2008, there were 205,977 vehicles and approximately 6,570 buses (FHWA 2008).

The only access to and exit from HO is exclusively via the HALE road corridor (Fig. 2-1) and then through the entrance to the HO complex, just past the turn-off to Pu'u 'Ula'ula. There is no general public access to HO, and a sign (Fig. 2-2) posted at the entrance to the facilities reads "AUTHORIZED ENTRY ONLY." Native Hawaiians are welcome to enter for cultural and traditional practices, as indicated on the sign.

An unimproved access road/trail known as Skyline Drive (Fig. 2-1) originates a half-mile from HO at what is commonly called the Saddle Area, which is between Kolekole and the next cinder cone to the southwest. The road traverses the southwest rift zone, ultimately leading to Spring State Recreation Area (also known as Polipoli State Park), which is at 6,200 feet above sea level (ASL) within the fog belt of the Kula Forest Reserve (DLNR 2008). Its entire length is on state land within the forest reserve. A locked gate near the Saddle Area allows only those holding DLNR permits to access the road from the Haleakalā summit. Hikers, hunters, bicyclists and HALE personnel leading tours or extended biological monitoring are primary users of the unpaved road. There are sections of this trail that have a steep grade and soft cinder roadbed that will not support standard construction truck traffic, only smaller vehicles with four-wheel drive.

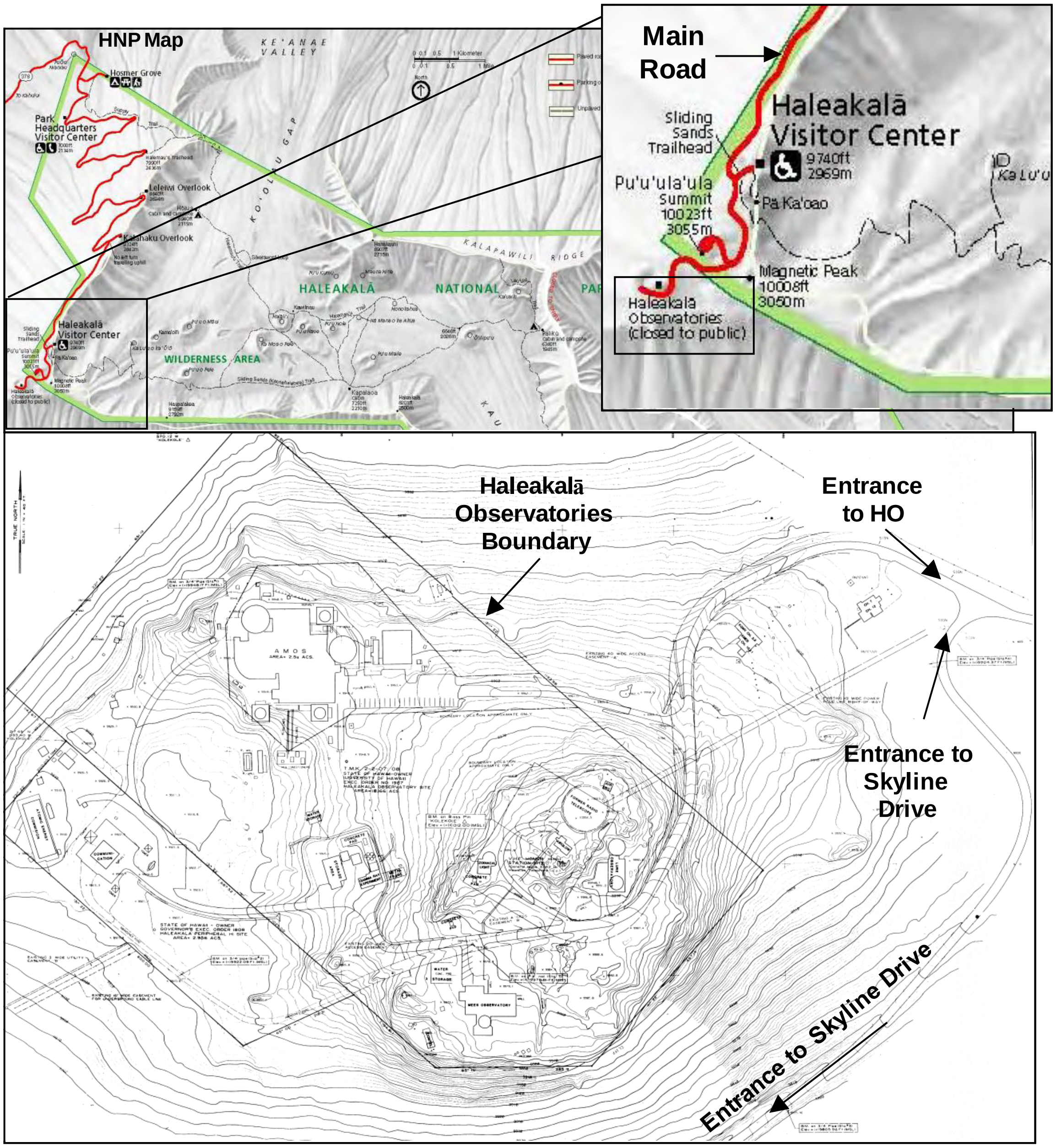


Figure 2-1 Existing Access to HO

Figure 2-2 Sign at Entrance to HO

Existing HO Facilities

Table 2-1 lists the astronomical research facilities for advanced studies of astronomy and atmospheric sciences at HO. These facilities are discussed in more detail below.

Table 2-1
Existing Facility Uses at HO

Facility	Primary Function	
U.S. Air Force Maui Space Surveillance Complex (MSSC)	Presently, of the 18.166 acres, 4.5 acres are leased to the United States Army Corps of Engineers for the MSSC. MSSC conducts space surveillance and research activities for the DoD.	
Ground-Based Electro-Optical Deep Space Surveillance System (GEODSS)	Another major part of the MSSC, which is one of four operational sites in the world performing ground-based optical tracking of space objects.	
C. E. Kenneth Mees Solar Observatory	Emphasizes studies of the solar corona and chromosphere.	
Zodiacal Observatory	Houses the test-bed Scatter-free Observatory for Limb Active Regions and Coronae (SOLAR-C) Telescope Facility, both supported by UH IfA.	
Panoramic-Survey Telescope and Rapid Response System (Pan-STARRS)	PS-1 South	These facilities house a 1.8-meter wide-field optical imaging system equipped with a 1.44-billion pixel charge-coupled device camera. This unique combination of sensitivity and field-of-view will address a wide range of time-domain astronomy and astrophysical problems in the Solar System, the Galaxy, and the Universe.
	PS-2 North	
Faulkes Telescope Facility (FTF)	Faulkes houses the largest educational outreach optical telescope in the world in support of astronomy research and education for grades Kindergarten through college in Hawaiʻi and the United Kingdom.	
Haleakalā Amateur Astronomers	The IfA dedicated a small building for the Haleakalā Amateur Astronomers to organize and host programs for professors and students at Maui Community College (MCC), K-12, Boy Scout groups, Akamai students, community members and others to conduct astronomy observations at HO.	

Presently, facilities within HO observe the Sun, provide a world-class telescope for education and research outreach to students all over the world, use lasers to measure the distance to satellites, track and catalog man-made objects, track asteroids and other natural potential space threats, and obtain detailed images of spacecraft. It is a principal site for optical and infrared surveillance, inventory and tracking of space debris, and active laser illumination of objects launched into Earth's orbit, activities that are all crucial to the nation's space program.

Over the past 45 years, HO has experienced managed growth of scientific research within its boundaries (UH IfA 2005). The first major UH facility at HO was the MSO facility. UH has operated the MSO facility since 1964. The scientific programs at the MSO facility emphasize studies of the solar corona and chromosphere. The former LURE facility was utilized from 1972 until 1993. LURE was operated by IfA under contract to the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center, supported the NASA Space Geodesy and Altimetry Projects, and provided NASA with highly accurate measurements of the distance between LURE and satellites in Earth's orbit, and was involved in the NASA Crustal Dynamics Project.

The Pan-STARRS (PS-1) was dedicated on June 30, 2006, and is within the footprint of the former LURE observatory South Dome. The testing of extremely high resolution camera imagery will lead to development and deployment of a small, economical four-telescope system for observing the entire available sky several times each month to discover and characterize objects approaching Earth, both "killer asteroids" and comets, that might pose a danger to our planet.

The University of Tokyo, the National Astronomical Observatory of Japan, and the Australian National University previously installed a 2-meter (6.6-foot) telescope in the 9-meter (29.5-foot) north dome of the LURE complex to support the MAGNUM Project, which was decommissioned in 2008.

The Faulkes Telescope Facility (FTF) was originally built by the Dill Faulkes Educational Trust and became operational in 2004. Ownership was assumed by the Las Cumbres Observatory Global Telescope Network, Inc. (LCOGT) in 2005 and continues to be a joint effort with IfA. The goal of this facility is to give students and teachers in Hawaiʻi and the United Kingdom (UK) access to a research grade telescope. With its 2-meter diameter primary mirror, this telescope (along with its twin in Australia) is the largest telescope designated solely for educational use in the world. This 2-meter (6.6-foot) telescope is operated remotely over the Internet, without need for permanent on-site operational staff.

The IfA also leases a site for optical and infrared experiments and observations carried out by the United States Air Force (USAF). The Air Force Research Laboratory (AFRL) is the host command with responsibility for the MSSC. One part of the MSSC is the Maui Space Surveillance System (MSSS), a state-of-the-art electro-optical facility combining operational satellite tracking facilities with a research and development facility. The MSSS houses the largest telescope in the Department of Defense (DoD) inventory, the 3.67-meter (12-foot)

Advanced Electro-Optical System (AEOS), as well as several other telescopes ranging from 0.4 to 1.6 meters (1.3 to 5.2 feet).

Another major part of the MSSC is the Ground-Based Electro-Optical Deep Space Surveillance System (GEODSS), which is operated for the Air Force Space Command. The GEODSS at HO is one of four operational sites in the world performing ground-based optical tracking of space objects. The main telescope has a 102-centimeter (3.3-foot) aperture and a 2-degree field-of-view and is used primarily to search the deep sky for faint (+16 magnitude), slow-moving objects. The auxiliary telescope has a 38-centimeter (15-inch) aperture and 6-degree field-of-view, and does wide area searches of lower altitudes where objects travel at higher relative speeds. The telescopes are able to "see" objects 10,000 times dimmer than the human eye can detect.

The IfA has dedicated a small building for the Haleakalā Amateur Astronomers to organize and host programs for professors and students at Maui Community College (MCC), K-12, Boy Scout groups, Akamai students, community members and others to conduct astronomy observations at HO.

At this time, there are no new projects being implemented or constructed at HO.

East and West Ahu

In 2005, in recognition of the cultural importance of Haleakalā and in the spirit of hoʻoponopono (to "make right"), UH contracted Native Hawaiian stonemasons to erect a west-facing ahu (altar or shrine) (Fig. 2-3) within the HO set-aside "Area-A" (Fig. 2-4) for the sole reverent use of Kanaka Maoli for religious and cultural purposes under the LRDP. A hoʻomahanahana (dedication or "warming" offering) was held, at which time the ahu was named Hinalaʻanui. As stated in the LRDP, Native Hawaiians are welcome to utilize these sites for reverent, religious, and cultural purposes, with the understanding that such use will not interfere with other uses and activities within HO.

In 2006, in the spirit of makana aloha (gift of friendship) for a proposed project, UH contracted the same Native Hawaiian stonemasons to erect an east-facing ahu near the Mees site (Fig. 2-3), but not within the land set aside at HO in figure 2-4 ("Area-A"). Upon its completion, a hoʻomahanahana was held and the ahu was named Pāʻele Kū Ai I Ka Moku. As stated in the LRDP, Native Hawaiians are welcome to utilize these sites for reverent, religious and cultural purposes, with the understanding that such use will not interfere with other uses and activities within HO.

Private or Public Projects

The State Land Use District for the Proposed Action is designated as Conservation District, General Subzone. The 18.166 acres of HO are within the Conservation District lands, so no private or public projects are planned in the areas that constitute the General Subzone of conservation lands around the summit of Haleakalā.

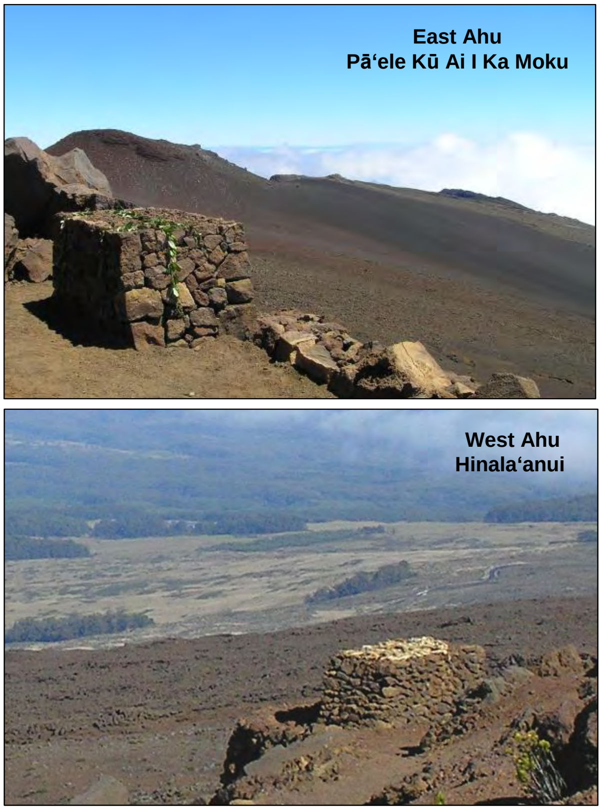


Figure 2-3 East- and West-Facing Ahu

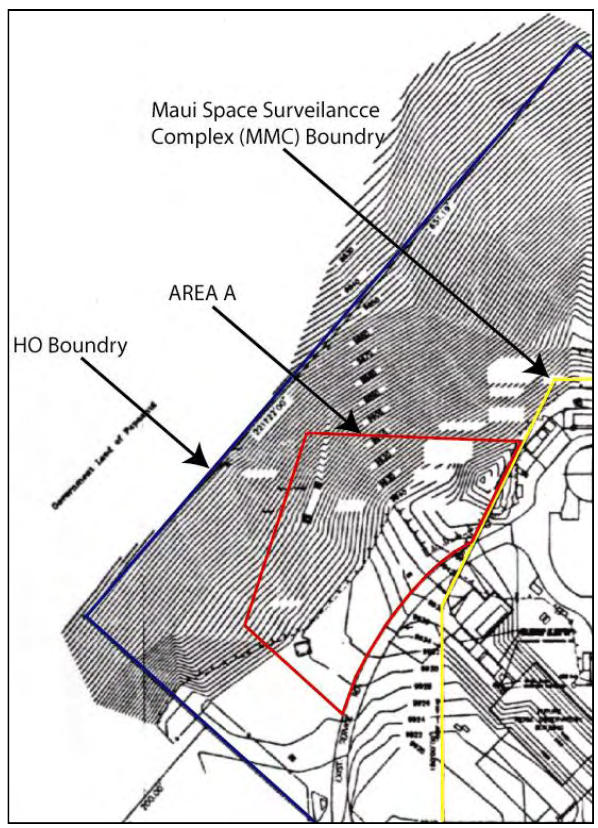


Figure 2-4. Set-aside "Area A" at HO

2.2 CULTURAL, HISTORIC, AND ARCHEOLOGICAL RESOURCES

"Haleakalā is the sacred home of our Sun, and the ancient Path to Calling the Sun as depicted in its ancient name: Ala Hea Ka Lā. Why is this critical to our survival? The Sun's energy is the source of all life, and governs our most basic rhythm of day and night. Ancient cultures have venerated its being and we as a human race follow its course without thought and are insignificant in respect of its power. However, our Native Hawaiian Culture praises its existence, until this very day the sun is praised for its cycle."
("E Mālama Mau Ka La'a", Page 8, Haleakalā's Importance.)

2.2.1 Introduction/Region of Influence

Cultural, historic, and archeological resources were evaluated within the ROI, which, for these resources, falls within HO boundaries. Cultural resources contain significant information about a culture and are tangible entities or cultural practices. Tangible cultural resources are defined as "districts, sites, buildings, structures, and objects for the National Register of Historic Places (NRHP) and categorized as archeological resources, cultural landscapes, structures, museum objects, and ethnographic resources". Ethnographic resources are defined as: a site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it. Archeological resources are defined as "any material remains or physical evidence of past human life or activities which are of archeological interest, including the record of the effects of human activities on the environment." They have the "potential to describe and explain human behavior." Historic resources include districts, sites, structures, or landscapes that are significant in American history, architecture, engineering, archeology or culture.

All of the areas within the ROI are within the boundaries of the Crater Historic District, which is listed on both the State Inventory of Historic Places (SIHP) (SIHP 50-50-11-12-1739) and on the NRHP. The Crater Historic District was listed on the NRHP on November 1, 1974 (DLNR 2009). All eligible cultural, historic, and archeological resources within the Crater Historic District, even if not formally listed, are nevertheless required to be protected and preserved as though they were formally listed on the NRHP.

Several assessments were conducted to evaluate the presence of cultural, historic, and archeological resources within the ROI and the results of these assessments are discussed below.

2.2.2 Resources Overview

Cultural Resources

The focus for describing current environmental conditions related to cultural, historic, and archeological resources for this DEA is Pu'u Kolekole.

The cultural resources of Kolekole date back more than a thousand years and are an integral part of the Hawaiian culture, both past and present. In ancient times, commoners could not even walk on the summit because it belonged to the gods. The sacred class of na poāo kāhuna (priest) used the summit area as a learning center. It was a place where the kāhuna could absorb the tones of ancient prayer and balance within the vortex of energy, experience spiritual manifestations, practice the art of healing, and study the heavens for navigation purposes. Kolekole itself was a very special religious place used by the kāhuna po'o (head priest) as a training site in the arts. There are numerous gods and goddesses said to reside on the summit, in the crater, and all around the mountain.

Haleakalā Crater was used as a trans-Maui thoroughfare and source for basalt stones. There are specific teachings related by the kupuna (elders) that guided commoners who were permitted access for gathering stones and to bury the dead. Numerous archeological sites have been recorded on the crest and in the crater, including, in order of frequency, temporary shelters, cairns, platforms with presumed religious purposes, adze quarries and workshops, caves, and trails (UH IfA 2005). These are all remnants of the very elaborate spiritual and cultural life that the Kanaka Maoli (indigenous Hawaiian people) focused around the summit area.

Within Kolekole, cultural resources of importance are temporary habitation or wind shelters, two petroglyph images, one site interpreted as a possible burial, and two ceremonial sites. The sites are important in that they have yielded information on prehistory. Native Hawaiians know that this area, as a remnant of a Native Hawaiian landscape, provides significant cultural value because of its ceremonial and traditional importance.

Cultural Resource Assessments

The Cultural Resources Evaluation for the Summit of Haleakalā (CKM 2003) was conducted in 2003, covered the entire HO property for the LRDP, and is appended in this DEA as Appendix A. The evaluation concluded that "Kolekole, known as the summit of Haleakalā, or 'Science City' as it is sometimes referred to, is a very sacred place for the Kanaka Maoli (Native Hawaiians), past and present". The summit was thought of as "the piko (navel), the center of Maui Nui O Kama (the greater Maui), and legends abound about the gods and goddesses that dwelled there in mythological times". The summit is still revered by the Kanaka Maoli, and some people express feeling "the 'essence' of Haleakalā" when visiting there. Numerous publications have been produced setting forth peoples' "feelings of being 'one with the gods' at the summit". The study concluded that "Hawaiian's history, from the beginning of their ancient culture, shows that they consider lava, cinders, rocks and other material from the land sacred because it was created by Pele (Goddess of the Volcano) … the 'essence' being the rock, cinders, and ash, which are the Kinolau (supernatural forms taken by Pele)". (CKM 2003)

A subsequent cultural resources study, Cultural and Historical Compilation of Resources Evaluation and Traditional Practices Assessment was conducted in 2006 as part of the environmental compliance process for the proposed Advanced Technology Solar Telescope (ATST) Project (CKM 2006).

In 2007, Cultural Surveys Hawaiʻi, Inc. (CSH) was commissioned to conduct a Supplemental Cultural Impact Assessment (SCIA). The SCIA was performed in accordance with the guidelines for assessing cultural impacts, as set forth by the Office of Environmental Quality Control (OEQC) (OEQC 1997) and was intended to supplement the initial Cultural Resource Evaluation (CKM 2006) for the proposed ATST Project. The primary purposes of the SCIA were to widen community outreach and to gather additional information on the Traditional Cultural Property of Haleakalā as an additional means to assess the potential effects of that particular proposed undertaking on Native Hawaiian traditional cultural practices and beliefs. Although the SCIA was conducted for a specific project, the preparers of the SCIA made an additional effort to gather supplementary information, community input, and knowledge of the summit area, and therefore the information is relevant to this DEA. The SCIA contains considerable additional historical perspective on Haleakalā. It discusses in great detail the symbology of the mountain, its role in the history of Maui as a living entity, as well as the archeological record. The information provided is intended to educate the reader about the spiritual sacredness and cultural relationship of Hawaiians to Haleakalā as a whole and to the summit area in particular and is appended to this DEA for its information content as Appendix B.

Haleakalā Summit as a Traditional Cultural Property

The summit of Haleakalā is considered a significant cultural resource in and of itself. It is eligible for listing on the NRHP as a Traditional Cultural Property (TCP) through consultation with the State Historic Preservation Division (SHPD under Criterion "A" for its association with the cultural landscape of Maui and this is reflected in the number of known uses, oral history, mele and legends surrounding Haleakalā. The term "Traditional Cultural Property" is used in the NRHP to identify a property "that is eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that, (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (DOI 1994). The summit is also eligible under NRHP Criterion "C" because it is an example of a resource type, a natural summit, and a source for both traditional materials and sacred uses. The value ascribed to Haleakalā as a TCP can be expressed in five distinct attributes, solidifying the role of the summit as a place of value.

1. Haleakalā summit is considered by Kanaka Maoli, as well as more recent arrivals to Hawaiʻi, as a place exhibiting spiritual power.
2. The summit of Haleakalā is significant as a traditional cultural place because of traditional cultural practices conducted there. For both Hawaiians and non-Hawaiians who live and visit here, the summit is a place of reflection and rejuvenation.
3. The moʻolelo and oli surrounding the summit present a collection of stories suggesting the significance of Haleakalā as a TCP.
4. Some believe that the summit possesses therapeutic qualities.
5. The summit provides an "experience of place" that is remarkable.

Summary of Haleakalā in Native Hawaiian Traditional Cultural Resource

The SCIA provides a comprehensive discussion about the role of Haleakalā in Native Hawaiian tradition. There are many legends and stories about Haleakalā that were identified in the SCIA. The SCIA also notes that early visitors to the Pacific Islands recorded traditional stories regarding the Hawaiian demigod Māui and the fire goddess Pele and references to Mauna Haleakalā (*see Appendix within* Appendix B).

Traditional Cultural Practices

During preparation of Traditional Practices Assessments in 2002 (UH IfA 2005) and 2005 (CKM 2006), it was understood that, because buildings have been constructed on the site for more than seventy years, much of the physical evidence of ancient Hawaiian traditional and cultural practices in the area was destroyed. The SCIA provides information about Haleakalā as an important place where traditional cultural practices take place. There are several types of traditional cultural practices that have taken place and continue to take place, as follows:

1. Gathering of plants
2. Traditional hunting practices
3. Collecting for basalt and tools
4. Pōhaku Pālaha – The Piko of East Maui
5. Traditional Birth and Burial Practices
6. Haleakalā as a Sacred Mountain
7. Ceremonial Practices, e.g., honoring the solstice or equinox
8. Astronomy
9. Travel

As mentioned previously, in recognition of the traditional cultural importance of Haleakalā, Native Hawaiian stonemasons erected the West and East *ahu* (altar or shrine) for ceremonial use by Kanaka Maoli at HO in 2005 and 2006, respectively. Figure 2-5 shows the location of each ahu with HO. Native Hawaiians practicing cultural traditions are welcome to use these sites, with the understanding that such use will not interfere with other uses and activities within HO.

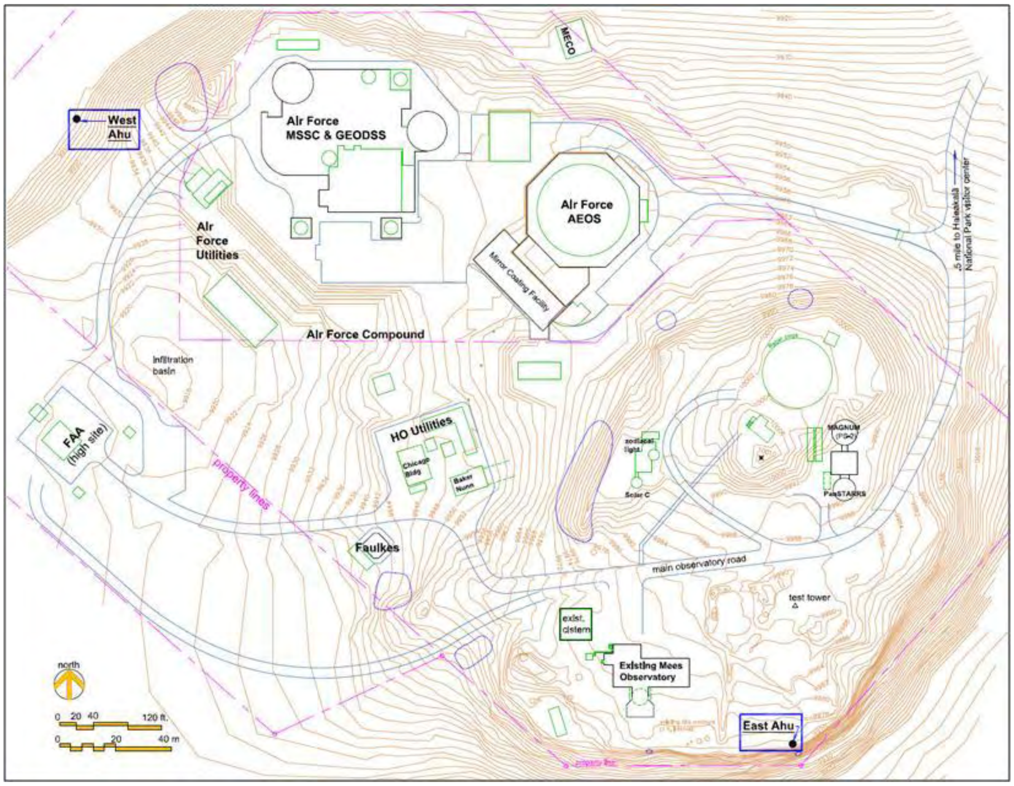


Figure 2-3 East and West Ahu Locations at HO

2.2.3 Historic Resources

To augment the comprehensive survey from 2002, a field investigation (for the proposed ATST Project) was conducted during fall 2005 (Appendix C). One historic site was identified at the Reber Circle site. This site remnant lies at the peak of Puʻu Kolekole. It is designated by the SIHP as Site 5443 (UH IfA 2005) and is eligible for listing on the NRHP under Criterion "A" because of its association with mid-20th century scientific studies at Haleakalā, and under Criterion "D" for its information content. This site remnant consists of a concrete and rock foundation that was part of the former radio telescope facility that was constructed in 1952 by Grote Reber, an early pioneer of radio astronomy. The bulk of this structure was dismantled about 18 months after the facility was completed. This site is composed of a concrete and rock foundation that is approximately 25 meters (82 feet) in diameter, the outer rim of which is up to 1 meter (3.28 feet) in width and approximately 80 centimeters (2.62 feet) in height.

2.2.4 Archeological Resources

There were two archeological surveys conducted in portions of HO during the 1990s. The first of these was in 1990 and consisted of a reconnaissance survey by Pacific Northwest Laboratory on behalf of the US Air Force for the Advanced Electro-optical System Environmental Assessment (Chatters 1991). Cultural Surveys Hawaiʻi, Inc., conducted the second study, an archeological inventory, in 1998. During the course of this study, a walkover, four archeological sites were identified, primarily along the western side of Kolekole. These sites included 23 temporary shelters and a short low wall. These wind shelters were typically constructed against the existing rock outcrop of the hill. The sites were designated Site 50-50-11-2805 through 50-50-11-2808. One sling stone was found on the floor of Feature J at Site 50-50-11-2807. In addition, one ʻopihi (limpet) (*Cellana* spp.) shell, was noted on the surface of the Feature B floor of Site 50-50-11-2808. There was no subsurface investigation carried out, and only Site 50-50-11-2805 was mapped (additional inventory work was done at these sites in 2005).

