STATE OF HAWAI`I
DEPARTMENT OF LAND AND NATURAL RESOURCES
OFFICE OF CONSERVATION AND COASTAL LANDS
Honolulu, Hawai`i

January 26, 2018

Board of Land and
Natural Resources
State of Hawai`i
Honolulu, Hawai`i

REGARDING: **Board Briefing on Maunakea Management**

1. 2017 Annual Report on the Status of the Implementation of the Maunakea Comprehensive Management Plan (CMP)
2. Update on decommissioning plans for Maunakea observatories
3. Update on the status of proposed revisions to the Maunakea CMP
4. Update on the status of proposed administrative rules for Maunakea
5. Update on the status of the EIS for new land authorizations on Maunakea
6. Review of the July 2017 report from the State Office of the Auditor

PERMITTEE: University of Hawai`i at Hilo

LANDOWNER: State of Hawai`i

UNIVERSITY LEASES: General Lease S-4191 for the Maunakea Science Reserve
General Lease S-5529 for Halepōhaku
Grant of Easement S-4697 for the Maunakea Access Road

LOCATION: Ka`ohe, Hāmakua District, Hawai`i

TMK: (3) 4-4-015:009 (Maunakea Science Reserve)
(3) 4-4-015:012 (Halepōhaku)

AREA OF PARCELS: approximately 11,288 acres (Maunakea Science Reserve)
19.3 acres (Halepōhaku)

SUBZONE: Resource

I. EXECUTIVE SUMMARY

The Office of Conservation and Coastal Lands is presenting this report on Maunakea Management as a "non-action" briefing. In particular it will focus on the status of the development of the Maunakea Comprehensive Management Plan and its associated subplans. We have included a map of the University-managed lands on Maunakea as **Exhibit 1**, and a map of the observatories on the summit as **Exhibit 2**.

On April 9, 2009, the Board of Land and Natural Resources approved the Maunakea Comprehensive Management Plan (CMP) for the Maunakea Science Reserve, including Halepōhaku and the Summit Access Road, Ka`ohe, Hāmakua District, Hawai`i

On March 25, 2010, the Board approved four associated resource subplans which elaborated on the management actions contained in the CMP. The four plans were the Natural Resource Plan, Cultural Resources Management Plan, Public Access Plan, and Decommissioning Plan.

Section V of this report contains more background on these subplans. It also provides brief updates on active issues involving public access, enforcement issues, commercial tours, and the decommissioning of observatories.

A condition of the CMP is that the permittee provide the Board with an annual written update on the status of the development of the management plan and subplans. The 2017 Annual Report is attached to this submittal as **Exhibit 3.** Related to this, we have included the University's 2006 report to the legislature on the long-term development of Maunakea as **Exhibit 4.**

OCCL is taking this opportunity to present updates on three interrelated items:

- Updates to the Maunakea Comprehensive Management Plan (Section V -F)
- Proposed new Administrative Rules for Maunakea (Section VI)
- New land authorizations on Maunakea (Section VII).

In addition, this report will review current University actions on some of the special conditions attached to the Decision and Order for the Thirty Meter Telescope (Section VIII). A summary provided by the University on Thirty Meter Telescope's THINK Fund & Workforce Pipeline Program is attached as **Exhibit 6**.

Finally, we will review the July 2017 Follow-up Report on Maunakea Management released by the State Office of the Auditor (Section IX). The report is attached to this submittal as **Exhibit 5.**

OCCL has created an online library for public documents relating to the management of lands on Maunakea at dlnr.hawaii.gov/occl/maunakea-management. The library contains Conservation District Use Permits and Applications, the Comprehensive Management Plan, sub-plans, and annual reports, and reports from the State Office of the Auditor. The current contents of the library are shown in **Exhibit 7**.

We have invited a representative from the Office of Maunakea Management to give a brief presentation to the Board on the 2017 Annual Report. Representatives from DOFAW, DOCARE, Land Division, SHPD, and OCCL will also be present following the briefing to answer any questions the Board might have.

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II. BACKGROUND: THE MAUNAKEA SUMMIT

For the sake of clarity, OCCL will use the following terms for the summit region in this report:

The ***summit plateau*** is the alpine desert ecosystem 3900 meters above mean sea level. The slope shifts abruptly here, from approximately 27% downslope to less than 10% on the plateau. Geological evidence indicates that this broad, circular region was formed by remnant lava flows in the former caldera, and subsequently sculpted by glaciers. The plateau itself varies only approximately 100 meters in elevation, but it is dotted with scattered cinder cones that rise 30 to 180 meters above the surface of the plateau. Other significant geological features are the outcrops of hawaiite, an olivine basalt formed via the interaction of glacial ice and hot lava, and prized for adze making; the alpine Lake Waiau; and remanant glacial from previous episodes of glaciation in the summit region. The highest point is 4205 meters.

> ***Pu'u o Kūkahau`ula*** is the traditional name for the cluster of cones and ridgelines that are above 4080 meters. The names of the individual cones, Pu`uwēkiu, Pu`ukea, and Pu`uhau`oki, are believed to be more recent cartographic designations.
>
> The State Historic Preservation Division identifies Kūkahau`ula, as well as Lake Waiau and Pu`u Līlīnoe on the summit plateau, as *traditional cultural properties.* This area has a strong association with Hawaiian folklore and mythology.
>
> The ***north plateau*** is the portion of the summit plateau to the north of Kūkahau`ula, identified as the Great Rocky Table Summit in an 1891 government survey.

The ***lower summit region*** is the alpine shrub and grassland ecosystem above the tree line at 2900 meters. OCCL notes that the record indicates that the tree line has shifted down-slope since the introduction of cattle.

Maunakea's ***lower slopes***, from approximately 2000 meters to the tree line, is composed of a māmane-naio forest.

This report will focus on land uses and management for areas above 2700 meters.

A note on spelling: The UH School of Hawaiian Language recommends spelling Maunakea and Halepōhaku as one word. The Office of Maunakea Management adopted the one-word spelling in 2013. This report will follow this format unless the two-word spelling (Mauna Kea) is part of a proper name or direct quote.

III. BACKGROUND: MAUNAKEA ADMINISTRATIVE UNITS

A. Administrative Units

The Department of Land and Natural Resources (DLNR) managed areas in the summit region and upper slopes of Maunakea are the Mauna Kea Natural Area Reserve and the Mauna Kea Forest Reserve. The University of Hawai‘i managed areas are the Maunakea Science Reserve, the Halepōhaku Midlevel Facilities, and the Maunakea Access Road between Halepōhaku and the summit.

The lower slopes of Maunakea also contain lands managed by or under the jurisdiction of the Department of Hawaiian Homelands, the U.S. Army (Pōhakuloa Training Area), and the U.S. Fish and Wildlife Service (Hakalau Forest National Wildlife Refuge). The County of Hawai‘i maintains the Access Road below Halepōhaku.

Mauna Kea Forest Reserve: The Forest Reserve encompasses 52,500 acres, and is under the jurisdiction of DLNR’s Division of Forestry and Wildlife (DOFAW). The māmane forest here is critical habitat for the federally listed palila.

Mauna Kea Ice Age Natural Area Reserve: The 2033-acre reserve was created in 1981. It is managed by DOFAW’s Natural Area Reserve System. Among its unique geological and cultural features are the Keanakakoi adze quarry, Lake Waiau, and Pu‘u Pōhaku). The Mauna Kea NAR is bounded by the Science Reserve and the Mauna Kea Forest Reserve.

The Maunakea Science Reserve is an 11.288-acre State-owned leased by the University of Hawai`i under General Lease S-4191, with day-to-day management delegated by the Board of Regents to the Office of Maunakea Management (OMKM). It contains most land within a 2.5-mile radius of the site of the UH 2.2-m telescope – in effect, all land above 3700 meters in elevation except for a pie-shaped wedge set aside as the Mauna Kea Ice Age Natural Reserve. The Science Reserve also includes a section in the lower summit region where the Very Long Baseline Array is located.

Halepōhaku is a 19.3-acre State-owned parcel below the summit region leased to the University of Hawai‘i through 2041 under General Lease No. S-5529, which describes the character of use as “premises leased to be used solely for permanent mid-level facilities, a construction camp, an information station as well as existing facilities purposes.” It is the site of the Onizuka Center for International Astronomy (Halepōhaku Mid-Level Facilities).

The portions of the **Summit Access Road** that extend from Halepōhaku to the boundary of the Science Reserve is also under UH management. This includes a 400-yard corridor on either side of the road, excluding those areas within the adjacent Mauna Kea Ice Age Natural Area Reserve.

The University’s 2000 Master Plan proposed the creation of an astronomy precinct encompassing approximately 525 acres of the overall Science Reserve. Although the Master Plan was never formally adopted, the term ‘astronomy precinct’ continues to be used informally in planning documents.

B. DLNR Management Responsibilities

The **Division of Forestry and Wildlife** (DOFAW) manages the Mauna Kea Forest Reserve, as well as outdoor recreation programs, trail and access systems, and the hunting program.

Land Division is charged with the management and enforcement of leases, permits, executive orders, and other encumbrances.

The **Office of Conservation and Coastal Lands** (OCCL) is responsible for the permitting and regulating of land uses in the Conservation District. Conservation District Use Applications are processed by OCCL, although the Board of Land and Natural Resources has the final authority to modify, grant, or deny permits. OCCL is also responsible for investigating potential land use violations and permit violations.

The **State Historic Preservation Division** (SHPD) is charged with preserving and protecting historically and culturally significant properties as outlined in the National Historic Preservation Act, the Statewide Historic Preservation Plan, and Chapter 6E of the Hawai‘i Revised Statutes. SHPD-managed programs include: Statewide Inventory of Historic Properties, Burial Sites Program, Certified Local Government Program, National Main Street Program, Historic Preserves Program, Information and Education Program, Interagency Archaeological Services, and maintenance of the Hawai‘i and National Register of Historic Places. SHPD also reviews proposed development projects to ensure minimal effects of change on historic and cultural assets.

The **Hawai‘i Island Burial Council** (HBC) falls under the jurisdiction of SHPD, and is responsible for the management of all human remains over fifty years old. Burial protection plans and burial treatment plans on Maunakea are required to be done in consultation with the HBC.

The **Division of Conservation and Resource Enforcement** (DCOARE) is responsible for enforcing all laws and rules that apply to lands that are managed by DLNR. Pursuant to Act 226 Session Laws of Hawai‘i 1981, DOCARE’s enforcement officers have full police powers to execute all state laws and rules within all state lands.

C. University Management Structure

The BLNR approved a Project Development Implementation Framework on February 18, 2010 that established a new management structure for the Science Reserve. The framework was based on the 2000 Mauna Kea Science Reserve Master Plan. The management structure now consists of:

- **The Office of Maunakea Management (OMKM):** The office is charged with the day-to-day management of the Maunakea Science Reserve as prescribed in the Master Plan, and reports directly to the UHH Chancellor.
- **Maunakea Management Board:** An advisory body comprised of seven members of the community who are nominated by the UH Hilo Chancellor and approved by the UH Board of Regents.
- **Kahu Kū Mauna Council:** A nine-member Native Hawaiian council appointed by the Board, and that advises the Board and Chancellor on cultural matters and issues

In addition, OMKM coordinates several advisory committees, including an Environment Committee and a Wēkiu Bug Scientific Committee.

The University’s **Institute for Astronomy** (IfA) is responsible for conducting and coordinating astronomical research in the Science Reserve.

The **Maunakea Observatories Oversight Committee** is funded by the observatories, and contains representatives from each observatory as well as IfA. The funds are used to fund road maintenance, snow removal, facilities maintenance, management at the midlevel facilities, the Visitor Information Center, weather forecasting, and other common activities affecting the observatories.

The **Maunakea Observatories Support Services (MKSS)** oversees the Visitor Information Station, provides administrative support for the weather center and communication system, and operates the food and lodging at Halepōhaku. MKSS provides administrative support to OMKM for the Maunakea Ranger program.

The **Maunakea Ranger Program** was established in 2001 to provide daily oversight on University-managed lands. The rangers help educate the public about the natural and cultural resources of Maunakea, advise visitors of the hazards of high-elevation travel, safe driving information, and participate in search and rescue operations. In addition, they report potential violations of DLNR rules in the surrounding Forest Reserve and Mauna Kea Ice Age Natural Area Reserve. Other duties include conducting trail maintenance, invasive species removal, coordinating litter removal, and assisting with research on the summit. Rangers conduct daily patrols of Kūkahauʻula, and assist DLNR with monthly patrols and trash pick-up at Lake Waiʻau, and periodic patrols to the Keanakakoi adze quarry, both part of the NARS.

There are currently eight full-time and three part-time rangers.

IV. BACKGROUND: MAUNAKEA BUILT ENVIRONMENT

There are currently thirteen observatories in the Maunakea Science Reserve: nine optical/infrared observatories[1] and three radio observatories[2] on Kūkahauʻula, and one radio observatory[3] in the lower summit region. A permit has been issued for one optical / infrared observatory[4] for the northern plateau in the Maunakea Science Reserve.

Two these telescopes are non-operational. The Caltech Submillimeter Observatory (CSO) was no longer scientifically competitive once the Atacama Large Millimeter/Submillimeter Array came online in Chile in 2011. Caltech has filed a Notice of Intent to Decommission, and has begun pre-assessment consultation and scoping for the decommissioning of the observatory. The UHH 0.9-m telescope, Hōkū Keʻa, is also non-operational. The University has filed a Notice of Intent to Decommission this telescope. The remaining observatories remain scientifically competitive.

A. Observatories

University of Hawaiʻi 2.2-meter Telescope (UH2.2)

The University of Hawaiʻi 2.2-meter telescope (UH2.2) was built in 1968 and became operational in 1970, making it the first large telescope built on the summit of Maunakea. It is currently owned and operated by the University of Hawaiʻi.

UH2.2 is the primary telescope used by UH professors, postdocs, and graduate students. In 1991 scientists discovered the first Kuiper Belt object, and in 1992 a team discovered forty-five of the known moons of Jupiter and additional moons on the outer planets. Current science includes an integral field spectrograph devoted to the observation of supernovae.

BLNR approved CDUP HA-954, an 'after-the-fact' permit, for the telescope in September 1977.

[1] UHH 0.9m Telescope (Hōkū Keʻa), UH 2.2-m Telescope, NASA Infrared Telescope Facility (IRTF), Canada-France-Hawaiʻi Telescope (CFHT), United Kingdom Infrared Telescope (UKIRT), W.M. Keck Observatory (Keck I and II), Subaru Telescope, and Gemini North Telescope.

[2] Caltech Submillimeter Observatory (CSO), James Clerk Maxwell Telescope (JCMT), and the Submillimeter Array (SMA)

[3] Very Long Baseline Array (VLBA)

[4] Thirty Meter Telescope (TMT)

UH Hilo Hōkū Ke`a Educational Observatory

The original 0.6-meter telescope on this site was built by Air Force Cambridge Research Laboratories in 1968. Ownership was ceded to the UH Institute for Astronomy in June 1970, and transferred to the UH Hilo Department of Physics in 2003.

The original telescope was decommissioned in 2008, and a 0.9-meter telescope named Hōkū Ke'a was installed in its place. This telescope never achieved first light. A 0.7-meter replacement for Hōkū Ke'a was purchased in 2015, but before it was installed the University of Hawai'i at Hilo decided to decommission the site to comply with Governor David Ige's Ten Point plan for the Maunakea summit. UH Hilo is currently looking for a permanent site to locate the observatory.

BLNR approved CDUP HA-954, an 'after-the-fact' permit, for the telescope in September 1977. The University filed a Notice of Intent to decommission the site in February 2016.

Canada-France-Hawai'i Telescope (CFHT)

The CFHT is 3.6-meter optical telescope developed jointly by the University of Hawai'i, the Centre National de la Recherche Scientifique (France), and the National Research Council of Canada. The University of Hawai`i provides ten percent of the operating costs and one full-time staff person for CFHT as part of the telescope's tri-partite agreement.

Current science includes studies of the winds of Venus, detection of exoplanets, observations of interstellar dust, and the tracking of the interstellar asteroid 'Oumuamua.