Cultural Surveys Hawaiʻi, Inc. conducted another study in 2000, in conjunction with the planned construction of the FTF. They located two previously unidentified sites (50-50-11-4835 and 50-50-11-4836) to the west of the MSO facility. Both of these sites were constructed against an exposed rock outcrop. Site 50-50-11-4835 consists of two features—both historic rock enclosures filled with burned remnants of modern refuse—obviously historic trash burning pits. The researchers speculated that the US Army might have initially used these during the war and later by UH workers used them (FTF EA). Site 50-50-11-4836 consists of three terraces, a rock enclosure, two leveled areas and a rock wall, all constructed against an exposed rock outcrop. Five of the features are interpreted as temporary shelters, while the two leveled areas were of indeterminate usage. Although one test unit did not reveal any pre-Contact cultural materials, their construction is consistent with pre-Contact structures used for temporary shelters in other areas of Haleakalā Crater (Bushnell and Hammatt). The IfA has preserved both sites.

A comprehensive archeological inventory survey of HO was completed in fall 2002 (Fredericksen 2003) and the inventory survey report was approved by SHPD. An archeological preservation plan for "Science City" (Xamanek Researches 2006) was prepared in 2006 and approved by SHPD in a July 10, 2006, review letter (Appendix D(2). Whereas surveys had previously been conducted for specific construction projects within HO and a number of archeological features had been identified, the 2002 survey of the entire 18.166 acres for the LRDP (UH IfA 2005) was exhaustive and included location and description of six previously unidentified sites. These sites were assigned State of Hawaiʻi designations, and further documentation was obtained for four previously identified sites that were listed with the SHPD. In total, 29 new features were identified and five excavation units were used to sample selected features that were located in some of the previously undocumented sites. These sites consist of wind shelters, two petroglyph images, a possible burial feature, and an historic foundation known as Reber Circle. Supplemental information was obtained from Sites 50-50-11-2805 to 50-50-11-2808 per discussions with Dr. Melissa Kirkendall of the SHPD Maui office. In addition, a trail segment was recorded at Site 50-50-11-4836 and designated as Feature F. Several isolated pieces of coral were noted in the southeastern portion of the 18.166-acre study area, but not assigned a formal site number because the coral pieces were not weathered. A possible site consisting of several pieces of coral in a boulder was plotted on the project map, but was determined to lie off the project area. The results of the inventory survey were submitted to SHPD for preservation review, although there was no triggering action requiring submittal of the survey, as described in HRS Section §6E-8. The significance assessments were accepted (DLNR 2003). The results of these surveys are summarized in Table 2-2.

Table 2-2
Summary of HO Archeological Sites

Site numbers are prefaced by 50-50-11: 50=State of Hawai'i, 50=Maui, 11=Kilohana quadrangle.

SIHP Site #	Description (Number of Features)	Age	NRHP Significance Criterion
2805	Wind shelter (1)	Pre-Contact/post-Contact	D
2806	Wind shelter (1)	Pre-Contact	D
2807	Wind shelter (13), wind shelter, C-shape (2), wind shelter/terrace (1)	Pre-Contact/post-Contact	D
2808	Wind shelter (3)	Pre-Contact/post-Contact	D
4835	Trash pit (2)	Possible WW II-era, modern trash observed	D
4836	Wind shelter (5), Trail (1)	Pre-Contact/post-Contact	D
5438	Wind shelter (1), terrace/wind shelter (1), terrace-like wind shelter (3), rock pile (1)	Pre-Contact/post-Contact	D
5439	Rock shelter (2), wind shelter (4), wind shelter, C-shape (6), rock pile (1)	Pre-Contact/post-Contact	D
5440	Wind shelter, enclosure (1), Wind shelter, C-shape(2), Wind shelter natural terrace (1), platform (1), petroglyph (2)	Pre-Contact/post-Contact	D
5441	Terrace (2)	Pre-Contact/post-Contact	D
5442	Rock wall partial enclosure (1)	Pre-Contact/post-Contact	D
5443	Foundation	1952	D

Most of the newly identified features are temporary habitation areas or wind shelters. Two features at one site are petroglyph images and, as indicated above, one new site is interpreted as a possible burial. Two small platforms thought to have ceremonial functions were also identified, as was a possible trail segment. All of the newly identified sites and previously designated ones retain their significance rating under at least Criterion "D" for their information content under NRHP and State historic preservation guidelines. All of the previously identified sites mentioned in this report qualify for significance because of their information content under Criterion "D" of State and NRHP historic preservation guidelines. In addition, the possible burial (Feature D) and the 2 petroglyph images (Features F and G) of Site 50-50-11-5440, as well as Site 50-50-11-5441 and the Site 50-50-11-4836 trail segment (Feature F) also qualify for their cultural significance under State Criterion "E". Finally, it is important to note that the various sites located in HO are a remnant of a Kanaka Maoli cultural landscape. Because Haleakalā is noted for its ceremonial and traditional importance to the Kanaka Maoli, the entire HO complex of sites may well qualify for importance under significance NRHP Criterion "A" and State criterion "E".

The general lack of material culture remains suggests that the HO area was used for short-term shelter purposes, rather than extended periods of temporary habitation. While there was no charcoal located during testing in the project area, the newly identified sites are nevertheless tentatively interpreted as indigenous cultural resources, some of which may have been modified or used in modern times.

2.3 BIOLOGICAL RESOURCES

2.3.1 Introduction/Region of Influence

This section describes biological resources in the project area and adjacent areas. Biological resources include plant and animal species and the habitats or communities in which they live (i.e., vegetation species and communities, general wildlife, sensitive species and habitats, and wetlands). The ROI for biological resources includes the areas within HO boundaries.

Biological resources in the ROI were evaluated in accordance with the applicable provisions of numerous statutes, executive orders, permits, and regulations. Species listed in the biological resource sections are identified as federally listed if protected by the Endangered Species Act and as State-listed, if considered a threatened or endangered species by the State of Hawaiʻi.

2.3.2 Resources Overview

HO is on State of Hawaiʻi land within the Conservation District on Puʻu Kolekole, approximately a third of a mile from the highest point, Puʻu ʻUlaʻula in HALE. Mountain summits are typically aeolian (windy) deserts populated by a few mosses, lichens, and grasses. The predominant vegetation type at HO is alpine desert/shrubland. Alpine ecosystems exist at elevations of from 9,842 to 11,155 feet above mean sea level (ASL) and can be extremely dry. Rainfall ranges from less than 15 inches to as much as 60 inches annually. Great daily variations in temperature occur, with frost most common at night. Cinder and ash soils underlie this community on Maui (UH IfA 2005). Dry alpine shrublands are sparsely vegetated with dwarf native shrubs. At HO, shrubs consist of interspersed *ʻahinahina* (Haleakalā silversword, *Argyroxiphium sandwicense*) and *naʻenaʻe* (*Dubautia menziesii*). Vegetation cover is restricted by harsh environmental conditions to 10 percent of the surface area or less. Some areas have as little as one percent vegetative cover. The vegetation is also low growing, generally less than three feet high (UH IfA 2005).

Within HO, undisturbed land is interspersed amid land that has been disturbed by construction. Undisturbed sites are inhabited by predominately native shrubs, including *naʻenaʻe*, *pukiawe* (*Styphelia tameiameiae*), and *ʻohelo* (*Vaccinium reticulatum*), herbs, such as tetramolopium (*Tetramolopium humile*), and, grasses, including bentgrass (*Agrostis sandwicensis*), hairgrass (*Deschampsia nubigena*), and mountain *pili* (*Trisetum glomeratum*). Three species of native ferns, *ʻiwaʻiwa* (*Asplenium adiantum-nigrum*), *ʻaliʻi* (*Asplenium trichomanes* ssp. *densum*), and *kalanoho* (*Pellaea ternifolia*), are found tucked into rock crevices and overhangs and on the steep slopes of the southeast part of the property. Areas of HO where construction has occurred generally support fewer native species and more weeds.

2.3.3 Botanical Resources

The landscape at HO is considered to be an *Argyroxiphium/Dubautia* alpine dry shrubland vegetation type. Dry alpine shrublands are typically open communities, occurring between about the 9,800 to 11,100-foot elevations in Hawaiʻi, predominantly on barren cinders, with very sparse vegetation cover (UH IfA 2005). The substrate is a mixture of ash, cinders, pumice, and lava (UH IfA 2005). Vegetation is sparse, varying from a near barren landscape (<1 percent cover) to about 10 percent cover. Vegetation is low to the ground, no more than 3 feet (1 meter) tall anywhere on the site. During the November 2002, LRDP survey conducted by Starr Environmental (UH IfA 2005), a total of 32 plant species were observed, consisting of 11 (34 percent) native species and 21 (66 percent) non-native species. The December 2005 survey (Appendix J, 2005 Survey) identified 25 plant species, consisting of 11 native species and 14 non-native species.

A more recent survey was conducted in June 2009 (Appendix J, 2009 Survey). It indicated that, in general, the number of species has increased over time and it appears the distribution and abundance of both native and non-native plants has increased. Global Positioning System (GPS) work conducted during this latest study will allow for greater resolution detail of future vegetation changes.

At HO, the total number of plant species has increased from a total of 32 plant species (11 were native and 21 were non-native) in 2002, to a total of 44 plant species (3 new natives and 9 new non-natives, for a total of 14 native species and 30 non-native species) in 2009. Species previously reported from HO that were not observed in 2009 include *Anthoxanthum odoratum* and *Senecio sylvaticus*. These species may have disappeared, may have been overlooked, or may persist as seed in the soil. The 9 new non-native species recorded in 2009 included *Ageratina adenophora, Bromus diandrus, Conyza bonariensis, Dactylis glomerata, Festuca rubra, Pennisetum clandestinum, Trifolium repens,* Unknown sp., and *Vulpia myuros*. These species may be new arrivals, they may have been overlooked in previous studies, or perhaps they were persisting as seeds in the soil and have recently germinated. The 3 new native species recorded in 2009 included *Dryopteris wallichiana*, *Pteridium aquilinum* var. *decompositum*, *Silene struthioloides*. These could be new arrivals, but these inconspicuous natives could have just as easily been overlooked in previous surveys.

The land in HO can be divided into two general areas: undisturbed and disturbed (i.e. those where construction or other human influence has occurred). Undisturbed areas are comprised of predominantly native plants including shrubs, herbs, and grasses. Three species of native ferns are found in rock crevices and overhangs around the Pan-STARRS (PS-1) observatory and on the steep slopes on the southeast portion of the property near the MSO facility.

Areas of HO property where construction has occurred generally support fewer native species and contain more weeds. One notable exception is the endemic ʻahinahina, or Haleakalā silversword, which is found exclusively on areas where construction has occurred. The only tree species found at HO were two unidentified pines (*Pinus* sp.) located between a weather station tower and the MSO facility, which were approximately 20 cm (7.87 inches) tall and looked more like a small multi-branched shrub than a tree. This was the first record of pines on the summit of Haleakalā. It was not known if the trees were planted, arrived as contaminants in soil, or arrived through natural wind dispersal. These trees were thought to be many years old despite their minimal height (compared to other pine species). At the recommendation of the Friends of Haleakalā National Park, these trees were removed.

There are ten native species and nine non-native plants species found on the Mees site. Portions of the site which were moderately disturbed, especially areas near buildings and roads, contain the most weeds (non-native species) and fewest native species. Non-native plants found on the Mees site include thyme-leaved sandwort (*Arenaria serpyllifolia*), storksbill, hairy cat's ear, black medick (*Medicago lupulina*), evening primrose (*Oenothera stricta* subsp. *stricta*), pine (*Pinus* sp.), English plantain (*Plantago lanceolata*), Kentucky bluegrass (*Poa pratensis*), and common or spring vetch (*Vicia sativa subsp. nigra*). (Appendix J, 2005 Survey)

Portions of the site that were the least disturbed contain the most native plant species and the least weeds. Native plants found on the Mees site include Hawaiian bentgrass, ʻiwa ʻiwa, ʻoaliʻi, hairgrass (*Deschampsia nubigena*), kupaoa, kalamoho (*Pellaea ternifolia*), pukiawe (*Styphelia tameiameiae*), tetramolopium (Tetramolopium humile), mountain pili (*Trisetum glomeratum*), and ohelo. (Appendix J, 2005 Survey)

The most undisturbed areas of HO hold remnant pockets of native plants indicative of relatively pristine conditions. Two native shrubs, ohelo and pukiawe, appear to be sensitive to disturbance/urbanization on Puʻu Kolekole and were found adjacent to the MSO facility.

The Reber Circle site is mostly disturbed, with the original profile of the rise evident only on the margins of the site, often where the land is steep. There were nine native and seven non-native plants found on the Reber Circle site. The most heavily disturbed portions of the site, such as the roads, parking lots, and existing buildings, contain virtually no plants, native or non-native.

Portions of the site which are moderately disturbed, especially those areas near buildings and roads, contain the most weeds and fewest native species. Non-native plants found on the Reber Circle site include Japanese sugi pine (*Cryptomeria japonica*), storksbill (*Erodium cicutarium*), Yorkshire fog (*Holcus lanatus*), hairy cat's ear (*Hypochoeris radicata*), lythrum (*Lythrum maritimum*), evening primrose, and Kentucky bluegrass. (Starr Environmental 2005)

Portions of the site that were the least disturbed contain the most native plants and the least weeds. Native plants found on the Reber Circle site include Hawaiian bentgrass, ʻahinahina (Haleakalā silversword),ʻiwa , ʻoaliʻi , hairgrass , kupaoa , kalamoho , tetramolopium , and mountain pili . (Appendix J, 2005 Survey)

2.3.4 Endangered, Threatened, Listed, or Proposed Plant Species

The ʻahinahina are federally-listed as a threatened species, meaning they may become endangered throughout all or a significant portion of their range if no protective measures are taken. In 2002, nine live *ʻahinahina* and three dead *ʻahinahina* flower stalks were located within the HO property. One of the dead plants, also found during the 2005 survey, was located east of Reber Circle. The area around the plant was searched for seeds, but none were found. During the June 2009 botanical survey, the same botanists who conducted the

2002 survey "...were pleasantly surprised to find silverswords were now locally common within the Air Force site at HO, with 159 silverswords counted. The silverswords were generally in the same places as in 2002, but in much greater abundance." (Appendix J, 2009 Survey) Table 2-3 lists the habitat preference and the likelihood of occurrence of plant species at the HO.

Table 2-3
Habitat Preference and Likelihood of Occurrence at HO

Scientific Name	Common Name	Federal Status	State Status	Habitat	Date Last Observed	Likelihood of Occurrence
Flora						
Argyroxiphium sandwicense ssp. *macrocephalum*	*'ahinahina*, Haleakalā silversword,	Protected under the Endangered Species Act (ESA)	Protected by State	May occur in alpine dry shrubland.	Known currently	Confirmed
Fauna						
Pterodoma phaeopygia	*'ua'u*, Hawaiian Petrel	Protected under ESA	Protected by State	May occur in alpine dry shrubland.	Known currently	Confirmed
	NOTE: Most likely observed during the nesting season, February to November.					
Branta sandvicensis	*nēnē*, Hawaiian goose	Protected under ESA	Protected by State	May occur in beach strands, shrublands, grasslands, woodlands.	Known currently	Confirmed
	NOTE: May be incidentally sighted at HO, but unlikely a resident.					
Lasiurus cinereus semotus	*'ope'ape'a*, Hawaiian hoary bat	Protected under ESA	Protected by State	May be seen foraging in open areas, including alpine shrublands, near the edges of native and non-native forests, or over open water. May roost in foliage of native and non-native trees.	Known currently	Potentially may occur
	NOTE: May be incidentally sighted at HO, but unlikely a resident.					

2.3.5 Faunal Resources

Fauna at HO consist of birds, mammals, and invertebrates. Three Federal- and State-listed animal species, described below, occur in the summit area and slopes of Haleakalā. Table 2-7 lists the habitat preference and the likelihood of occurrence of birds and mammals in HO.

Endangered, *Threatened*, *Listed or Proposed Avifaunal Species*

'Ua'u

The 'ua'u, or Hawaiian Petrel*,* a Federal- and State-listed endangered bird species, is present in the summit area (Natividad Bailey, unpublished report for IfA). The largest known nesting colony of 'ua'u is located in and around HALE (Simons and Natividad Hodges 1998). Approximately 30 known burrows are along the southeastern perimeter of HO, and several burrows are northwest of HO (Fig. 2-6), with a large number of burrows in and around HO (Fig. 2-7). This was derived from data obtained during the 2006 and 2007 surveys by the NPS and KC Environmental, Inc.

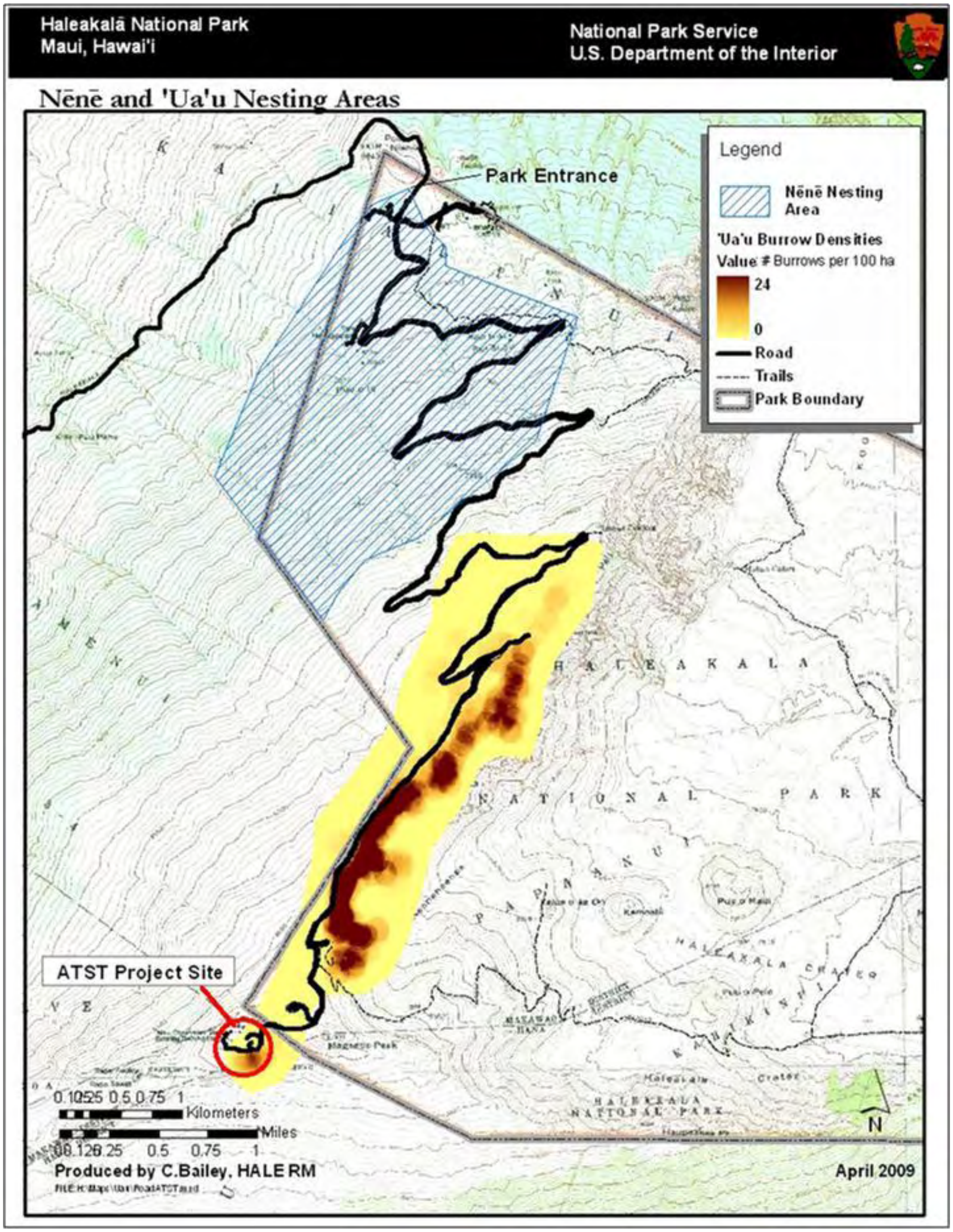


Figure 2-4 Petrel Burrows Near Summit of Haleakalā

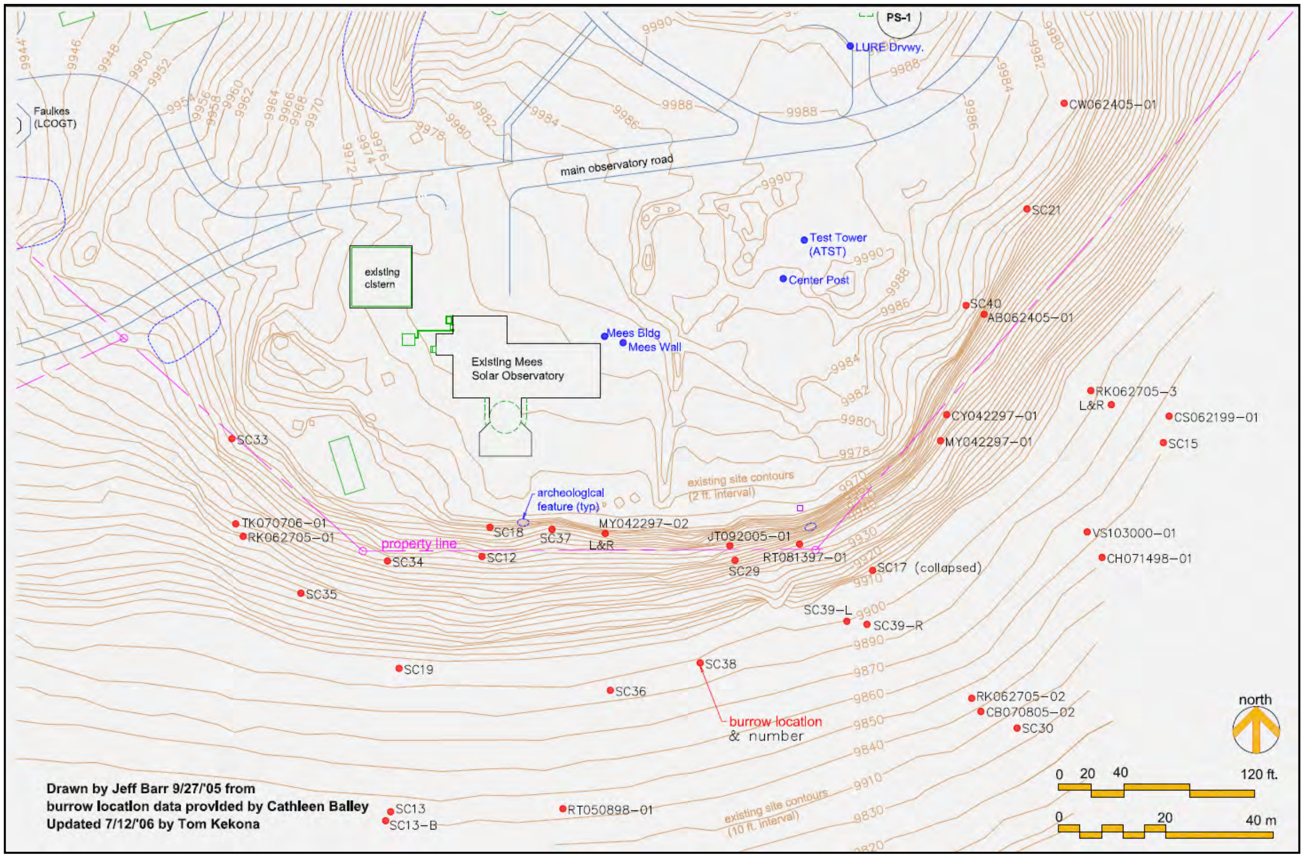


Figure 2-5 Petrel Burrows In and Around HO

The ʻuaʻu can be found nesting at Haleakalā from February to November. The birds make their nests in burrows and return to the same burrow every year. The species distribution during their non-breeding season is poorly known, but they are suspected to disperse north and west of Hawaiʻi, with very little movement to the south or east. The ʻuaʻu typically leave their nests just before sunrise to feed on ocean fish near the surface of the water, and just before sunset they transit from the ocean back to Haleakalā. These birds have limited vision, and their high speed and erratic nocturnal flight patterns may increase the possibility of collisions with fences, utility lines, and utility poles (UH IfA 2005).

ʻUaʻu are believed to navigate by stars, so man-made lights may confuse in-flight ʻuaʻu. Evidence suggests these birds will fall to the ground in exhaustion after flying around lights, where they are susceptible to being hit by cars or attacked by predators (Simons and Hodges 1998); however, this has not been observed at HO. In addition to these hazards, confirmed causes of ʻuaʻu mortality include nest collapse by wild goats, predation by native owls and introduced predators, road kills, collision with such objects as buildings, utility poles, fences, lights, and vehicles, and disturbance from road resurfacing (Natividad Hodges and Nagata 2001).

During fall 2004, ABR, Inc., conducted a study for the MSSC (Appendix H). Using ornithological radar and visual sampling techniques, the MSSC objective was to determine movement patterns of ‘ua‘u near the summit of Haleakalā, including spatial movement patterns, temporal movement patterns, and flight altitudes. Many of the patterns observed in this study matched what is known about the biology of ‘ua‘u. Breeding adults, non-breeding sub-adults, and adults are active in the summer when the displaying non-breeders are active and fly erratically and circle the colonies at low altitudes. In contrast, only adults visit the colonies during the fall, when they simply fly in and land at burrows to feed young. It is suspected that fewer birds were seen on the radar in the vicinity of the MSSC than near the crater because the crater is much more active for breeding and displaying birds than is that part of the colony along the southwestern ridge, the site of the observatories and the FAA.

Nēnē (*Hawaiian Goose*)

The nēnē, or Hawaiian goose (*Branta sandvicensis*, also known as *Nesochen sandvicensis*), is a Federal- and State-listed endangered species on Haleakalā and is the only species of goose not occurring naturally in continental areas. The nēnē formerly bred on most of the Hawaiian Islands, but currently is restricted to the islands of Hawai‘i, Kaua‘i and Maui. *Nēnē* seem to be adaptable and are found at elevations ranging from sea level to almost 8,200 feet (Fig. 2-8) in a variety of habitats, including non-native grasslands, sparsely vegetated, high elevation lava flows, cinder deserts, native alpine grasslands and shrublands, open native and non-native alpine shrubland-woodland community interfaces, mid-elevation (approximately 2,300 to 3,900 feet) native and non-native shrubland, and early successional cinder fall. Critical habitat has not been designated for the nēnē. The nēnē population on Maui is thought to consist of approximately 330 individuals. While the nēnē has been known to fly over HO, the summit area is outside of the known feeding range of the bird.

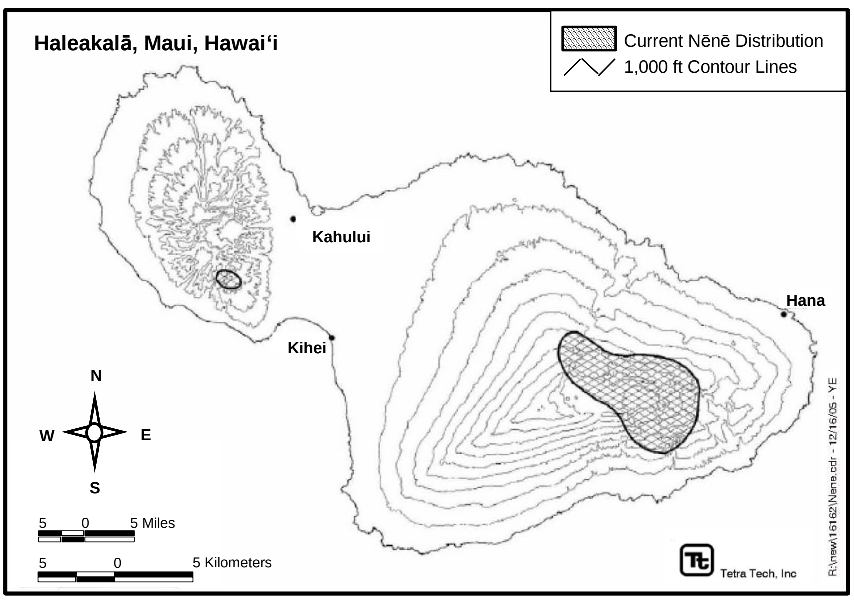


Figure 2-6 Current Distribution of Nēnē on Maui

The nēnē is a non-migrating terrestrial goose that nests from October to March. The preferred nest sites include sparsely to densely vegetated beach strands, shrublands, grasslands, and woodlands on well-drained soil, volcanic ash, cinder, and lava rock substrates. Nēnē are ground nesters and their nests are usually well hidden in the dense shade of a shrub or other native vegetation, but on Kaua'i nēnē have built nests under alien species. *Nēnē* are browsing grazers, eating over 50 species of native and introduced plants.