Approximately 15% of the observing time is dedicated to the University of Hawai'i.

BLNR approved CDUP HA-527 for the telescope in 1974, and it began operations in 1979.

NASA InfraRed Telescope Facility (IRTF)

The IRTF is a 3-meter telescope that was initially built to support the Voyager missions to Jupiter, Saturn, Uranus, and Neptune. It is currently operated by the University of Hawai'i under a contract with NASA.

Current science includes research on the aurora on Saturn, observations of ozone on Mars, spectral monitoring, and observations of the moons of the outer solar system planets. The facility continues to provide support for NASA missions.

Approximately 15% of the observing time is dedicated to the University of Hawai'i.

BLNR approved CDUP HA-653 for the facility in 1975. It became operational in 1979.

United Kingdom Infrared Telescope (UKIRT)

BLNR approved CDUP HA-653 for the facility in 1975. It became operational in 1979. The University has discussed decommissioning UKIRT in accordance with Governor Ige's Ten Point Plan for Maunakea.

The 3.8-meter UKIRT is the second largest dedicated infrared telescope in the world. UKIRT was originally owned by the United Kingdom. Ownership was transferred to the University of Hawai'i in 2014. It was then funded by NASA until June 2017, and operated under a cooperation agreement among Lockheed Martin Advanced Technology Center, the University of Arizona, and the University of Hawai'i. In June 2017 the UH Institute for Astronomy took over the operation of UKIRT.

The majority of UKIRT's current science is dedicated to the Infrared Deep Sky Survey, though it has also been used to study orbital debris and for research by planetary scientists at the University of Hawai'i.

The actual viewing time by the University of Hawai'i on UKIRT fluctuates between 15% and 50%, depending on funding and its partnership agreements.

Very Long Baseline Array (VLBA)

The Mauna Kea Very Long Baseline Array (VLBA) is one unit in an integrated system of ten identical radio telescopes stretching from the U.S. Virgin Islands to Hawai'i, which are operated remotely from Socorro, New Mexico. Each VLBA station consists of a 25m antenna and an adjacent control building. The ten stations work together as one single instrument. It is in the lower summit region at approximately 3700 meters elevation.

The VLBA has been operated by the Long Baseline Observatory (LBO) since October 2016, when it separated from the National Radio Astronomy Observatory. The LBO is a facility of the National Science Foundation operated under a cooperative agreement by Associated Universities, Inc.

Current science includes a long-term project to map the complete 3D structure of the Milky Way; coordinated effort with NASA Fermi Gamma-ray Space Telescope to observe gamma-ray sources; long-term study of active galactic nuclei; tracking near-earth asteroids; and monitoring movements of the earth's crust by tracking the distance between the telescopes. Such measurements are an integral part of the earth-based control segment in the development and maintenance of the U.S. government's Global Positioning System (GPS).

BLNR approved the CDUP HA-2174 for the facility in 1989. The facility has been operational since 1992.

Caltech Submillimeter Observatory (CSO)

CSO is a 10.4 meter-diameter telescope located alongside the James Clark Maxwell telescope which is owned by the California Institute of Technology.

BLNR approved CDUP HA-1492 in December 1982. The facility was operational from 1986 through September 2015, with 15% of the viewing time dedicated to UH.

Caltech filed a Notice of Intent to Decommission with OCCL in February 2016. The public scoping period on the draft Environmental Assessment was completed on January 15, 2018.

James Clark Maxwell Telescope (JCMT)

The 15-meter JCMT is the largest submillimeter telescope in the world, and contains the second largest mirror on Maunakea

JCMT was originally funded by a partnership between the United Kingdom and Canada, and the Netherlands, and operated by the Joint Astronomy Centre. In March 2015 the operation of the JCMT was taken over by the East Asian Observatory.

Current science includes the study of the solar system, interstellar and circumstellar dust and gas. JCMT is also part of the Event Horizon Telescope, an array of global telescopes that coordinate observations and research on the Milky Way's supermassive black hole Sagittarius A.

Between 12.5% and 15% of the observing time is dedicated to the University of Hawai'i.

BLNR approved CDUP HA-1515 for the telescope in 1983, and it began operations in 1987.

Submillimeter Array (SMA)

SMA consists of eight 6-meter radio telescopes that operate as one unit. The telescopes can be arranged in varying configurations using 24 concrete pads. SMA is located at the base of Pu`u Poli'ahu in an area informally known as "Submillimeter Valley."

Current science includes the study of newly-formed planetary systems, asteroids, comets, both dying and new-born stars, and red-shifted radiation from the oldest objects in the universe.

The SMA is jointly operated by the Smithsonian Astrophysical Observatory and the Academia Sinica Institute of Astronomy and Astrophysics (Taiwan).

Between 12.5% and 15% of the observing time is dedicated to the University of Hawai'i.

BLNR approved CDUP HA-2728 for the array in 1994. The system became fully operational in 2003.

Subaru Telescope

Subaru Telescope is an 8.2-meter optical-infrared telescope operated by the National Astronomical Observatory of Japan (NAOJ), National Institutes of Natural Sciences.

Current science includes the recent identification of 11 dwarf galaxies and two star-containing halos, tracking the source of gravitational waves, and mapping the hydrogen gas in the early universe.

Fifty-two nights per year, approximately 15% of the observing time, are dedicated to the University of Hawai‘i.

The BLNR approved CDUP HA-3462 for Subaru in 1992. It achieved first light in 1999.

W. M. Keck Observatory (Keck I and Keck II)

The twin Keck Observatory telescopes primary mirrors are 10-meters, each composed of 36 hexagonal segments that work in concert as a single piece of reflective glass.

The W. M. Keck Foundation funded both the original Keck I telescope and Keck II. Today Keck Observatory is a 501(c)3 governed by the California Association for Research in Astronomy (CARA), whose Board of Directors includes representatives from the California Institute of Technology and the University of California, with liaisons from NASA and the Keck Foundation.

Keck currently produces over 150 papers per telescope per year, making it the most productive of any of the world’s ground-based observatories. Current science includes the discovery of dozens of exoplanets, new studies on the rings and atmosphere of Uranus, high-resolution imaging of comets, and the study of protoplanetary accretion disks around fifteen young stars.

Approximately 10% of the observing time on Keck I and 15% on Keck II is dedicated to the University of Hawai‘i.

BLNR approved CDUP HA-1646 for Keck I in 1984, and it saw first light in 1990. BLNR approved CDUP HA-2509 for Keck II in 1992, and it saw first light in 1993.

Gemini North Observatory

The Gemini Observatory consists of paired 8.1 meter optical/infrared telescopes, one in Chile and one in Hawai'i. It replaced the NASA-Lowell Observatory 24" telescope.

Gemini is operated by a partnership between the National Optical Astronomy Observatory (USA), National Research Council Canada, Comisión Nacional de Investigación Científica y Tecnológica de Chile, Institute for Astronomy University of Hawaii, Instituto de Astrofísica La Plata (Argentina), and the Laboratório Nacional de Astrofísica (Brazil).

The pairing of the telescope allows near complete coverage of both the northern and southern skies. Current research includes the imaging and analysis of exoplanets, star formation and evolution, quasars, and the large-scale structure of the universe.

Approximately 10% of the observing time is dedicated to the University of Hawai'i.

The BLNR approved CDUP HA-2691 for Gemini in 1994. The telescope saw first light in 2000.

Thirty Meter Telescope (TMT)

The core of the project is a 30-meter in diameter aperture telescope composed of 492 individual mirror segments, secondary and tertiary mirrors directing the gathered light, and a network of interchangeable sensors and instruments that will collect and process the light. TMT will be located on the north plateau, approximately ½ mile from the Kūkahau`ula Summit, at an approximate elevation between 4008 meters and 4015 meters.

The telescope will be operated by TMT International Observatory, LLC, an international partnership between the California Institute of Technology, the University of California, the National Institutes of Natural Sciences of Japan, the National Astronomical Observatories of the Chinese Academy of Sciences, the Department of Science and Technology of India, and the National Research Council (Canada).

Approximately 7.5% of the observing time will be dedicated to the University of Hawai'i.

The BLNR approved CDUP HA-3568 for TMT in a Decision and Order in October 2017. Should TIO secure all the necessary authorizations, it is estimated that construction will take seven years.

Five appeals of the Decision were filed in the State Supreme Court. DLNR filed the Record on the Appeal with the Court on December 5, 2017. Appellate briefs are due on the appeal February 15th, 2018. Answering briefs, and then reply briefs, will be due after this. The Court will schedule oral arguments once all briefs have been filed.

Oral arguments before the Court have not been scheduled yet.

OCCL notes that the 2000 Master Plan foresaw the construction of the Keck Outrigger Project on Maunakea. This project did not proceed. The Comprehensive Management Plan and its associated Decommissioning Plan foresaw the replacement of the UH 2.2-meter observatory with Pan-STARRS. This project did not proceed either, although a reduced version of Pan-STARRS was built on Haleakala.

B. Midlevel Facilities at Halepōhaku (Onizuka Center for International Astronomy)

The 19.3 acre Halepōhaku parcel (TMK (3) 4-4-015:012) is situated at an elevation of about 9,200 feet on the south slope of Maunakea. The parcel is leased to the University of Hawai'i through 2041 by the State Board of Land and Natural Resources (BLNR) under General Lease No. S-5529, which describes the character of use as "premises leased to be used solely for permanent mid-level facilities, a construction camp, an information station as well as existing facilities purposes."

The first cabins were built at Halepōhaku by the Civilian Conservation Corps in the 1930s to provide shelter for hunters and hikers. Wooden dormitories were built in 1967, and were used to supply support facilities and housing for construction workers, University of Hawai'i telescope observers, and support staff throughout the 1970s.

In 1976 the Board approved CDUP HA-781 for the construction of a 2600-square foot dormitory to house construction workers working on the United Kingdom Infrared Telescope (UKIRT).

In 1977 the Board approved CDUP HA-895 to demolish and replace two of the existing buildings with a fourteen-bed and an eight-bed dormitory, and to retrofit two existing mess halls.

In 1982 the Board approved CDUP HA-1430 for the construction of a 12,913-square foot support services and common area building, three dormitories totaling 13,938-square feet with a 59-bed capacity, a 2500-square foot maintenance building, an 800-square foot generator building, and an 1181-square foot Visitor Information Station (VIS).

In 1986 the Board approved CDUP HA-1819 for the subdivision of the Halepōhaku parcel, the establishment of a construction camp site with four cabins and a parking area, and the designation of a one-acre staging area south of the camp site.

In December 2017 OCCL accepted for processing Conservation District Use Application (CDUA) HA-3812 for parking and infrastructure improvements at the VIS. The application is currently out for public and agency comment. OCCL anticipates presenting the application to the Board for consideration in the second quarter of 2018.

The lower portion of Halepōhaku contains two unimproved gravel parking areas, one of which is used for overflow parking for the VIS and the other as a staging area for construction activities. The overflow parking is often used by commercial tour groups if the paved parking area adjacent to the VIS is full.

The section of the Maunakea Access Road above Halepōhaku is also under University management. In 1974 the Board approved CDUP HA-537 for the construction of a 4.6 mile one-lane road between Halepōhaku and the summit, and the filling and grading of an additional 1.9 miles of existing roadway. Fill material came from a seven-acre quarry near Pōhakuloa on the site of the 1843 lava flow.

V. MANAGEMENT OF THE MAUNAKEA SCIENCE RESERVE

A. Comprehensive Management Plan

The Board of Land and Natural Resources approved a Comprehensive Management Plan for Maunakea on April 9, 2009. The CMP included management actions of previous management documents, including the 1995 Management Plan for UH Management Areas and the 2000 Mauna Kea Master Plan.

A Comprehensive Management Plan (CMP) differs from the standard Management Plan referred to in Hawai`i Administrative Rules (HAR) §13-5 Exhibit 3, MANAGEMENT PLAN REQUIREMENTS. The Conservation District rules requires management plans discussed in Exhibit 3 which are intended for projects with a specific, limited use (e.g. astronomy projects, forestry, or aquaculture). A CMP, by contrast, is needed for larger parcels with multiple significant land uses. The CMP provides a framework and management guidelines ranging from cultural and natural resource preservation, to managing the built environment, construction activities, and access to outreach and education.

The Maunakea CMP contained 103 management actions and associated reporting requirements that would govern the future of Maunakea. A condition of BLNR approval was that the University develop a *Project Development and Management Framework* and four resource sub-plans *Natural Resources Management Plan; Cultural Resource Management Plan; Public Access Plan;* and *Decommissioning Plan*. The Resource subplans were approved by BLNR on March 25, 2010.

The University of Hawaii Board of Regents (BOR) is the entity ultimately responsible for the implementation of the Management Plan.

The Office of Maunakea Management submits annual reports to the BLNR discussing status of the implementation of each management section. The 2017 Annual Report is attached to this report as **Exhibit 3**.

OCCL has invited a representative from OMKM to give a presentation to the Board following this report.

In reviewing the plans OCCL finds that OMKM has had successes with its natural and cultural resources management programs and its ranger program. Challenges remain, including managing both permitted and unpermitted commercial tours, and managing public access in the absence of administrative rules.

B. Subplan: Natural Resource Management

Studies of the arthropods on the summit have been on-going since 2002. Studies including surveys provide baseline data for monitoring the status of resources and for habitat restoration for the wēkiu bug, a species of endemic arthropod found only on the summit region of Maunakea. In addition to establishing baseline information on arthropods, including the wēkiu bug, botanical resources, and geological conditions, a new multi-year study was recently started on the of survey sea bird, forest bird, and bat populations.

Preventing invasive species from becoming established on the summit is an on-going concern, with particular focus on controlling fireweed (*Senecio madagascarensis*) and on limiting the spread of two invasive ant species, *Cardiocondyla kagutschi* and *Ochetellus glaber.* Monthly surveys for invasive species have been conducted since 2007 and the interior of buildings including those on the summit and Halepōhaku since 2013. OMKM is currently studying the efficacy of current invasive species control measures the results of which may be used towards determining the feasibility of establishing a vehicle washing facility.

On October 24, 2008, the Board gave the Chair authority to negotiate and sign a cooperative agreement with the University of Hawai‘i at Hilo’s Office of Maunakea Management for cooperative management of the Mauna Kea Ice Age Natural Area Reserve. This would formalize an existing relationship between DOFAW and

OMKM, and provide for continued coordinated resource monitoring and management on the summit such as photo documentation of the Lake Waiau water level, trash pick-up and monitoring of activity in the NAR.

A cooperative agreement was signed by the president of the University in 2011; however, it was not forwarded to DLNR for signature as the contested case regarding the Thirty Meter Telescope was still active. Should DLNR and the University decide to move forward with the agreement it would need to be updated, as the signatories for both entities has changed since 2011.

Collaborative efforts between DOFAW/NAR/DOCARE and OMKM on resource protection including ranger assistance, invasive species control, research and monitoring of resources, and DLNR rules violations such as unpermitted commercial tours and harmful and destructive activities on natural resources.

C. Subplan: Cultural Resources Management

Historic properties, primarily archaeological sites in both the Science Reserve and the NAR, have been inventoried. A five-year monitoring program was developed and approved by SHPD in 2014. Pursuant to this, OMKM has assessed all the historic properties in its management areas. Sites located in the Astronomy Precinct and those close to human activity, including roads, are assessed every year. More remote sites are assessed on a three and five-year rotating basis.

The treatment of burials is described in a Burial Treatment Plan that was also approved by SHPD in 2014.

Kahu Kū Mauna is tasked with developing policies related to cultural activities, including the construction of new cultural features and the handling of offerings. They are currently consulting with cultural practitioners on potential policies that can be presented to the Maunakea Management Board for consideration.

D. Subplan: Public Access

The Public Access Plan for Maunakea identifies a number of principals and policies related to public access. The purpose of the plan was to provide guidance to UH in addressing public access and activities within the UH management areas in full cooperation with DLNR's authority over public access. public and commercial access.

There has been a significant increase in visitors to the summit in recent years, due in large part to improvements to the Saddle Road and the lifting of the prohibition by rental car agencies from driving on this road. The number of vehicles and visiting parties has increased both within the Science Reserve and in the Forest Reserve, particularly for sunset viewing. Some of the issues associated with this include an increase in light pollution during star-gazing events, an increase in off-road parking, the inadvertent introduction of potentially invasive species, and an increase in high-risk behavior such as filming stunts for social media videos.

MKSS has addressed off-road parking in the Forest Reserve by installing guard rails along the Access Road near Halepōhaku in March 2017. OMKM has submitted an application addressing traffic, pedestrian safety and parking improvements at the Visitors Information Center. OCCL is currently processing this application, and anticipates presenting it to the Board for consideration in the second quarter of 2018.

1. Commercial Tours

In 2000 BLNR transferred the authority to administer commercial tours to the University. Following an approval by DLNR's Attorney General, the University accepted the responsibility in 2005. The University currently allows a maximum of eight commercial tour permits, one less than the number permitted by BLNR. Each commercial tour operator is charged a fee of $6.00/tour passenger which is submitted to the Office of Maunakea Management on a monthly basis. All fees are deposited into the Mauna Kea lands management

special fund and are used to cover expenses related to the management of the UH's managed lands include the ranger program, road maintenance, and expenses related to commercial tour activities on Maunakea. Twenty percent of the fees are included in UH's payment to the Office of Hawaiian Affairs.

There has been an increase in unauthorized commercial tours to the summit; these are the subject of an active investigation by DOFAW and DOCARE.

OMKM is planning to initiate a study of the carrying capacity of commercial tours to the summit.

2.. Enforcement Issues

Land uses on Maunakea are currently regulated pursuant to Hawai'i Administrative Rules (HAR) Chapter 13-5 governing the Conservation District. OCCL notes that these rules cover land uses, but do not address activities.

The Public Access Plan lays out principles and policies, but does not provide OMKM with any enforcement capabilities. DLNR's Division of Conservation and Resource Enforcement is tasked with providing enforcement in the Conservation District, while OCCL is tasked with regulating and potential land use and permit violations.

However, the increased commercial and public pressure on the mountain has led to an increase in enforcement needs. The OMKM rangers are active in reporting observed violations of conservation district rules to DLNR. However, OCCL feels that there is a need for improvement in this area, either through clear administrative rules that allow for enforcement by the University or a more formal arrangement between DLNR and the University.

E. Subplan: Decommissioning

The Maunakea Decommissioning Plan. a subplan of the Maunakea Comprehensive Management Plan, describes the process for decommissioning observatories on Maunakea. The plan defines decommissioning as a process that results in the partial or total removal of all structures associated with an observatory facility and the restoration of the site.

Provisions for financial planning for decommissioning are included to ensure that adequate funds are available to pay for the costs of deconstruction and site restoration at the end of the life of the observatory.

The Decommissioning Plan describes two options for removing the infrastructure:

- Complete infrastructure removal. This involves the removal of the entire facility, including underground utilities, pilings, and foundation to the extent practicable under normal engineering deconstruction practices;
- Infrastructure capping. Capping involves removal of above ground facilities with or without utilities and leaves all part of the underground portion of the facility in place.

The Plan describes three levels to which a site may be restored:

- Minimal restoration, meaning removing all man-made structures and grading the site;
- Moderate restoration, meaning removing all man-made structures, grading the site, and enhancing any native species habitat;
- Full restoration, meaning returning the site to its original topography and restoring any native-species habitat.

The decommissioning of an astronomy facility in the Science Reserve is a multi-step process involving

- Submitting a Notice of Intent.
- Completing an environmental due diligence review,
- Approval of the facility decommissioning plan by the University Board of Regents. Submitting a Conservation District Use Application which covers site deconstruction, observatory removal, and site restoration, and if necessary a remedial action plan;
- Securing a Conservation District Use Permit (CDUP) from the Department of Land and Natural Resources.

Governor David Ige, in his May 26, 2015 10-point action plan for the stewardship of Maunakea, called for the University of Hawai`i to *decommission—beginning this year—as many telescopes as possible with at least 25 percent of all telescopes gone by the time the Thirty Meter Telescope (TMT) is ready for operation*.

In addition, the Decision and Order for the Thirty Meter Telescope contains two conditions relating to decommissioning: 10) *The University will decommission three telescopes permanently, as soon as reasonably possible, and no new observatories will be constructed on those sites. This commitment will be legally binding on the University and shall be included in any lease renewal or extension proposed by the University for Mauna Kea*; and 11) *Notwithstanding any lease renewal or extension, consistent with the Decommissioning Plan, at least two additional facilities will be permanently decommissioned by December 31, 2033, including the Very Long Baseline Array antenna and at least one additional observatory.*

The California Institute of Technology submitted a Notice of Intent to Decommission the CSO to OMKM on November 18, 2015. The Institute has begun pre-assessment consultation and scoping for the environmental assessment. The scoping process will help determine how much of the infrastructure will be removed and the preferred level of site restoration.

The University of Hawai‘i at Hilo submitted a Notice of Intent to Decommission Hōkū Ke‘a to OMKM on September 16, 2015. The environmental review began in late 2017 with the public scoping process.

The University of Hawai‘i has identified UKIRT as the potential third observatory to be decommissioned by the time TMT is operational. OCCL notes that, unless UKIRT voluntarily ceases operation before that time, this will be the first case of mandatory / involuntary decommissioning of a functioning astronomy facility on Maunakea.

Exhibit 4, *Report on long-term development of observatory sites on the summit of Mauna Kea*, contains a summary that the Director of the Institute for Astronomy prepared for the State legislature on the history of observatory development, decommissioning, and long-range plans for astronomy on Maunakea.

F. Comprehensive Management Plan Update

The University began the process of updating the CMP in 2014. OMKM is currently preparing a report on the status of the cultural and natural resources on Maunakea. Once this is completed it will be submitted to stakeholders and agencies for review. This report along with the feedback will form the basis for drafting proposed revisions to the CMP.

This process will help determine which of the resource subplans, including the public access plan, need to be updated.

The final plan will be presented to both the University Board of Regents and the BLNR for approval.

VI. OFFICE OF MAUNAKEA MANAGEMENT'S PROPOSED ADMINISTRATIVE RULES

With Act 132 of the Session Laws of Hawai`i, 2009, the State legislature authorizes the UH to adopt administrative rules to regulate public and commercial activities on University-managed lands. The stated purpose of the rules will be *to provide for the proper use, management, and protection of cultural, natural, and scientific resources of the UH management areas; to promote public safety and welfare by regulating public and commercial activity within the UH management area, and to ensure safe and appropriate access to the UH management areas for the public.*

The need for administrative rules for Maunakea has been recognized in the Comprehensive Management Plan, in Governor David Ige's 10-point action plan for the stewardship of Maunakea, and by the State Office of the Auditor.

Currently only Conservation District rules are in effect on the University-managed areas on the summit. While these regulate land uses, they don't address land use activities.

The CMP also notes that the lack of administrative control limits the University's ability to enforce rules and regulations within the University-managed areas. As such, the University is limited in its ability to manage public and commercial access and activities in its management areas.

The University has prepared a draft of proposed rules, incorporating public input and consultation with the Office of Hawaiian Affairs and DLNR. Kahu Kū Mauna and the Maunakea Management Board reviewed the draft rules, with the Maunakea Management Board approving the draft and recommending that the process move forward. The draft contains provisions for the preservation of natural and cultural resources, the management of public and commercial access and activities, measures for preventing the introduction of invasive species; addressing health and safety, and the administration and enforcement the rules.

The Board of Regents is required to approve the draft rules prior to forwarding them to the Governor's office. With the authorization from the office of the Governor the proposed rules will go out for formal public hearings.

The University estimates that the process can be completed and that new rules can be in place within 18 months.

VII. LAND AUTHORIZATIONS ON MAUNAKEA

A. General Leases

The Maunakea Science Reserve encompasses 11,288 acres of State land leased to the University of Hawai`i under General Lease S-4191. The lease commenced on January 1, 1968, and is set to expire on December 31, 2033.

The character of use for GL S-4191 reads: *For a scientific complex and as a scientific reserve being more specifically a buffer zone to prevent the intrusion of activities inimical to said scientific complex. Activities inimical to said scientific complex shall include light and dust interference to observatory operation and certain types of electric or electronic installation on the demised lands, but shall not necessarily be limited to the foregoing*.

The Halepōhaku parcel encompasses 19.261 acres of State land leased to the University under General Lease S-5529. The lease commenced on February 28, 1986, and is set to expire on February 28, 2041.

The character of use for GL S-5529 reads: *The lessee shall use or allow the premises leased to be used solely for permanent mid-level facilities, a construction camp, an information station as well as existing facilities purposes*.

Grant of Easement No. S-4697 covering the Maunakea Access Road was issued to the University as of September 8, 1981. The easement is coterminous with GL No. S-4191, ending on December 31, 2033.

B. EIS for New Land Authorizations

In 2013 the University sought the mutual cancellation of General Lease Nos. S-4191 and S-5529, and the issuance of a new 65-year direct lease. They also requested that the amendment of Grant of Easement No. S-4697 covering the Maunakea Observatory Access Road to be coterminous with the new general leases. The Board deferred action on the request until after an Environmental Impact Statement (EIS) was prepared for the proposed action.

The University is currently preparing an EIS preparation notice for new land authorization on Maunakea. UH anticipates publishing the notice in the Department of Health's *Environmental Notice* in the first quarter of 2018. The University will then compile public comments and prepare a draft EIS for review.

The Department anticipates that the University will be requesting a new land authorization. Other anticipated proposed terms will be that no telescope development will take place on a new site except for the TMT project, that named decommissioned sites will not be redeveloped, and that existing observatories will not expand beyond their existing sublease footprint.

The EIS will be exploring three alternatives: 1) new land authorization for the current areas under UH management, 2) let the leases and easement expire at the end of 2033 and the lands revert back to DLNR, or 3) issue a new land authorization for a reduced area including the astronomy precinct access road and Halepōhaku, effectively withdrawing 10,000 acres from the science reserve and returning them to DLNR management.

OCCL notes that the withdrawal of lands from the science reserve will present DLNR with several management challenges. Currently OMKM takes the lead regarding, among other issues, visitor safety; archaeological monitoring (at the approximate cost of $60,000-$65,000/annum, wēkiu bug monitoring, invasive species monitoring; resource research and management program development; photo documentation of the water level of Lake Waiau and trash clean-up; periodic monitoring of the adze quarry.

The withdrawal would necessitate that DLNR and the University formalize many of their working relationships with the development of collaborative management agreements and joint enforcement agreements. We would also note that the proposed Administrative Rules are for University-managed lands, and would not address DLNR managed lands on the summit.

OCCL notes that it is currently unclear whether the Maunakea Comprehensive Management Plan would continue to be in effect for and lands that are withdrawn from the Science Reserve.

C. Subleases

The University currently has subleases with seven organizations for the purposes of operating astronomical observatories. Institutions were to build and operate observatories at their own cost and risk, in exchange for providing UH with time on the telescopes. Each sublessee pays the University a nominal fee of $1.00 per annum in addition to giving the University a percentage of observing time on their respective telescope. UH used its dedicated time on the telescopes to build its astronomy program.

The subleases are:

1974: National Aeronautics and Space Administration, 70,650 square feet (NASA IRTF)
1975: Canada-France-Hawai'i Telescope Corporation, 2 acres (Canada-France-Hawai'i Telescope)
1983: California Institute of Technology, 0.75 acres (Caltech Submillimeter Observatory)
1985: California Institute of Technology, 2 acres (Keck I and Keck II)
1997: National Astronomy Observatory of Japan, 5.4 acres (Subaru)
1997: Smithsonian Institution, 3 acres (Smithsonian Submillimeter Array)
1997: Associated Universities Inc., 87,500 square feet (Very Long Baseline Array)
1997: National Science Foundation, 2 acres (Gemini North)

All subleases are co-terminus with the University's General Lease.

In June 2014, the Board consented to a sublease between the University and TMT International Observatory. The consent is currently being challenged in the courts (ref. CAAP-17-0000059 Flores vs BLNR et al filed February 3, 2017). All briefs have been filed in the case. The Supreme Court has not yet scheduled oral arguments.

UH has notified the observatories that they will be paying rent under any new subleases.

VIII. THIRTY METER TELESCOPE (TMT) SPECIAL CONDITIONS

The operating agreements for telescopes prior to TMT focused on providing observing time for UH scientists, with the goal of developing the astronomy program in the UH system. TMT presents a new paradigm, wherein observatories pay sublease rent and a public benefits package. It is anticipated that this will be the model for the renegotiation of the subleases for other facilities on the mountain.

The Board's Decision and Order for TMT contained special conditions that need to be implemented by the University of Hawai'i at Hilo (UHH), Office of Maunakea Management (OMKM) and TMT International Observatory LLC (TIO), as applicable, as part of the permit. The full set of special conditions is copied below. OCCL notes that the permit is still under litigation, and that many of the conditions would only apply if all authorizations are approved and the telescope begins construction. As such, our discussion on the status of the conditions will be limited to those that are currently active:

1. Ensuring that employees attend mandatory cultural and natural resources training with a minimum of one days' training;

   A draft orientation plan has been developed. OMKM is currently working with the 'Imiloa Astronomy Center on specific content.

2. Working with the 'Imiloa Astronomy Center, OMKM, and Kahu Kū Mauna to develop informational exhibits for visitors regarding the natural, cultural and archaeological resources of Mauna Kea that could be used at the Mauna Kea VIS, 'Imiloa, TMT facilities, and other appropriate locations;

   OMKM has initiated planning meetings to develop the exhibits.

3. Funding the re-naturalization of the closed access road on Pu'u Poli'ahu, partial re-naturalization of the batch plant staging area after construction has been completed, and camouflaging of the utility pull boxes in certain locations to reduce the visual impact from the summit area;

   The University received Site Plan Approval HA-10-04 to demolish the road and restore the natural grade.

4. Implementing an invasive species control program;

   The invasive species control program is guided by an invasive species management plan that was approved by the Maunakea Management Board. It is a component of the Comprehensive Management Plan and is actively implemented.

5. Working with OMKM to develop and implement a wēkiu bug habitat restoration study;

   A study of the first component of a wēkiu bug habitat restoration program is nearing completion; this will form the basis for habitat restoration plans.

6. Implementing the "Zero Waste Management" policy;

   The TMT design includes a zero waste' management system.

7. Filling employment opportunities locally to the greatest extent possible;

   TMT is committed to this condition when it begins operation.

8. Mandating that employees traveling beyond Hale Pōhaku take part in a ridesharing program using project vehicles;

   TMT is committed to this condition when it begins operation.

9. Using energy savings devices such as solar hot water systems, photovoltaic power systems, energy efficient light fixtures, and Energy Star rated appliances;

   The TMT project includes energy savings devices and systems.

10. The University will decommission three telescopes permanently, as soon as reasonably possible, and no new observatories will be constructed on those sites. This commitment will be legally binding on the University and shall be included in any lease renewal or extension proposed by the University for Mauna Kea;

    Two telescopes have issued notices of intent to decommission and have begun the decommissioning planning process.

11. Notwithstanding any lease renewal or extension, consistent with the Decommissioning Plan, at least two additional facilities will be permanently decommissioned by December 31, 2033, including the Very Long Baseline Array antenna and at least one additional observatory.

    The University will execute this condition prior to the end of 2033 in accordance with conditions set in the sublease agreements.

12. Providing $1 million annually, adjusted for inflation, for "Community Benefits Package" which will commence with construction and continue through the term of the sublease. The package will be administered via The Hawai'i Island New Knowledge (THINK) Fund Board of Advisors. In addition to the types of programs described in the "Community Benefits Package" in the Findings of Fact, at least $5,000 annually of the $1 million shall support a program or programs to assist at risk youth, specifically focusing on the children of incarcerated parents;

    TIO has been contributing $1 million to the fund each year since 2014. The next payment in mid-February will bring the total to $4 million. TIO is currently looking into potential recipient agencies for the $5000 earmarked for at-risk youth. A summary of Thirty Meter Telescope's THINK Fund & Workforce Pipeline Program is attached as ***Exhibit 6****.*

13. The Board of advisors shall ensure that a reasonable amount of funding is directed at programs for the most vulnerable and underserved members of Hawai'i Island communities so that they can participate in our technological future;

    TIO's funding of the THINK Fund includes funding for STEM related programs for Hawai'i Island public schools and after school programs, charter schools, and scholarships.