Once abundant, the nēnē population has declined. The primary causes of this decline include habitat loss, hunting during the breeding season (fall and winter), and the impacts of alien mammals introduced during both Polynesian and western colonization.

Current threats to the nēnē population include predation, nutritional deficiency due to habitat degradation, and lack of lowland habitat, human-caused disturbance, behavioral problems, and inbreeding depression. Dogs (*Canis familiaris*), cats (*Felis cattus*), mongoose (*Herpestes auropunctatus*), roof rats (*Rattus rattus.*), and pigs (*Sus scrofa*) prey on *nēnē*, while feral cattle (*Bos taurus*), goats (*Capra hircus*), pigs, and sheep (*Ovis aries*) can alter and degrade *nēnē* habitat through foraging.

Potential threats to the nēnē are identified below and follow U.S. Fish and Wildlife Service (USFWS) classification of factors that may negatively affect a species, leading to its decline, as identified in Section 4(a) of the ESA:

- The present or threatened destruction, modification, or curtailment of its habitat or range;
- Overuse of habitat for commercial, recreational, scientific, or educational purposes;
- Disease or predation;
- The inadequacy of regulatory mechanisms; and
- Other natural or man-made factors affecting its continued existence.

The "Draft Revised Recovery Plan for Nēnē or Hawaiian Goose" (USFWS 2004) indicates there is a high degree of threat to this species. The USFWS also believes that this species has a high recovery potential because it is a taxonomically, or genetically pure, species and as such does not interbreed with domestic geese and is generally not in conflict with regular human activities.

'Ope'ape'a

The 'ope'ape'a, or Hawaiian hoary bat (*Lasiurus cinereus semotus*), is a federal-listed endangered species that resides on the lower slopes of Haleakalā. The 'ope'ape'a is found on Hawai'i, Maui, O'ahu, Kaua'i and Moloka'i. On the island of Hawai'i, most observations have been from between sea level and 7,500 feet ASL, although individuals have been recorded at elevations as high as 13,000 feet. On Maui, the bat resides in the lowlands of the Haleakalā slopes. Even though several sightings have been reported near HO, it is unlikely that the bat is a resident of the area, due to the relatively cold summit temperatures and the lack of flying insects in the area, which is the preferred food of the Hawaiian hoary bat (AFRL 2005).

The nocturnal ‘ope‘ape‘a is the only native terrestrial mammal known to occur in the Hawaiian archipelago, although other bat species have been found in sub-fossil remains. According to the USFWS, relatively little research has been conducted on this endemic Hawaiian bat, and data regarding its habitat and population status are very limited. It is believed that bats typically depart the roost shortly before sunset and return before midnight, although this is based on a small number of observations (USFWS 1998). Bats are most often observed foraging in open areas, near the edges of native and non-native forests, or over both marine and fresh open water and over lava flows. Bats have been recorded roosting in a variety of tree species, including hala (*Pandanus tectorius*), kukui (*Aleurites moluccana*), pukiawe, java plum (*Syzygium cumini*), ohia lehua (*Metrosideros polymorpha*), and eucalyptus sp. Bats have been observed feeding from 3 to 492 feet above ground and water. Most of the available data suggests that this elusive bat roosts alone in the foliage among trees in forested areas.

Habitat requirements may vary seasonally and with reproductive condition, but this is not clear. Breeding probably occurs mostly between September and December, with young being born in May or June. Hawaiian hoary bats do not migrate off island, although seasonal elevation movements and island-wide migrations may occur. The availability of roosting sites is believed to be a major limitation in many bat species, but other threats to this subspecies include direct and indirect effects of pesticides, predation, alteration of prey availability (introduced insects), and roost disturbance (USFWS 1998). The recovery plan for the Hawaiian hoary bat (USFWS 1998) suggests the subspecies is experiencing a moderate degree of threat and has a high potential for recovery. Critical habitat has not been designated for this species.

Other Native and Introduced Fauna

Introduced fauna that could be observed within the summit area include the chukar (*Alectoris chukar*), the feral goat, the Polynesian rat (*Rattus exulans*), and the roof rat (*Rattus rattus*) (AFRL 2005). The Indian mongoose is occasionally observed on the summit. These species are not included on Federal or State threatened or endangered lists.

Invertebrate Resources

The highest elevations of Haleakalā were once considered lifeless, but biologists have discovered a diverse fauna of resident insects and spiders. These arthropods inhabit unique natural habitats on the bare lava flows and cinder cones. Because they feed primarily on windblown organic materials, they form an aeolian ecosystem.

In Hawai‘i, aeolian ecosystems are on non-weathered lava substrates mostly, but not exclusively, found at high elevations (Medeiros, et al 1994). On Haleakalā an aeolian ecosystem extends up the summit from about the 7,550 feet. It is characterized by relatively low precipitation, porous lava substrates that retain relatively little moisture, little plant cover, and high solar radiation. The dark, heat-absorbing cinder provides only slight protection from the extreme temperatures, and thermal regulation and moisture conservation are critical adaptations of arthropods occurring in this unusual habitat.

Due to the harsh environment, fewer insects are present at upper elevations on Haleakalā than are found in the warm moist lowlands. However, an exceptional assemblage of insects and spiders make their home on the mountain's upper slopes. A survey and inventory of arthropod fauna was conducted for the 18.166 acres of HO in 2003 for the LRDP. In the 2003 study, several species were added to the previous 1994 inventory site records.

An additional survey including arthropod collection and analysis was conducted in 2005 at the Mees and Reber Circle sites for the proposed ATST Project (Appendix E(1). The arthropod species that were collected in this study were typical of what had been found during previous studies. Although the study was conducted during the fall months, no species were found that are locally unique to the site, nor were there any species found whose habitat is threatened by normal observatory operations.

A supplemental arthropod inventory was conducted in March 2007 for sampling of arthropods at the sites considered in the proposed ATST Project (Appendix E(2). The goal was to detect additional species that may have been missed during previous samplings. This additional survey, including night sampling, covers a seasonal component not included in the two previous studies. This survey was conducted during the winter months. The results of the 2007 arthropod survey indicate there are no special concerns or legal constraints related to invertebrate resources in the project area. No invertebrate species listed as endangered, threatened, or that are currently proposed for listing under either Federal or State of Hawai'i endangered species statutes were found.

The diversity of the arthropod fauna at HO is somewhat less than what has been reported in nearby undisturbed habitat. This is expected, in that buildings, roads, parking areas, and walkways occupy 40 percent of the site. However, the undisturbed habitat on the site that was sampled has an arthropod fauna generally similar to what could be expected from other sites on the volcano with similar undisturbed habitat. Most of the arthropods collected during the 2003 study were largely associated with vegetation at the site. Observatory construction and operations have increased the suitability of some habitats for plants, and increased vegetation has probably caused an increase in the populations of some native arthropod species.

A June 2009 arthropod survey was conducted and extended to larger portions of the HO property (Appendix E(3). There were a number of additional species collected, including one endemic carabid beetle (*Mecyclothorax*), and two species of long horn beetles of the genus *Plagithmysus*. Carabid beetle populations appear to be impacted when alien predators are introduced to their habitats and their conservation is considered important. The two species of long-horn beetles are considered rare and are infrequently collected. (Appendix E(3).

2.4 TOPOGRAPHY, GEOLOGY, AND SOILS

2.4.1 Introduction/Region of Influence

The ROI for the following discussion on topography, geology, and soils includes the areas within HO. The discussion in this section applies equally to all areas within the ROI, unless otherwise noted.

2.4.2 Resource Overview

Topography

Maui, nicknamed "The Valley Isle," is the second largest of the Hawaiian Islands and is a volcanic doublet: an island formed from two volcanic mountains that abut one another via an isthmus (Fig. 2-9). Mauna Kahalawai, also known as the West Maui Mountain, is the much older volcano and has been eroded considerably. Haleakalā, the larger volcano on the eastern side of Maui, rises 10,023 feet ASL. The last eruption occurred at some time between 1650 and 1790, and the lava flow can be seen between Āhihi Bay and La Perouse Bay on the southwest shore of East Maui. Both volcanoes are shield volcanoes, and the low viscosity of the Hawaiian lava makes the likelihood of large explosive eruptions negligible.

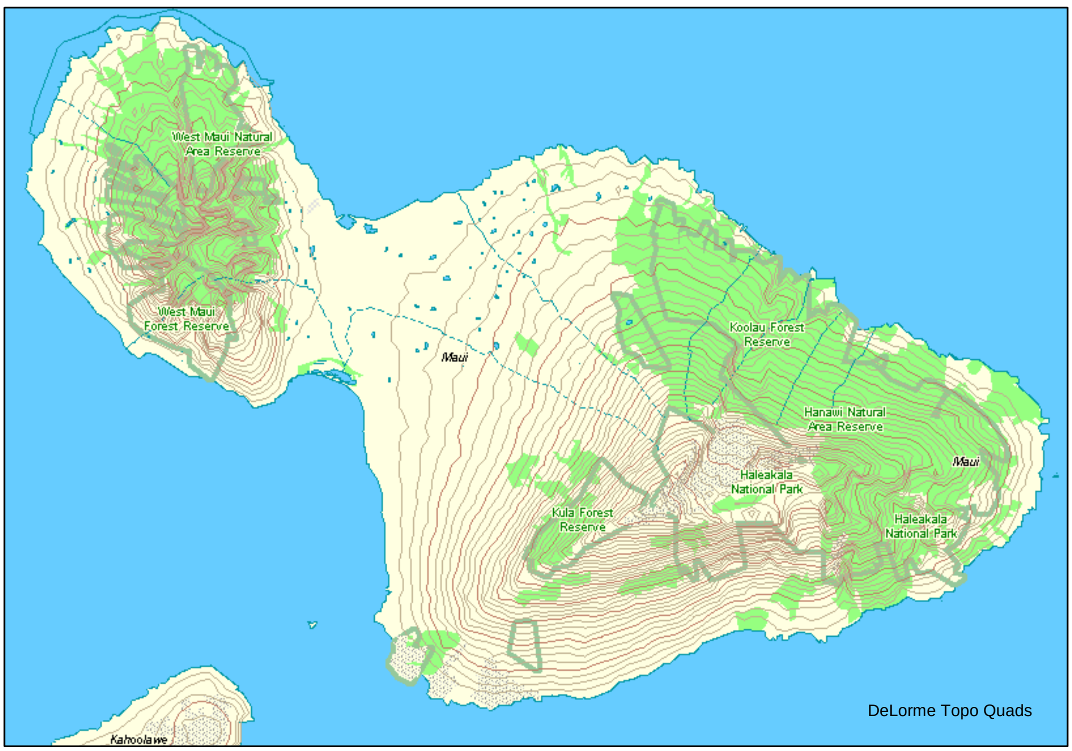


Figure 2-7 Topography for Island of Maui, Hawai'i

The summit of Haleakalā is rugged and barren, consisting of lava and pyroclastic (formed by volcanic action) materials. Within a four-mile radius of HO, the elevation drops to approximately 3,600 feet ASL, with an average slope of greater than 30 percent.

HO is in the crater area of the Kolekole cinder cone, which developed in the central region of the triple junction rift zone where the Southwest Rift Zone, the East Rift Zone, and the North Rift Zone meet (Chatterjee, et al 2005). Lava deposits in the area are from both the Kula and Hana series.

Geology

Over the course of Haleakalā's formation, three distinct phases of eruption have taken place. The first, called the Honomanu Volcanic Series, is responsible for the formation of Haleakalā's primitive shield and most likely its three prominent rift zones. Honomanu lavas are exposed over less than one percent of Haleakalā but are believed to form the foundation of the entire mountain to an unknown depth below sea level. The second series, or Kula Volcanic Series, overlaid the previous Honomanu Series with its lava flows. Eruptions of this series were considerably more explosive than its predecessor, leading to the formation of most of the cinder cones along the three rift zones.

A period of inactivity followed the Kula Series, during which erosion began to predominate the formation of the Haleakalā Crater by forming great valleys leading to the coast. After this long period of erosion, the final volcanic eruptions, called the Hana Volcanic Series, partially filled the deep valleys. Several cinder cones and ash deposits lined the East and Southwest Rift Zones, ranging from a few feet high to large cones more than a mile across at the base and 600 feet high. Lava flows within the Haleakalā Southwest Rift Zone range from 200 years to 20,000 years old. Six flows have erupted in this area within the last 1,000 years. During the latest eruption, sometime between 1650 and 1790, lava emerged from two vents and flowed into La Perouse Bay, where a small peninsula formed. Recent studies have indicated that Haleakalā volcano may still be active, in light of the numerous eruptions during the last 8,000 years (Bergmanis et al. 2000).

According to a geological report prepared in 2005 for multiple sites at HO, there are no indications or gross evidence of faulting, instability, or mass wasting, and in a human time scale, the sites are suitable for construction (Appendix F).

Soils

The summit is covered with volcanic ejecta consisting of lava, cinder, and ash of the Kula and Hana Volcanic Series. There is no soil development in the immediate vicinity of HO. Soil development occurs with increased distance (greater than 1.5 miles) from the summit. Most of the area is on Cinder Land (rCl), which is thought to be of the Kula period of volcanism (U.S. Soil Conservation Service 1972). A foundation investigation conducted in 1991, in the northern area of HO, revealed that cinder in this area is underlain by 5 feet of volcanic clinker and 16 feet of volcanic cinder.

In March 2005, soil borings at the Mees observatory site identified a soil profile generally consisting of cinder sands and gravels on top of a basalt layer. Soil profiles were obtained from cores at six locations near the Mees observatory (Appendix G). Moderately hard to hard basalt substrate was identified at depths of 5 to 21 feet below grade. Two cores taken at the Reber Circle site identified hard basalt substrate beneath a thin (5- to 15-foot) layer of less consolidated basalt (Dames and Moore 1991).

2.5 VISUAL RESOURCES AND VIEW PLANE

2.5.1 Introduction/Region of Influence

Visual resources are the visible physical features on a landscape, such as land, water, vegetation, animals, and structures. The ROI for visual resources is HO (18.166 acres; Fig. 2-10) and surrounding lands due to the elevation of the site. HO is on State of Hawai‘i land within the Conservation District on Pu‘u Kolekole, near the summit of Haleakalā.

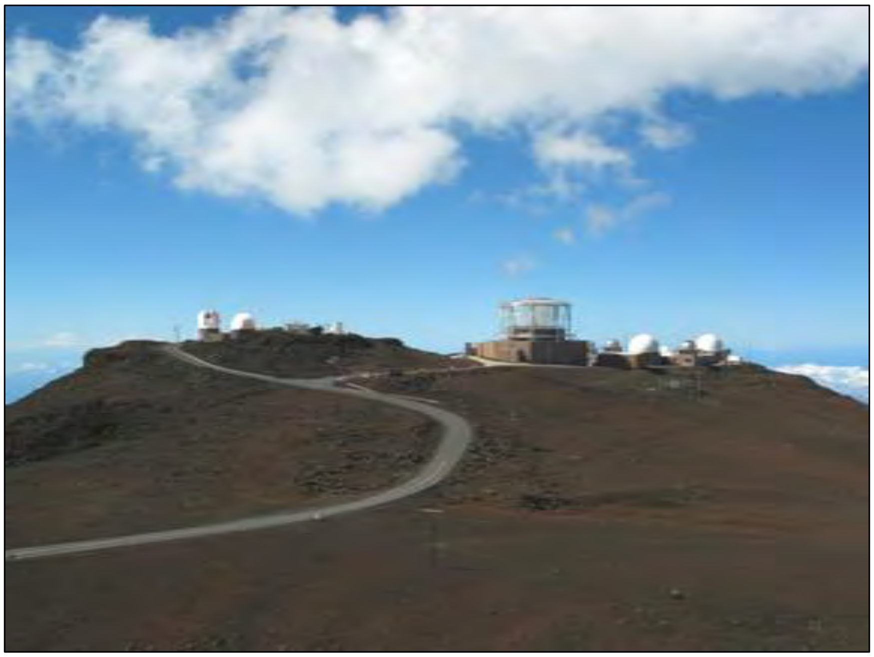


Figure 2-8 Current View of HO from Pu‘u Ula‘ula

2.5.2 Resources Overview

The 18.166 acres of HO is restricted to only a small number of employees of the various facilities working any time within a 24-hour period. A paved road and utility infrastructure wind up the sloped terrain to the site.

At 10,000 feet elevation, HO is above one third of the Earth’s atmosphere. HO is above the cloud inversion layer, is surrounded by a relatively clean atmosphere, and has minimal light pollution. No prominent vegetation or water sources are visible. Buildings and equipment of various heights are dispersed around the site. Building and equipment colors are primarily white, gray, and browns/tans. Because the summit area of Haleakalā is blanketed with dark-hued cinders and ash and because it lacks prominent vegetation, its appearance contrasts sharply with the lush tropical forests found at lower elevations.

Overall, visibility of the HO facilities is highly variable depending on a combination of factors: locations from where one views them on the island, atmospheric conditions, such as dust content and humidity), time of day, cloud cover, and human activity, such as cane burning, which creates smoke.

There are no State scenic byways on Maui, but there are scenic drives and viewpoints around the island. The Draft Maui Island Plan identifies scenic resource corridors (County of Maui 2009). Each roadway corridor is rated exceptional, high, medium, or low, based on its overall scenic resource value. Haleakalā Highway is rated as exceptional. Roadways with exceptional or high scenic resource values are typically in areas that consistently convey dramatic and diverse resource values throughout the corridor. These corridors are typically in a natural condition and remain relatively unmarked by development. The Draft Maui Island Plan states that a Scenic Roadway Corridor Overlay District would establish special controls along scenic roadway corridors to prevent or mitigate the impact of development on scenic resources.

Visibility of the summit area from below would be more likely in the early morning before the daytime cloud inversion layer builds up and in the late afternoon after the inversion layer dissipates. When mid- and upper-level cloud cover is absent, many of the structures at HO are visible from miles away. Some of the facilities can also be seen from public viewpoints and highways that climb the slopes of the mountain (UH IfA 2005).

HALE is approximately two-thirds of a mile northeast of HO and is predominantly used by tourists and Park personnel. Approximately 1.7 million visitors annually are attracted to Haleakalā's various lookouts and vantage points for its spectacular vistas and astronomical views. Visibility of the HO facilities within HALE varies depending on one's vantage point within the HALE. Several HO facilities are highly visible from Pu'u Ula'ula. Some HO facilities are partially visible from the HALE entrance station to about the first mile of the HALE road, the headquarters visitor center, portions of the HALE road corridor (particularly the last third of the road closest to the summit), and near the summit from the parking lot adjoining the Haleakalā Visitor Center (Pa Ka'oao).

The facilities at HO that are closest to its northern boundary are visible in various locations on Maui. The tallest of these, the aluminum-clad 117-foot tall US Air Force AEOS telescope, completed in 1994, is easily seen with the unaided eye from most areas within the Central Valley. It also is visible from some windward and leeward communities, especially in morning and late afternoon. The two white 60-foot tall domes of the MSSS (completed in 1965) are also visible in many of those same areas when the summit is free of clouds. The domes of some of the facilities within HO are painted white, while others are aluminized. Each of these colors is visible, depending on sun angle, cloud cover, and position of the viewer. On a clear low-humidity day, some of the HO facilities would be distinguishable as very small man-made objects from as far away as Ma'alaea Bay, which is a distance of approximately 17 linear miles. However, in humid or dusty conditions, these structures may not be visible at all from Ma'alaea Bay, or even from locations in Upcountry Maui at half that distance.

2.6 HYDROLOGY

2.6.1 Introduction/Region of Influence

The ROI for hydrology includes HO, which is entirely within the Waiakoa and the Manawainui Gulch watersheds. As shown on Figure 2-11, the groundwater boundaries are the Kamaole and Makawao Aquifer Systems of the Central Aquifer Sector and the Lualailua and Nakula Aquifer Systems of the Kahikinui Aquifer Sector (AFRL 2005). A sector is a large region with hydrogeological similarities that primarily reflects broad hydrogeological features, and secondarily, geography. A system is an area within a sector showing hydrogeological continuity.

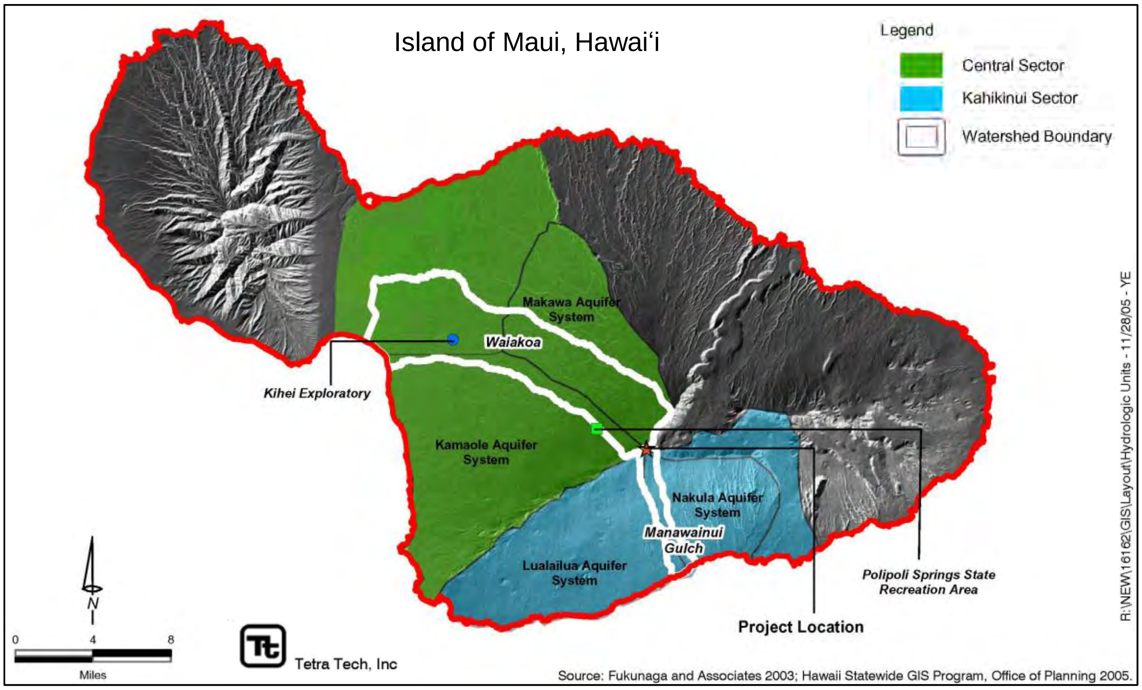


Figure 2-9 Hydrologic Features

There is no continuous source or supply of water at the summit area of HO. At various times during the year, particularly in the winter months- water catchment systems store rainwater collected from building roofs. To supplement this source, water is trucked to each user in certified tanks where it is stored on-site. Users maintain their own collection systems and storage tanks for potable and non-potable water, as well as their individual pumping and distribution systems.

2.6.2 Resource Overview

Surface Water

The primary hydrologic unit for describing stream flow is the drainage basin, whereas the principal division for groundwater is the aquifer system. Because groundwater flow is governed by subsurface geological continuity rather than by topographic controls (Yuen and Associates 1990), the boundaries of drainage basins and aquifer systems do not necessarily coincide. Drainage basin boundaries for the ROI are the Waiakoa and Manawainui Gulch watersheds, two of the 112 Maui Watershed Units, totaling 466,437 acres.

Most streams on Haleakalā are intermittent because of the steep, permeable lava terrain. The nearest intermittent streams are approximately 1.9 miles down-slope of HO. Perennial streams at low elevations originate from groundwater springs.

There are no water bodies at HO. An area of lower elevation within HO acts as a ponding and infiltration area for stormwater at Kolekole cinder cone (AFRL 2005). The Polipoli Springs water system is within the HO aquifer system. The Polipoli Spring State Recreation Area water system is in the Kahikinui Forest Reserve, 9.7 miles upland from Kula on Waipoli Road. The water system is owned and operated by the State of Hawai'i and is managed by the Hawai'i DLNR (DLNR 2008). The water system serves a park cabin and campground area. The non-potable source for the water system is an unnamed spring whose water flows through a 1.5-inch pipe to the campground area. The estimated water demand is 2,000 gallons daily (Fukunaga and Associates 2003).

Drainage Features

On the native slopes of Haleakalā, virtually all precipitation infiltrates the soil profile. Once in the soil, gravity continues to force the water downward. When the water hits a less permeable layer, such as basalt, it flows in the path of least resistance. Driven by gravity, this subsurface water flows down-gradient along the surface of the basalt layer. The flow continues along the interface between the highly pervious cinder material and the basalt layer until it either resurfaces as a spring or stream or it flows into a fissure in basalt, contributing to groundwater storage (UH IfA 2005a).

In March 2005, results of the exploratory soil borings revealed that the soil profile generally consists of sands and gravels on top of basalt layer (Appendix G). This means water can easily infiltrate the upper soils and then become significantly slowed when it reaches the basalt layer, which ranges from 5 to 21 feet (UH IfA 2005a).

All precipitation falling near the summit infiltrates and flows subsurface toward the natural drainage courses, such as Manawainui Gulch. Loss of rainfall would be caused by evaporation in the soil column (UH IfA 2005a). Due to site topography, as well as a small collection of stormwater conveyance systems, consisting of concrete channels and culverts, runoff generated within HO is controlled and conveyed via natural drainage paths to an infiltration basin at the western extremity of HO property. This infiltration basin is a depression that represents an old vent on the cinder cone, and its substrate is considerably more porous than the lava or spatter portions of Kolekole. The runoff collection system was originally designed to maintain stormwater runoff on paved surfaces and consists of gutters and channels intended to prevent stormwater from discharging onto native soils next to paved surfaces. Ten main stormwater flow paths have been identified at HO. Figure 2-12 illustrates the runoff patterns associated with HO.

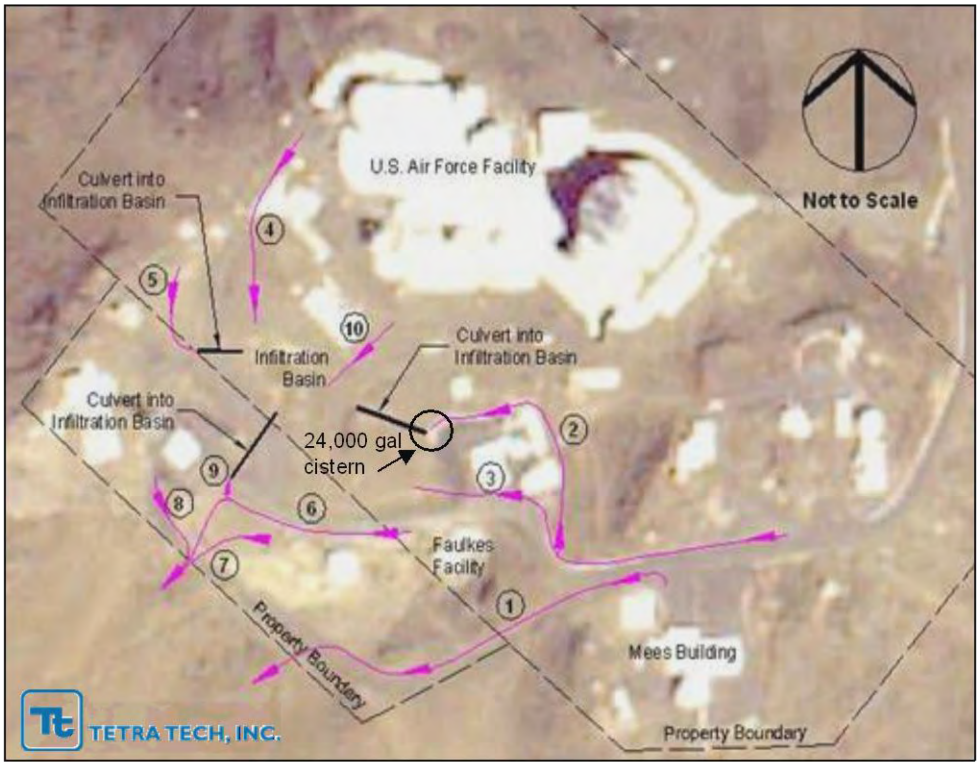


Figure 2-10 Existing Stormwater Runoff Patterns at HO

The following is a brief description of each flow path in the HO drainage system:

Flow Path 1: Runoff from the parking lot associated with the MSO facility leaves the paved surface and flows down an abandoned road. The runoff then flows across a flat area before discharging along the southern slopes of the volcanic cone.