14. The funding shall be distributed with reasonable promptness and not be used to build a permanent endowment;

    TIO and the Hawai``i Community Foundation have made arrangements to discontinue the endowment it set up and will begin spending the funds.

15. Partnering with other institutions to implement a Workforce Pipeline Program, headed by at least one full-time position through the Community Outreach office, to prepare local residents for jobs in science, engineering, and technical fields;

    TMT is the major funder of the Akamai program, a workforce pipeline program for students who either live on-island and attend a Hawai'i Island college or university, or is an island resident who is attending a school outside Hawai'i. The program is expanding this year and will have ten additional interns funded by TIO.

16. UHH will ensure that the survey of the power line corridor easement complies with DLNR standards and is in accordance with the conditions contained in the grant of easement (including the Mauna Kea Ice Age Natural Area Reserve) that was approved by the BLNR in August 1985. The University will provide copies of the survey to DOFAW;

    The survey has been completed and provided to DOFAW.

17. OMKM will consult with the U.S. Fish and Wildlife Service and experts who are advising OMKM, including representatives from the DLNR regarding surveys of the wēkiu bug and invertebrates along the utility corridor, including Pu‘u Hau Kea and the pu‘u west of the Parking Area 1;

    The utility corridor work will not occur for approximately 5 years after on-site work begins. OMKM has brought this survey up for discussion at past wēkiu bug workgroup meetings, but formal consultation will occur after work has begun as there is ample time to conduct the survey and implement any mitigation or other associated action.

18. The construction contractor will be required to minimize the visual changes to land within the utility line right-of-way during utility upgrades. Any disturbance outside of the easement area of the construction corridor will be restored to the extent possible;

19. UH Hilo will present a plan for handling recreational parking during construction to the OCCL for review and approval, at least one month prior to beginning construction;

20. Following construction, TMT shall keep their area clean and free of trash or unattended tools and equipment, unless authorized in writing by OMKM and OCCL;

21. The Archaeological Monitoring Plan will be submitted to the State Historic Preservation Division for review and approval prior to the onset of construction;

    The Archaeological Monitoring Plan was submitted and approved in 2014.

22. Sublease rent will be deposited into the Mauna Kea Lands Management Special Fund, and only used for management of Mauna Kea and related purposes as provided by law;

    This is a requirement of Act 132, SLH 2009

23. UH Hilo/OMKM will notify OCCL of the date of the twice-annual inspections of the project site and allow Department staff to attend if available;

24. UH Hilo/OMKM will provide OCCL and BLNR a copy of TIO's annual report to OMKM, as required by Section 5.3 of the TMT Management Plan;

25. UH Hilo will allow BLNR to name a DLNR representative to participate in the CMP five-year management review process;

    OMKM has requested that the BLNR name a representative at this meeting, if possible.

26. When provided or required, potable water supply and sanitation facilities shall have the approval of the Department of Health and the county Board of Water Supply;

27. UH Hilo understands and agrees that this permit does not convey any vested rights or exclusive privilege;

28. In issuing this permit, the Department and Board have relied on the information and data that UH Hilo has provided in connection with this permit application. If, subsequent to the issuance of this permit, such information and data prove to be false, incomplete or inaccurate, this permit may be modified, suspended or revoked, in whole or in part, and/or the Department may, in addition, institute appropriate legal proceedings;

29. Where any interference, nuisance, or harm may be caused, or hazard established by the use, UH Hilo shall be required to take the measures to minimize or eliminate the interference, nuisance, harm, or hazard;

30. Should historic remains such as artifacts, burials or concentration of charcoal be encountered during construction activities, work shall cease immediately in the vicinity of the find, and the find shall be protected from further damage. The contractor shall immediately contact the State Historic Preservation Division (692-8015), which will assess the significance of the find and recommend an appropriate

mitigation measure, if necessary; the Applicant will also notify the Office of Hawaiian Affairs at the same time;

31. During construction, appropriate mitigation measures shall be implemented to minimize impacts to off-site roadways, utilities, and public facilities;

32. No construction work shall be initiated until the Applicant demonstrates compliance with all preconstruction conditions and mitigation measures specifically required in this decision. Once this condition has been satisfied, the Department will issue notice to proceed with construction;

33. TIO shall set aside funds annually in a sufficient amount to allow for site observatory and access way site restoration;

The estimated cost of decommissioning the observatory and restoring the site is $11.7 million (2013 dollars). TIO has developed an Initial Decommissioning Funding Plan (April 2014) which includes a Financial Assurance Statement of Intent.

34. Daytime activities at TMT will be minimized on up to four days per year, as identified by Kahu Kū Mauna;

35. UHH shall consult with the Kahu Kū Mauna Council and cultural practitioners to the extent feasible to plan for, and establish, an appropriate area on Mauna Kea, within the MKSR, to be used by native Hawaiians for religious and cultural purposes; provided that this condition shall not affect the timing of TMT construction or operation;

Kahu Kū Mauna will consult with native Hawaiians for feedback regarding the set aside of an area for use by native Hawaiian for religious and cultural purposes.

36. UHH shall allow reasonable access to the area established under Condition 35 for the exercise of any native Hawaiian traditional and customary practices to the extent feasible, reasonable, and safe. The allocation of this area shall be in addition to all other cultural and access rights of native Hawaiians to other areas of Mauna Kea as provided by law or by other conditions set forth herein;

Native Hawaiians, including cultural practitioners, have year-round access to University-managed lands, except when hazardous and unsafe conditions require the closing of the access road. While access does not require any permitting or registration, land use policies are still being developed.

37. In order to enhance the Hawaiian cultural presence on Mauna Kea, UHH shall include products and handicrafts with a native Hawaiian cultural theme among those sold at the Mauna Kea VIS, and explore whether an expanded area for specifically native Hawaiian crafts can be accommodated at or near the VIS;

UHH has begun discussions on how to provide culturally-themed products and handicrafts for sale at the Visitors' Center.

38. UHH shall implement a cooperative internship and mentorship program between personnel working at the astronomy facilities on Mauna Kea and Hawaiian communities;

The Canada France Hawaii Telescope, UH Institute for Astronomy (IfA) and the Hawai'i Department of Education entered into an agreement to provide opportunities for Hawai'i high school students. Students work with mentors, predominantly graduate students with IfA, in developing research proposals. The students with winning proposals are given time on one of the Maunakea telescopes to conduct their research. All students who participate in the program are also given the opportunity to visit Mauanakea and the telescopes. To date, high schools participating in this program are Waiakea, Honoka'a, and Kealakehe (Hawai'i); Kapolei, Nanakuli, Kalani, and Waipahu (O'ahu); Moloka'i High; and King Kekaulike (Maui). The program continues to expand annually.

39. UHH and TIO shall develop a plan to implement and extend early entry programs for at-risk children of Hawaiian ancestry and other at-risk youth in the community of UH Hilo. The early entry program shall provide educational opportunities in STEM-related and other curriculum such as the following:

    (a) Astronomy, math, science, engineering, environmental science and technical support careers at astronomy facilities;

    (b) Hawaiian language and culture;

    (c) Navigation;

    (d) Geology;

    (e) Biology and agriculture;

    (f) Law Enforcement/criminal justice;

    (g) New disciplines of learning dependent on career fields needed; and

    (h) On-the-job training as necessary.

    UHH/TIO shall report to BLNR on the progress of this condition prior to the completion of TMT construction; provided that progress on this condition or lack thereof shall not affect the construction or operation of the TMT Project and provided further that it requires no commitment for funding other than staff time for plan development;

40. UHH shall make reasonable accommodations for the use of facilities at Hale Pōhaku for the Hawaiian Language and Hawaiian Studies programs at UHH and HCC, along with their continued use by others;

    Mauna Kea Support Services will be exploring ways to comply with this condition.

41. Kahu Kū Mauna shall review policies concerning the construction and retention of personal or group shrines such as ‘ahu, and recommend policies to OMKM and/or BLNR as appropriate, within 18 months;

    Kahu Kū Mauna has prepared draft policies to be presented to the Maunakea Management Board.

42. UHH and OMKM are allowed to take reasonable measures consistent with law, including limitations on the use of the TMT Access Way, if necessary for the security of the TMT Observatory.

IX. REPORTS FROM THE STATE OFFICE OF THE AUDITOR

A. Background

In 1998 an audit by the State Office of the Auditor found significant deficiencies in the management of Maunakea by both DLNR and the University. Specifically, the audit found that the University appeared to place a higher value on developing observatories than on protecting Maunakea's natural and cultural resources, and that DLNR was not engaged in effective monitoring and enforcement of permitting requirements.

A 2005 follow-up audit found that the University's Master Plan and new management structure addressed many of the 1998 concerns, but found that the lack of administrative rule-making authority was limiting the University's ability to manage resources. The follow-up also noted that DLNR had tightened permit approval conditions, but that the terms of the leases and subleases remained dated. The follow-up also recommended that DLNR better monitor the University for permit compliance, and that the department's divisions better coordinate its efforts to protect Maunakea's natural resources.

A second follow-up audit, in 2014, found that the University's CMP and associated subplans addressed many of the previous concerns. The auditor also recognized that contractual terms had prevented DLNR and the University from updating existing lease and sublease terms, and that future leases would incorporate the auditor's earlier recommendations. The lack of administrative rules remained a significant concern.

B. July 2017 Follow-Up

In July of 2017 the Office of the Auditor submitted follow up report on the 2014 audit to the governor and the legislature. This is attached as **Exhibit 5**, Follow-Up on Recommendations from Report No. 14-07, *Follow-Up Audit of the Management of Mauna Kea and the Mauna Kea Science Reserve*.

The Auditor found that four of their recommendations have been partially implemented, two not implemented, one not implemented with the agency disagreeing on the recommendation, and one no longer applicable.

The previous sections of this report have covered the issues raised by the Office of the Auditor; as such we will present a brief summary here.

Rec 1: UH should adopt administrative rules governing public and commercial activities as soon as possible, but no later than 2017. *(partially implemented)*

As discussed in Section VI of this report, the University has prepared an internal draft of proposed rules, and is awaiting Board of Regents review and approval.

Rec 2. UH should obtain the UH Board of Regents' approval for the conditions and fee schedule included in commercial tour use permits issued by UH–Hilo via a Board of Regents open public meeting pursuant to Chapter 92, HRS. *(not implemented)*

The University anticipates that this will be done concurrently with the approval of the final administrative rules. The rules will include a draft fee schedule. There have been discussions with DLNR about modeling the schedule after the Department's Civil Resource Violations system.

Rec. 3. UH should determine whether unauthorized fees collected since FY2007 should be returned to commercial tour operators. *(not implemented/disagree)*

The University maintains that the BLNR provided authorization to collect fees from commercial operators, as discussed in Section V-D of this report.

Rec. 4 UH should complete Comprehensive Management Plan (CMP) management actions, the implementation of which under the CMP implementation plan is scheduled as "immediate," as soon as possible, but no later than the end of 2016. *(partially implemented)*

The auditor reported that the University had completed 20 of the 25 management actions called for in the CMP. The actions that remain open are:

1. Develop and adopt guidelines for the culturally appropriate placement and removal of offerings.
2. Kahu Kū Mauna shall take the lead in determining the appropriateness of constructing new Hawaiian cultural features.
3. Develop and adopt a management policy for the UH Management Areas on the scattering of cremated human remains.
4. A management policy for the culturally appropriate building ahu or "stacking of rocks" will need to be developed by Kahu Kū Mauna who may consider similar policies adopted by Hawai'i Volcanoes National Park.
5. Develop and implement a signage plan to improve signage throughout the UH Management Areas.

Kahu Kū Mauna developed proposed policies on the first four items in 2012. However, the Maunakea Management Board deferred action on the policies after a lawsuit was filed in federal court against the Board members. Kahu Kū Mauna reinitiated consultation with cultural practitioners after that suit was dismissed without prejudice, and has prepared a revised proposed draft to be presented to the Board for consideration.

The University reports that the signage plan was completed in the second quarter of 2017.

Rec 5. UH should further its efforts to renew general leases for UH-managed lands on Mauna Kea by continuing to work with DLNR and proceeding with the Environmental Impact Statement (EIS) process under Chapter 343, HRS. *(partially implemented)*

Rec. 6. UH should renegotiate with existing sublessees to amend subleases to include provisions that address stewardship issues, as modeled by the provisions in the 2014 TMT sublease, following execution of the new general leases for UH-managed lands on Mauna Kea*. (not implemented)*

Rec. 7. DLNR should continue working with UH to renew the general leases for the UH-managed lands on Mauna Kea and ensure the leases are substantially in the form DLNR's Land Division recommended for approval by the Board of Land and Natural Resources. *(partially implemented)*

As discussed in Section VII of this report, the University is currently preparing an EIS preparation notice for new land authorization on Maunakea. UH anticipates publishing the notice in the Department of Health's *Environmental Notice* in the first quarter of 2018. The University will then compile public comments and prepare a draft EIS for review.

Rec. 8. DLNR should use additional stewardship-related conditions contained within the TMT observatory permit as a template in all new observatory permits issued for the summit of Mauna Kea. *(not implemented / not applicable)*

OCCL notes that there are no applications pending for new observatories on Maunakea.

X. POTENTIAL FUTURE BOARD ACTIONS

The following are potential items discussed in this briefing that would require approval from the Board of Land and Natural Resources:

- CDUA HA-3812 for proposed Maunakea Visitor Information Station (VIS) improvements. OCCL anticipates presenting this to the Board in the second quarter of 2018.
- Any new master lease between the University and DLNR for the Maunakea Science Reserve and Halepōhaku.
- The University's decommissioning plans for individual observatories, including CSO and Hōkū Ke'a.
- The revised Comprehensive Management Plan. BLNR to name representative to the CMP review process.
- Any potential collaborative management agreements with DOFAW and NARS, or of any Joint Enforcement Agreement between DOCARE and OMKM.

RECOMMENDATION

OCCL is presenting this report as a "non-action" item on the Board's Agenda.

Respectfully submitted,

Michael Cain

Michael Cain, Staff Planner
Office of Conservation and Coastal Lands

Approved for submittal:

Suzanne D. Case

Suzanne D. Case, Chairperson
Board of Land and Natural Resources

Figure 3-1. UH Management Areas

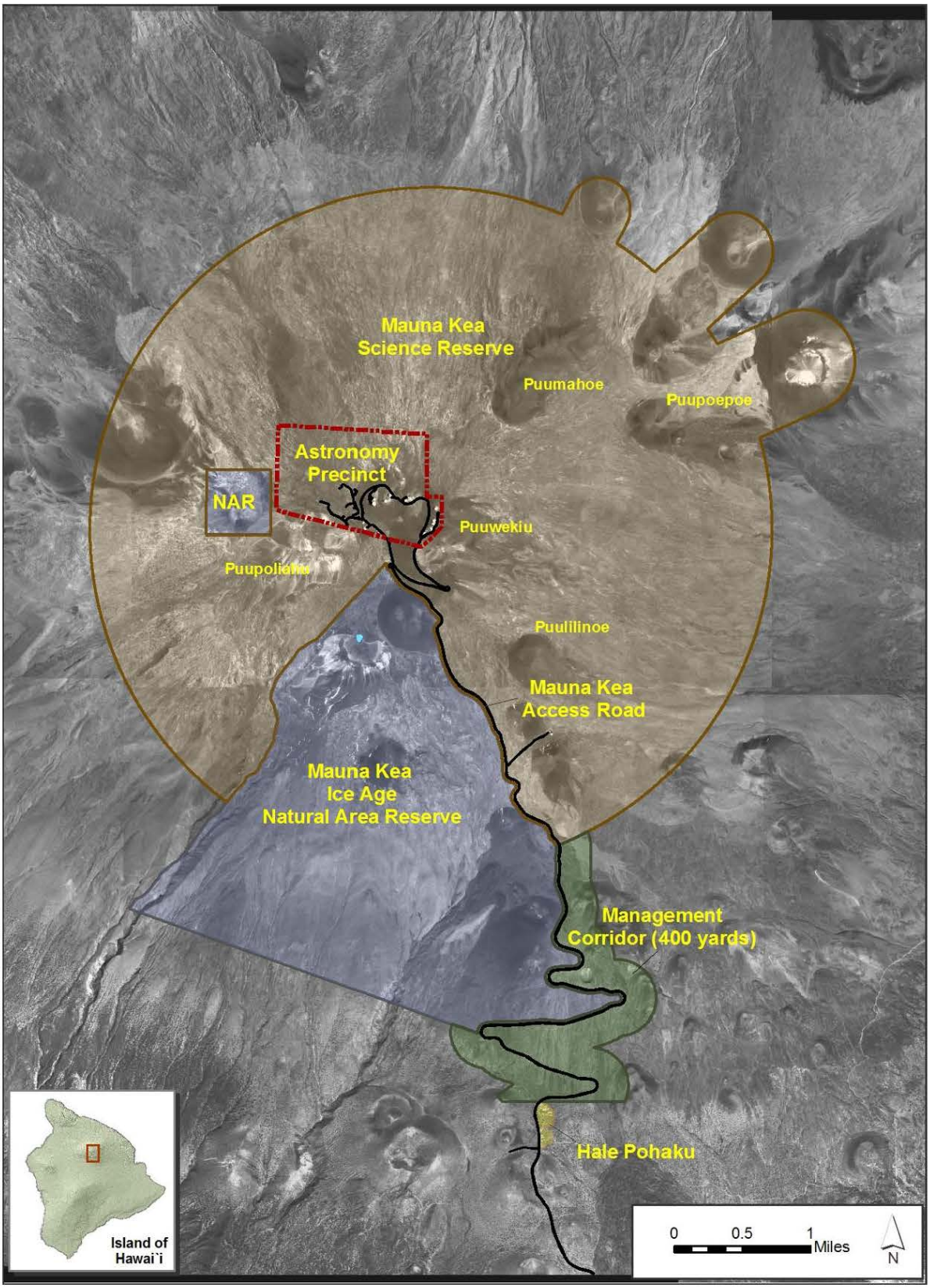

Exhibit 1
University-Managed Lands on Maunakea

INSTITUTE FOR ASTRONOMY
UNIVERSITY OF HAWAI`I
2680 Woodlawn Drive, Honolulu, HI 96822
Information Bulletin 19, March 2015

The Maunakea Observatories

Locations of Summit Facilities

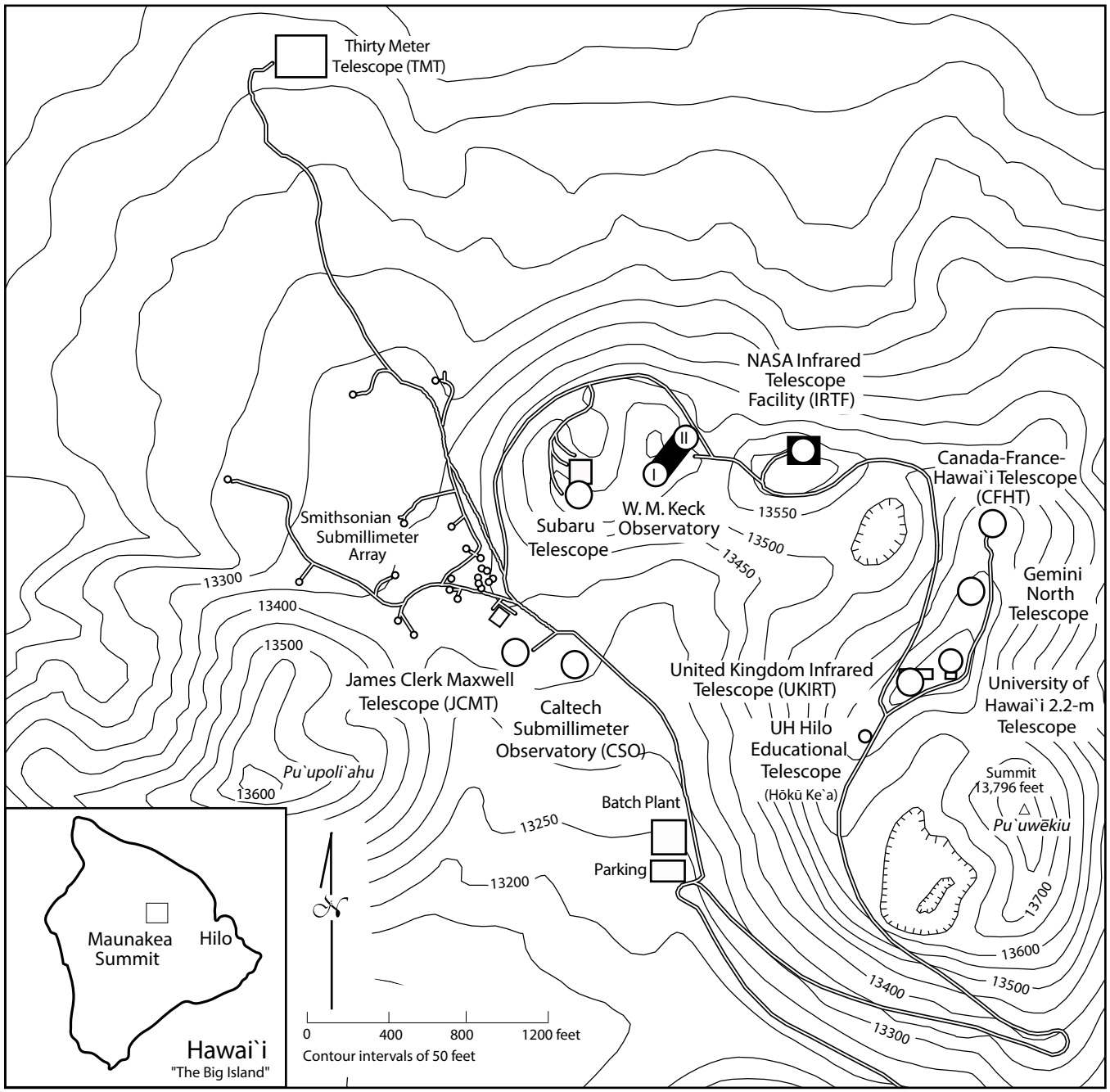

Exhibit 2
Maunakea Observatories

2017 Annual Report to the Board of Land and Natural Resources

Status of the Implementation of the Mauna Kea Comprehensive Management Plan

Purpose

As identified in the 2009 Mauna Kea Comprehensive Management Plan, management action MEU-1 states: OMKM shall produce an annual progress report on the management goals, objectives, and actions for the year and what progress was made towards meeting them. "This Progress Report is not intended to be a status report on the resources in the UH Management Areas; rather, it is meant to inform management and stakeholders of the progress of the program and direction it is to take in the future."

Overview of CMP Management Actions

The CMP contains 103 management actions categorized into four component plans which are further subdivided into sub-components (Table 1).

Table 1. CMP component plans.

CMP Section	Component Plan
7.1	Understanding and Protecting Mauna Kea's Resources
7.1.1	Native Hawaiian Cultural Resources
7.1.2	Natural Resources
7.1.3	Education and Outreach
7.1.4	Astronomy Resources
7.2	Managing Access and Use
7.2.1	Activities and Uses
7.2.2	Permitting and Enforcement
7.3	Managing the Built Environment
7.3.1	Infrastructure and Maintenance
7.3.2	Construction Guidelines
7.3.3	Site Recycling, Decommissioning, Demolition and Restoration
7.3.4	Considering Future Land Use
7.4	Managing Operations
7.4.1	Operations and Implementation
7.4.2	Monitoring, Evaluation, and Updates

Assigning Categories and Priorities

All of the management actions were assigned into one of four categories. These categories represent time periods during which it was estimated the actions would be implemented.

Immediate	1 - 3 years
Short term	4 - 6 years
Mid-term	7 - 9 years
Long-term	10 + years

Reporting Definitions

2010 and 2011. Each management action was initially assigned one of four progress status designations: **As Needed**, **Short to Long Term**, **Ongoing**, or **Completed**.

2012. In 2012 the **Ongoing** category was further divided into two groups, **Ongoing** and **In Progress**, to distinguish management actions that are part of OMKM's regular responsibilities (ongoing) and those that require specialized implementation (in progress).

2014. Based on feedback from the Office of the Auditor, State of Hawaii, beginning with 2014, the definitions for Ongoing and In Progress were further refined. **Ongoing** refers to activities that have established processes in place and are performed as part of OMKM's daily responsibilities. For example, processes for reporting disturbances to historic properties are established while actual reporting is **Ongoing** as necessary. **In Progress** refers to actions that require specialized implementation such as the development of policies or hiring consultants and researchers, and while efforts are **In Progress** the action or process is not yet complete.

Evolution of the Definition of the Terms Ongoing and In-Progress (years 2010 through 2014)

<table>
<tr><th>2010 – 2011</th><th colspan="2">2012 - 2013</th><th>2014</th></tr>
<tr><td rowspan="2">Ongoing are actions that are being implemented</td><td colspan="2">Ongoing was divided into two groups</td><td>Auditor's recommendation</td></tr>
<tr><td>Ongoing are activities that are performed as part of OMKM's daily responsibilities</td><td>In–Progress are actions that require specialized implementation, e.g., development of policies or hiring of consultants</td><td>Ongoing was further defined as activities that have established processes in place and are performed as part of OMKM;s daily responsibilities. In-Progress are actions that requires specialized implementation and while efforts are in-progress, the action or process is not yet complete.</td></tr>
</table>

Short to Long Term	Management action still to be implemented during its scheduled time period.
In Progress	Management action that requires specialized implementation has been initiated, process is not yet complete.
Ongoing	Management action is implemented and processes are in place to fulfill this requirement, actions will continue indefinitely because they are part of OMKM's continuing management responsibilities.
Completed	Management action is completed.

Annual Reports are Cumulative

With the exception of the first annual report to the BLNR in 2010, each successive report builds upon the previous year's report, thereby the annual reports beginning with 2011 are cumulative.

2017 Summary of Implementation Status

Most management actions have either been implemented or are in progress. Many actions are considered 'ongoing' as they are long term, continuous land management responsibilities. Appendix A details the implementation status with explanations for individual CMP management actions. Appendix B details the cumulative annual progression of implementation status from 2010 to present.

CMP Implementation Activities

As reported in earlier reports OMKM identified five priority categories. Efforts have been initiated in all of the categories and are described below.

Priority Categories:

- Research
- Monitoring
- Resources Management Programs
- Education, Training and Outreach
- Printed Materials & Public Forums

A summary of implementation activities are described below.

Research (Table 1)
Data derived from research provides the basis for the development of resource protection programs. OMKM continues its efforts to conduct research including establishing baseline data of the various resources. In the case of the wēkiu bug studies also focused on the bug's life history, habitat and genetics. OMKM utilizes resources available within the UH system including faculty, graduate and undergraduate students, in its efforts to fulfill the CMP mandates.

Biological Research
The 2011 study of the biodiversity of arthropods in the summit region in the Halepōhaku area is anticipated to be completed in 2017. A study of the characterization and mapping of wēkiu bug habitat was completed in 2016 while a study on the restoration of wēkiu bug habitat was initiated in 2015. Research initiated in 2017 included: 1) a project to investigate diets and parasitoid loads for important native and invasive arthropods; and a multi-year sea and forest bird, and bat survey.

Invasive Species
In 2015, OMKM initiated a study to evaluate measures to prevent the introduction of invasive species, in particular the inspections of vehicles and equipment. This includes analysis of the feasibility of a vehicle washing facility as a means of helping to prevent the introduction of invasive species.

Geology and Erosion
A multi-year study of surface erosion processes on cinder cones that was initiated in 2014 is still in progress. This study will help to better understand natural erosion, and is being used to help characterize arthropod habitat. OMKM funded a four-year study to assess the presence of permafrost and whether conditions for formation of permafrost still exist.

Weather and Climate
A multi-year study developing climate change models to determine impacts to the summit ecosystem 50-years in the future is finalizing a public archive of data. A study to extend the long-term temperature records for the state by integrating other types of climate data for earlier years when temperature was not recorded was completed and a journal manuscript is in preparation. These studies in conjunction with a study to site a weather station on the summit as part of a sea level to summit network of weather stations will help to track changes in weather and climate over the long term and will provide data to evaluate altitudinal changes and impacts on ecosystems from sea level to the summit.

Other Studies
OMKM intends to initiate a study of commercial tour activities to determine, if possible, the capacity for commercial tour operations on UH's managed lands.

Monitoring (Table 2)
Following surveys to determine the baseline inventory of a resource, the next step is monitoring to assess the status of the resource over time.

Historic Properties
Following the completion of an archaeological inventory survey of the Maunakea Science and access road, annual monitoring of the historic properties began in 2012. In compliance with the Long Term Historic Property Monitoring Plan, approved by SHPD in 2014, annual monitoring of the Astronomy Precinct and access road is conducted annually while the more remote sites are monitored on a three and five year rotation basis.

While not part of UH's managed lands, in a cooperative effort with the Natural Area Reserve, OMKM rangers photo document monthly the level of Lake Waiau in the Mauna Kea Ice Age Natural Area Reserve, and periodically hike to the adze quarry to assess conditions.

Wēkiu Bug and Alien Species
Monitoring surveys of the wēkiu bug, which began in 2002, and alien arthropods, in 2007, continue to be conducted annually.

Invasive Species
Monitoring of invasive species has been ongoing since 2007. Beginning in 2013 monthly surveys are made in and around the surrounding areas of the facilities at the 9,200 foot elevation. In addition, quarterly surveys are conducted at facilities at the summit.

Botanical Resources
Monitoring of botanical resources is completed in conjunction with Historic Property monitoring. A more detailed monitoring plan for botanical resources will be developed in collaboration with recommendations for arthropod monitoring.

Resource Management Programs (Table 3).
Resource management programs may be policies, plans, or long-term action programs which purpose is to preserve or protect the resources, or to help ensure the health and safety of those visiting and working on the mountain.

Cultural Resources
It was reported previously that OMKM together with Kahu Kū Mauna developed preliminary policies for the construction of new cultural features, including the stacking of rocks, the scattering of human remains, buffers around historic properties and visitation and use of ancient shrines. The Maunakea Management Board (MKMB) approved the latter two policies. Kahu Kū Mauna also drafted policies related to the placement and removal of offerings. Kahu Kū Mauna is currently re-evaluating some of their earlier policies for alignment with State Law and DLNR rules. Community consultation and outreach efforts continue.

Invasive Species
As mentioned in previous reports, data from surveys and studies provide valuable information for developing management programs to protect the resources such as the endemic wēkiu bug. Invasive flora and fauna are a concern because of their potential impact not only on the wēkiu bug, but also on other native species, and on the "health" of Maunakea's unique ecosystem. OMKM's invasive species prevention, response and control plan is actively being implemented, especially regarding observatory related activities. As an adaptive-management plan, this is periodically reviewed and updated, with annual reports prepared and made publicly available.

OMKM continues its efforts to remove fireweed (*Senecio madagascarensis*). While on patrol, rangers remove fireweed found along the road and in the summit areas. OMKM's invasive weed pull program brings volunteers to the Halepōhaku area to pull fireweed, mullein and other invasive plants. It is OMKM's goal to control invasive weeds and to revegetate the area with native vegetation.

Preventing the introduction of predatory ants remains a high priority.

Operations Monitoring, and Maintenance Plan (OMMP)
An OMMP is implemented and identify maintenance needs, protocols and strategies that minimizes impacts to the resources and ensures that permittees comply with the conditions of their CDUPs,

CMP Compliance
Twice annually OMKM rangers conduct inspections of all summit facilities for compliance with their Conservation District Use Permits.

CMP Actions and Mitigation
Applicants of projects are required to review the CMP and submit measures to comply with relevant CMP actions as part of the project's proposal. When applicable, mitigation measures are also included in the proposals.

Infrastructure
Parking, vehicle and pedestrian flow and visitor capacity concerns are being addressed in design improvements to keep parking, drop off and pickup of visitors on the same side of the road as the VIS. It is currently being addressed with the proposed construction of a vehicular ingress/egress-parking system. Road repair and improvements are also being evaluated. Capital improvement project funds were provided for this study.