Flow Path 2: Runoff from the upper portion of the site drains onto the road and flows into a pipe conduit. As originally designed, the runoff was to enter a concrete channel constructed behind the gathering of buildings and then be conveyed through a culvert into the infiltration basin. However, the concrete channel was subject to debris entry.

Flow Path 3: Due to temporary blockage of Flow Path 2, concentrated runoff flow was redirected along the paved areas associated with the cluster of buildings. An asphalt berm was constructed to direct the runoff away from the buildings and toward the infiltration basin. Once the runoff discharges onto the native material, the flow dissipates into multiple undefined channels leading toward the infiltration basin.

Flow Path 4: Stormwater runoff from a small portion of the Air Force complex, along with runoff from the access road and concrete storage areas, flows along the edge of the road leading toward the infiltration basin.

<u>Flow Path 5:</u> The native soil in this Department of Energy-controlled area appears to have been impacted from past activities, such as parking and storage. Runoff from this area is conveyed to the infiltration basin through a culvert under the access road.

<u>Flow Path 6:</u> This concrete channel is designed to convey runoff from the road and from the Faulkes facility. The channel leads to two culverts under the access roads. The lower portion of the channel is a deposition location for sediment before it enters the first culvert.

<u>Flow Path 7</u>*:* Runoff flows southward.

<u>Flow Path 8:</u> A portion of the runoff from the FAA facility flows southward and discharges over the slopes of the volcanic cone.

<u>Flow Path 9:</u> Runoff within the concrete channel was designed to flow into the infiltration basin through a series of two culverts that were placed under access roads

<u>Flow Path 10:</u> A portion of the U.S. Air Force facility generates stormwater runoff that flows into the infiltration basin. The paved surfaces associated with the facility have curbs, which keep the runoff on paved surfaces until it enters the pipe network, which discharges into the infiltration basin.

Runoff harvesting is also part of the drainage features at HO. Runoff from the MSO facility is captured and stored in the nearby 64,100-gallon cistern and is used for domestic water. A 24,000-gallon cistern is associated with the former Neutron Monitoring Station below the MSO facility. Some of the runoff from the UH facilities is captured by these cisterns before it reaches the infiltration basin.

Groundwater

As previously mentioned, the groundwater resources below HO are characterized as part of the Kamaole and Makawao systems of the Central Sector and the Lualailua and Nakula systems of the Kahikinui Sector. The characteristics of the groundwater of the Kamaole, Makawao, Lualailua, and Nakula systems are the same as those of the nearby systems and sectors. Two high-level, unconfined, perched aquifers exist one on top of the other in dike compartments. Groundwater in both the upper and lower aquifers was identified as freshwater (containing less than 250 milligrams per liter of chloride) that has the potential for future use as drinking water, but it was not being used when the aquifer was classified. The upper aquifer is classified as being replaceable and highly vulnerable to contamination, while the lower dike aquifers are classified as being irreplaceable and moderately vulnerable to contamination. There are no drinking water wells within 11 miles of the summit (AFRL 2005).

The current MSO facility at HO uses a cesspool for handling wastewater and septic waste. This could affect subsurface water quality, but plans are in place to remove the cesspool, to remediate the site, and to construct a wastewater treatment facility in accordance with appropriate permits and procedures of Maui County and the State Department of Health.

Generally speaking, cesspools do not treat wastewater, but rather remove solids and provide for anaerobic digestion of solids. The cesspool effluent is then filtered through the surrounding soil and groundwater providing for the general "treatment" of the (non-solids) wastewater. Pathogens and nutrients in potentially high concentrations (particularly nitrogen and phosphorous) are typically released from such systems, possibly degrading subsurface water quality and resulting in minor, adverse, and long-term impacts on groundwater within a discrete distance of the cesspool. Given the distance of approximately 11 miles to the nearest drinking water well, it is unlikely that continued operation of the cesspool would have an adverse affect on drinking water. If cesspool contaminants reach perched groundwater several thousand feet below HO, which then flows to surface water, then some adverse affects from cesspool operation could occur to human or ecological exposures to the surface water. Any dissolved recalcitrant contaminants (e.g. metals) discharged to the cesspool would be expected to migrate further from the cesspool, and/or remain present longer than less recalcitrant contaminants. Organic and inorganic solids would continue to accumulate in the cesspool, requiring ongoing periodic removal and off-site disposal.

2.7 INFRASTRUCTURE AND UTILITIES

2.7.1 Introduction/Region of Influence

The ROI for infrastructure and utilities is the stormwater and drainage system, domestic wastewater, electrical system, communication system, and roadway and traffic within HO.

2.7.2 Resources Overview

Stormwater and Drainage System

On the slopes of Haleakalā, virtually all precipitation will infiltrate the soil profile. Once in the soil, gravity continues to force the water downward. When the water hits a less permeable layer, such as basalt, it will flow in the path of least resistance. At HO, this confining layer of basalt ranges from depths of five to over twenty feet. The significance of a confining layer of basalt near the summit is that all precipitation falling near the summit is infiltrated and flows subsurface toward the natural drainage courses, such as Manawainui Gulch. As a result, runoff from the impervious surfaces associated with HO facilities and nearby roads may not increase the total volume of stormwater flow entering natural drainages, but it may only affect the way it is transported there (UH IfA 2005a).

Domestic Wastewater

Septic tanks are the primary means of sewage disposal within HO. There is no central waste/sewage collection or storage system at the Haleakalā summit. Each user provides for the collection and proper storage of wastewater and sewage generated by that site.

Electrical Systems

Maui Electric Co., Inc. (MECO) generates electricity for HO. The 3750/4688 kilovolt-ampere (kVA) transformer at the Kula substation serves HO. The site is connected via 23-kV conductors on power lines to a 450-kVA transformer bank and voltage regulators at a substation within HO and is distributed from there. The reserve capacity in the existing MECO substation at HO is estimated by MECO engineers to be approximately 1900 kVA;

which is adequate for the existing connected loads. MECO is planning to upgrade the HO substation, which would provide sufficient power for potential future power demands.

Communications Systems

Hawaiian Telcom provides telephone and other communications services for the HO complex. HO is currently served by a range of copper and fiber-optics. The U. S. Air Force facilities are served by a dedicated fiber cable with OC3C capacity. The IfA facilities are served by link with fiber cables with OC3C and Gigabit capacity. Hawaiian Telecom provides commercially available copper and fiber-optic lines to HO with more than 100 percent reserve capacity.

The FAA operates and maintains 50-watt transmitter and receiving equipment for remote air/ground interisland and trans-Pacific communications to and from aircraft. The antennas for these transmitters/receivers are located on two towers within the FAA property adjacent to HO. The frequencies for transmission and receiving are in the Very High Frequency (VHF) and Ultra-High Frequency (UHF) radio bands, to and from transiting aircraft at altitudes from 8,000 to 50,000 feet.

Roadways and Traffic

The Haleakalā Crater Road (State Route 378) is the only route to the summit of Haleakalā. Various route options to the summit intersect in the Kula community, from which a single, two-lane county- and State-maintained road ascends to the HALE entrance station and continues as a two-lane thoroughfare to the park boundary next to HO. This road is the only access to and exit from HO and is owned and maintained by HALE.

There are two other access roads that serve the Haleakalā summit. The FAA maintains a non-exclusive access road to facilities in the Saddle Area and the FAA Low Site. There is also an unimproved access road known as Skyline Drive, which originates at the Saddle Area and traverses the Southwest Rift zone, ultimately leading to the Spring State Recreation Area (also known as Polipoli State Park) (DLNR 2008). Its entire length is on State land within the fog belt of the Kula Forest Reserve. Approximately half of it is in the limited subzone of the State Conservation District and the other half is in the resource subzone. A locked gate near the Saddle Area restricts vehicle access to the road from the Haleakalā summit to those holding DLNR permits. Hikers, hunters, and bicyclists use the unpaved road. The slopes along the road range from flat to 28 percent. The surface area consists of small lava cinder rock from which the small particulate resulting from weathering over time has been washed to a level approximately three feet below the surface (UH IfA 2001). Due to the steep grades, tight turns, and soft roadbeds of this access road, it is not appropriate for the range of vehicles necessary for construction, maintenance, and operation of HO facilities.

The current daily operational workforce level at HO averages from 60 to 80 individuals, including technicians and science team members and facilities staff (UH IfA 2005). As shown in Table 2-4, a 2003 traffic study included in the LRDP showed an average daily total traffic volume of 48 vehicles entering and leaving HO.

The State of Hawaiʻi Department of Transportation (DOT) conducted a 24-hour traffic survey on September 19 and 20, 2007 (DOT 2007) at the intersection of Haleakalā Crater Road, Haleakalā Highway, and Kekaulike Avenue. DOT also counted individual vehicles traveling on Haleakalā Crater Road. On September 19, 2007, the traffic volume in a 24-hour period totaled 1,562 vehicles (796 entering the region and 766 exiting). On February 20, 2009, the 24-hour traffic volume totaled 1,439 (734 entering and 705 exiting) (DOT 2007). These counts are relatively consistent with a previous traffic study in 2003, which recorded a total two-way 24-hour traffic volume of 1,616 at the same location (DOT 2003).

Visitors to HALE generate most of the vehicle traffic on Haleakalā Crater Road, with the highest traffic volumes occurring in the early morning, when visitors experience the sunrise. The high elevations, combined with relatively steep grades and numerous switchback curves on the road, limit vehicle speeds, particularly trucks and tour buses.

Table 2-4
HO Traffic Study Summary

Date	Day	Vehicles In	Vehicles Out	AM Peak In	PM Peak In	AM Peak Out	PM Peak Out	Total Vehicles
24-Oct	Fri	55	55	12	7	5	10	110
25-Oct	Sat	32	24	4	7	3	5	56
26-Oct	Sun	23	25	3	3	4	5	48
27-Oct	Mon	52	50	12	5	4	19	102
28-Oct	Tues	60	66	13	4	4	25	126
29-Oct	Weds	82	63	13	11	4	24	145
30-Oct	Thurs	67	74	14	5	3	25	141
31-Oct	Fri	47	44	6	4	4	9	91
1-Nov	Sat	24	25	6	5	5	4	49
2-Nov	Sun	23	22	3	4	2	4	45
3-Nov	Mon	57	61	14	4	4	22	118
4-Nov	Tues	68	61	14	7	3	23	129
5-Nov	Weds	62	67	13	8	2	21	129
6-Nov	Thurs	84	78	12	5	4	26	162
7-Nov	Fri	47	49	7	4	3	11	96
8-Nov	Sat	17	19	3	4	3	4	36
9-Nov	Sun	17	16	3	4	2	3	33
10-Nov	Mon	55	56	10	4	4	19	111
Total Traffic		**872**	**855**					**1727**
Daily Average		**48.4**	**47.5**	**9.0**	**5.3**	**3.5**	**14.4**	**95.9**

(Source: UH IfA 2005)

2.8 CLIMATOLOGY AND AIR QUALITY

2.8.1 Introduction/Region of Influence

HO is the ROI for determining the affected environment for climatology and air quality.

2.8.2 Resources Overview

Climatology

Maui County is composed of four islands: Maui, Molokai, Lana'i and Kaho'olawe. Maui stands out among the other islands in the county as having the tallest summits and thus the most extreme climate variations. The elevation at the summit of Haleakalā is 10,023 feet ASL and at times experiences snow and hail. In contrast to the beach areas, the summit of Haleakalā can become quite cold at times, with temperatures that can be below freezing. Rainfall on Maui usually is heaviest in the mountain areas, while the beaches and coasts are the driest. Rainfall on Haleakalā peaks in a band at elevations between 3,000 and 5,000 feet ASL, where the moisture-laden trade winds are cooled as they rise against the mountain front and are held below 5,000 feet ASL by a temperature inversion that acts as a climatological boundary. At higher elevations, the air can be much drier, resulting in average rainfall of from less than 15 inches to as much as 60 inches a year.

The precipitation levels of Maui County are on the whole somewhat low, occasionally resulting in mild droughts in some areas during the summer (Yuen and Associates 1990). The annual average total precipitation on Haleakalā summit between 1949 and 2005 was 52.92 inches (WRCC 2005). Rainfall in the microclimate area on the western slope of Haleakalā is usually from frontal systems or storms and is about 29.5 inches a year or less. This microclimate is characterized by the temperature inversion. Rainfall above the inversion is predominantly from storms or frontal systems (Scholl, et al. 2002).

The lowest 7-year monthly average temperature at the MSSC between 1985 and 1991 was 42 degrees Fahrenheit and the highest 7-year monthly average temperature was 50 degrees Fahrenheit. Temperature lows usually occur in December, January, and February; highs usually occur in August. During the winter months, sub-freezing temperatures and frost are common at higher elevations with occasional sub-zero temperatures recorded. Between December and February the summit area occasionally experiences snow, hail and sleet.

Maui experiences predominantly northeasterly trade winds spurred by high-pressure anticyclones and ridges that occur several hundred miles to the north and northeast of the island. These trade winds are most persistent from March to November. Conversely, southwesterly (Kona) winds occasionally occur in the winter, usually accompanied by clear weather ahead of frontal storms. However, wind speeds at the summit can be extreme; the greatest wind speed recorded at the summit is over 125 miles per hour (mph). Gusts exceeding 60 mph are common throughout the year, as are sustained winds of 50 mph. Winter storm systems from the North Pacific have been known to bring the strongest winds through the island chain.

Air Quality

All areas in Hawai'i are considered to comply with Federal and State ambient air quality standards; no areas of Hawai'i are classified as non-attainment or maintenance areas. Therefore, all of Maui, including Haleakalā, is an attainment area for the US Environmental Protection Agency (EPA) "criteria" pollutants: sulfur dioxide, nitrogen oxides, carbon monoxide, ozone, lead, and certain particulate matter. Furthermore, Haleakalā is categorized as a Class 1 area under the Clean Air Act's (CAA) Prevention of Significant Deterioration Program, a category the EPA reserves for the most pristine areas of the country in order to maintain the excellent level of air quality already attained. HALE has a long-term visibility-monitoring agenda in effect under this program to ensure the region's continued Class 1 attainment (HALE 2005a).

The relatively limited commercial or industrial development in Haleakalā results in few local man-made emission sources with the potential to affect air quality. However, since the natural substrate at the project site is a mixture of fine volcanic sand and cinders, a small amount of naturally occurring fugitive dust from the finer material is released when the substrate is disturbed. The primary sources of man-made pollutant emissions at HO are the intermittent activities associated with research facility operations. These include low-impact mobile emission sources, such as light vehicle traffic to and from the summit, as well as stationary source emissions resulting from periodic testing of diesel-fueled emergency generators. General maintenance activities at HO likewise result in temporary and low-impact emissions. For example, mirrors at observatories are periodically recoated and this produces short-duration air emissions well below those requiring a State permit.

Another contributing factor to the excellent air quality at the summit of Haleakalā is the favorable meteorological conditions, including a temperature inversion layer that rings the mountain at an elevation of approximately 5,000 to 7,000 feet ASL (HALE 2005b). This inversion layer stabilizes the atmosphere above the basin and limits airborne pollutants from rising to the summit, including that of the largest source of air pollution in the area, Kilauea Volcano on the island of Hawai'i (HALE 2005a). Additionally, prevailing trade winds from the northeast are persistently gusty at HO, which accelerates dispersion of any locally generated air emissions. Ambient winds of 20 to 50 miles per hour are commonly reported at the summit, creating turbulence and accelerating the atmospheric dispersion.

2.9 PUBLIC HEALTH AND SAFETY

2.9.1 Introduction/Region of Influence

HO is the ROI for determining the affected environment for public health and safety.

2.9.2 Resources Overview

Hazardous Materials

Hazardous waste, as defined by the EPA, Title 40 of the Code of Federal Regulations (CFR), Chapter 1, Subchapter I-Solid Wastes, Part 261-299, refers to substances that have "imminent and substantial danger to public health and welfare or the environment."

Contaminated sites are areas of soil or water where hazardous substances occur at concentrations above background levels and where assessment shows it poses, or is likely to pose, an immediate or long-term hazard to human health or the environment.

Guidance on hazardous materials (HAZMAT) at HO that cover the entire HO property is provided via management plans from IfA (UH Manoa 2002; UH IfA 2005b) and the AFRL (Boeing 2005), which are required by several Federal and DoD regulations. Table 2-5 lists these plans, an overview of their guidance, and the regulations under which they are required. Implementing these plans ensures that EPA requirements for hazardous waste management and spill contingency are fulfilled at HO.

Hazardous waste and petroleum product wastes from operations at the MSSC are segregated at their generation points (e.g., utility building or laboratory) and are handled separately. Other facilities at HO have varying amounts and types of HAZMAT on-site and would be considered small quantity generators (SQGs) or contain no HAZMAT at their facility. The MSO facility, the FTF, the Pan-STARRS, the Zodiacal Light Observatory, and the Airglow Facility do not have HAZMAT on-site and are not considered SQGs.

Hazardous waste at MSSC is managed in the 270-day hazardous waste storage unit, and the average storage time in fiscal year 2004 ranged from 42 to 153 days. A waste disposal contractor transports and disposes of hazardous waste two to three times per year. Hazardous wastes are sampled and analyzed by the waste disposal contractor prior to off-site disposal. MSSC is a SQG, which means that it generates between 220 and 2,205 pounds of hazardous waste per month (AFRL 2005). The amount of Resource Conservation and Recovery Act (RCRA)-regulated wastes generated at MSSC for FY 2004 was 684 pounds and included such materials as waste aerosols, gel-cell batteries, combustible liquid materials, chemicals, paint, and mercury, among others. Hawai‘i does not have a hazardous waste disposal facility; therefore, hazardous waste is shipped to the continental United States for proper disposal.

Spill prevention at MSSC is guided by the February 2003, Spill Prevention Control and Countermeasure Plan for MSSC, prepared by Rocketdyne Technical Services, a Boeing Company (Rocketdyne 2003). This plan outlines procedures for carrying out response actions for releases of hazardous materials into the air, soil, or water that pose a threat to human health or the environment.

Table 2-5
Hazardous Materials Management Plans at HO

Category	Plan Title	Description	Required by
Hazardous Waste	Hazardous Waste Management Plan	Plan should contain information on emergency contacts, hazardous waste inventory and location, and waste management procedures and must include a waste analysis plan.	UH Hazardous Materials Management Program, Oct. 2002 and Air Force Instruction (AFI) 32-7042.
	Contingency Plan	The plan should set forth the procedures for conducting response actions in case of hazardous waste releases into the air, soil, or water that pose a threat to the environment.	Title 40 CFR Part 265, Subpart and UH IfA Hazardous Material and Hazardous Waste Management Program, Rev. Dec. 1, 2005.
Hazardous Materials	Hazardous Material Emergency Planning and Response Plan	Provides guidance on handling known and unknown hazardous materials. The plan must integrate the various emergency action, response, and contingency plans for releases into the environment.	AFI 32-4002
	Halon Management Plan	Also referred to as the Halon 1301 Management Plan. The plan must provide an inventory of Halon 1301 systems and an implementation schedule for removal or replacement.	AFI 32-7086
	Refrigerant Management Plan	Also known as Class I ODS (ozone-depleting substance) Refrigerant Management Plan. This plan should include information on leaking equipment, a retrofit schedule, and set forth procedures for recovery of ODSs.	AFI 32-7086

Boeing 2004, 2005, 2005a; UH IfA 2005b; and UH Manoa 2002

The UH Hazardous Material Management Program, dated October 2002, governs the handling of hazardous materials for HO. The management plan complies with applicable Federal, State, and local regulations that govern the use of hazardous materials and the disposal of hazardous wastes. The handling of hazardous materials emergencies at MSSC is directed by the Hazardous Material Emergency Response Plan for the MSSC, which was most recently revised in June 2004 by The Boeing Company, which has the prime responsibility for spill response (Boeing 2005). The HazMat Plan identifies emergency contacts, an emergency action plan, organizational roles and responsibilities, site-specific contingency plans, information on hazards analysis, response functions, public information and community relations, as well as information on containment and cleanup.

Spills or Releases

There has been only one recorded material spill incident within HO. On September 11, 1999, a subcontractor working at MSSC released 330 gallons of a 20 percent mixture of propylene glycol and water into the cinders and rock. (NOTE: The Food and Drug Administration (FDA) has determined propylene glycol to be "generally recognized as safe" for use in food, cosmetics, and medicines.) All required notifications were made to the appropriate agencies and personnel. A containment trench and a plastic covering were installed immediately. The Environmental Protection Agency (EPA) was not contacted because the material was not a hazardous waste and not federally regulated.

The site was cleaned up on Saturday, September 18, 1999. A trench was dug around the contaminated area and covered with plastic sheeting. Photographs were taken and samples were collected and prepared for shipment to a certified lab in Honolulu. Soils were excavated to a depth of three feet along an area where a concrete slab acted as a dam, and to six inches in the remaining contaminated areas. The excavated soil was placed in containers and covered with plastic sheeting. A "no further action" letter was received from the State of Hawai'i, Hazard Evaluation and Emergency Response Office on September 27, 1999 (Ueshiro 1999), and the site does not pose any risk to human health or the environment. There have been no spills or releases at any of the other facilities on HO (Shimko 2005).

Solid Waste

Solid waste, as defined under Section 1004(27) of the RCRA, refers to any solid, semisolid, liquid, or contained gaseous materials discarded from industrial, commercial, mining, or agricultural operations, and from community activities.

Because of the remote location of HO, each facility must be diligent when handling or managing waste. Each facility within the HO complex has its own trash receptacle and each facility's building maintenance personnel are responsible for trash collection. Non-hazardous trash is disposed of off-site in a licensed landfill, with computer paper and aluminum being recycled (UH IfA 2001). IfA picks up approximately four to five bags of solid waste once a week from the MSO facility and other facilities at HO under their jurisdiction (i.e., the Atmospheric Airglow facility, the Zodiacal Observatory, and the FTF). Municipal solid waste from MSSC, such as food trash, is collected twice a week for off-site disposal at the Central Maui Landfill. Other wastes associated with MSSC operations and maintenance, such as used oil, are collected in containers within the Advanced Electro-Optical System (AEOS) facility and transported off-site for disposal as non-hazardous waste. MSSC generated 3,335 pounds of non-hazardous waste in fiscal year 2004 (Shimko 2004).

Maui County owns and operates two municipal solid waste landfills on Maui: the Central Maui Sanitary Landfill and the Hana Sanitary Landfill. The Central Maui Landfill recently opened a new section, referred to as Phase 4, which accepts approximately 450 tons per day and is expected to reach capacity in 2012. The Hana Sanitary Landfill accepts approximately three tons per day and is expected to reach capacity in 2055 (Baker 2005). Commercial construction and demolition debris is banned from the County landfills on Maui. The private Maui Demolition and Construction Landfill in Ma'alaea receives this type of debris from commercial haulers for disposal. (County of Maui 2008a)

Noise

Noise is defined as unwanted sound. Airborne sound is a rapid fluctuation of air pressure above and below atmospheric pressure. There are several ways to measure noise, depending on the source of the noise, the receiver, and the reason for the noise measurement. Hawai'i has adopted statewide noise standards that apply to fixed stationary noise sources and equipment related to agricultural, construction, and industrial activities. HO is zoned as a Class A district under these statewide community noise regulations in accordance with the State of Hawai'i HAR 11-46-4. Class A zoning districts include "all areas equivalent to lands zoned residential, conservation, preservation, public spaces, open space or similar type," and are the most restrictive of maximum allowable ambient noise levels. The "A-weighted" decibel scale (dBA) is used in statewide standards because it best approximates the way the human ear responds to noise levels. Maximum permissible daytime sound levels in Class A zones under HAR 11-46-4 are 55 dBA for non-impulsive noise and 65 dBA for impulsive noise. These noise limits are defined as levels that can be exceeded no more than 10 percent of the time in any 20-minute period, or L10.

Existing noise conditions at the summit of Haleakalā vary, depending on location, wind conditions, and the nature of nearby noise sources. Previous sound level measurements conducted at HO indicated truck traffic as the primary mobile noise sources, while HVAC units including chillers and exhaust fans are the loudest stationary noise sources. Moderate wind speeds at the summit had instantaneous noise levels measured in the range of 45 to 50 dBA, backup generators had noise levels averaging 73 to 84 dBA at a distance of 50 feet, while construction-related vehicles (general) were recorded at 82 to 93 dBA, also at a distance of 50 feet (AFRL 2005). Natural sound levels, in the Crater area, absent wind or other ambient sources, are typically 10 dBA (NPS 2009).

There are no permanent noise-sensitive human receptors at HO, such as residences, schools, hospitals, or other similar land uses where people generally expect and need a quiet environment. Native Hawaiians, however, practice traditional and cultural practices at various locations on Haleakalā including anywhere within the ROI. HO is not open to the public, with the exception of Native Hawaiians participating in cultural and traditional practices. Although multiple observatories and research facilities are stationed at HO, the majority of personnel at these operations work indoors in structurally insulated facilities with negligible outdoor occupational tasks. The public areas closest to HO are the Puʻu ʻUlaʻula Overlook in HALE, which is approximately a quarter-mile away and the Haleakalā Summit Visitor Center, which is approximately a half-mile away.

2.10 SOCIOECONOMICS

2.10.1 Introduction/Region of Influence

This is a discussion of the economy and the sociological environment of the ROI, which is the HO and greater Maui. Socioeconomic indicators used for this study are population and housing, employment, economy, and income, and education.

2.10.2 Resources Overview

The baseline year for socioeconomic data is 2006, the most recent year for which U.S. Census Bureau data are available for most of the socioeconomic indicators. When available, more recent data are used to best characterize the current socioeconomic conditions.

Resident Population and Housing

The population Maui County roughly doubled between 1980 (71,600 persons) and 2006 (139,995 persons) (County of Maui 2006; DBEDT 2007). While the increase in population in the State of Hawai'i was approximately 29.2 percent, between 1980 and 2006, the population increase for Maui County was approximately 97.5 percent.

The County of Maui has experienced significant growth over the 26 years between 1980 and 2006, and the trend is projected to continue. The resident population for the island of Maui is expected to grow from 129,471 persons in 2005 to 186,254 persons in 2030. This is a 1.68 percent annual growth rate, for a total of approximately 42 percent increase in population over the 25 year period (County of Maui 2008b).

Housing value in Maui County had increased 111.96 percent from 2000 to 2006 when the median housing value was $529,700. Housing on Maui made up 94 percent of the total housing units of Maui County in 2000. Total housing units in Maui County increased by 12.8 percent from 2000 to 2006. For 2000, the rate of owner-occupied units on Maui and in Maui County was the same, at 44 percent. For 2006, the rate of owner-occupied units for Maui County was similar to that of the State of Hawai'i, at approximately 59 percent. Vacancy rate in 2006 was at 25.3 percent for Maui County and 13.5 percent for the State of Hawai'i.

Employment, Economy, and Income

As the most recent Bureau of Economic Analysis (BEA) available data indicates, the major increase in personal income in Maui County, between 2005 and 2007, came from the construction (33.39 percent), wholesale trade at (22.68 percent), and farming (20.10 percent) sectors. In the State of Hawai'i, between 2005 and 2007, the major increase in personal income came from construction (19.27 percent), Government, Government Enterprise (15.59 percent), and Accommodation and Food Service (13.73 percent) (BEA 2007).

As of June 2009, Maui County experienced sharp increases in the number of unemployed people, pushing the 2009 unemployment rate to 8.1 percent. One year earlier, Maui County recorded a 3.2 percent unemployment rate. The upward changes from a year ago in Maui County saw the local government sector had the largest gain of 150 jobs (6.1 percent), followed by Educational Services with a gain of 50 jobs (4.8 percent). Economic downturns from a year ago show the Natural Resources, Mining and Construction sector lost 800 jobs, the Transportation, Warehousing, and Utility sector lost 500 jobs (-13.7 percent), and the Agriculture (farming) sector lost 200 jobs (-11.4 percent) (DBEDT 2009).

The State of Hawai'i, as a whole, had a higher per capita personal income than Maui County between 2001 and 2005. For 2005, the per capita personal income of Hawai'i ($34,890) exceeded that of Maui County ($31,156) by $3,333 (10.7 percent). For 2001, the per capita personal income for Hawai'i ($28,759) exceeded that of Maui County ($25,398) by $3,361 (13.2 percent). Maui County experienced a higher growth in per capita personal income between 2001 and 2005, with a 15.7 percent increase, compared to 13.6 percent increase for the State (BEA 2007).

Education

Based on the most current official data available, Maui District has a total of 53 schools, with 32 public and 21 private schools. The number of teachers in public schools for the school year 2004 to 2005 was 1,296, with an enrollment of 20,888 students. The number of high school enrollment in public schools for 2004 to 2005 was 6,164 students. The total number of degrees earned from Maui Community College (MCC) in 2005 was 899, including 561 associate degrees and 338 certificates of achievement. During fall 2005, there were 1,163 full-time students and 1,740 part-time students enrolled in MCC. The UH had a total of 56 distance-learning courses in 2005 (County of Maui 2006).