Vehicle Counter
An automated vehicle counter was installed to count the number of vehicles that drive above Halepōhaku.

Road Condition Sensor
A test road condition sensor installed in 2013 has shown the device accurately senses the presence of ice on the road. Additional sensors will be installed over the next two years along a steep incline, an area prone to development of ice, in particular black ice. When ice is detected the sensors automatically send email notifications to rangers who take action such as closing the road to protect the safety of the visiting public.

Education, Training and Outreach
OMKM recognizes the need to formally educate and train management staff, stakeholders and the general public about the resources and significance of Maunakea. One of the key tenets of the Public Access Plan is that "an informed public is best prepared to make good decisions and act responsibly." OMKM also recognizes the importance of establishing community relationships and keeping them informed of OMKM's activities.

Orientation
The OMKM Maunakea User/Resource Orientation program was launched in the Summer of 2013. It is a requirement that all observatory and support staff (both office and on-mountain), vendors, construction workers, mid-level support and VIS staff, UH employees, and commercial tour drivers attend the orientation. A plan for implementing the orientation has been adopted and circulated, identifying a renewal requirement every 3 years. Since the orientation began in 2013, nearly 1,800 people have attended the orientation. Beginning in 2016 those who took the orientation in 2013 have begun their renewal process. An online version with an assessment quiz is available as a more efficient means of delivery and an alternative to in-person sessions. A video orientation for visitors will also be developed to be shown in the Visitor Information Station (VIS).

Training

Beginning in 2016, a staff/employee training program was initiated. All OMKM and Maunakea Observatory Support Services employees are required to attend.

Volunteer Program

Since its inception in the Spring of 2012, OMKM 's community volunteer weed pull program filled a total of 1,795 bags of weeds by 1,118 volunteers putting in 8,164 hours. Groups participating in 2016 include various UH Hilo student groups, local primary school students and families, Observatories, and local Rotary club and chambers of commerce members. OMKM is propagating plants for future restoration efforts in the Halepōhaku area.

Outreach

OMKM seeks opportunities to go into the community to share OMKM's activities. OMKM also participates in school and community events showcasing some interesting "critters" that are found on Maunakea, fun science and keiki activities.

As part of their educational efforts with young children, researchers working on OMKM projects have been going to schools to demonstrate the use of equipment that is used in their scientific studies, such as unmanned aerial vehicles (drones) or conducts experiments with the students. Others mentor students, including those who wish to conduct and enter the results of their studies in the State science fair.

Printed Materials & Public Forums.

Education and outreach efforts include the development of educational materials, such as brochures, signage and the dissemination of materials, OMKM recently updated its resource brochure. This brochure along with the safety brochure, "*Visiting Maunakea Safely and Responsibly,"* are distributed at the VIS at the 9,200 foot elevation and at the 'Imiloa Astronomy Center. OMKM also seeks opportunities to speak to groups, such as Rotary clubs, and community associations about OMKM's activities.

Daily Implementation of Ongoing Actions

The Maunakea rangers continue to monitor activities on UH's managed lands on a daily basis. They record pertinent data including the number of vehicles by type (4- vs. 2-wheel drive, observatory, commercial and motorcycles) and observations of visitor activities, including hikers, bikers, vehicle speeds, trash, etc. Through their interactions with the public they help to educate people about Maunakea. Many of the management actions relating to public and commercial activities, and trash pick-up and removal are carried out by the Rangers as part of their daily responsibilities.

The Maunakea ranger corps is composed of eight full-time and two part-time rangers. This allows OMKM to schedule three rangers for duty and ensures a minimum of two rangers on duty should one ranger be sick or on vacation.

Administrative Rules

Draft administrative rules were reviewed by Kahu Kū Mauna and the Mauna Kea Management Board and a recommendation was submitted to the Board of Regents for their review and a request to the Governor authorizing the University to conduct public hearings seeking community comments.

Table 1. Research Activities

Surveys and studies on: • Historic Properties • Arthropods • Geology and erosion • Climate and weather	• 2005 – 2009. Archaeological inventory of historic properties of the Science Reserve, access road and Halepōhaku. • 2006. Climatological analysis of meteorological observations at the summit of Maunakea • 2007. Review Mauna Loa weather data dating back to 1958 to assess climate conditions on Maunakea to help with wēkiu bug research • 2012 –ongoing. Four year study to assess presence of • 2006. Climatological analysis of meteorological observations at the summit of Maunakea • 2007. Review Mauna Loa weather data dating back to 1958 to assess climate conditions on Maunakea to help with wēkiu bug research • 2012 –ongoing. Four year study to assess presence of permafrost and whether conditions for formation of permafrost still exist. • 2011- ongoing. A multiyear study on the development of a climate change modeling program to help forecast climate change on the summit to help determine impacts to the summit ecosystem. • 2012. High Altitude Climate of the Island of Hawai'i publication. • 2013 – ongoing. OMKM is working with the Department of Geography at UH Manoa on the development of a sea level to summit weather monitoring network to help track climate change. OMKM's participation is to help the location and installation on weather station on the summit. • 2014 –ongoing. Surficial study of the geology and erosion in cinder cone environments above 12,500'. High-resolution topographic maps, and imagery have been completed. • 2013 – 2016. Study to extend the long term temperature records for the State of Hawaii by integrating other climate data for earlier years when temperature was not recorded. • 2016. MS Thesis and Peer-Review Publication (Draft): Regional Temperature Trends in Hawai'i, A Century of Change. 1916-2015. • 2017 – ongoing. Study to investigate diet and parasite loads in alpine arthropods.
• Surveys on human activities and needs:	• 2001 – ongoing. Rangers continue to submit daily reports on human activities; data are input in a database. • 2016 – ongoing. An automated vehicle counter keeps a real time count of all vehicles traversing above Halepōhaku. Rangers also conduct daily counts of vehicles identifying 2 wheel vs 4 wheel drive vehicles.
Ongoing surveys and studies of the wēkiu bug and other arthropods	• 2011. A study of how geology (pu'u and terrain), wind speeds and direction influence insect and snow pack deposits on the summit to help supplement wēkiu bug research. • 2011 – ongoing. Multi-year survey of the summit region and at the mid-level area at 9,200 ft elevation to assess the biodiversity of arthropods. Including a 2016 MS Thesis on biodiversity in the Halepōhaku area. • 2014 – 2016. A study evaluating the characterization and mapping of wēkiu bug habitat has been completed. • 2015 – ongoing. A multi-year wēkiu bug habitat restoration plan is being implemented. Originally it was part of the (now vacated) TMT CDUP requirement. OMKM is pursuing this management action. • 2016. Habitat mapping of wēkiu bugs using existing remote sensing and arthropod trap data. • 2017 – ongoing. Study to investigate diet and parasite loads in alpine arthropods.
Alien and invasive species	• 2012 – 2015. Development of an invasive species management plan. It is composed of modules addressing various aspects of the invasive species prevention, response, and control. Implementation is ongoing

	• 2015 – ongoing. A study to evaluate measures to prevent the introduction of invasive species, in particular the inspection of vehicles and equipment was initiated in 2015.
Other Studies	• 2004 - 2006. Archival study and compilation of native traditions, historical accounts, and oral history interviews for Mauna Kea. • 2005 – 2009. Archaeological inventory of historic properties of the Science Reserve, access road and Halepōhaku. • 2016. Initiate seabird, forest bird and bat inventory study

Table 2. Monitoring

Historic Properties (archaeological sites)	• 2012. Annual archaeological monitoring of historic properties (archaeological sites) began in 2012. The Long-Term Historic Monitoring Plan was approved by State of Hawaii Historic Preservation Division (SHPD) in 2014. • 2014. SHPD approved the Long Term Historic Properties Monitoring Plan for UH Managed lands on Maunakea. • On a monthly basis, OMKM Rangers photo document the level of Lake Waiau in DLNR's Mauankea Ice Age Natural Area Reserve (MKIANAR). Rangers also periodically hike to the adze quarry in the MKIANAR) to assess conditions. Rangers pick up and remove trash from their hikes into the MKIANAR.
Wēkiu bug and alien species.	• 2002 – ongoing. Annual surveys on wekiu bug have been conducted since 2002. • 2007 – ongoing. Annual surveys of alien species are conducted on UH Managed lands
Invasive species	• 2013 – ongoing. Monthly surveys for invasive species are conducted at the facilities at the mid-level, 9,200 ft elevation, including the VIS and the support facilities. • 2013 – ongoing. Quarterly surveys for invasive species are conducted at all the summit facilities for invasive species. • 2013 – ongoing. Natural resources personnel accompany archaeologists in their annual monitoring to assess sites and surrounding areas for native and invasive species

Table 3. Resource Management Programs

Polices and plans related to cultural resources	• 2012 – 2014. A burial treatment plan was reviewed by the Hawaii Island Burial Council and approved by the Division of Historic Preservation. It contains a schedule for monitoring. • 2012 – currently under re-evaluation. Policies relating to the placement and removal of offerings, the scattering of human remains, the construction of new cultural features including the stacking of rocks were developed by Kahu Kū Mauna. In 2016 following public consultation Kahu Kū Mauna approved the policies. The MKMB felt that more community consultation was required before finalizing the policy. Community consultation on these policies is on-going. • 2016 - The U.S. Department of Defense was contacted to begin the review process prior to any removal efforts of military aircraft.
Invasive species control	• 2012 – ongoing. An active volunteer program to remove fireweed (*Senecio madagascariensis*) and other invasive plants continues at the mid-level area. Rangers continue to remove fireweed in the upper elevations. • 2013 – ongoing. The Maunakea Invasive Species Management Plan was approved by the MKMB. It is composed of modules addressing various aspects of the invasive species prevention, response, and control. Implementation is ongoing. • 2013 – ongoing. The Hawaii Ant Lab and Big Island Invasive Species Committee continue to support implementation of the Invasive Species Management Plan by providing technical support, and assisting with inspections and monitoring work.
Wēkiu bug management plan and habitat restoration plan.	• Data from wēkiu bug, invasive/alien arthropod, biodiversity arthropod studies, topography and wēkiu bug food distribution, and climate studies will provide the basis for developing management and habitat restoration plans for the bug
Public facilities	• 2014 – ongoing. An automated vehicle counter was installed to count the number of vehicles (differentiating: public, commercial, tour, observatory, etc.) that drive above Halepōhaku. • 2014 – 2017. CIP funds are being used to study and design improvements to the ingress and egress at the VIS and to address parking and pedestrian flow. The study also included an assessment of road conditions, and recommendations for repair and estimated costs. An Environmental Assessment is currently being finalized and a CDUA will be submitted for DLNR consideration.
Other Plans and activities	• 2001. OMKM ranger program established. • 2007 – ongoing. Biannual inspection of facilities for compliance with their CDUPs • 2009. BLNR approved the Maunakea Comprehensive Management Plan (CMP) • 2010. BLNR approved the Cultural and Natural Resources Management Plans, Public Access Plan and the Decommissioning Plan, sub-plans to the CMP. • 2012 – ongoing. Beginning in 2012 applicants of projects are required to review the Comprehensive Management Plan (CMP) and submit measures to comply with relevant CMP actions as part of their project proposals. When applicable, mitigation measures are included in the project proposal. • 2016 – ongoing. An Operations, Monitoring, and Maintenance Plan has been developed. The plan recognizes the need to identify maintenance needs, protocols and strategies that minimizes impacts to the resources and ensures that permittees comply with the conditions of their CDUPs. It also serves as a reporting mechanism for CMP compliance activities calls for the coordination of maintenance activities and

	schedules. • 2016 – ongoing. A Sign Plan was approved by the MKMB. This plan helps ensure appropriate review and consistency in sign design and use.

Table 4. Education, Training and Welfare

Initiate programs to educate stakeholders, management staff, and the general public.	• 2012 – ongoing. OMKM has been conducting orientations relating to the cultural and environmental significance to those who work on UH's managed lands including observatory and UH personnel, contractors and vendors, and commercial tour operators. • 2016 - OMKM launched an online video version of the orientation as a more efficient means of reaching contractors, vendors, visiting staff, or other interested parties. Regular feedback is solicited from Kahu Kū Mauna and attendees. • A three-year refresher interval requirement has been adopted and original orientation attendees have begun the renewal process. • A video orientation for visitors will be developed and shown in the VIS. • A staff/employee training plan has been implemented. All OMKM and Maunakea Observatory Support Services are required to attend.
Develop and maintain a GIS and database program.	• 2013 – ongoing. A GIS-based data storage and reporting system has been developed. The system is continuously being expanded and enhanced. • 2001 – ongoing. Rangers have been and continue to submit daily reports summarizing their observations and their activities, including documenting number of vehicles, hikers, incidents, permitted and unpermitted commercial tour operators, etc. • 2015 – ongoing. An automated vehicle data collection system is operational recording individual observatory, permitted commercial tours, and OMKM vehicles using radio frequency identification tags (RFID) and general public vehicles.
Develop an outreach program.	• 2012 – ongoing. In 2016, 200 volunteers, working 1,500 hours, removed 299 bags of invasive weeds. This year's program once again focused on removing invasive plants in the Halepōhaku parcel and along the access corridor. Since 2012, a total of 1,118 volunteers putting in 8,164 hours pulled and filled 1,795 bags of weeds. • Volunteer groups have included the Hawaii Island Chamber of Commerce, Circle K (Kiwanis youth), Interact (Rotary Youth) Hawaii National Guard Youth Challenge Academy, UH Hilo student groups, school groups, and general community members. • Mentoring young students with science projects and participation in local science and State science fairs. Dr Jesse Eiben, wēkiu bug researcher for OMKM, continued his mentorships with local middle and high-school students. This year one of the mentored students investigating Maunakea's lycosa spiders advanced to the State Science Fair competition on Oahu. • Dr. Norbert Schorghofer's (principle investigator for OMKM's sponsored permafrost study) colleague Dr. Kenji Yoshikawa continues work with Hilo Intermediate School 7th & 8th grade science classes to collect comparable data in their school yard for comparison with Maunakea and other sites across the globe. • Dr. Ryan Perroy visits a community based charter school and demonstrate the use of unmanned aerial vehicles and how they are used for scientific purposes. He also participates in OMKM outreach activities • 2015 –ongoing OMKM participated in Kealakehe Elementary School annual "Science Showcase" with interactive materials on ecosystems, arthropods, and art. • 2016. Participated in the Panaewa community Prince Kuhio Day keiki festivities with exhibits, coloring activities, trading cards and resource and safety brochures. • 2017. OMKM participated in the annual Astroday event in Hilo and Astrobash in Kona with exhibits of arthropods found on Mauankea, coloring activities, tattoos and natural science trading cards for the kids,

	and resource brochures and safety for the adults.

Table 5. Printed Materials and Public Forums

Develop and print brochures.	• 2016. OMKM updated its resource brochure containing information about the resources and significance of Maunakea incorporating community and Kahu Kū Mauna input. • 2002- ongoing. Also available are Visiting Maunakea Safely and Responsibly and a brochure about the purpose of the Office.
Distribution of informational materials.	• Brochures are available for public distribution at the VIS, 'and other public venues, or distributed at public and outreach events.
Participate in public events, community gatherings and other opportunities to inform the community about Maunakea.	• Continue to seek opportunities to participate or speak at public forums, including community meetings, local organization membership meetings, etc.
Signs	• 2012 – An inventory and map of all the signs on UH's managed lands was completed. The inventory of the signs on UH managed lands is being updated. • 2016 – ongoing. A Sign Plan was approved by the MKMB. Installation of signs still requires DLNR approval, the plan helps ensure appropriate review and consistency in design and use. • With input from Rangers and Kahu Kū Mauna, signs were installed to highlight cultural awareness and safety issues.