The anticipated scientific plan for HO facilities for the next decade is to ensure unobtrusive scientific access and to increase high-level skilled jobs and local educational benefits for both Maui and the international scientific communities. These are the sectors that are assumed to contribute to the local educational and economic environment in a truly meaningful way. The world's largest telescope devoted to global astrophysical education would be accessed electronically from around the world and would be partly controlled from Maui using the FTF. Also, the potential astronomical plans would enable visiting scientists to conduct experiments at the AEOS facility at HO (UH IfA 2005).

Faulkes Telescope Facility

The FTF within HO provides observations for students in Hawai'i and the UK. Students in secondary schools and undergraduate institutions use the data for research projects mentored by professional astronomers. When the primary clients of the telescope are unavailable, such as during school vacations and summers, observing time is made available to other serious amateur astronomers and educational users, such as the Bishop Museum (UH IfA 2001).

Teaching the basics of research is the primary goal of the FTF. The research undertaken by the students is published in scientific literature. Data from the FTF is archived and made available to the public for research and education. A collection of the spectacular images that help make astronomy a subject that has wide appeal is made available to schools and publishers.

Current plans for the FTF include students from MCC participating in the project, which ranges from controlling the telescope to assisting with telescope maintenance to analyzing observations.

University of Hawai'i Space Grant Program

The UH Space Grant Program has previously sponsored students at MCC in astronomy-related projects. Additionally, future projects for Space Grant students associated with HO are being considered. IfA and MCC are also pursuing opportunities to develop training internships at HO.

IfA also supports amateur astronomers and accommodates visitation requests to HO from public and private schools; however, no public tours are offered.

Towards Other Planetary Systems

HO was a key participant in the Towards Other Planetary Systems (TOPS) program, a five-year NSF-sponsored teacher enhancement program. Teachers learned basic astronomy content and began integrating State and national science/astronomy standards into their classrooms. In addition, a privately funded student component of the program was available to local high school students with interest in astronomy. The program gives students an opportunity to learn astronomy, to engage in hands-on activities, and to get an idea of what careers in astronomy and related sciences have to offer (UH IfA 2005).

Center for Adaptive Optics

The Center for Adaptive Optics (CfAO), a National Science Foundation Science and Technology Center headquartered at the University of California Santa Cruz, MCC, and the Maui Economic Development Board, Inc. (MEDB) began a partnership in 2002, which has now matured into a successful set of programs, with three major components: the Akamai Internship Program, the Professional Development Workshop and Teaching Fellowships, and an education/industry collaborative.

The partnership includes a range of academic, industry, and government partners, extending to the islands of Hawaiʻi, Kauaʻi, and Oʻahu. Current and past participating Maui partners are the US Air Force Maui Optical and Supercomputing Site, IfA, Oceanit, Trex Enterprises, Inc., Textron Systems, Akimeka, LLC, the Maui High Performance Computing Center, Maui Scientific Research Center, Boeing LTS, Northrop Grumman Corp., the Pacific Disaster Center, and the County of Maui. The goals of this partnership are as follows:

- Advance local students, particularly Native Hawaiians and women, into the Maui technical and scientific workforce to immediately impact the workforce;
- Develop courses and programs to prepare students for the local workforce by involving the scientific and technical community in teaching and mentoring; and
- Develop courses and programs that promote equity in science and technology, integrate awareness and respect of host culture, and open opportunities for students from underrepresented groups, particularly Native Hawaiians.

Akamai Internship Program: Advancing students from underrepresented groups

The CfAO Akamai Internship Program is designed for all community college and university undergraduates in Hawaiʻi and for kamaʻāina (local residents of the State of Hawaiʻi) studying on the mainland, who are interested in pursuing a career in science, technology, engineering, or math and who have had to overcome barriers to achieve their educational or career goals. All students must be US citizens or permanent residents and must be at least 18 years old. The CfAO is committed to increasing diversity in the sciences. Underrepresented groups (African Americans, Native Americans, Hispanics, Pacific Islanders, women, and persons with disabilities) are strongly encouraged to apply. Each student is matched with a research advisor and is integrated as a member of the advisor's research group with daily guidance by a research supervisor. Integrated into the program is a communication curriculum, which was expanded in 2006 to include the integration of Hawaiian cultural components, with consultation from Kahu Charles K. Maxwell, Sr.

The Maui program is a collaboration between the CfAO, IfA, MEDB, MCC, UH, and local Maui industries. It is an intensive eight-week introduction to research method and tools, with an emphasis on adaptive optics science. The program provides opportunities at various sites over the summer, with additional activities that will provide support and opportunities during the academic year. The interns start with a five-day short course in general optical principles and adaptive optics taught at MCC. On completing the internship program, participants will be better prepared to pursue their educational and research career goals.

Working with the MEDB Women in Technology Project, the Akamai Internship Program has a strong focus on increasing the participation of women and under-represented minorities (URM), such as Native Hawaiians. In 2006, 28 students (29 percent Native Hawaiian, 18 percent other URM, and 25 percent women) from Hawaiʻi had completed the Maui Akamai Program, with 12 working in part-time or full-time technical positions in Hawaiʻi, and an additional 14 enrolled in a science or technology degree program. The 2006 Akamai Maui interns selected included the highest participation from underrepresented groups (36 percent Native Hawaiian, 21 percent other URM, and 36 percent women).

Professional Development Workshop and Teaching Fellowships: Designing Curriculum to Promote Equity and Diversity in Science and Technology

The Professional Development Workshop (PDW) brings graduate students and post-doctorates from CfAO's mainland sites together with community college faculty members and observatory personnel from Hawaiʻi for an intensive five-day training on inquiry-based teaching methods. A major part of the workshop includes an opportunity for workshop participants to work in teams on their own teaching activities for CfAO educational programs, all of which are aimed at increasing participation of underrepresented groups.

All workshop participants sign on as "teaching fellows" in exchange for a fully funded workshop experience. The teaching fellows receive ongoing consultation after the PDW as they work on course design and a practical teaching experience. The PDW in combination with teaching fellowships is the engine behind the extremely productive teaching teams that staff CfAO short courses, internships, and high school programs. It also trains people for teaching assistants for community colleges.

Each year approximately 40 instructors teach in these courses and programs, and to date more than 30 new inquiry-based laboratory units and seven new courses have been developed. All courses and programs emphasize teaching strategies that engage all students and focus on achieving cultural and gender equity. Approximately one-third of all PDW participants teach in Hawaiʻi-based programs and courses; however, in the coming years the focus will change to create a PDW that specifically focuses on Hawaiʻi-based educational activities. The need for new courses, laboratory units, and other activities has grown considerably as MCC develops new degree programs that will broadly serve the Maui community and increase the participation of Native Hawaiians in the technical fields. The

PDW and teaching fellowships are ideally suited to meet this need, including the development of high school programs.

Industry/Education Collaborative

A key component to the success of the partnership comes from a strong collaboration with the technical and scientific community on Maui. Specific activities have been developed to engage this community, as well as mechanisms to obtain input on the courses and programs.

Activities include the Akamai Selection and Advisory Committee, the ARPA Maui Optical Station (AMOS) Technical Conference Student Session, the annual Maui Science and Technology Education Exchange (MSTEE), and a range of meetings throughout the year. For example, the 2006 MSTEE event included a working session where internship employers and direct supervisors worked with community partners and CfAO members to define internship projects, to identify knowledge and skills necessary for a successful internship experience, and to make recommendations for short-course topics.

The Akamai Internship Program has become a point of intersection between the technical and educational community. In 2005, more than 50 individuals from Maui's technical community contributed time to the Akamai Program. The collaborative has matured from years of experience, has clearly articulated shared goals and community-based leadership, and is now positioned with the necessary ingredients to sustain and expand the Maui-based initiatives.

2.11 NATURAL HAZARDS

2.11.1 Introduction/Region of Influence

HO is the ROI for natural hazards on State of Hawai'i land within the Conservation District on Pu'u Kolekole, near the summit of Haleakalā. HO is restricted to only a small number of employees of the various facilities working any time within a 24-hour period.

2.11.2 Resources Overview

Drought

Although drought and the possibility of subsequent wildfires are a normal and a recurrent feature of climate, it can occur in virtually all-climatic zones, with its characteristics varying significantly from one region to another. Drought is a temporary aberration and differs from aridity. However, drought is restricted to low rainfall regions and is a permanent feature of climate. Although drought has many definitions, it originates from a deficiency of precipitation over an extended period of time, usually a season or more. It is also related to the timing and the effectiveness of precipitation. Other climatic factors such as high temperatures, high wind, and low relative humidity are often associated with drought and wildfires in many regions, including the Pacific basin (Pacific Disaster Center 1967). Most days, clouds ring the mountain between 5,000 and 7,000 feet ASL. They form at the temperature inversion layer where warm air coming up the mountain from the ocean is trapped by cooler air above. The prevailing trade winds from the northeast also bring clouds and moisture to Haleakalā. Clouds can envelop the summit at any time, with or without rain.

Earthquake

Table 2-6 provides an overview of the effects of earthquakes based on their relative magnitude. Hawaii's largest earthquakes, up to magnitude 7.5 to 8.1 (USGS), are associated with dike intrusions into the active volcanoes and expansion of the volcanoes across the old seafloor. Other earthquakes that are potentially damaging are caused by the load of the Hawaiian Islands on the Pacific lithosphere. Earthquake movement can sometimes be felt at the summit of Haleakalā. Since Hawaiian volcanoes are so large they are an immense burden on the lithosphere, and it sags beneath their weight (the phenomenon of isostasy). In addition to sagging, the lithosphere will "creak", resulting in earthquakes. Earthquake movement can sometimes be felt at the summit of Haleakalā.

The last such earthquake of any size was a magnitude 6.7. This earthquake took place on October 15, 2006, approximately 6 miles (10 km) southwest from Puakō, Hawaiʻi. Prior to this, there was a 6.2 Honomu event on April 26, 1973, beneath the Hamakua Coast of Hawaiʻi Island (USGS). Although this earthquake was 100 miles from Maui, it was felt on Haleakalā because of its depth. The Maui earthquake of 1938 had its epicenter north of Maui and was about a magnitude 6.5. The Lanaʻi earthquake of 1871 had a magnitude of approximately 6.8 and may have had its epicenter near Palaoa Point.

Table 2-6
Earthquake Magnitudes and Their Effects

Richter Scale (magnitude)	Earthquake Effects
2.5 or less	Usually not felt, but can be recorded by seismograph.
2.5 to 5.4	Often felt, but only causes minor damage.
5.5 to 6.0	Slight damage to buildings and other structures.
6.1 to 6.9	May cause a lot of damage in very populated areas.
7.0 to 7.9	Major earthquake. Serious damage.
8.0 or greater	Great earthquake. Can totally destroy communities near the epicenter.

MichiganTech 2004

Storms and Hurricanes

Hurricanes are classified according to their wind speed intensity. There is a direct relationship between the central pressure of a hurricane and its maximum wind speed—the lower the pressure, the stronger the winds. Hurricanes do not strike Hawaiʻi often, with most weakening before reaching the islands, or passing harmlessly westward and to the south. However, strong winds are always a potential threat from these rare storms, which can occur from June to November, with wind speeds increasing at the higher elevations, such as the summit of Haleakalā (Pacific Disaster Center website). Storms at other times of the year can result in wind speeds in excess of 100 mph at the summit, along with rainfall measured in feet rather than inches.

Temperature

The weather at the summit of Haleakalā is unpredictable, as weather changes rapidly at higher elevations. Intense sunlight, thick clouds, heavy rain, and high winds are possible daily. Temperatures commonly range between 40 and 65 degrees Fahrenheit, but can be below freezing at any time of year with the wind chill factor. Hypothermia is a medical condition in which the victims' core body temperature has dropped significantly below normal (occurring below 95 degrees Fahrenheit) and normal metabolism begins to be impaired.

Snow and Ice

A thin coating of ice, also known as black ice, forms when super cooled liquid precipitation, such as freezing rain or drizzle, falls onto exposed objects whose temperature is below or slightly above freezing. Generally, black ice is a thin sheet of clear ice, which is rather dark in appearance. This climatic condition can occur on the Haleakalā roadways, making it dangerous for motorists, because, visually, the road appears wet, rather than icy. Under black ice conditions drivers should be prepared to expect little to no traction, little to no braking capability, extremely poor directional control, and the high possibility of skids.

The winter months of November to April are generally wetter and stormier than the rest of the year. Much of the island's rain falls during these months, and strong winds are common. In December 1990, a wind indicator near the summit of Haleakalā broke at 128 miles per hour. Snow is an occasional occurrence even during this time of the year, but it has been recorded in drifts as deep as six feet. Ice and frost are much more common and can occur any time of the year. Snow conditions on Haleakalā roadways make driving hazardous for motorists.

Hypoxia

Hypoxia is a pathological condition in which the body as a whole (generalized hypoxia) or a region of the body (tissue hypoxia) is deprived of adequate oxygen supply. Hypoxia is often associated with high altitudes, where it is called altitude sickness. Also known as acute mountain sickness, it is a pathological condition that is caused by lack of adaptation to high altitudes, commonly occurring above 8,000 feet. The composition and temperature of the atmosphere at high altitudes is substantially different than at sea level due to two competing physical effects: 1) gravity, which causes the air to be as close as possible to the ground; and, 2) temperature of the air, which causes the molecules to bounce off each other and expand. These differences can affect living organisms, including humans. Symptoms of generalized hypoxia depend on its severity and speed of onset. They include headaches, fatigue, shortness of breath, nausea, unsteadiness, and sometimes even seizures and coma. Severe hypoxia induces a blue discoloration of the skin where deoxygenated blood cells lose their bright red color in favor of a dark blue/red color.

CHAPTER 3
ENVIRONMENTAL CONSEQUENCES

Introduction

This chapter is an evaluation of the potential environmental impacts of the Proposed Action and the No-Action Alternative. This analysis identifies likely effects on the environment, including short- and long-term impacts, and direct and indirect impacts. The analysis of effects on resources focuses on environmental issues in proportion to their potential effects. Detailed consideration is given to those resources that have a potential for environmental effects. Interpretation of effects in terms of their duration, intensity, and scale are provided where possible. Effects identified under the No-Action Alternative are compared against baseline conditions of each resource discussed in Chapter 2.

Chapter Organization

Impacts are all described where they would occur for each resource, including both direct and indirect impacts. Direct impacts are caused by the Proposed Action and occur at the same time and place, while indirect impacts are caused by the Proposed Action, but occur later in time or at a distance from the Proposed Action. Each section describes the method used for effects analysis and factors used to determine the significance of effects as required by HAR 343 §11-200-12, Significance Criteria, and as summarized in Table 3-1.

Hawai'i Administrative Rules (HAR) 343 §11-200-12, Significance Criteria

a) In considering the significance of potential environmental effects, agencies shall consider the sum of effects on the quality of the environment, and shall evaluate the overall and cumulative effects of an action.

b) In determining whether an action may have a significant effect on the environment, the agency shall consider every phase of a Proposed Action, the expected consequences, both primary and secondary, and the cumulative as well as the short-term and long-term effects of the action. In most instances, an action shall be determined to have a significant effect on the environment if it:

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

2. Curtails the range of beneficial uses of the environment,
3. Conflicts with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or Executive Orders,
4. Substantially affects the economic welfare, social welfare, and cultural practices of the community or State,
5. Substantially affects public health,
6. Involves substantial secondary effects, such as population changes or effects on public facilities,
7. Involves a substantial degradation of environmental quality,
8. Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions,
9. Substantially affects a rare, threatened, or endangered species, or its habitat,
10. Detrimentally affects air or water quality or ambient noise levels,
11. Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters,
12. Substantially affects scenic vistas and view planes identified in county or State plans or studies; or
13. Requires substantial energy consumption.

Effects are described where they would occur for each resource, including those that are direct, indirect, or cumulative. Direct effects would be caused by the Proposed Action, the implementation of the MP, which would involve management of current operations and any future astronomy experiments or facilities at HO, and would occur at the same time and place. Indirect effects would be caused by the Proposed Action at HO but would occur later in time or at a distance from the Proposed Action. The No-Action Alternative is evaluated under the same parameters. Cumulative impacts are the incremental impacts of the action when added to the past, present, and reasonably foreseeable future actions and are analyzed in Chapter 4.0.

Terminology

To determine whether an effect is significant, HRS 343 regulations require the consideration of context and intensity of potential effects (HRS 343, HAR §11-200-9, 12). Context normally refers to the setting, whether local or regional, and intensity refers to the severity and duration of the effect. Each resource has its own effect intensity standards, which are listed and explained in each resource section.

Impacts are described by the following levels of significance:

- Significant impact;
- Significant impact but mitigable to less than significant;

- Less than significant impact;
- No impact; or
- Beneficial impact.

There may be both adverse and beneficial impacts within a single resource category; for example, a project could result in increased wastewater (an adverse effect), while improving wastewater treatment (a beneficial effect). Where there are adverse and beneficial impacts, both are described. Mitigation is identified where it may reduce the significance of an impact.

Summary of Impacts

Table 3-1 is a summary of impacts on resources areas from the Proposed Action and the No-Action Alternative. Under the MP, less than significant impacts were identified for most resource areas. A detailed description of the impacts can be found under each resources section in Chapter 3.

Table 3-1
Summary of Potential Impacts for
the Proposed Action and the No-Action Alternative

Impact Issues	Proposed Action	No-Action
Land use and existing activities	○	○
Cultural and historic resources	⊙	⊙
Archeological resources	+	○
Biological resources	+	⊙
Topography, geology, and soils	+	⊙
Visual resources and view plane	+	○
Hydrology	+	⊙
Infrastructure and utilities	○	○
Climatology and air quality	○	○
Public health and safety	+	○
Socioeconomics	○	○
Natural hazards	+	⊙

LEGEND:

⊗ = Significant impact
+ = Beneficial impact
⊘ = Significant but mitigable to less than significant impact
N/A = Not applicable
⊙ = Less than significant impact
○ = No impact

3.1 LAND USE AND EXISTING ACTIVITIES

3.1.1 Impact Methodology

Impacts on land use were assessed based on whether the proposed implementation of the HO Management Plan is consistent with site-specific and surrounding land uses, as described in Section 2.1-Land Use and Existing Activities, above. The methods used to determine whether the Proposed Action and No-Action Alternative would have a major effect on land use and existing activities are as follows:

1. Review and evaluate MP;
2. Review and evaluate each alternative with respect to prior Conservation District Use Permits (CDUPs) granted for past and current actions, including records of past and present concerns of Office of Conservation and Coastal (OCCL), which identifies ways that proposed projects may affect land use and existing activities within State land; and,
3. Assess the compliance of the Proposed Action and No-Action Alternative with applicable Federal, State, or County regulations concerning land use.

3.1.2 Consistency of Land Use

Because HO is within the State Conservation District, the evaluation of potential impacts on land use and existing activities considered consistency of land use as defined in HAR 13-5. The criteria used to determine whether the Management Plan would have a significant impact on land use and existing activities resources are as follows:

- The placement or erection of any solid material on land if that material remains on the land more than fourteen days, or which causes a permanent change in the land area on which it occurs;
- The grading, removing, harvesting, dredging, mining, or extraction of any material or natural resource on land;
- The subdivision of land; or,
- The construction, reconstruction, demolition, or alteration of any structure, building, or facility on land.

For purposes of this section, harvesting and removing does not include taking aquatic life or wildlife that is regulated by State fishing and hunting laws, nor gathering natural resources for personal non-commercial use or pursuant to Article 12, Section 7 of the Hawaiʻi State Constitution or Section 7-1, HRS, relating to certain traditional and customary Hawaiian practices.

3.1.3 Summary of Impacts

Table 3-2 is a summary of impacts on land use and existing activities from the Proposed Action and No-Action Alternative. Under the implementation of the MP, there would be no impact on land use and existing activities because the management of HO is consistent with the goals and objectives of the State, County, HO, and community plans. No impacts are expected from the No-Action Alternative.

Table 3-2
Summary of Potential Impacts on Land Use and Existing Activities

Impact Issues	Proposed Action	No-Action
Land Use	○	○

LEGEND:
⊗ = Significant impact
⊘ = Significant but mitigable to less than significant impact
⊙ = Less than significant impact
○ = No impact
\+ = Beneficial impact
N/A = Not applicable

3.1.4 Proposed Action

There would be no changes to the identified land use and existing activities within HO because the management of HO is consistent with the goals and objectives of the State, County, HO, and community plans, as follows:

- Current HO land use and management of cultural and biological resources comply and are consistent with HRS Chapter 344, State Environmental Policy.
- HO is designated as an acceptable land use by the DLNR OCCL for the Conservation District, General Subzone.
- Development within HO is consistent with Maui County Code, Title 16-Building and Construction, Chapter 16.26-Building Code, Subsection 16.26.101.3 amended, which reads as follows:

  > *101.3 Scope.* The provisions of this code shall apply to the construction, alteration, moving, demolition, repair, and use of any building or structure within the county, except those lands within the county that are designated by the State land use commission to be within the conservation district boundaries or designated as Hawaiian Home Lands. (County of Maui Title 16)

  This exception applies to repairs, refurbishment, structure, height, and materials incumbent on construction at HO; however, the Proposed Action would comply with most of the Maui County Code for Building and Construction.

- Development within HO was consistent with Maui County's General Plan (County of Maui 1990) for growth in a manner sensitive to the protection and enhancement of cultural and historical resources. It would also be consistent with the Maui General Plan for 2030, in which the final recommendation on policy prepared by the General Plan Advisory Committee (GPAC) is to support a sustainable, culturally-sensitive astronomy industry (County of Maui 2009). Development would also support economic diversity by continuing to provide jobs in Maui's high technology industry. Development at HO would not be subject to Chapter 2.80A, of the Maui County Code, pertaining to the General Plan and the community plans.

3.1.5 No-Action Alternative

There would be no impacts on land use and existing activities under the No-Action Alternative.

3.2 CULTURAL, HISTORIC, AND ARCHEOLOGICAL RESOURCES

This section is a discussion of the potential environmental effects on cultural, historic, and archeological resources caused by the Proposed Action. The ROI for cultural, historic, and archeological resources includes the area encompassing HO.

3.2.1 Impact Methodology

The methods for assessing potential impacts on cultural resources include identifying significant cultural resources in the ROI under the Proposed Action and determining the direct and indirect impacts that may affect these resources.

Maps and other documents were examined to determine the locations of the project ROI, the cultural site areas, and buildings where impacts are anticipated during the implementation phase of the HO Management Plan. Historical and current maps and photographs, cultural resources reports, and archival records were reviewed to identify cultural resources in the ROI. Federal, State, and local inventories of historically-significant places, including the inventories of the NRHP, were reviewed for information related to prehistoric and historic (pre-Contact and post-Contact) resources considered to be NRHP-eligible.

3.2.2 Factors Considered for Impacts Analysis

The factors that determine the significance of impacts on cultural resources in a ROI are determined according to the State law and regulations that sets the standards for cultural resources protection. Specifically, Hawaiʻi Revised Statutes § 6E, Historic Preservation, for which the intent is stated in §6E-1:

The Constitution of the State of Hawaiʻi recognizes the value of conserving and developing the historic and cultural property within the State for the public good. The legislature declares that the historic and cultural heritage of the State is among its important assets and that the rapid social and economic developments of contemporary society threaten to destroy the remaining vestiges of this heritage. The legislature further declares that it is in the public interest to engage in a comprehensive program of historic preservation at all levels of government to promote the use and conservation of such property for the education, inspiration, pleasure, and enrichment of its citizens. The legislature further declares that it shall be the public policy of this State to provide leadership in preserving, restoring, and maintaining historic and cultural property, to ensure the administration of such historic and cultural property in a spirit of stewardship and trusteeship for future generations, and to conduct activities, plans, and programs in a manner consistent with the preservation and enhancement of historic and cultural property.

All projects, including the implementation of the HO Management Plan are subject to HRS §6E-8 Review of effect of proposed State projects: (a) Before any agency or officer of the State or its political subdivisions commences any project which may affect historic property, aviation artifact, or a burial site, the agency or officer shall advise the department and allow the department an opportunity for review of the effect of the proposed project on historic properties, aviation artifacts, or burial sites, consistent with section 6E-43, especially those listed on the Hawai'i register of historic places. The proposed project shall not be commenced, or in the event it has already begun, continued, until the department shall have given its written concurrence.

In connection with individual projects and for the LRDP, IfA has consulted with Native Hawaiian Cultural Specialists, archeologists and the SHPD with regard to protection of HO cultural resources and preservation and recovery planning for historic resources within HO. Those consultations and the cultural and historic protection measures outlined in the LRDP are the basis for the procedures and practices for protection of those resources described in the MP for HO. The potential impacts from these measures are evaluated with respect to compliance with HRS §6E.

In addition, since certain projects that would be developed at HO, and which would be subject to the requirements of the MP would also be subject to Section 106 requirements of the NHPA, Federal agencies planning projects at HO would need to consider the possible effects of their actions on NRHP-eligible properties within their boundaries. Eligible properties include, in addition to archeological and other cultural sites, properties considered significant for their importance to Native Hawaiian groups. Section 106 and its implementing regulations state that an undertaking has an effect on a historic property (an NRHP-eligible resource) when that undertaking may alter those characteristics of the property that qualify it for inclusion on the NRHP. An undertaking is considered to have an adverse effect on a historic property when it diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects include the following:

- Physical destruction, damage, or alteration of all or part of the property;
- Isolation of the property or alteration of the character of the property's setting when that character contributes to the property's qualifications for listing on the NRHP;
- Introduction of visual, audible, or atmospheric elements that are out of character with the property or changes that may alter its setting;
- Neglect of a property, resulting in its deterioration or destruction; and,
- Transfer, lease, or sale of a property without adequate provisions to protect its historic integrity.

Native Hawaiian sites, including sacred sites, burials, and cultural items, whether or not they are considered NRHP-eligible, may also be protected under the American Indian Religious Freedom Act, Archaeological Resources Protection Act, or Native American Graves Protection and Repatriation Act. Factors considered in determining whether an action would have a significant impact on cultural resources include the extent or degree to which its implementation would result in the following:

- An adverse effect on a historic property or TCP, as defined under Section 106 of the NHPA; or
- A violation of the provisions of American Indian Religious Freedom Act, Archaeological Resources Protection Act, or Native American Graves Protection and Repatriation Act.

Public concerns are also considered as part of impact analysis. For example, based on the information gathered during preparation of the SCIA during the recent EIS process for the proposed ATST Project, there was overwhelming evidence, from a cultural and traditional standpoint, that construction of a large, visible structure at HO would result in a significant impact on some Native Hawaiian traditional cultural practices and beliefs. As Haleakalā plays a central role in the history and culture of Maui Kanaka Maoli, the SCIA found that it is imperative that there be open lines of communication and that efforts be made to hear, understand, and respect the cultural concerns and beliefs of the community during the course of project planning and construction, as well as throughout the operational time span of the facility itself.

The IfA has prepared the MP such that it provides detailed guidance and requires specific training to continue open communications with Kanaka Maoli and focuses on respect for cultural practices and beliefs, so that the cultural needs of Maui Kanaka Maoli are addressed. Some will continue to believe that any man-made structure or activities on Haleakalā would have adverse impacts on the sacredness of the summit area. The MP is intended to reduce such impacts wherever possible. However, it is acknowledged that for some, the implementation of any action, including implementation of the MP, would result in an outcome that would continue to desecrate the summit area. Those feelings are acknowledged in the summary of impacts and the discussion below.

3.2.3 Summary of Impacts

Table 3-3 is a summary of impacts on cultural resources from the Proposed Action and No-Action Alternative. Under the implementation of the MP, less than significant impacts can be expected for cultural resources and historic buildings and structures. No impacts are expected for archeological resources. Impacts from the No-Action Alternative are similar to impacts expected from the Proposed Action.

Table 3-3
Summary of Potential Impacts on Cultural Resources

Impact Issues	Proposed Action	No-Action
Cultural Resources	⊙	⊙
Historic (significant) buildings/structures	○	○
Archeological resources	+	○

LEGEND:
⊗= Significant impact
⃠= Significant but mitigable to less than significant impact
⊙= Less than significant impact
○= No impact
+ = Beneficial impact
N/A = Not applicable

3.2.4 Proposed Action

Cultural Resources

Section 2.2-Cultural, Historic, and Archeological Resources, outlines a variety of traditional cultural practices that have taken place and continue to take place within the ROI. As part of their cultural heritage, Native Hawaiians believe that Haleakalā is a sacred mountain: a wahi pana, or "legendary place," and wao akua, a "place for the gods and spirits." Presently, there are Native Hawaiians and non-Native Hawaiians who go to the summit of Haleakalā for solitude, prayer, ceremony, and inner attunement. Under the MP, there would be less than significant impacts on cultural and historic resources, explained below.

For cultural resources, to limit the assessment of the impacts from the Proposed Action to the 18.166-acre area would be difficult because the presence of HO facilities, including the overall size and color of the structures, has a more wide-ranging effect. The assessment needs to take into account the whole of the summit and crater area. Part of the cultural value of Haleakalā is the ability to see only the mountain when viewing the summit. A number of the traditional cultural practices that continue to take place within the ROI require silence and solace and an uninterrupted view and sacred space.

From previous Section 106 consultations involving proposed Federal actions, it has been stated that the very presence of HO facilities impacts cultural resources, as described by a number of Native Hawaiians during cultural resource evaluations. Responses to HO activities taking place on Haleakalā were deeply emotional. Overall, there is a belief by some that the use of Haleakalā for HO purposes is a desecration of a sacred site, with some claiming the presence of HO caused them physical pain and equating the effects to building an observatory next to the Wailing Wall in Jerusalem or within Mecca. A number of reasons given for the impact include the obstruction of the cultural landscape by the presence of HO facilities on the summit, the physical destruction and desecration of a sacred place through activities required for construction, and the disturbance created by the day-to-day ongoing operations of HO facilities.

Based on the testimony presented by some members of the community, there is a necessity for some people to have an unimpeded view plane from mountain to ocean, particularly in the context of ceremonial activities. For example, unimpeded views are found at the east and west ahu in the HO. It is clear that the height and color of some HO facilities would impede the view and is seen by some as a personal affront to their cultural beliefs. For some Kanaka Maoli, the unaesthetic nature of HO facilities has led to objections to further develop structures at HO because more structures would provide an additional eyesore to the summit. It would compound the adverse effects of the existing facilities.

Additionally, some Native Hawaiians would find excavation within HO to be a wound to Haleakalā. For those who view any amount of excavation as a desecration of a sacred site, the impacts on cultural resources would be significant. No mitigation measures would lessen the impacts. For some Kanaka Maoli, the excavation of the cinder in and of itself is seen as a desecration of the kinolau, or "body of Pele." There are disagreements within the community as to the degree to which this effect can be mitigated, if it can be mitigated at all. Steps toward preservation and education with regard to Kanaka Maoli cultural beliefs and sense of place have been put forth in "Ku I Ka Mauna, Upright at the Mountain, Cultural Resources Evaluation for the Summit of Haleakalā" (CKM 2003), a document prepared as a part of the IfA LRDP.

It is acknowledged that ongoing HO operations affect cultural resources. The presence of built facilities, people, and associated noise and operations-related activities has been said by some to have a noticeable impact on the conduct of traditional practices within the ROI (ATST 2009). The potential turnover in HO facilities operations personnel, with the accompanying loss of individuals who are knowledgeable of cultural preservation, also has an impact on cultural resources (although all personnel would be required to take such training, in accordance with the MP).

Other individuals have expressed opposite opinions, e.g., that HO represents an appropriate modern expression of ancient Hawaiian scientific curiosity. Some have presented evidence to validate that opinion. In consideration of the research and all opinions offered, the impact of implementing the MP would not result in a significant impact to cultural resources within the ROI.

3.2.5 MP Requirements for Cultural Resource Preservation

It is acknowledged that ongoing operations of HO facilities affect cultural resources. Although the survival of Hawaiian cultural practices and beliefs is not in question, the HO activities has been said by some to interfere with the relationship between Native Hawaiians and Haleakalā (UH IfA 2005). As the responsible agency, UH IfA is committed to preserving the cultural resources at the site and has sought advice from the Native Hawaiian community on Maui concerning the best methods to use to achieve that objective. One outcome of those consultations and the cultural resource evaluations of HO is that the IfA has adopted policies and practices for the long-term preservation of cultural resources for all facilities past, present, and future, based on recommendations in the Cultural Resources Assessment (UH IfA 2005).

IfA policies and practices to preserve the cultural and historic resources at HO were established in the LRDP and would be continued in the MP (Appendix K, Section 3.5.2-Monitoring Strategies). All HO facility operations are currently required to adhere to those policies and practices, which are designed to reduce the impact intensity for these types of adverse impacts on cultural resources. This would be continued in the MP. Specifically, in accordance with Section 3.5.2.1-Cultural and Historic Preservation Management of the HO MP, the following requirements are imposed on activities at HO, in order to reduce impacts on the cultural and historic resources:

1. The sign at the entrance to HO states that Native Hawaiians are welcome to practice in traditional cultural practices within the HO property.
2. All contractors and personnel working within HO must receive IfA-approved environmental and cultural training before beginning work. Training programs explain and amplify the requirements applicable to all construction projects within HO boundaries. For preservation of cultural and historic resources, the requirements to protect these resources are as follows:
    a. Any construction within HO requiring a permit from DLNR requires the consultation and monitoring of a Cultural Specialist. This person will be engaged at the earliest stages of the planning process, will monitor the construction process, and will consult with and advise the onsite project manager about any cultural or spiritual concerns. For the purposes of this section, a Cultural Specialist must be a Kanaka Maoli, preferably a kupuna (elder) and a kahu (clergyman, caretaker), and one who has personal knowledge of the spiritual and cultural significance and protocol of Haleakalā.
    b. All cultural and archeological sites and features identified in the Archeological Inventory Surveys should be protected and preserved in accordance with HAR, Title 13, Subtitle 13, Chapter 277, "Rules Governing Requirements for Archeological Site Preservation Development." Protection should include the establishment of clearly marked buffer zones and periodic monitoring by both the project archeologist and Cultural Specialist throughout any construction.
    c. All construction crewmembers shall attend IfA-approved "Sense of Place" training before working at projects within HO.
    d. All permanent employees working at HO shall attend IfA-approved "Sense of Place" training before working at HO facilities.

The requirements specified above apply to and must be included in all land use-related memoranda, facility use agreements, operating and site development agreements, and leases.

Incorporating these requirements into the MP would not, in themselves, result in significant impacts on cultural resources, but they would not be considered beneficial by some Native Hawaiians, who believe that any action results in adverse impacts to the summit area. However, the intention of these requirements is to reduce the intensity of any impacts from activities at HO. It should be noted that separate environmental documentation will be completed for each new Proposed Action and any impacts to cultural resources for each project will be analyzed individually.

Historic (Significant) Buildings and Other Structures

As mentioned in Section 2.2.3-Historic Resources, the only historic site at HO is the Reber Circle site (Site 50-50-11-5443), the radio telescope foundation. In 2006, IfA prepared a recovery plan for this historic site and the plan was approved by SHPD (Appendix D(1). The Reber Circle site would be removed as part of the mitigation for the proposed ATST Project, should that project be approved.

Archeological Resources

Archeological sites exist throughout the HO property. In some portions, such as the Mees site, inspections indicate that this portion of the HO parcel was previously affected by earthmoving associated with construction. Any archeological resources that may have existed before construction are no longer present and effects are not expected on archeological resources at the HO. Under the MP, any future construction at HO would be conducted in accordance with the "Science City Preservation Plan" approved by the State Historic Preservation Division (SHPD). The plan (Appendix D(2) calls for passive preservation of sites during future activities, which would be a beneficial impact of the MP.

In the event that a burial site is uncovered under the Proposed Action, the requirements in HAR, Title 13, Subtitle 13, Chapter 300, Rules of Practice and Procedure Relating to Burial Sites and Human Remains would be followed.

3.2.6 No-Action

Impacts under the No-Action Alternative are similar to those under the Proposed Action. There would be less than significant impacts for cultural resources. For some, HO structures and activities would continue to interfere with the relationship between Native Hawaiians and Haleakalā. There would be no impacts on historic and archeological resources. The only historic site at HO is the Reber Circle site, Site 50-50-11-5443, the radio telescope foundation. The "Science City Preservation Plan" calls for passive preservation of archeological sites during future activities. Under the No-Action Alternative, the Proposed Action would not be implemented and there would not be any impacts on historic resources at HO.

3.3 BIOLOGICAL RESOURCES

3.3.1 Impact Methodology

The evaluation of potential impacts on biological resources was based on the MP and the No-Action Alternative's consistency with the following:

1. Compliance with applicable Federal, State, and County regulations that apply to preserving biological resources, including the HAR §11-200-12 and ESA, Section 7 (a) 2, Interagency Cooperation; and,

2. Compliance with the Coastal Zone Management Act (CZMA).

3.3.2 Factors Considered for Impacts Analysis

Impacts on biological resources were assessed based on the appropriateness and utility of the MP provisions that would be implemented to protect and conserve biological resources at HO.

3.3.3 Summary of Impacts

Table 3-4 is a summary of impacts on biological resources from the MP and No-Action Alternative. The impact evaluation for the No-Action Alternative is based on a comparison to the baseline effects. For at least some biological resources at HO, the MP would have beneficial impacts, while the No-Action Alternatives would have less than significant impacts on biological resources.

Table 3-4
Summary of Potential Impacts on Biological Resources

Impact Issues	Proposed Action	No Action
Biological Resources	+	⊙

LEGEND:
⊗= Significant impact
⃠= Significant but mitigable to less than significant impact
⊙= Less than significant impact
○= No impact
+ =Beneficial impact
N/A=Not applicable

3.3.4 Proposed Action

To minimize the potential effects of HO operations on biological resources, including endangered species, the IfA plans to either continue or to implement measures which are described in the MP. From year-to-year, these are subject to State funding availability, and include, but are not limited to:

1. Weeding of the HO property. (The entire 18.166 acres was weeded in July 2009 to remove weeds and to document likely areas of regrowth.)
2. Vector control for rodents.
3. Soil and erosion control in accordance with the Storm Water Management Plan (SWMP) to maintain habitat ecosystem.
4. Nighttime lighting restrictions to prevent misdirecting ‘ua‘u.
5. Frequent removal of trash to prevent predators from obtaining food sources.

In addition, the MP ensures that any construction would be in accordance with the practices listed below.

1. IfA requires any contractor to take the following measures at HO to prevent construction or repair activities from introducing new species:

a. Any equipment, supplies, and containers with construction materials that originate from elsewhere, such as the other islands or the mainland, must be checked for unwanted species infestation by a qualified biologist or agricultural inspector before these materials are transported to the summit. Specimens of non-native species found in these inspections are to be offered to the State for curation, and those not wanted are to be destroyed. All construction vehicles that will be used off paved surfaces must be steam cleaned before they travel or are transported through HALE. It shall be the sole responsibility of the contractor to coordinate inspections with the HALE Business and Revenue Program Specialist.

b. Importation of fill material to the site is prohibited, unless such fill, for example, sand, is sterilized to remove seeds, larvae, insects, and other biota that could survive at HO and propagate. All material obtained from excavation is to remain on Haleakalā. Surplus excavated cinders and soil is to be offered to other agencies located at the summit or to the NPS.

c. Contractors are required to participate in IfA-approved pre-construction briefings to inform workers of the damage that can be done by unwanted introductions. Satisfactory fulfillment of this requirement can be evidenced by a signed certification from the contractor.

d. Parking heavy equipment and storing construction materials outside the immediate confines of HO property is prohibited.

e. Contractors are required to remove construction trash frequently, particularly materials that could serve as a food source that would increase the population of mice and rats that prey on native species.

2. The endangered ʻuaʻu, or Hawaiian petrel, occupies burrows on the upper slopes of Haleakalā from February to October. The burrows are in cinder and are active year after year, because the birds return to the site of their birth. Petrels are night-flying birds, leaving their burrows to search for food during nesting and fledgling seasons. The nearest burrows are on the south slopes below the MSO facility and on the north slopes below the MSSC. The following requirements are in place to ensure that the ʻuaʻu habitat will be protected during construction:

   a. During the months when birds are present on Haleakalā, care must be exercised to ensure that they will not be disturbed. Therefore, vibration and noise from heavy construction equipment or activities must not impact the normal life cycle of resident birds. If heavy construction equipment will be necessary at HO, consultation with the USFWS, the Division of Forestry and Wildlife (DOFAW), and avifaunal experts will be required to determine feasibility and any mitigation requirements.

   Furthermore, it would be necessary to determine whether human receptors in areas outside of the HO would be affected by construction noise. There are areas within HO close enough to HALE visitors, such that they would be able to detect noise from construction of and traffic at the proposed facilities. These sounds could affect Native Hawaiian cultural practitioners and those engaged in recreation at nearby locations. The analyses provided by the contractor would be used to help develop methods to avoid, minimize, or mitigate such noise, where it would or may affect endangered species, sensitive cultural practices or the experience of visitors to the summit area outside of HO.

Such methods could include:

- Workers at HO must be informed of vibration, noise, and lighting hazards to endangered species, that their activities are to be confined to the construction site to minimize risk to birds in adjacent areas, and that noise sources should be shielded where possible.
- Conducting all noise-emitting activities within strict day and time constraints, with work prohibited during sensitive nighttime periods.
- Reducing or substituting power operations/processes through use of proportionally sized and powered equipment necessary only for tasks at hand.
- Maintaining all powered mechanical equipment and machinery in good operating condition with proper intake and exhaust mufflers.
- Turning off or shutting down equipment and machinery between active operations.

b. Contractors will be given current maps of locations of ‘ua‘u burrows to assist with ‘ua‘u conservation. HALE biologists are continuously finding and mapping new ‘ua‘u burrows and these maps are made available to IfA for planning purposes.

c. HO personnel will notify USFWS of any ‘ua‘u mortalities. Contractor personnel will report mortalities to IfA immediately.

d. Construction of fences will be avoided, to prevent ‘ua‘u mortality from collisions.

e. Lighting for construction hazards or night work must be approved by IfA prior to installation. All lighting must be shielded from above, so that night flying birds will not be disoriented by upward projecting lights that are mistaken for natural sources of navigable lighting.

f. To avoid attracting ‘ua‘u, contractors will make every effort not to use safety/security lighting the same color as stars. Other colors, such as red, blue, or orange or similar colors, should be considered.

The measures described in the MP would have beneficial impacts on the biological ecosystems described in Chapter 2.3 above. For example, earlier monitoring and preservation requirements imposed by the LRDP have already resulted in a major increase in the ‘ahinahina population at HO (Appendix J) in the last five years, and it is anticipated that the requirements imposed by the MP would have additional positive impacts on that species. It is also anticipated that the ‘ua‘u colony population at HO would also benefit from the measures described above

3.3.5 No-Action

The ongoing activities and operations under the No-Action Alternative would result in a less than significant impact on biological resources, since HO would still be operated in accordance with the biological protection policies and practices in the LRDP, which have proven to be effective, but not as comprehensive. The MP is based on more complete experience protecting those resources, and it is anticipated that without the benefit of such experience, adverse impacts could occur.

3.4 TOPOGRAPHY, GEOLOGY, AND SOILS

3.4.1 Impact Methodology

The MP was evaluated for adverse impacts on people or the environment in the context of existing geologic conditions within the ROI. The methods used to determine whether the MP and No-Action Alternative would have a major impact on the topography, geology, and soils are as follows:

1. Review and evaluate MP to identify what impacts it would have on topography, geology, and soils within the ROI in order to evaluate the Proposed Action and No-Action Alternative potential impacts on the topography, geology, and soils;
2. Review and evaluate MP to determine whether it would adversely affect the ecosystem and its component parts within and adjacent to HO, including damage to the existing topography, geology, and soils; and
3. Assess the compliance of each alternative with applicable Federal, State, or County regulations to ensure that any impacts of the Proposed Action on topography, geology, and soils would not result in regulatory non-compliance.

3.4.2 Factors Considered for Impacts Analysis

Factors considered in determining whether the Proposed Action would have a significant impact on the topography, geology, and soils include the extent to which its implementation would do the following:

- Increase the exposure of people or structures to geologic hazards;
- Cause a substantial loss of soil (such as through increased erosion);
- Conflict with Federal, State, or local statutes or regulations; or
- Alter the function of the landscape (for example, altering drainage patterns through large-scale excavation, filling, or leveling).

3.4.3 Summary of Impacts

Table 3-5 is a summary of the potential impacts on topography, geology, and soils. The MP would have no impacts on topography or geology, and a positive impact on soils. No impacts would result on geology if the No-Action Alternative is implemented, but adverse, less than significant impacts to topography and soils could occur.

Table 3-5
Summary of Potential Impacts on Topography, Geology, and Soils

Impact Issues	Proposed Action	No-Action
Topography	○	⊙
Geology	○	○
Soils	+	⊙

LEGEND:
⊗= Significant impact
⃠= Significant but mitigable to less than significant impact
⊙= Less than significant impact
○= No impact
+ = Beneficial impact
N/A = Not applicable

3.4.4 Proposed Action

Topography

In 1963, the University of Michigan team chosen to operate a space surveillance research facility on Haleakalā filmed the groundbreaking and excavation activities for the AMOS Observatory at HO. The 16 mm film (Jensen 2005) shows a large area on the north side of HO being graded by bulldozers, even though only a small portion on the northern rim of Kolekole was to be occupied by the AMOS facility. Ground disturbance for construction of the Mees Solar Observatory on the southern side of HO followed the next year, and ultimately a substantial portion of HO underwent grading, excavation and reshaping for new facilities and modifications. More recently, topographic changes were accomplished at HO to better manage stormwater runoff at the site. The underlying geologic structures at HO are unchanged, with pyroclastic debris and ankaramitic lavas constituting the bulk of the subsurface structure (Appendix F). Aside from the use of the site east of MSO and the Reber Circle site, projects proposed for construction at HO in the future would replace existing facilities so as to avoid potential impacts on topography.

Geology

Under the MP, there would be no impacts on geology at HO. Any potential projects proposed for construction at HO in the future would replace existing facilities and would not likely increase the potential for faulting, instability or mass wasting.

According to a geological report (Appendix F) prepared for multiple sites at HO, no indications or gross evidence of faulting, instability or mass wasting, and in a human-references time scale, the sites were suitable for construction

Soils

The MP has substantial requirements for prevention of soil erosion, which are described in the Stormwater Management Plan (Appendix I) and are applicable to all relevant activities at HO. In accordance with the MP, any future construction activities would be required to place excavated materials in designated locations to minimize adverse impacts on stormwater drainage and infiltration. Best management practices (BMPs) would be implemented as recommended in the SWMP to prevent erosion, excessive losses of soils, and reduce the potential for off-site sedimentation. Aside from potential projects at the Reber Circle and Mees Site, any other projects proposed for construction at HO in the future would replace existing facilities; therefore, avoiding impacts from increased impervious areas. Less than significant impacts on soils from erosion would be expected during construction of new facilities and long term operation of new facilities at HO. These measures were implemented to good effect when the SWMP was completed in 2006, and would be continued as part of the MP. It is anticipated that the MP would continue to have beneficial impacts on soil erosion.

3.4.5 No-Action

Although the LRDP policies, practices and rules for preventing impacts to topography and soils would continue to be in effect, new information on erosion processes, infiltration rates for stormwater, and soil composition, would not be applied to management planning at HO As such, there would be less than significant impacts to topography, and soils under the No-Action Alternative.

3.5 VISUAL RESOURCES AND VIEW PLANE

3.5.1 Impact Methodology

Visual resources are the visible physical features on a landscape (e.g., land, water, vegetation, animals, structures, and other features). The potential for adverse and beneficial impacts that involve visual resources is analyzed below. The analysis includes addressing policies and practices intended to manage visual resources. With the exception of the proposed ATST Project on a previously undeveloped site east of Mees, the lack of new sites for construction means that future facilities and structures at HO would not have larger footprints or higher structures that could block visible sky for current facilities. Instead, existing facilities and structures would be replaced with facilities and structures of similar size, scale, dimension, and appearance (projects such as the proposed ATST Project that would be substantially different from these criteria are analyzed for impacts on an independent basis). Although the number of personnel is also assumed to remain relatively constant, new personnel is expected to replace existing personnel as activities and experiments at HO evolve.

3.5.2 Factors Considered for Impacts Analysis

The criteria used to determine whether the MP would have a significant impact on visual resources is as follows:

- Would implementation of the MP result in a substantial adverse effect on a scenic vista?
- Would the implementation of the MP result in damage to scenic resources, including trees, rock outcroppings, and historic buildings, within a State scenic highway?
- Would the implementation of the MP result in substantial degradation of the existing visual character or quality of the site and its surroundings?
- Would implementation of the MP result in a new source of substantial light or glare, which would adversely affect day or nighttime views in the area?

3.5.3 Summary of Impacts

Table 3-6 is a summary of potential impacts on visual resources and view plane. Implementation of the MP would result in beneficial impacts on visual resources and the view plane in the ROI. The No-Action Alternative would have no impacts on visual resources and the view plane.

Table 3-6
Summary of Potential Visual Resources and View Plane Impacts

Impact Issues	Proposed Action	No Action
Substantial adverse effect on a scenic vista	+	○
Damage scenic resources within a State scenic byway	+	○
Substantially degrade the existing visual character or quality of the site and its surroundings	+	○
Create a new source of substantial light or glare	+	○

LEGEND:
⊗= Significant adverse impact + = Beneficial impact
⃠= Significant but mitigable to less than significant adverse impact N/A = Not applicable
⊙= Less than significant adverse impact
○= No impact

3.5.4 Proposed Action

The intention of IfA is to have facilities that are as appropriate as possible on a mountain summit that has rich natural, cultural, and historic resources. The policies, practices, and design criteria in the MP were developed in keeping with that intention:

- Existing observatories require a clear line-of-sight, insofar as is possible given the terrain. New facilities will not be permitted to obscure the observation function of existing facilities.
- New facilities will not be permitted to impact the ʻuaʻu habitat. Facilities will not be fenced in order to protect ʻuaʻu flyways, and they will not have unshielded lights or other attractants. (*see* Section 3.3.4-Proposed Action, Items 2e and f regarding lighting.)

  During the nesting season (February to November) when birds are present on Haleakalā, care must be exercised to ensure that the birds will not be disturbed. Vibration and noise from heavy construction equipment or activities must not impact the normal life cycle of resident birds. If heavy construction equipment will be necessary at the site, consultation with IfA and avifaunal experts will be required to determine feasibility and any applicable mitigation requirements.
- New facilities will not impact known archeological resources. The resources at HO have been mapped and those sites nearest to facilities have been delineated with single post and railing buffers. No construction will be permitted within 50 feet of any archeological site or feature.
- Presently, all HO facilities are painted with a formula that was computer-matched to the most common color of the cinders and lava within HO boundaries. Whenever possible,

new buildings will be painted to blend with their surroundings; however, solar observatories that operate during daylight will be allowed to be painted white, as it would otherwise be virtually impossible to keep the enclosure and building surfaces cool enough to prevent degradation of sight conditions.

- Construction design will consider sight planes to population centers of Maui. Where buildings can be oriented to limit visibility or be built partly underground, they will be. Where this is not possible, every effort will be made to not use materials that draw attention from a distance, such as reflective surfaces, unusual shapes, and incompatible colors.
- Wherever possible, natural materials from the construction site will be used for building facings, walls, walkways, and entryways.
- IfA will seek early and broad public comments and input concerning any proposed construction at HO.
- The summit area poses certain risks to people and structures from natural hazards, and since these are well understood, new projects will be required to be designed such that they would minimize such potential adverse impacts, including structural damage to facilities from wind, storm flooding, earth movement, ice and other natural events, vehicular accidents, and personnel requiring medical treatment for illness

As a result of these requirements in the MP, there would be a beneficial impact on the visual character of HO. Again, it is noted that any new proposed facility at HO that does not replace facilities and structures with similar size, scale, dimension, and appearance would require further analysis of potential adverse impacts on visual resources. Future construction and operation of any facilities and structures at HO would be required to comply with applicable Scenic Roadway Corridor Overlay District controls.

3.5.5 No-Action

There would be no change from existing conditions under the No-Action Alternative, and while no new impacts would be anticipated without further analysis, the benefits of compliance with the MP would not be realized.

3.6 HYDROLOGY

3.6.1 Impact Methodology

The ROI for hydrology includes HO, which is entirely within the Waiakoa and the Manawainui Gulch watersheds. The groundwater boundaries are the Kamaole and Makawao Aquifer Systems of the Central Aquifer Sector and the Lualailua and Nakula Aquifer Systems of the Kahikinui Aquifer Sector. The methods used to determine whether the MP would have significant impacts on hydrology are as follows:

1. Review and evaluate existing and past actions to identify what impacts they have had on the hydrology within the ROI in order to evaluate the Proposed Action’s potential impact on surface water, drainage, and ground water; and,

2. Assess the compliance of each alternative with applicable Federal, State, and local regulations with respect to surface and groundwater resources.

3.6.2 Factors Considered for Impacts Analysis

Factors considered in determining whether the implementation of the MP would have a significant impact on the hydrology include the extent to which its implementation would do the following:

- Degrade surface or groundwater quality in a manner that would reduce the existing or potential beneficial uses of the water;
- Alter the existing pattern of surface or groundwater flow or drainage in a manner that would adversely affect the uses of the water within or outside the project region; or,
- Be out of compliance with existing or proposed water quality standards or with other regulatory requirements related to protecting or managing water resources.

3.6.3 Summary of Impacts

Table 3-7 is a summary of the potential impacts on hydrology from the implementation of the MP and No-Action Alternative. The Proposed Action would result in beneficial impacts on surface water and on groundwater resources. The No-Action Alternative would have less than significant impacts on hydrology.

Table 3-7
Summary of Potential Impacts on Hydrology

Impact Issues	Proposed Action	No-Action
Surface water	+	⨀
Groundwater	+	⨀

LEGEND:
⊗ = Significant impact
⃠ = Significant but mitigable to less than significant impact
⨀ = Less than significant impact
○ = No impact
\+ = Beneficial impact
N/A = Not applicable

3.6.4 Proposed Action

Surface Water

The MP would require that erosion and sediment control measures be implemented as recommended in the Appendix I-Stormwater Management Plan (SWMP) for HO to prevent erosion and off-site sedimentation.

The existing stormwater collection system includes an on-site infiltration basin located near the western end of the HO property which captures runoff from impervious surfaces. The infiltration basin appears to have adequate capacity to contain the stormwater runoff for all but the most extreme storm events (Appendix I). In the event that either the site east of

MSO or the Reber Circle site were to be used, additional analysis would be provided to evaluate/mitigate any contributions to stormwater and erosion There are a few locations around the site where stormwater runoff flows from impervious surfaces associated with HO observatories and discharges onto the slopes of Haleakalā (UH IfA 2005a). Measures implemented under the SWMP would continue to have beneficial effects on erosion and sediment control.

Groundwater

The MP would include the use of existing cesspool systems or installation of advanced individual wastewater systems. The existing cesspool system discharges wastewater into the subsurface through a leach field resulting in long term less than significant impacts on groundwater resources. New projects would not employ existing cesspool systems, and the installation of a new wastewater treatment system would provide treatment and would discharge higher quality effluent than that of the existing cesspool systems. This could result in beneficial impacts to groundwater resources.

3.6.5 No-Action

There would continue to be beneficial effects on hydrology under the No-Action alternative, since stormwater and groundwater would continue to be managed in accordance with the SWMP and State water quality standards.

3.7 INFRASTRUCTURE AND UTILITIES

3.7.1 Impact Methodology

The methods that were used to determine whether implementation of the MP would have a significant impact on infrastructure and utilities are as follows:

1. Review and evaluate existing and past activities to identify the action's potential to affect infrastructure and utilities;
2. Review and evaluate each alternative to identify the potential of the MP to affect infrastructure and utilities; and,
3. Assess the compliance of the MP with applicable Federal, State, or local regulations, guidelines, and pollution prevention measures.

The infrastructure and utilities section is an analysis of potential effects of the MP on the stormwater and drainage systems, domestic wastewater, electrical systems, communications systems, and roadways and traffic. The effects would be potential infrastructure shortfalls, inconsistencies, inadequacies, or deficiencies identified between the existing infrastructure and the requirements of the MP.

3.7.2 Factors Considered for Impacts Analysis

Factors considered in determining whether implementation of the MP would have a significant impact on infrastructure and utilities include the extent or degree to which its implementation would result in the following:

- Interrupt or disrupt any infrastructure and public utility service, as a result of physical displacement and subsequent relocation of infrastructure and utilities, to the extent that the result would be a direct long-term service interruption or permanent disruption of essential infrastructure or utilities; or,
- Require an increase in demand for infrastructure or utilities beyond the capacity of the provider, to the point that substantial expansion, additional facilities, or increased staffing levels would be necessary.

3.7.3 Summary of Impacts

Table 3-8 is a summary of the potential impacts on infrastructure and utilities. If implemented, the MP would result in no impacts on the stormwater and drainage system, domestic wastewater, solid waste disposal, electrical systems, communications systems, and roadways and traffic. Under the No-Action Alternative, no impacts on the infrastructure and utilities are expected.