Appendix A

Implementation Status of Maunakea CMP Management Actions

MKMB = Maunakea Management Board; MKSS = Maunakea Observatories Support Services; OMKM = Office of Maunakea Management; VIS = Visitor Information Station

COMPONENT PLAN: UNDERSTANDING AND PROTECTING MAUNA KEA'S RESOURCES			
		Implementation Schedule	Comments
NATIVE HAWAIIAN CULTURAL RESOURCES			
Management			
CR-1	Kahu Kū Mauna shall work with families with lineal and historical connections to Maunakea, cultural practitioners, and other Native Hawaiian groups, including the Maunakea Management Board's Hawaiian Culture Committee, toward the development of appropriate procedures and protocols regarding cultural issues.	Ongoing	Identification of lineal and historical connections was part of the development and State Historic Preservation division approval (2014) of the Burial Treatment Plan (see CR-13). Solicitations were made through announcements in the daily newspapers and the OHA newsletter. There were no responses to the solicitations but OMKM continues to seek out individuals as part of its interaction and relationship building with the community. Fall 2013 the Hawaii Island Burial Council officially recognized several individuals as cultural descendants of Kaohe Ahupua'a.
CR-2	Support application for designation of the summit region of Mauna Kea as a Traditional Cultural Property, per the National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470 et seq. in consultation with the larger community.	Ongoing	An application for the designation of the summit region of Maunakea as a Traditional Cultural Property has not yet been prepared for filing by State Historic Preservation Division with the appropriate Federal agency.
CR-3	Conduct educational efforts to generate public awareness about the importance of preserving the cultural landscape.	Ongoing	Rangers through their interactions with the visiting public help to educate and raise awareness about Mauna Kea. An informational brochure on cultural and natural resources was developed in 2014 and revised in 2016. OMKM sends out eNewsletters informing the public about OMKM and its activities. Resource orientation of those who work on the mountain including observatory personnel, VIS and MKSS staff, rangers, commercial tour operators and staff, and construction workers commenced in 2013. An online orientation is also available. A brief public / visitor orientation is complete and provided for scheduled group visits.

COMPONENT PLAN: UNDERSTANDING AND PROTECTING MAUNA KEA'S RESOURCES			
		Implementation Schedule	Comments
Cultural Practices			
CR-4	Establish a process for ongoing collection of information on traditional, contemporary, and customary cultural practices.	Short-Term	OMKM staff met with State Historic Preservation Division staff in 2015 to discuss practices at various sites. Discussions with Kahu Kū Mauna Council to craft a culturally appropriate process continue.
CR-5	Develop and adopt guidelines for the culturally appropriate placement and removal of offerings.	In Progress	In 2016, Kahu Kū Mauna reviewed and approved the wording of draft policy guidelines. Approval by MKMB was deferred. Kahu Kū Mauna is engaging in additional consultation. In addition, a law suit was filed in federal court and dismissed without prejudice; the plaintiff may still seek further judicial relief. The final outcome will likely be formally included in administrative rules for UH's managed lands. Note: CR-5 overlaps with CR-7 (constructing new Hawaiian cultural features) being that offerings are usually associated with the construction of new features. It is noted that the proposed policy acknowledges there are existing statutes and rules governing this type of activity.
CR-6	Develop and adopt guidelines for the visitation and use of ancient shrines.	Ongoing	In 2016 Kahu Kū Mauna drafted and the MKMB approved the policy. Visitation is a public access issue and will likely be formally be included in administrative rules for UH's managed lands. State law also governs.
CR-7	Kahu Kū Mauna shall take the lead in determining the appropriateness of constructing new Hawaiian cultural features.	In progress	In 2012, Kahu Kū Mauna reviewed a draft of a process. In 2016 Kahu Kū Mauna re-evaluated the policy, consulted with OHA and held a consultation session. Approval by MKMB was deferred. Kahu Kū Mauna is engaging in additional consultation. In addition, a lawsuit was filed in federal court which was dismissed without prejudice; the plaintiff may still seek further judicial relief. It is noted that the proposed policy acknowledges there are existing statutes and rules governing this type of activity. Community consultations are ongoing.
CR-8	Develop and adopt a management policy for the UH Mgt. Areas on the scattering of cremated human remains.	In Progress	In 2012 Kahu Kū Mauna developed and approved a draft policy. In 2016 Kahu Kū Mauna re-evaluated the policy and held a consultation session. Approval by MKMB was deferred. Kahu Kū Mauna is engaging in additional consultation. In addition, a law suit was filed in federal court which was dismissed without prejudice; the plaintiff may still seek further judicial relief. The final outcome will likely be formally included in administrative rules for UH's managed lands

CR-9	A management policy for the culturally appropriateness of building ahu or "stacking of rocks" will need to be developed by Kahu Kū Mauna who may consider similar policies adopted by Hawai'i Volcanoes National Park.	In Progress	In 2012 Kahu Kū Mauna approved a draft policy. In 2016 Kahu Kū Mauna re-evaluated the policy and held a consultation session. Approval by MKMB was deferred. Kahu Kū Mauna is engaging in additional consultation. In addition, a law suit was filed in federal court which was dismissed without prejudice; the plaintiff may still seek further judicial relief. CR-7 was combined with CR-9 under the guidance of Kahu Kū Mauna who pointed out that the "stacking of rocks" is no different from the creation of new cultural features. See CR-7 above.

COMPONENT PLAN: UNDERSTANDING AND PROTECTING MAUNA KEA'S RESOURCES			
		Implementation Schedule	Comments
Historic Properties			
CR-10	Develop and implement a historic property monitoring program to systematically monitor the condition of the historic district and all historic properties, including cultural sites and burials.	Completed	SHPD approved OMKM's long term historic properties monitoring plan; monitoring is ongoing according to the plan's schedule.
CR-11	Complete an archaeological survey of the portions of the Summit Access Road corridor that are under UH management.	Completed	
CR-12	Consult with Kahu Kū Mauna about establishing buffers (preservation zones) around known historic sites in the Astronomy Precinct, to protect them from potential future development.	Ongoing	In 2012 Kahu Kū Mauna determined that this should be reviewed on a case-by-case basis. They identified criteria for when to consult for routine (minimal impact) project proposals, as well as with future development. In 2016, Kahu Kū Mauna revised their policy. MKMB approved their policy.
CR-13	Develop and implement a burial treatment plan for the UH Management Areas in consultation with Kahu Kū Mauna Council, MKMB's Hawaiian Culture Committee, the Hawai'i Island Burial Council, recognized lineal or cultural descendants, and SHPD.	Completed	SHPD reviewed and approved the Burial Treatment Plan for Mauna Kea in 2014.
CR-14	Immediately report any disturbance of a shrine or burial site to the rangers, DOCARE, Kahu Kū Mauna Council, and SHPD.	Ongoing	Rangers report disturbance to OMKM and OMKM in turn notifies other parties.

COMPONENT PLAN: UNDERSTANDING AND PROTECTING MAUNA KEA'S RESOURCES		Implementation Schedule	Comments
NATURAL RESOURCES			
Threat Prevention and Control			
NR-1	Limit threats to natural resources through management of permitted activities and uses.	Ongoing	OMKM consulted with agencies on a draft of administrative rules governing public and commercial activities. An Operations, Monitoring and Maintenance Plan (OMMP) relating to the coordination of maintenance plans, activities and schedules was developed and approved by the MKMB, and is being implemented.
NR-2	Limit damage caused by invasive species through creation of an invasive species prevention and control program.	Ongoing	The Maunakea Invasive Species Management Plan is approved and implemented. Additional topics are addressed as situations arise, and procedures are developed based on scientific, management board, and community feedback. A volunteer program was established to pull invasive weeds on UH's managed lands with emphasis in the Halepōhaku area. Long term goal is to re-vegetate the mid-level area with native plants. Beginning in 2007 OMKM conducted annual surveys of invasive arthropod species on UH's managed lands. This program was expanded to include monthly monitoring at the facilities at the 9,200 ft mid-level facilities, and quarterly monitoring of the summit facilities. Rapid response strategies were drafted as part of the Invasive Species Management Plan. Inspections of heavy equipment, construction material, and other items too large to be carried by an individual occur prior to coming on to UH's lands. Specific requirements are part of the Invasive Species Management Plan. A MS Student is evaluating program efficacy as part of his thesis, expected to be complete in 2017.
NR-3	Maintain native plant and animal populations and biological diversity.	Ongoing	Non-native plants and arthropods are monitored. The Division of Forestry and Wildlife is completing a circum-Maunakea fence and ungulate removal from Palila critical habitat. OMKM staff investigated māmane leaf curl frequency at Halepōhaku (plant disease response) in coordination with UHH scientists. Arthropod food webs and parasites are being investigated.
NR-4	Minimize barriers to species migration to help maintain populations and protect ecosystem processes and development.	Ongoing	OMKM coordinates with Forest Reserve, Natural Area Reserve, and Department of Land and Natural Resources technical staff to identify issues, craft appropriate responses, and investigate concerns regarding ecosystems and flora and fauna populations.
NR-5	Manage ecosystems to allow for response to climate change.	Ongoing	OMKM coordinates with Forest Reserve and Natural Area Reserve staff to ensure management activities do not inadvertently impede natural ecosystem response. Research into climate change forecast downscaling and climate monitoring helps inform potential future management action. OMKM participated in Pacific Islands Climate Change Cooperative workshops on climate change to help identify mitigation and adaptation strategies. A climate monitoring sea level to summit network plan is in preparation.

NR-6	Reduce threats to natural resources by educating stakeholders and the public about Mauna Kea's unique natural resources.	Ongoing	Rangers help to educate visitors about Maunakea as part of their daily activities. Resource orientation of those who work on the mountain including observatory personnel, VIS and MKSS staff, rangers, commercial tour operators and staff, and construction workers commenced in 2013. An online orientation is also available. A brief public / visitor orientation is complete and provided for scheduled group visits. See also CR-3 and EO-2

COMPONENT PLAN: UNDERSTANDING AND PROTECTING MAUNA KEA'S RESOURCES			
		Implementation Schedule	Comments
Ecosystem Protection, Enhancement & Restoration			
NR-7	Delineate areas of high native diversity, unique communities, or unique geological features within the Astronomy Precinct and at Hale Pōhaku and consider protection from development.	Ongoing	Botanical survey of UH managed lands is completed. Biodiversity, wēkiu bug, and erosion and surficial geology surveys are ongoing. A study and mapping of wēkiu bug habitat is completed..
NR-8	Consider fencing areas of high native biodiversity or populations of endangered species to keep out feral ungulates (applies to areas below 12,800 ft elevation).	Ongoing	Assisted DLNR with fencing natural population of Silverswords. Other areas will be fenced when areas are identified and needed.
NR-9	Increase native plant density and diversity through an outplanting program.	Ongoing	Māmane seedlings germinated from seeds found in the Halepōhaku area were planted near the VIS Worked with DLNR and planted 200 Silversword seedlings in the Halepōhaku area. Collaborated with Kamehameha Schools to build plant propagation benches and start seedlings for eventual habitat restoration and enhancement at Halepōhaku. Germination of māmane seedlings continues. A small greenhouse at Halepōhaku is included in plans for improvements to visitor facilities.
NR-10	Incorporate mitigation plans into project planning and conduct mitigation following new development.	Ongoing	Mitigation and best management practices plans are required for projects as appropriate.
NR-11	Conduct habitat rehabilitation projects following unplanned disturbances.	Ongoing	Damage assessments and rehabilitation following unplanned disturbances are conducted on a case-by-case basis as needed. Generally, unplanned disturbances, such as vehicle oil leaks, occur on previously disturbed areas such as roadways, where humans frequent.
NR-12	Create restoration plans and conduct habitat restoration activities, as needed.	Ongoing	A study of wēkiu bug habitat restoration was initiated in 2015. A study and mapping of wēkiu bug habitat has been completed. Restoration plans and greenhouse for long-term program use are part of a project to improve the ingress/egress and parking at the VIS.
Program Management			
NR-13	Increase communication, networking, and collaborative opportunities to support management and protection of natural resources.	Ongoing	OMKM has established and continues to establish working relationships with the community and DLNR through working groups such as the Environment and Big Island Invasive Species committees, and OHA.
NR-14	Use the principles of adaptive management when developing programs and methodologies. Review programs annually and revise any component plan every five years, based on the results of the program review.	In Progress	Potential CMP revisions are identified in annual program documentation. Program plans, such as the Maunakea Invasive Species Management Plan, are updated and communicated at MKMB meetings as issues are identified.

COMPONENT PLAN: UNDERSTANDING AND PROTECTING MAUNA KEA'S RESOURCES			
		Implementation Schedule	Comments
Inventory, Monitoring and Research			
NR-15	Conduct baseline inventories of high-priority resources, as outlined in an inventory, monitoring, and research plan.	Ongoing	Baseline surveys of wēkiu bugs, other arthropods, including invasive species have been completed or are continuing. A botanical survey was completed in the Summer of 2011 and published in 2013. OMKM is funding a 4-year study on permafrost and working on designing a climate monitoring network. OMKM is also studying erosion to better understand surficial geology, cinder cone erosion, and characterize arthropod habitat. A bird and bat inventory commenced in 2017.
NR-16	Conduct regular long-term monitoring, as outlined in an inventory, monitoring, and research plan.	Ongoing	OMKM conducts annual wēkiu bug, alien and invasive species surveys. Botanical and arthropod surveys are conducted as part of the annual archaeological monitoring. Other monitoring plans to be developed following baseline surveys.
NR-17	Conduct research to fill knowledge gaps that cannot be addressed through inventory and monitoring.	Ongoing	OMKM funded a study to develop a long term model relating to climate change and potential impact to the summit ecosystem; a study of native arthropod habitats and vegetation association, arthropod food webs; analysis of historical weather climate conditions on the summit and meteorological and geological influences on insect and snowfall drops on the summit terrain to help inform wēkiu bug research; study to assess the presence and persistence of permafrost; surficial geology and erosion,; and several studies related to the wēkiu bug including life history, genetics, habitat restoration, and habitat mapping. OMKM funded an international symposium on Tropical Alpine Ecosystems. Invited speakers are experts in research and management of alpine ecosystems. OMKM hopes to develop a network with other researchers and managers to gain knowledge to better manage Maunakea.
NR-18	Develop geo-spatial database of all known natural resources and their locations in the UH Management Areas that can serve as baseline documentation against change and provide information essential for decision-making.	Ongoing	Wēkiu bug and botanical data, infrastructure and signs have been mapped. A GIS database of resources surveyed utilizing ArcGIS and distributed as GoogleEarth layers has been developed; new data as available is added to this database..
EDUCATION AND OUTREACH			
Program Development			
EO-1	Develop and implement education and outreach program	Ongoing	Volunteer, Orientation, Brochures (Safety, Culture, Resources, What is OMKM) are available. In-school visits (Hilo Inter, Hawaii Academy of Arts and Sciences PCS, Ke Ana La'ahana, Waiakea High, Kealakehe Elementary) occur regularly. Community organizations and members help support OMKM's volunteer program. Work with Kealakehe Elementary School to support their annual Science Showcase at the school. Outreach activities by researchers are conducted at various schools; OMKM research affiliate also helps advise young scientists with their science fair projects Updates on OMKM activities are given to various community organizations. OMKM also participates in community events.

COMPONENT PLAN: UNDERSTANDING AND PROTECTING MAUNA KEA'S RESOURCES			
		Implementation Schedule	Comments
Education			
EO-2	Require orientation of users, with periodic updates and a certificate of completion, including but not limited to visitors, employees, observatory staff, contractors, and commercial and recreational users.	Ongoing	Resource orientation of those who work on the mountain including observatory personnel, VIS and MKSS staff, rangers, commercial tour operators and staff, and construction workers commenced in 2013. Orientation is available to all interested parties in-person or online.
EO-3	Continue to develop, update, and distribute materials explaining important aspects of Mauna Kea.	Ongoing	Materials on the cultural and natural resources, visiting safely and responsibly and Mauna Kea hazards are distributed at the VIS. .
EO-4	Develop and implement a signage plan to improve signage throughout the UH Management Areas (interpretive, safety, rules and regulations).	Ongoing	A sign plan was approved by the MKMB in 2016. An inventory of sign locations on UH's managed lands has been completed. Cultural and safety related signs have been installed.
EO-5	Develop interpretive features such as self-guided cultural walks and volunteer-maintained native plant gardens.	In Progress	Included as part of ongoing CIP funded project.
EO-6	Engage in outreach and partnerships with schools, by collaborating with local experts, teachers, and university researchers, and by working with the 'Imiloa Astronomy Center of Hawai'i.	Ongoing	See EO-1
Outreach			
EO-7	Continue and increase opportunities for community members to provide input to cultural and natural resources management activities on Mauna Kea, to ensure systematic input regarding planning, management, and operational decisions that affect natural resources, sacred materials or places, or other ethnographic resources with which they are associated.	Ongoing	OMKM through the MKMB, Kahu Kū Mauna, and Environment Committee provide opportunity for members of the community and other organizations to participate in the management activities of the mountain. Bi-monthly volunteer activities provide an opportunity for the community to participate and share knowledge. Meetings with community groups and open houses were conducted to give the public an opportunity to provide input and feedback on administrative rules being developed by OMKM.
EO-8	Provide opportunities for community members to participate in stewardship activities.	Ongoing	OMKM through the MKMB, Kahu Kū Mauna, and Environment provide opportunity for members of the community to participate in the management activities of the mountain. Bi-monthly volunteer activities provide an opportunity for the community to participate and share knowledge. Student projects and mentoring provides opportunities (science fair, legacy, etc.) for one-on-one interaction and more in-depth efforts.