Table 3-8
Summary of Potential Infrastructure and Utilities Impacts

Impact Issues	Proposed Action	N-Action
Stormwater and drainage system	○	○
Domestic wastewater	○	○
Electrical systems	○	○
Communications systems	○	○
Roadways and traffic	○	○

LEGEND:
⊗= Significant impact + = Beneficial impact
⃠= Significant but mitigable to less than significant impact N/A = Not applicable
⊙= Less than significant impact
○= No impact

3.7.4 Proposed Action

Stormwater and Drainage System

Most of HO is served by a stormwater collection system of paved channels designed to convey runoff from impervious areas to a central infiltration basin, as outlined in the Stormwater Management Plan (Appendix I) implemented for HO in 2006. Any new proposed facility design would include stormwater drainage capacity and configuration that would tie it into the drainage system for HO.

Proposed projects would implement the guidance of the MP and the SWMP for HO (UH IfA 2006) prepared according to the recommendations stated in the Stormwater Erosion Report (UH IfA 2005a). This report states that runoff from the impervious surfaces associated with the HO and adjacent roads may not increase the total volume of stormwater flow entering the natural drainages but may only affect the way it is transported there (UH IfA 2005a). Proposed facilities would capture stormwater and surface water for reuse through gutters, rainwater leaders, and catchment drains piped to an underground storage tank and ultimately pumped to the existing cistern. As such, changes to runoff are not expected to increase as a result of any proposed projects, and no measurable or perceptible consequences on the existing stormwater management system or drainage patterns would result. Capturing surface water and stormwater and implementing the guidance of the SWMP for HO would reduce the potential for increased runoff entering the stormwater management system. Therefore, implementation of the MP would not have any impacts on stormwater and drainage patterns.

Independent of the MP, future projects that qualify with respect to an area to be disturbed may need to obtain a National Pollutant Discharge Elimination System (NPDES) permit under HAR 11-55, Water Pollution Control Appendix C 1(a), from the State of Hawai'i Department of Health (DOH) for stormwater runoff during construction, and a second permit from DOH for permanent operations.

Domestic Wastewater

Under the MP, each user at HO would continue to be required to provide for the collection and proper storage of wastewater and sewage generated by that site. New on-site septic tanks would be constructed as necessary to meet the demand at HO. All on-site sewage facilities would conform to State regulatory standards.

There would be some potential concerns about contaminants from the wastewater system being released into surrounding soils and water resources through improper operation and maintenance of these facilities. The proper installation of the on-site wastewater facilities would greatly reduce the potential for sewage, human excreta, or other organic waste to transmit disease to humans. However, implementation of the MP itself would not have any impact on domestic wastewater issues.

Electrical Systems

Depending upon demand for electrical service within the "Science City" area, MECO would upgrade to a new 2,500-kilovolt ampere substation with improved efficiency and safer reserve capacity (Kauhi 2005). The electric power available at HO for future development depends on the capability of MECO to upgrade its hardware at HO. The increased electrical demand for the new facilities could have long-term adverse impacts on the electrical distribution system; however, but since the MP does not prescribe requirements for future electrical use or systems, any potential future impacts would not be related to implementation of the MP in any way, and therefore the MP would have no impacts on electrical systems at HO.

Communication Systems

Telecommunications equipment and services are expected to be provided by Hawaiian Telcom. The service would continue to be distributed to various sites via underground conduits, and the principal organization responsible for a new facility would negotiate directly with the telephone company to obtain service. These required changes to the communication system would have no perceptible consequence, so no impacts on the communication systems are expected from implementation of the MP. Communication connections to serve any proposed facility would be through existing reserve lines or new lines that would follow the path of existing lines. Any required new lines would be placed during site excavation.

Roadways and Traffic

Under the MP, no changes from current conditions would occur for roadways or traffic. Any new construction would have to independently consider impacts to roadways and traffic. There would be no new road construction at HO, but there could be minor realignment of roads. There would also be a potential increase in vehicles resulting from construction and operation of new facilities. There would be temporary adverse impacts on traffic from smaller projects, considered less than significant; but larger proposed projects could have higher intensity impacts. Such projects would require independent assessment of impacts to roadways and traffic both within HO and for access roads to HO. None of these effects would be related to, or caused by implementation of the MP.

Roadways at HO. The roads within HO are maintained by IfA. Vehicular traffic is normally slow and low in volume and would not be substantially affected by the cyclic integration of construction vehicles and equipment. Currently, most roadways within HO require very little maintenance and have considerable longevity. The MP is intended to support this longevity. However, these observatory roads were not designed to support unusually heavy loads, such as large trucks and construction vehicles. Any future construction of a proposed facility would inevitably result in adverse short-term impacts on the condition of the roads within HO. Contractors would be made aware of the potential for road damage and would be required to take measures to minimize the damage. Any damage to HO roadways that does result from construction traffic would be repaired so as to, at a minimum, restore those roadways. Damage and restoration of HO roadways due to future activities is not related to implementation of the MP, and therefore the MP would have no impact on roadways at HO.

Roadways Leading to HO. The roadways leading to HO include a series of State-maintained highways up to HALE. On any given day, HO traffic constitutes a small fraction of the total traffic on the State highways. Implementation of the MP would not have any impact on the roads leading to HO, since there would be no changes to traffic frequency or type associated with the MP.

In the event that construction was to occur at HO, detailed traffic analysis would be conducted to evaluate the potential impacts on both the State highways and the HALE Park road corridor. Analysis would include the impacts from heavy equipment, delivery of concrete and materials, and miscellaneous service trips. During the entirety of any construction, all large vehicle traffic would be coordinated around heavier traffic periods and neighboring activities to minimize adverse effects. Furthermore, to minimize highway traffic and the need for on-site vehicle parking, construction workers would be required to carpool.

In additional, the project staff and its construction contractors would be required to contact the DOT for the appropriate truck permit and traffic route coordination for any heavy or wide truck transportation of project equipment on State Route 378.

During construction, large trucks carrying heavy and wide loads and other construction-related traffic would use the HALE road corridor leading up to HO. All construction-related traffic would be coordinated with HALE during use of the Park road corridor and would be conducted in compliance with a Special Use Permit (SUP) that would be issued by the HALE Superintendent, so as to avoid or minimize damage to the road pavement, potential damage to historic structures along the park road corridor, traffic congestion, and other potential adverse effects on HALE resources and the visitor use and experience. The contribution of the proposed facility projects to a future road repair project as compensation for this effect would be subject to the provisions of the SUP. Any traffic on roadways leading to HO related to operation of either current or new HO facilities is expected to be minimal in comparison with normal HALE traffic.

The implementation of the MP for routine HO operations and small projects, e.g., facility refurbishment, is anticipated to result in no impacts on the roadways leading to HO from operating new facilities at HO. Each new project will have to be evaluated for potential impacts to infrastructure and utilities at HO, including impacts to roadways and traffic.

3.7.5 No-Action

Under the No-Action Alternative, conditions affecting infrastructure and utilities would remain approximately as they are under existing conditions. Without the MP, there would not be guidance for new projects, which then could not be implemented. There would still be routine maintenance activities, which under the No-Action Alternative, are anticipated to have no effects on infrastructure and utilities.

3.8 CLIMATOLOGY AND AIR QUALITY

3.8.1 Impact Methodology

The methods used to determine whether the Proposed Action would have a significant impact on climatology and air quality are as follows:

1. Review and evaluate existing and past actions with respect to their effects on air quality from dust generation and emissions, in order to identify the potential effect on air quality from implementation of the MP;
2. Review and evaluate the MP and No-Action Alternative with respect to human health and hazardous air pollutant industrial hygiene criteria, to identify its potential to adversely affect the air quality within and adjacent to HO; and,
3. Assess the compliance of the MP with applicable Federal, State, or County regulations promulgated by the Hawaiʻi Department of Health and contained in the HAR.

3.8.2 Factors Considered for Impacts Analysis

The evaluation of potential impacts on climatology and air quality was based on the potential for construction, ongoing operations, and traffic generation as those activities would be addressed by the MP.

3.8.3 Summary of Impacts

Table 3-9 is a summary of impacts on climatology and air quality. The MP would not likely have any impacts as it pertains to conducting astronomy experiments in the ROI. The No-Action Alternative would not change the present conditions at HO; the low levels of emissions from baseline HO operations would continue, so no impacts are expected.

Table 3-9
Summary of Potential Impacts on Climatology and Air Quality

Impact Issues	Proposed Action	No Action
Climatology and Air Quality	○	○

LEGEND:
⊗ = Significant impact
⃠ = Significant but mitigable to less than significant impact
⊙ = Less than significant impact
+ = Beneficial impact
N/A = Not applicable
○ = No impact

3.8.4 Proposed Action

The MP addresses direct impacts on air quality from the use of vehicles and heavy equipment associated with operations and potential future construction at HO. Routine observatory operations do not produce air emissions, and the passive electro-optical telescopes, sensors, and other equipment at HO are no exception. Minor emission sources at HO include facility maintenance that could emit minimal levels of nitrogen oxides. This would include occasional testing of emergency generators for those facilities. Any construction would result in low-level, intermittent exhaust emissions. These emissions would result from on-site excavators, bulldozers, backhoes, graders, compactors, and cranes, as well as from petroleum-powered generators used to power construction equipment. Other site development activities, such as welding and metal working, would also generate minor quantities of hazardous air pollutants, including greenhouse gases. Minor amounts of mobile source emissions would result from occupational vehicle traffic accessing the project site. However, the actual increase in daytime traffic during construction periods would be minor. Meteorological conditions at the HO would not be impacted by construction. Operations and construction would not produce any major air emissions, and as a result, all applicable Federal and State air quality standards would be met.

The MP addresses air quality (*see* Appendix K, Section 3.5.3.2-Construction Practices), where measures are designed to minimize fugitive dust emissions, and contractors would be required to comply with applicable State regulations under HAR 11-60.1-33, which require taking “reasonable precautions” for controlling fugitive dust (DOH 2005). Operational practices by the contractor would limit controllable emissions from site activities that could adversely impact the local air quality. These practices would be established through an ongoing program by contractors to control fugitive dust by strictly adhering to the procedures for construction projects at HO.

The following procedures and practices would be incorporated into any future construction projects at HO to minimize fugitive dust and emissions:

1. Contractors must establish a written dust control plan that must be observed by all contractor personnel during the project. Contractors will adhere strictly to the requirement that dust be controlled at all times, including non-working hours, weekends, and holidays.
2. Dust control must be accomplished by equipment that the Contractor keeps on site and sprinkling or similar methods will be required to keep disturbed finer material from becoming airborne and must result in less than 10 pounds of fugitive dust released into the atmosphere per 24-hour period, as measured by standard collection methods.
3. No oil or chemical treating shall ever be used at the site for dust control.
4. Dust resulting from surface preparation of surfaces to be painted by sanding, power tools, or scraping and brushing shall be controlled by the Contractor by use of catchments and filtering systems/devices to prevent damage to the telescope mirrors, lenses and sensors.
5. Where practical, erect a designated on-site facility with wash racks to clean equipment and machinery before they are removed from construction zones.
6. Reduce vehicle emissions from construction projects and operations at HO by establishing worker carpools and shuttles to and from the job site, and mitigate construction equipment/machinery emissions by using proper emission-control technologies and standard exhaust filtration devices.

The application of these measures with implementation of the MP would have no impacts on the air quality of HO, since all these measures are already in place under the LRDP.

3.8.5 No-Action

Impacts under the No-Action Alternative are the same as those under the MP. The ongoing activities and operations under the No-Action Alternative are required to adhere to air quality requirements of the LRDP.

3.9 PUBLIC HEALTH AND SAFETY

3.9.1 Impact Methodology

Numerous Federal, State, and local laws regulate the storage, use, recycling, disposal, and transportation of hazardous materials and solid waste. There are similar regulations and public health and safety guidance regarding noise exposure. The methods for assessing potential public health and safety impacts generally include the following:

1. Reviewing and evaluating the MP to identify its role in the use of hazardous or toxic materials or to generate hazardous waste, based on the activities proposed;
2. Assessing the compliance of the MP with applicable site-specific hazardous materials and waste management plans;
3. Assessing the compliance of the MP with applicable site-specific standard operating procedures and health and safety plans in order to avoid potential hazards; and,
4. Examining the typical noise generation of construction and operational activities.

3.9.2 Factors Considered for Impacts Analysis

Regulatory standards and guidelines have been applied to determine the significance of each alternative's potential impact from non-chemical hazards and hazardous materials and waste and noise. Factors considered in determining whether an alternative would have a significant public health and safety impact include the extent or degree to which its implementation would result in the following:

- Generate either hazardous or acutely hazardous waste, resulting in increased regulatory requirements over the long term;
- Cause a spill or release of a hazardous substance (as defined by 40 CFR, Part 302, [CERCLA], or Parts 110, 112, 116, and 117 [Clean Water Act]);
- Expose the environment or public to any hazardous condition through release or disposal;
- Generate new sources of substantial noise;
- Increase the intensity or duration of noise levels to sensitive receptors; or,
- Expose more people or the environment to high levels of noise.

3.9.3 Summary of Impacts

Table 3-10 is a summary of impacts on public health and safety. The MP would have beneficial impacts on public health and safety, and no impacts are expected under the No-Action Alternative.

Table 3-10
Summary of Potential Impacts on Public Health and Safety

Impact Issues	Proposed Action	No-Action
Hazardous materials	+	○
Solid waste	+	○
Noise	+	○

LEGEND:
⊗ = Significant impact
⃠ = Significant but mitigable to less than significant impact
⊙ = Less than significant impact
○ = No impact
\+ = Beneficial impact
N/A = Not applicable

3.9.4 Proposed Action

Hazardous Materials

HO is in a cinder cone in a State Conservation District. Operations and construction at the site require special care to maintain the unpolluted environment, as discussed in the MP below:

1. No hazardous materials are to be released at the site. Substances such as surplus or used paint, oil, solvents, and cleaning chemicals must be removed from the area and disposed of properly.
2. Accidental spills of any hazardous material during the execution of a contractor's project at the site must be reported immediately to the on-site IfA supervisor. Spill containment will be supervised by UH personnel at the site.
3. Spill response methods must be approved by the University of Hawaiʻi Environmental Health and Safety Office (EHSO) prior to clean-up, and all costs incurred for cleanup will be paid by the contractor. In the event of a release, the contractor will be liable for any Federal- or State-imposed response costs or penalties.
4. Washing and curing water used for such activities as aggregate processing, concrete curing, and cleanup cannot be released into the soil at the site. The contractor is required to recover wastewaters.

The implementation of the MP would reinforce and/or strengthen the policies and procedures in place at HO for management of hazardous materials. While the operation of future facilities could result in an increase in hazardous materials, no appreciable effect on public health and safety is expected. Therefore, the implementation of the MP would not result in any new impacts from handling or use of hazardous materials at HO.

Solid Waste

Solid waste cannot be stockpiled or dumped at HO or on the slope below the HO facilities. Because of the remote location of HO, each facility must be diligent when handling or managing waste. Each facility within the HO complex has its own trash receptacle and each facility's building maintenance personnel are responsible for trash collection. Non-hazardous trash is disposed of off-site in a licensed landfill, with computer paper and aluminum being recycled. IfA picks up approximately four to five bags of solid waste once a week from the MSO facility and other facilities at HO under their jurisdiction (i.e., the Atmospheric Airglow facility, the Zodiacal Observatory, and the FTF). Municipal solid waste from MSSC, such as food trash, is collected twice a week for off-site disposal at the Central Maui Landfill. Other wastes associated with MSSC operations and maintenance, such as used oil, are collected in containers within the AEOS facility and transported off-site for disposal as non-hazardous waste. Implementation of the MP will reinforce and/or strengthen these practices and therefore will have beneficial effects on solid waste.

For future construction projects, the MP requires that contractors remove construction trash frequently, particularly food sources that could increase the population of mice and rats that prey on native species. Most construction waste should be removed in roll-off trash receptacles that are covered before transport.

During demolition and construction, solid waste requiring disposal would be generated. The MP requires that construction waste and debris would be secured, particularly during weekends, holidays, and other non-working hours to minimize windblown materials. Construction and demolition solid waste and debris should be transported to the Maui Demolition and Construction Landfill in Maʻalaea. The amount of demolition and construction debris generated is expected to be minimal, with no appreciable effect on waste streams. Implementation of the MP should have a beneficial impact on solid waste management during construction-related activities.

During operation of any facilities, the MP requires that solid waste generated on-site would be carried out of the buildings by facility workers and kept in covered refuse containers. No food is to be left on the ground or in HO solid waste storage areas. This is to prevent attraction of rats and other pests. Non-hazardous trash and recyclable material would be disposed of off-site at Maui's licensed landfill. There would be no change in the long-term solid waste disposal practices from operating any new facilities, although solid waste would increase. The operations of such facilities would have no appreciable effect on waste streams and MP measures would be beneficial.

Noise

Existing noise conditions at the summit of Haleakalā vary, depending on location, wind conditions, and the nature of nearby noise sources. Previous sound level measurements conducted at HO indicated truck traffic as the primary mobile noise sources, while HVAC units including chillers and exhaust fans are the loudest stationary noise sources. Noise levels at the summit were described in the ATST FEIS (ATST 2009). Moderate wind speeds at the summit had instantaneous noise levels measured in the range of 45 to 50 dBA, backup generators had noise levels averaging 73 to 84 dBA at a distance of 50 feet, while construction-related vehicles (general) were recorded at 82 to 93 dBA, also at a distance of 50 feet. Natural sound levels, in the Crater area, absent wind or other ambient sources, are typically 10 dBA.

There are no permanent noise-sensitive human receptors at HO, such as residences, schools, hospitals, or other similar land uses where people generally expect and need a quiet environment. Native Hawaiians, however, practice traditional and cultural practices at various locations on Haleakalā including anywhere within the ROI. HO is not open to the public, with the exception of Native Hawaiians participating in cultural and traditional practices. Although multiple observatories and research facilities are stationed at HO, the majority of personnel at these operations work indoors in structurally insulated facilities with negligible outdoor occupational tasks. The public areas closest to the proposed ATST Project area are the Puʻu ʻUlaʻula Overlook in HALE, which is approximately a quarter-mile away, and the Haleakalā Summit Visitor Center, which is approximately a half–mile away.

Under the MP, workers at HO must be informed of noise hazards to endangered species and the consequences of noise on cultural practices (via the "Sense of Place" training). These requirements would be more comprehensive than those in the LRDP, and therefore there would be a beneficial impact from implementation of the MP.

The construction and operation of new facilities could increase the amount of noise generated and most would come from machinery and equipment, particularly powered mechanical equipment, and construction-related traffic. These noise emissions would increase the ambient noise levels for the soundscape at the summit but they would be temporary and intermittent. Trucks and mobile construction machinery would also raise ambient noise above background levels during any construction period.

Each future project would be required to assess noise generation to determine whether endangered species at Kolekole could be affected during construction, and to determine whether human receptors in areas outside of the HO ROI would be affected. There are areas within HO close enough to HALE visitors, such that they would be able to detect noise from construction of and traffic at the proposed facilities. These sounds could affect Native Hawaiian cultural practitioners and those engaged in recreation at nearby locations. The analysis to be furnished for each such project would be used to help develop methods to avoid, minimize, or mitigate such noise, where it would affect endangered species, sensitive cultural practices, or the experience of visitors to the summit area outside of HO.

Standard operational processes for the proposed facilities do not emit significant nuisance noises or vibrations to the surrounding research environment. Furthermore, ambient noise conditions at HO resulting from vehicle traffic are negligible and any future project would likely also only result in less than significant impacts on the soundscape, because any relative increase in daytime commuters accessing the proposed facilities would not noticeably add to the current level and pattern of vehicle use associated with existing HO operations. The operations of any new facilities would likely have less than significant impacts on baseline noise levels at HO, but as stated above, any proposed project would be required to assess potential noise levels on an individual basis.

3.9.5 No-Action

Under the No-Action Alternative, without a MP for HO, public health and safety conditions would remain approximately as they are under existing conditions. Routine operations would continue without the MP and no impacts on public health and safety are expected.

3.10 SOCIOECONOMICS

3.10.1 Impact Methodology

The methods used to determine whether the MP would have an impact on socioeconomics are as follows:

1. Review and evaluate the MP with respect to its effects on socioeconomics and environmental justice; and,

2. Review and evaluate available data on socioeconomic indicators from State sources and the U.S. Census Bureau for Maui.

3.10.2 Factors Considered for Impacts Analysis

The analysis of socioeconomics assumes that the MP does not address any specific future project, but is a planning document for current operations at HO. Any future development project would be required to evaluate impacts on socioeconomics as they pertain specifically to that project.

Factors considered in determining whether the MP would have a significant impact on socioeconomics include the extent which its implementation would do the following:

- Substantial population growth or population concentrations;
- Permanent population that exceeds official regional or local population projects;
- Displacement of a substantial proportion of residents in a community;
- A demand for additional housing that could not be sustained within the HO areas;
- Substantially adversely affect expenditures or income associated with the potential projects within the study area;
- Cause a substantial decrease in local or area employment; and,
- Displace or substantially disrupt business.

3.10.3 Summary of Impacts

Table 3-11 is a summary of the impacts from implementation of the MP on socioeconomics. Implementing the MP would not result in any changes to population and housing, nor would it have any effect on employment, the economy or income for Maui. Education and public outreach are not within the scope of the MP, and therefore it would not have any effect on these resources. Implementing the No-Action Alternative would have no impacts on socioeconomics.

Table 3-11
Summary of Potential Impacts on Socioeconomics

Impact Issues	Proposed Action	No-Action
Population and Housing	○	○
Employment, economy and income	○	○
Education and Public Outreach	○	○

LEGEND:
⊗= Significant impact + = Beneficial impact
⃠= Significant but mitigable to less than significant impact N/A = Not applicable
⊙= Less than significant impact
○= No impact

3.10.4 Proposed Action

No impacts on population and housing are anticipated from implementation of the MP. A less than significant impact on population and housing occurs as IfA and visiting staff relocate to or from Maui in response to staff turnover at individual facilities within HO or the need for additional staff to implement new research and astronomy experiments, but the turnover is not related to any provision or management plan within the MP. Most of the staff at these facilities resides on Maui. At any given period, a small number of visiting staff or technical personnel would contribute to the local economy on a temporary basis. Again, this has no relation to implementation of the MP.

Implementing new astronomy experiments provides additional opportunities for astronomy education and studies at HO. Local universities and schools benefit from the generated data and research conducted at the HO. These projects are discussed in Section 2.10.2-Resources Overview. While these new opportunities exist at IfA, there would be no impact on those activities from implementation of the MP.

3.10.5 No-Action

The No-Action Alternative to not implement the MP would not have any effect on population and housing or on employment and total income, and public education and outreach.

3.11 NATURAL HAZARDS

3.11.1 Impact Methodology

Natural hazards at the higher elevations of Haleakalā consist of the potential for drought, earthquake movement, storms and hurricanes, extreme temperatures, snow and ice, and hypoxia. The potential for adverse and beneficial impacts occurring that involve these natural hazards is analyzed below. Because there are only two available sites for new facilities, most future facilities and structures at HO would not increase, but rather replace existing facilities and structures. Although the number of personnel is also assumed to remain constant, new personnel is expected to replace existing personnel as activities and experiments at HO evolve.

The methods used to determine whether the implementation of the MP would have a significant impact on natural hazards are as follows:

1. Review and evaluate existing and past actions with respect to earthquakes, hurricanes and other storms, hypoxia, and extreme temperatures to identify the potential impact of natural hazards on the Proposed Action;
2. Review and evaluate the Proposed Action and No-Action Alternative with respect to available earthquake, storm, and temperature data from HO, and reports of hypoxia to identify its potential to adversely affect the nature of natural hazards within and adjacent to HO, and for natural hazards to affect the Proposed Action, including damage, destruction, and loss of life; and,

3. Assess the compliance of the Proposed Action and No-Action Alternative with applicable Federal, State, or County regulations for seismic design factors.

3.11.2 Factors Considered for Impacts Analysis

The criteria used to determine whether the Proposed Action would have a significant impact involving natural hazards is as follows: Would implementation of the MP expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving natural hazards?

3.11.3 Summary of Impacts

Table 3-12 is a summary of impacts involving natural hazards. The MP would have a beneficial impact on the safety of the public and the environment as it relates to potential damage, destruction, or loss of life.

Table 3-12
Summary of Potential Impacts Involving Natural Hazards

Impact Issues	Proposed Action	No-Action
Expose people or structures to the risk of loss, injury, or death	+	○

LEGEND:
⊗ = Significant adverse impact
⃠ = Significant but mitigable to less than significant adverse impact
⊙ = Less than significant adverse impact
○ = No impact
+ = Beneficial impact
N/A = Not applicable

3.11.4 Proposed Action

The implementation of the MP would not permanently expose people to drought conditions. There would be no adverse impacts involving drought.

Those individuals or structures exposed to earthquake movement during present operations would not benefit or be impacted by the MP. There are specific emergency action plans for HO facilities that address those issues. However, at future facilities under the MP, individuals and structures would be better protected, and therefore there would be a beneficial impact.

Potential adverse effects involving seismic activity vary depending on the magnitude of an earthquake and include damage to buildings and equipment to minimize adverse impacts in the event of seismic activity, any future structures would be designed and constructed to meet applicable seismic building codes. There would be beneficial impacts involving earthquake movement, because while adverse impacts involving earthquake movement cannot be entirely prevented, they can be reduced through proper construction in a seismic zone.

For those people or structures exposed to storms and hurricanes at HO, the MP would not have any impact, since response to storms and hurricanes is part of emergency planning for facilities. Potential adverse impacts of storms include property damage. To minimize adverse impacts, standard evacuation and manning procedures are employed at HO during storms and hurricanes and these are enforced to reduce the likelihood of significant adverse impacts involving storms and hurricanes.

At HO there is a potential for exposure to extreme temperatures. Due to the proximity of indoor facilities for shelter from extreme temperatures, the possibility of hypothermia is not a concern, resulting in no adverse impacts involving extreme temperatures. The implementation of the MP would have no impact on either exposing individuals to extreme temperatures or addressing the risks of exposure. Standard procedures are employed by each facility at HO to address such risks.

Individuals at HO could be exposed to snow and ice, which could affect driving conditions. Procedures are in effect for the various facilities at HO for driving in adverse weather conditions. Appropriate planning results in reduced risk of such adverse impacts. These safety-related risks are within the scope of facility safety plans and the MP would not pose any impacts on those plans

Hypoxia can occur at HO. People at HO are trained to identify the symptoms of hypoxia and address the potential for hypoxia occurring, as part of their safety training. Again, because these risks are within the scope of facility safety plans, the MP would not affect or pose any impacts on those plans.

3.11.5 No-Action

There would be no change from existing conditions under the No-Action Alternative. There would be no new impacts.

CHAPTER 4
CUMULATIVE IMPACTS AND ANTICIPATED DETERMINATION

Cumulative impacts is defined herein as the impact on the environment that results from the incremental impacts of the project when added to other past, present, and reasonably foreseeable actions, regardless of who carries out the action (HRS 343). For the purposes of this EA, the temporal boundary of analysis is from approximately 2000 to 2015. This boundary encompasses a range within which data are reasonably available and forecasts can be reasonably made.

The geographic boundaries of analysis vary, depending on the resource and potential impacts. For most resources, the analysis area is the same as introduced in the resource-specific affected environment sections, primarily characterized by the boundaries of HO. Resources with farther-reaching impacts, such as air quality or socioeconomics, are analyzed with a more regional perspective. The analysis area is described under each resource. Specific projects that are subject to planning and management under the MP, and which are similar in size or scope or have the potential to cumulatively affect the resources evaluated for the project are identified in Table 4-1. Under the MP, some resources would be affected by several or all of the described activities, while others could be affected very little or not at all.

Table 4-1
Past, Present, and Reasonably Foreseeable Future Actions
Subject to the HO Management Plan

Project	Related Project Location	Construction Date	Project Description	Project Status
Mees Solar Observatory	HO	1966	Remain as-is, or be replaced by the proposed ATST Project	Currently used
Atmospheric Airglow	HO	1961	Remain as-is, or be replaced by Pan-STARRS or the proposed ATST Project	Currently used
Zodiacal Light	HO	1961	Remain as-is	Currently used
Cosmic Ray Neutron Monitor Station	HO	1961	Future to be determined	Currently used
Baker-Nunn Site	HO	1957	Remain as-is	Currently used
Faulkes Telescope Facility	HO	2003	Remain as-is	Currently used
Pan-STARRS, PS-1 South	HO	June 2007	Remain as-is (was formerly Lunar Ranging Experiment facility)	Currently used
PS-2 North, 2nd Facility	HO	2010	Remain as-is	Currently used
Maui Space Surveillance Complex	HO	1963	Remain as-is. Construction occurred over several years since 1963.	Currently used
SLR-2000	HO	No date	Reuse of site behind Mees facility for Laser Ranging	Proposed
Haleakalā Visitor Center Comfort Station	HO	2002	Upgrades to water and wastewater treatment system. Renovations occurred in 2002.	Currently used
FAA site adjacent to HO, Homeland Security tower	HO	2006	Remain as-is	Currently used
Advanced Technology Solar Telescope (ATST)	HO	2010	Reuse of Reber Circle or Mees site for the construction of a new telescope with a 4 meter (13.1-foot) aperture.	Proposed
Maui Electric Co., Inc.	HO	No date	Replace transformers, voltage regulators, upgrade and relocate substation for proposed ATST Project. Combined with the proposed ATST Project for effects.	Proposed upgrades
Hawaiian Telcom	HALE Road Corridor	2007	Repair to damaged/exposed conduits	Currently used

4.1 LAND USE

For the purpose of evaluating the cumulative effects of the MP on land use and existing activities, the ROI is the HO and a portion of the HALE road corridor next to the HO boundary, which provides access to HO. The temporal extent is 1961 when HO was an identified land user. Conservation land, for purposes of this analysis, is defined in the same way that it is in HAR 13-5, as follows:

- The placement or erection of any solid material on land if that material remains on the land more than fourteen days, or which causes a permanent change in the land area on which it occurs;

- The grading, removing, harvesting, dredging, mining, or extraction of any material or natural resource on land;
- The subdivision of land; or,
- The construction, reconstruction, demolition, or alteration of any structure, building, or facility on land.

There are intended uses within the various protective subzones of the Conservation District, such as open lands, watersheds, timberlands, etc, and there are uses that are permitted through OCCL within the protective rules, such as aquaculture, astronomy facilities, and commercial forestry. In the case of HO, the 18.166 acres within a Conservation District have been set aside for astronomy-related uses and development under the management of UH. The subzones and permitting are discussed in detail in Section 3.1-Land Use and Existing Activities. HAR 13-5 is designed to regulate land use within the Conservation District for the purpose of conserving, protecting, and preserving the natural resources of the State through appropriate management and use to promote their long term sustainability and the public health, safety, and welfare (HAR 13-5-1).

Since the rules were issued in 1994, all new facilities within HO that involve conservation land use (excluding interior renovation and reuse of lands) have required a CDUP. These permits involve a CDUA that require detailed effects analysis. In general, the permits are temporally limited (although often renewable) because the intent of the OCCL administering CDUPs is to return the land to its undeveloped conservation use when the permitted activity is completed.

The CDUPs for facilities at HO typically have attached terms and conditions requiring environmental and cultural/historic monitoring and mitigation measures, where required. For example, the CDUP for the FTF at HO requires maintaining a buffer zone between FTF activities and nearby archeological resources. Facilities built before the rules are similar in land use characteristics, e.g., grading and permanent changes. Therefore, by virtue of the variances granted to these non-conservation uses within the Conservation District, past and present facilities at HO may be considered to have at most less than significant impacts on intended land use and existing activities.

The two reasonably known future projects at HO are the construction of the minor SLR 2000 facility located behind the southwest side of the Mees facility and the proposed ATST Project. SLR 2000 would be located on a small site less than 900 square feet and would not alter land use or existing activities. The construction of the proposed ATST project would increase the level of existing telescope activities. While a separate analysis of land use resources for the proposed ATST Project describes specific impacts, it can be stated that this proposed project would be an incremental addition of approximately 4 percent to the use of Conservation District lands within HO and only a fraction of a percent of the total resource subzone. In consideration of these factors, if construction is approved, the proposed ATST Project is anticipated to result in less than significant cumulative impacts on land use.

Overall, the combined impacts of implementing the MP with all past, present, and reasonably foreseeable future actions would be less than significant.

4.2 CULTURAL, HISTORIC, AND ARCHEOLOGICAL RESOURCES

Cultural, historic, and archeological resources were evaluated within the ROI for the MP, which, for these resources, falls within HO.

It is acknowledged that there have been impacts on traditional cultural resources resulting from past and ongoing actions. In light of past, present, and reasonably foreseeable future actions, the impacts of the MP and other projects on cultural resources are an important consideration and must be addressed. Over the years, development at HO has displaced and damaged cultural resources. Since implementation of the LRDP in 2005, the IfA has made every effort to avoid irretrievable loss of resources previously used for spiritual and cultural practices, including restoration of resources (the two ahu) that had been destroyed elsewhere on Haleakalā (outside of HO).

While passive preservation is accepted by SHPD and there is a MP requirement for protecting archeological resources in the ROI, the effective loss from past actions prior to the implementation of State CDUP requirements is unknown. Those resources that remain, including any undiscovered sites, constitute an important source of information, a cultural legacy passed down from the traditional and early post-Contact periods.

There is no way to fully quantify the cumulative effects of past and ongoing action on traditional cultural practices and spiritual values. In consideration of these past and present actions, foreseeable future actions would result in readily detectable, localized effects, with additional consequences to traditional cultural practitioners within greater Hawaiʻi. The practices and procedures in the MP for cultural preservation are intended to be helpful and to reduce adverse impacts from routine management of the site. However, the cumulative impact of the MP, along with past and ongoing actions would still be adverse, but less than significant.

Individual projects that may have the potential for significant impacts on cultural resources would need to be analyzed to quantify those impacts, and to avoid, minimize, and mitigate those impacts where possible. For projects proposed or funded by Federal agencies, such as the proposed ATST Project, the Section 106 process discussed in Section 3.2.2-Factors Considered for Impacts Analysis is required.

With respect to historic resources, the Reber Circle site is the only historic resource within HO, which is an NRHP-eligible structure (Site 50-50-11-5443). Past and ongoing actions have resulted in less than significant impacts on this historic resource. Actions in the foreseeable future may include construction of the SLR 2000 facility and/or the proposed ATST Project, which would result in no adverse impacts to this historic resource. However, if Reber Circle is to be removed, an SHPD-approved data recovery plan (Appendices D(1) and D(2)) enforced by the requirements of the MP would be pursued. Therefore, the cumulative impacts of past, present, and reasonably foreseeable future actions would result in less than significant impacts to historic resources.

New impacts from projects listed in Table 4-1 (in particular, any future excavation) could affect archeological resources at HO. Possible future effects and measures to mitigate them would be considered in the environmental review documents completed for specific projects, such as SLR 2000 and the proposed ATST Project. Combined impacts may affect known (but not located) traditional cultural properties or areas of traditional importance. However, implementation of the MP for HO would not result in significant cumulative impacts on those resources.

Impacts on cultural resources resulting from implementation of the MP are expected to be less than significant. Therefore it would not substantially contribute to the adverse impacts from past, present, and reasonably foreseeable future activities on cultural resources. In addition, the MP would not combine with any other actions to produce incrementally different impacts on historic or archeological resources.

4.3 BIOLOGICAL RESOURCES

Past, present, and reasonably foreseeable future actions, combined with implementation of the MP, would impact biological resources. However, implementing the monitoring strategies and protection requirements in Section 3.5.3-Environmental Protection of Site Resources of the MP would minimize any potential impacts on those resources. These include:

1. Monitoring for AIS infestation
2. Prohibition on importation of fill materials unless it is sterilized
3. Training to prevent unwanted introduction of AIS
4. Prohibition on parking of heavy equipment outside confines of HO
5. Frequent removal of construction trash to discourage vermin
6. Measures to avoid disturbing, harassing, injuring, or killing endangered ‘ua‘u

A cumulative impacts analysis for biological resources would be completed for projects that are proposed at HO, such as SLR 2000 or the proposed ATST Project. Overall, the cumulative impacts on biological resources from implementation of the MP would be minor, resulting in a less than significant impact.

4.4 TOPOGRAPHY, GEOLOGY, AND SOILS

Past, present and reasonably foreseeable future actions combined with the beneficial impacts from implementation of the MP would have no impacts on geological resources in the ROI. The implementation of BMPs recommended in the SWMP for HO would minimize any potential impacts from erosion and off-site sedimentation. Future projects at HO, such as SLR 2000 and the proposed ATST Project, that may affect topography, geology and soils require that a cumulative impacts analysis would be completed. Past and ongoing actions at

HO have had a less than significant impact on soils from erosion and on topography from grading, and with the addition of the MP, overall, the incremental cumulative impacts to those resources would be less than significant.

4.5 VISUAL RESOURCES AND VIEW PLANE

The implementation of the MP would result in a beneficial impact on visual resources. However, past and ongoing actions at HO have had less than significant adverse impacts on visual resources and the existing visual character, or quality of the site and its surroundings and light or glare. The implementation of requirements in Section 3.5.4-Facility Design Criteria of the MP are intended to minimize such visual impacts, so that the impacts would continue to be less than significant on visual resources. The cumulative impact from past, present, and known foreseeable future actions in addition to implementation of the MP would still be less than significant.

Future projects could involve impacts similar to or greater than current impacts of HO on visual resources. The proposed ATST Project is a project that would have adverse impacts on visual resources beyond those addressed in the MP, and those have been analyzed elsewhere (ATST 2009).

4.6 HYDROLOGY

The implementation of the MP would have beneficial impacts on hydrology, as described in Section 3.6-Hydrology, above. Past and ongoing actions have had less than significant impacts on hydrology, and along with reasonably foreseeable future actions and implementation of the MP there would be less than significant impacts on hydrology. If projects are identified in the future at HO that would impact hydrologic resources, a cumulative impacts analysis would be completed. Overall, the cumulative impacts to hydrology from implementation of the MP would be minor, resulting in a less than significant impact.

4.7 INFRASTRUCTURE AND UTILITIES

Stormwater and Drainage Systems

Runoff from the impervious surfaces associated with HO facilities and nearby roads has not been likely to increase the total volume of stormwater flow entering natural drainages, although it may have affected the way it is transported there (UH IfA 2005a). Past and present actions at HO have had less than significant impacts on stormwater and drainage systems. However, due to inadequate maintenance of runoff pathways within HO between 2002 and 2006, soil erosion occurred that changed local water drainage and infiltration patterns on Kolekole, at least in the short term. Since the SWMP was implemented in 2006 (Appendix I), present actions have not resulted in local erosion or drainage issues. Also, within HO, minor adverse impacts on stormwater systems have occurred from surfaces, such as roads, buildings, and parking lots, directing flow off Kolekole and causing minor soil erosion at HO. In recent years, sheet flow has been redirected at both the north and south sides of Kolekole to minimize such effects.

The two known potential future projects—SLR 2000 and the proposed ATST Project—would not have significant impacts on runoff or drainage patterns. The proposed ATST Project facility design includes stormwater capacity and path configuration that would tie it into the operating drainage system for HO (ATST 2009). As such, changes to runoff are not expected to increase and no measurable or perceptible consequences on the existing stormwater management system or drainage patterns would result.

The implementation of the MP would have no impacts on stormwater and drainage patterns. Therefore, overall cumulative impacts of past, present, and reasonably foreseeable future actions at HO, combined with the requirements of the MP to maintain proper stormwater and drainage, would be less than significant.

Domestic Wastewater

There is no centralized means of sewage disposal within HO. Septic tanks have been used since at least the first facilities were installed at HO in 1963. Most facilities at HO have their own septic systems and these generally have either simple cesspools or separation tanks and leach fields. Occasionally, throughout the history of HO, some of these systems have needed to be serviced via off-site waste removal contractors. Construction of the SLR 2000 would have no effect, since it would not require connectivity to cesspools. However, the proposed ATST Project would likely result in a beneficial change in effluent quality that, along with present and past actions at HO and adjacent neighbors, would constitute a minor, beneficial impact on wastewater generation (ATST 2009).

The implementation of the MP would have no impacts on domestic wastewater. Therefore, overall cumulative impacts of past, present, and reasonably foreseeable future actions at HO, combined with the MP would be less than significant with respect to wastewater, and in the event that ATST is approved, the impact on wastewater would be minor, but beneficial.

Electrical and Communication Systems

MECO generates electricity for HO. There have been minor upgrades since 1963, including newer substation components on the north side during the 1990s. Past and present actions at HO have used and continue to use considerably less than the current reserve capacity of the main power line to Haleakalā, which is estimated by MECO to be approximately 1,900 kilovolt amperes. As such, overall, the cumulative impacts on electrical systems from past and present actions at HO have been less than significant.

Hawaiian Telcom provides telephone and other communications services for the HO complex. Over the years, HO communications have been upgraded by new technologies, and they are currently served for data and telephone connectivity by a range of copper, fiber-optic, and microwave lines. The U.S. Air Force facilities are served by a dedicated fiber cable with OC3C capacity. The IfA facilities are served by a microwave link with DS3 capacity. Hawaiian Telecom provides commercially available copper and fiber-optic lines to HO. With more than 100 percent reserve capacity, these communication links result in less than significant on communications within HO.

The two potential projects at HO in the reasonably foreseeable future would not have significant impacts on electrical or communications systems. SLR 2000 would require only minimal electrical supplies, roughly the same as one household; however, if approved, the proposed ATST Project would require complex electrical and communication systems that require cumulative analysis for impacts on current capacities.

The implementation of the MP would have no impacts on electrical and communication systems. Therefore, overall, the cumulative impacts of past, present, and reasonably foreseeable future actions at HO (excluding the proposed ATST Project), combined with the Proposed Action with respect to electrical and communication systems, would be less than significant.

Roadways and Traffic

The Park road is traveled by upwards of 1.7 million persons each year as the only route to the summit for visitors and HO users. The road also experiences extremes of weather throughout the year and, therefore, the condition of the Park road is the result of a combination of factors that include travel to and from HO. A 2003 traffic study included in the LRDP showed an average daily total traffic volume of 48 vehicles entering and leaving HO. That approximate number has not changed substantially since about 1995, when AEOS, the last major facility, became operational at HO. Prior to AEOS construction, HO contributed smaller numbers of vehicles to the traffic on the Park road. HO traffic constitutes approximately 5 to 10 percent of the daily traffic, depending on the day of the week.

The road within HO is used exclusively by those going to and from HO. Traffic patterns and parking have been modified over the years to accommodate new facilities and security concerns. However, with less than 50 cars each day using the roadway, it has not required much surface maintenance other than berms and shoulder work for stormwater control. The past and present actions at HO have resulted in less than significant impacts on the condition of the HO roadway.

State Road 378, the State-maintained portion of the Haleakalā Crater Road, is the access road that begins at the Haleakalā Highway (State Road 377) and Kekaulike Road junction to the entrance of the HALE. State Road 378 has been used for access to HO through HALE since 1961. Traffic on this road was measured by the Hawaiʻi DOT in a recent traffic survey on September 19 and 20, 2007 (DOT 2007). State Road 378 was reported to have total, two-way, 24-hour traffic of 1,439 vehicles (September 19, 2007) and 1,562 vehicles (September 20, 2007) in the traffic count conducted by the DOT. The traffic from past and present actions at HO constitutes approximately 3 percent of that volume, which is small enough to be considered less than significant with respect to impacts on that roadway.

There are two other access roads that serve the Haleakalā summit area. The FAA maintains a non-exclusive access road to facilities in the Saddle Area and the FAA Low Site. There is also an unimproved access road known as Skyline Drive, which originates at the Saddle Area and traverses the Southwest Rift zone, ultimately leading to Spring State Recreation

Area (also known as Polipoli State Park) (DLNR 2008). Its entire length is within State land and most of it is within the fog belt of the Kula Forest Reserve. Approximately half of Skyline Drive is in the Limited Subzone of the State Conservation District and the remaining half in the Resource Subzone. A locked gate near the Saddle Area restricts vehicle access to the road from the Haleakalā summit to those holding DLNR permits. Hikers, hunters, and bicyclists use the unpaved road. The slopes along the existing road range from flat to 28 percent. Due to the steep grades, tight turns, and soft roadbed conditions of this access road, it is not appropriate for the range of vehicles necessary for construction, maintenance, and operation of HO facilities and this road has experienced less than significant impacts from past and present actions at HO.

The implementation of the requirements described in the MP would result in less than significant cumulative impacts on roadways and traffic.

4.8 Air Quality

Past, present, and reasonably foreseeable future actions, directly and indirectly impact air quality. Implementation of the MP would not have any new impacts, although implementing measures such as those described in Section 3.5.3.2-Construction Practices of the MP would minimize any potential impacts in the future. Reasonably foreseeable future projects that would affect air quality during construction or operations would be required to conduct a cumulative impacts analysis. The potential future SLR 2000 project at HO would likely have no effect on air quality, while the proposed ATST Project, if approved, would provide analysis of cumulative impacts to air quality during construction and operations (ATST 2009). The cumulative impacts on air quality from implementation of the MP would be minor, resulting in a less than significant impact.

4.9 Public Health

Hazardous Materials

Recently completed projects require the use of hazardous materials during construction and operations, with commensurate increases in the amounts of hazardous materials brought to HO. Past actions at HO have resulted in only one recorded spill since 1961. On September 11, 1999, a subcontractor working at MSSC released 330 gallons of a 20 percent mixture of propylene glycol and water into the cinders and rock. To date, there have been no spills or releases at any of the other facilities on HO (Shimko 2005).

The MP imposes construction constraints, such that no oil or chemicals may be used at the site for dust control. While the contribution of future facilities would likely be negligible, in keeping with the minimal use of such materials by astronomical facilities, there would be an added risk from and volume of hazardous materials, when combined with the past, present, and reasonably foreseeable future actions at HO, such as SLR 2000 and the proposed ATST Project, the cumulative impacts including implementation of the MP, would still be less than significant.

Solid Waste

With respect to solid waste, the remote location of HO has required certain practices and procedures. Each facility has its own trash receptacle and each facility's building maintenance personnel are responsible for trash collection. Non-hazardous trash is disposed of off-site in a licensed landfill, with computer paper and aluminum being recycled (UH IfA 2001).

At IfA, approximately four to five bags of solid waste are produced from the MSO facility and other facilities at HO under the jurisdiction of the Atmospheric Airglow facility, the Zodiacal Observatory, and the FTF. Municipal solid waste from MSSC, such as food trash, is collected twice a week for off-site disposal at the central Maui Landfill. Other wastes associated with MSSC operations and maintenance, such as used oil, are collected in containers within the AEOS facility and are transported off-site for disposal as non-hazardous waste. Amounts of solid waste vary, with MSSC as the largest producer, generating 3,335 pounds of non-RCRA waste in fiscal year 2004 (Shimko 2004). These amounts are a small fraction of the total daily capacity permitted at the receiving landfill in central Maui, which accepts approximately 450 tons per day.

In accordance with MP requirements, construction contractors would remove construction trash frequently, particularly food sources that could increase the population of mice and rats. Most construction waste would be removed in roll-off trash receptacles that would be covered before transport. During demolition and construction, solid waste requiring disposal would be generated. Construction waste and debris would be secured to minimize windblown materials, particularly during off-hours. The amount of demolition and construction debris generated by the proposed facilities is expected to be minimal, with only a small effect on waste streams; however, the short-term cumulative effects on the solid waste management from implementation of the MP, along with past, present, and reasonably foreseeable future actions would be minor and less than significant.

After completion, solid waste generated from future projects would be carried out of the building by facility workers and kept in covered refuse containers. Non-hazardous trash and recyclable material would be disposed of at Maui's licensed landfill. There would be no change in the long-term solid waste disposal practices from future actions, although solid waste generation would increase. When operational, the proposed facilities are expected to have negligible adverse impacts on waste disposal. Overall, while these amounts are considered small, when added to the small quantities generated by past, present, and future known activities within HO, the combined long-term cumulative impacts would be less than significant.

Noise

Past and present actions have resulted in a small continuous ambient noise level increase within HO, which can be attributed primarily to the increased traffic to facilities at HO since 1964. Additional short-term noise increases have occurred as a result of construction and installation associated with the activities. General operations of telescope facilities are inherently low-noise activities and have made a negligible contribution to the ambient noise level.

The current ambient noise level within HO is low, but some users of Haleakalā may be particularly noise sensitive. In particular, cultural practitioners within the immediate vicinity of a noise source could be disturbed. Most disturbances are low level discrete events rather than a substantial increase in the overall ambient noise level. In general, current noise levels are compatible with existing activities.

Reasonably foreseeable future actions within HO would require analysis of noise impacts from construction and operations. Section 3.5.3.2-Construction Practices of the MP provide requirements for avoiding, minimizing and mitigating noise from potential future construction activities. Future potential projects could result in construction noise that has an adverse impact on cultural resources and on visitors to the summit area, whose expectations of a natural soundscape may not be met. These projects would require noise analysis to evaluate the cumulative contribution to noise from past and present HO activities.

The implementation of the MP would have some beneficial, impacts to baseline noise levels from implementation of noise reduction requirements for any construction activity. Therefore, overall, the cumulative impacts of past, present, and reasonably foreseeable future actions at HO, combined with the requirements of the MP for noise management, would be less than significant.

4.10 SOCIOECONOMICS

Population and Housing

Negligible impacts on population and housing have been associated with past or present actions at HO. Although approximately 195 people on Maui are directly employed through activities at HO (County of Maui 2005) these employees have not increased the demand for housing, given that a majority are drawn from the local Maui population. As much as possible, many employment positions are filled from the growing number of available qualified Maui-based individuals. There has been no displacement of residents in their communities and demand for housing can be accommodated with existing vacant housing units. Therefore, there has been a negligible impact on population and housing. Potential impacts on population and housing resulting from the implementation of the MP would be minor and of little consequence. When added to past, present, and reasonably foreseeable future actions at HO, the cumulative impact of the MP would be less than significant.

Employment, Economics, and Income

The past and present actions at HO have had minor, beneficial, and long-term impacts on local economy and employment because these activities have contributed to the Maui-based technical industry through well-paying jobs that are generally stable and do not have high turnover rates. Some employees at HO have more than thirty years of service. In addition nearly 2,000 people on Maui perform services and provide materiel for direct use at HO. These include subcontractors, vendors, repair services, and others (UH IfA 2009).

The implementation of the MP is anticipated to have further, cumulative beneficial effects on employment, economics and income.

Education and Outreach

The past and present actions at HO have had minor, beneficial, and long-term impacts on the schools within the ROI. Section 2.10.2-Resources Overview describes the numerous educational and professional outreach programs that have been offered in the Maui community by the participating agencies at HO. The implementation of the MP is expected to result in further, cumulative beneficial effects on education and outreach.

Environmental Justice

HO is located in a Conservation District where no urban or rural population or housing is permitted. It is not in a predominantly minority or low-income community, so none of the activities have disproportionately affected minority or low-income groups. The MP does not alter that result, and therefore there is no additional cumulative impact on environmental justice.

Protection of Children from Environmental Health or Safety Risk

The past and present actions at HO have not had disproportionate health and safety impacts on children. Impacts have been negligible and changes so small that they are not measurable or perceptible consequences. HO is close to HALE, where children may be present; however, since HO is not open to the public, unescorted and unauthorized children cannot gain access to the site to potentially suffer any mishaps. Children are only allowed into HO accompanied by adults and supervised as part of a visiting group to HO facilities. The MP continues this policy and therefore the cumulative impact on children would continue to be negligible.

4.11 NATURAL HAZARDS

The implementation of the MP would result in no impacts involving exposing people or structures to earthquake movement, exposing people or structures to storms and hurricanes, extreme temperatures, and snow and ice, and placing people in situations where hypoxia can occur. When considered along with past, present, and reasonably foreseeable future actions, there would be only minor increase in risk from natural hazards at HO. In consideration of the risks, future projects would be required to be designed such that they would minimize potential adverse impacts including structural damage to facilities from wind, storm floods, earth movement, ice and other natural events, vehicular accidents, and personnel requiring medical treatment for illness (*see* Appendix K, Section 3.5.4-Facility Design Criteria) Thus they would not contribute more than very little to risk from those hazards, and the cumulative impact from implementation of the MP would be less than significant.

4.12 ANTICIPATED DETERMINATION

Based on the foregoing analyses of the information contained in this DEA, UH is anticipating that the Proposed Action will not have a significant impact on the environment within HO. Accordingly, UH anticipates that it will issue a FONSI for the Proposed Action.

This anticipated determination will be reviewed after all comments on the DEA are received. At that time, UH will either issue a FONSI or will prepare an EIS.

CHAPTER 5
OTHER REQUIRED ANALYSES

5.1 INTRODUCTION

In addition to the analyses presented in Chapters 3 and 4, HRS 343 requires additional evaluation of the project's impacts with regard to the following:

- The relationship between local short-term uses of the environment and long-term productivity; and,
- Any irreversible or irretrievable commitment of resources.

HRS 343 also requires that a DEA discuss the agencies consulted during preparation of the document.

5.2 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

There would be no short-term damage to the environment relating to the implementation of the MP.

The long-term productivity of the Proposed Action are based on the UH IfA's mission to carry out its own program of fundamental research into the stars, planets and galaxies that make up our Universe. The implementation of the MP is designed to meet these goals and further the quality and welfare of its staff and the natural environment.

5.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

HRS 343 requires an analysis of the extent to which the proposed project's primary and secondary effects would commit non-renewable resources to uses that would be irretrievable to future generations.

Implementing the Proposed Action would not by itself require committing both renewable and non-renewable energy and material resources for HO operations, such as the fuel used by vehicles; the increases in water, power, and other resources necessary to maintain and operate facilities; or an increase in local resources required to support HO.

5.4 AGENCY CONSULTATION

The following agencies were consulted in preparation of this document:

<table>
<tr><td rowspan="15">State of Hawaiʻi</td><td colspan="2">Department of Accounting and General Services Public Works</td></tr>
<tr><td colspan="2">Department of Accounting and General Services Public Works,
Information and Communications Services Division</td></tr>
<tr><td colspan="2">Department of Business, Economic Development and Tourism,
Office of Planning, Land Use Division</td></tr>
<tr><td colspan="2">Dept. of Hawaiian Homelands, Land Management Division (Non-Homestead)</td></tr>
<tr><td colspan="2">Dept. of Health, Clean Water Branch</td></tr>
<tr><td colspan="2">Dept. of Health, Office of Environmental Quality Control</td></tr>
<tr><td colspan="2">Dept. of Health, Wastewater Branch</td></tr>
<tr><td colspan="2">Dept. of Land and Natural Resources, Division of Forestry and Wildlife</td></tr>
<tr><td colspan="2">Dept. of Land and Natural Resources, Island Burial Council</td></tr>
<tr><td colspan="2">Dept. of Land and Natural Resources, Land Division</td></tr>
<tr><td colspan="2">Dept. of Land and Natural Resources, Maui Na Ala Hele Advisory Council</td></tr>
<tr><td colspan="2">Dept. of Land and Natural Resources, Office of Conservation and Coastal Lands</td></tr>
<tr><td colspan="2">Dept. of Land and Natural Resources, State Historic Preservation Division</td></tr>
<tr><td colspan="2">Department of Transportation</td></tr>
<tr><td colspan="2">University of Hawai'i Institute for Astronomy</td></tr>
<tr><td rowspan="3">Maui Commercial Organizations</td><td>Boeing LTS</td><td>Maui Electric Company, Inc.</td></tr>
<tr><td>Hawaiʻi Telecom</td><td>Raycom Media, Inc.</td></tr>
<tr><td>Maui Economic Development Board</td><td>Sandia Laboratories</td></tr>
<tr><td>Federal</td><td colspan="2">Federal Aviation Administration
National Park Service, Haleakalā National Park</td></tr>
</table>

UH IfA will go through the process of obtaining a Conservation District Use Permit and will be filing the necessary applications in the event future projects are proposed within HO and are subject to the requirements of HAR 13-5.

CHAPTER 6
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CHAPTER 7
LIST OF PREPARERS

KC Environmental, Inc.
P.O. Box 1208
Makawao, Hawai‘i 96768
(808) 573-1903

Tetra Tech, Inc.
737 Bishop Street, Suite 3020
Honolulu, Hawai‘i 96813
(808) 533-3366

Name	Role	Years of Experience
KC Environmental, Inc.		
Charlie Fein, Ph.D.	Vice President	41
Sharon Loando-Monro	Planning Projects Manager	32
Tetra Tech, Inc.		
George Redpath	Project Manager	34
Interdisciplinary Team		
Jenny Benz	Biological Resources, Air Quality	15
Derek Holmgren	Visual Resources and View Plane, Natural Hazards	9
Dawn Lleces	EA Manager/Deputy Project Manager Land Use and Existing Activities Cultural, Historic, and Archeological Resources	7
Marleina Overton	EA Manager/Deputy Project Manager Topography, Geology, and Soils, Hydrology, Socioeconomics	9
Chad Ricklefs	Infrastructure and Utilities, Public Health and Safety	7
Administrative Support		
Cindy Schad	Word Processor	16
John Flournoy	Word Processor	7
Randolph Varney	Technical Editor	18