COMPONENT PLAN: UNDERSTANDING AND PROTECTING MAUNA KEA'S RESOURCES			
ASTRONOMICAL RESOURCES			
AR-1	Operate the UH Management Areas to prohibit activities resulting in negative impacts to astronomical resources.	In Progress	These will likely be addressed in administrative rules. MKMB approved a draft of administrative rules governing public and commercial activities. UH is waiting for the Governor's approval to hold public hearings seeking community input.
AR-2	Prevent light pollution, radio frequency interference (RFI) and dust.	Ongoing	Project proposals requesting the use of radio signals are reviewed by the Institute for Astronomy for potential interference with astronomical research activities. At the State level, the Starlight Reserve Advisory Committee was active from 2010 to 2015. Efforts by UH and DBEDT .to make the committee permanent were unsuccessful at the 2015 and 2016 Legislature were unsuccessful. They will try again in 2107. UH has been working closely with Hawaii County officials on outdoor lighting issues. This has resulted in the adoption of public-health, wildlife, and astronomy-friendly LED lights to replace the previous low-pressure sodium lights. UH and the County are now requesting the State to use similar lights at Hawaii Island airports and harbors. UH continues to provide advice on amendments to the Hawaii County lighting ordinance
COMPONENT PLAN: MANAGING ACCESS AND USES		Implementation Schedule	Comments
ACTIVITIES AND USES			
General Management			
ACT-1	Continue and update managed access policy of 1995 Management Plan.	In Progress	This will likely be addressed in administrative rules. MKMB approved a draft of administrative rules governing public and commercial activities. UH is waiting for the Governor's approval to hold public hearings seeking community input.
ACT-2	Develop parking and visitor traffic plan.	In Progress	Capital improvement funds are being used to implement an Ingress/egress, and parking plan to address concerns of traffic flow and pedestrian safety. An Environmental Assessment that identifies potential impacts of this project is being finalized. OMKM Rangers assist staff at the VIS with the implementation of their interim parking plan to maintain order, accommodate as many vehicles as possible and to ensure the safety of visitors to the VIS. An automated vehicle counter counts the number of vehicles (differentiating: public, commercial, tour, observatory, etc.) that drive above Halepōhaku.
ACT-3	Maintain a presence of interpretive and enforcement personnel on the mountain at all times to educate users, deter violations, and encourage adherence to restrictions.	Ongoing	Mauna Kea Rangers are present year round from 7 am to 10 pm daily; DOCARE officers and Hawaii County Police are called for assistance on an as needed basis.

ACT-4	Develop and enforce a policy that maintains current prohibitions on off-road vehicle use in the UH Management Areas and that strengthens measures to prevent or deter vehicles from leaving established roads and designated parking areas.	Ongoing	OMKM prohibits the use of off-road vehicles on UH's managed lands. Vehicle access to the top of Pu'upoli'ahu has been blocked since 2001 at the request of Kahu Kū Mauna. Commercial operators and film crews are required to stay on the road or within the footprint of existing facilities, unless granted permission by OMKM. This will likely be addressed in administrative rules. MKMB approved a draft of administrative rules governing public and commercial activities. UH is waiting for the Governor's approval to hold public hearings seeking community input.
Recreational			
ACT-5	Implement policies to reduce impacts of recreational hiking	In Progress	This will likely be addressed in administrative rules. MKMB approved a draft of administrative rules governing public and commercial activities. UH is waiting for the Governor's approval to hold public hearings seeking community input.
ACT-6	Define and maintain areas where snow-related activities can occur and confine activities to slopes that have a protective layer of snow.	Ongoing	Generally, this is a self-regulated activity. People usually do not venture to areas where there is no snow. Administrative rules will also address this activity. A map of areas where snow play generally occurs has been developed, but areas change depending on the weather and snow deposition.
ACT-7	Confine University or other sponsored tours and stargazing activities to previously disturbed ground surfaces and established parking areas.	Ongoing	Star gazing activities on UH's lands are limited to parking lots, or in areas in close proximity to the VIS
ACT-8	Coordinate with DLNR in the development of a policy regarding hunting in the UH Management Areas.	In Progress	Hunting policy similar to DLNR's is being addressed in the UH's administrative rules.
COMPONENT PLAN: MANAGING ACCESS AND USES			
		Implementation Schedule	Comments
Commercial			
ACT-9	Maintain commercial tour permitting process; evaluate and issue permits annually.	Ongoing	UH oversees commercial tour permits, a responsibility transferred to UH from BLNR. This will likely be addressed in administrative rules. MKMB approved a draft of administrative rules governing public and commercial activities. UH is waiting for the Governor's approval to hold public hearings seeking community input.
ACT-10	Ensure OMKM input on permits for filming activities	Ongoing	All film permits require OMKM's approval. This will likely be addressed in administrative rules. MKMB approved a draft of administrative rules governing public and commercial activities. UH is waiting for the Governor's approval to hold public hearings seeking community input.
ACT-11	Seek statutory authority for the University to regulate commercial activities in the UH Management Areas.	Completed	The function of commercial tour permitting was transferred by BLNR to UH. OMKM oversees commercial tour operations and film activities. Statutory authority to promulgate administrative rules was granted by the Legislature in 2009. This will likely be addressed in administrative rules. MKMB approved a draft of administrative rules governing public and commercial activities. UH is waiting for the Governor's approval to hold public hearings seeking community input.

Scientific Research			
ACT-12	Ensure input by OMKM, MKMB, and Kahu Kū Mauna on all scientific research permits and establish system of reporting results of research to OMKM.	Ongoing	All research proposals must be approved by OMKM. Proposals requiring ground disturbing activities or potential impact to the cultural and/or natural landscape are reviewed by Kahu Kū Mauna and MKMB. Permitted by DLNR as appropriate.
PERMITTING AND ENFORCEMENT			
Laws and Regulations			
P-1	Comply with all applicable federal, state, and local laws, regulations, and permit conditions related to activities in the UH Management Areas.	Ongoing	This is a condition of UH's leases with DLNR. Rangers monitor activities. Regular communication with DLNR's Division of Conservation and Resources Enforcement, County of Hawaii police, and Sheriff's department continues as demonstrated during TMT protests.
P-2	Strengthen CMP implementation by recommending to the BLNR that the CMP conditions be included in any Conservation District Use Permit or other permit.	Ongoing	Relevant CMP management actions were incorporated into the CDUA for the Thirty Meter Telescope project. The MKMB requires proposals for projects for Maunakea include a review and comments on how the proposer will comply with CMP action items relevant to the project.
P-3	Obtain statutory rule-making authority from the legislature, authorizing the University of Hawai'i to adopt administrative rules pursuant to Chapter 91 to implement and enforce the management actions.	Completed	
P-4	Educate management staff and users of the mountain about all applicable rules and permit requirements.	Ongoing	Included as part of the orientation and with new project start-up meetings.

COMPONENT PLAN: MANAGING ACCESS AND USES			
		Implementation Schedule	Comments
Enforcement			
P-5	Continue coordinating with other agencies on enforcement needs.	Ongoing	OMKM coordinates with DOCARE on enforcement activities. Ranger observations are sent to DLNR, NAR, DOFAW, and US Fish & Wildlife Service.
P-6	Obtain legal authority for establishing, and then establish, a law enforcement presence on the mountain that can enforce rules for the UH Management Areas on Mauna Kea.	Completed	
P-7	Develop and implement protocol for oversight and compliance with Conservation District Use Permits.	Ongoing	OMKM rangers conduct twice yearly inspections of all observatories for CDUP compliance.
P-8	Enforce conditions contained in commercial and Special Use permits.	Ongoing	Rangers' responsibilities includes oversight of commercial tour activities and special use permits issued by OMKM.
COMPONENT PLAN: MANAGING THE BUILT ENVIRONMENT			
		Implementation Schedule	Comments
INFRASTRUCTURE AND MAINTENANCE			
Routine Maintenance			
IM-1	Develop and implement an OMMP.	Completed/ Ongoing	An Operations Monitoring and Maintenance Plan (OMMP) was reviewed by Kahu Kū Mauna and approved by the MKMB. Implementation is ongoing.
IM-2	Reduce impacts from operations and maintenance activities by educating personnel about Mauna Kea's unique resources.	Ongoing	A cultural and natural resources orientation program has been developed and is implemented. Training sessions on resources and safety are conducted for OMKM and Maunakea Observatory Support Staff.
IM-3	Conduct historic preservation review for maintenance activities that will have an adverse effect on historic properties.	In Progress	OMKM is currently developing a Programmatic Agreement/MOU relating to maintenance activities that will be submitted to State Historic Preservation Division.
IM-4	Evaluate need for and feasibility of a vehicle wash station near Hale Pōhaku, and requiring that vehicles be cleaned.	In Progress	OMKM is funding a study to evaluate the efficacy current measures to prevent the introduction of invasive species, including vehicle and equipment wash practices
IM-5	Develop and implement a Debris Removal, Monitoring and Prevention Plan.	Ongoing	Trash from the HP facilities and VIS are removed daily. Each observatory removes trash from their respective facilities. Rangers routinely check for and pick up trash and debris while on their daily patrols. Rangers pick up and map the location of trash at the parking lot near the trail head to Lake Waiau (NAR). The amount of trash decreased following the installation of a portable toilet. A draft plan is under review.
IM-6	Develop and implement an erosion inventory and assessment plan.	In Progress	OMKM partnered with UH Hilo geography department to study surficial geology and cinder cone erosion issues.
IM-7	Prepare a plan, in collaboration with the Department of Defense, to remove military wreckage from a remote area of the UH Management Areas, while ensuring protection of natural and cultural resources.	Ongoing	An inventory of all known aircraft and military wreckage was submitted to the Department of Defense for review and updating. OMKM anticipates working with DOD and SHPD to determine appropriate plans for removal or preservation in place.

COMPONENT PLAN: MANAGING THE BUILT ENVIRONMENT			
		Implementation Schedule	Comments
Infrastructure			
IM-8	Assess feasibility of paving the Summit Access Road.	Completed/ Ongoing	An engineering study related to the paving of the access road from Halepōhaku to the summit was completed in 1984. This study was the basis for paving the road from the summit to about the boundary of the Science Reserve. Another study was prepared in 2017 of the damage caused by large storms over the past 10 years. The report assessed repairs needed and potential cost. .
IM-9	Evaluate need for additional parking lots and vehicle pullouts and install if necessary.	In-Progress	As part of the CIP ingress/egress project at the VIS, additional parking was assessed. Because the cost to execute the entire project scope was much more than available funding, the parking lot had to be scaled back.
IM-10	Evaluate need for additional public restroom facilities in the summit region and at Hale Pōhaku, and install close-contained zero waste systems if necessary.	Ongoing	OMKM is currently studying VIS renovation and expansion to meet safety needs and to educate the visiting public. Initial consideration of converting the presentation room building into a rest and eating stop for commercial tours as a means of reducing congestion at the VIS and providing greater access by the independent travelers, has been put on hold until completion of the ingress/egress project is completed, or if another solution presents itself. Additional portable toilets are available at the summit to address restroom facilities needs at the summit.
Sustainable Technologies			
IM-11	Encourage existing facilities and new development to incorporate sustainable technologies, energy efficient technologies, and LEED standards, whenever possible, into facility design and operations.	Ongoing	The proposed Thirty Meter Telescope is incorporating energy efficiency in its design. Maunakea Observatory Support Services installed a photovoltaic system at Halepōhaku; Gemini observatory installed, and Keck observatory is planning to install photovoltaic systems on their respective summit facilities.
IM-12	Conduct energy audits to identify energy use and system inefficiencies, and develop solutions to reduce energy usage.	Ongoing	Energy audits are part of the photovoltaic system design process, completed or in progress at Gemini, Keck, and Halepōhaku.
IM-13	Conduct feasibility assessment, in consultation with Hawaii Electric Light Company, on developing locally-based alternative energy sources.	Ongoing	MKSS installed a photovoltaic system at Halepōhaku. Additional energy conservation and sustainable generation possibilities are discussed by UHH, MKSS, and Observatories as opportunities arise.
IM-14	Encourage observatories to investigate options to reduce the use of hazardous materials in telescope operations.	Ongoing	With the development of new technology, observatories are beginning to reduce their need to use hazardous materials. An example, is the TMT observatory, which will not be using mercury.

COMPONENT PLAN: MANAGING THE BUILT ENVIRONMENT		Implementation Schedule	Comments
CONSTRUCTION GUIDLINES			
General Requirements			
C-1	Require an independent construction monitor who has oversight and authority to insure that all aspects of ground based work comply with protocols and permit requirements.	Ongoing	Included as part of the proposed TMT Management Plan in its CDUA.
Best Management Practices			
C-2	Require use of Best Management Practices Plan for Construction Practices.	Ongoing	Included as part of the proposed TMT Management Plan in its CDUA. A template for adaptation and use by others is also available.
C-3	Develop, prior to construction, a rock movement plan.	Ongoing	Included as part of the proposed TMT Management Plan in its CDUA.
C-4	Require contractors to provide information from construction activities to OMKM for input into OMKM information databases.	Ongoing	Included as part of the proposed TMT Management Plan in its CDUA.
C-5	Require on-site monitors (e.g., archaeologist, cultural resources specialist, entomologist) during construction, as determined by the appropriate agency.	Ongoing	Included as part of the proposed TMT Management Plan in its CDUA.
C-6	Conduct required archaeological monitoring during construction projects per SHPD approved plan	Ongoing	Included as part of the proposed TMT Management Plan in its CDUA.
C-7	Education regarding historical and cultural significance	Ongoing	Included as part of the proposed TMT Management Plan in its CDUA.
C-8	Education regarding environment, ecology and natural resources	Ongoing	Included as part of the proposed TMT Management Plan in its CDUA.
C-9	Inspection of construction materials	Ongoing	Included as part of the proposed TMT Management Plan in its CDUA.
SITE RECYCLING, DECOMMISSIONING, DEMOLITION AND RESTORATION			
SR-1	Require observatories to develop plans to recycle or demolish facilities once their useful life has ended, in accordance with their sublease requirements, identifying all proposed actions.	Ongoing	This will be part of the TMT decommissioning plan, with the TMT decommissioning funding plan approved by the MKMB in 2014.
SR-2	Require observatories to develop a restoration plan in association with decommissioning, to include an environmental cost-benefit analysis and a cultural assessment.	Ongoing	Included as part of the proposed TMT Management Plan in its CDUA.
SR-3	Require any future observatories to consider site restoration during project planning and include provisions in subleases for funding of full restoration.	Ongoing	Included as part of the proposed TMT Management Plan in its CDUA.

		Implementation Schedule	Comments
CONSIDERING FUTURE LAND USE			
Facility Planning Guidelines			
FLU-1	Follow design guidelines presented in the 2000 Master Plan.	Ongoing	The Design Review Process, which incorporated the 2000 Master Plan's design guidelines, were used in the review of the Thirty Meter Telescope project
FLU-2	Develop a map with land-use zones in the Astronomy Precinct based on updated inventories of cultural and natural resources, to delineate areas where future land use will not be allowed and areas where future land use will be allowed but will require compliance with prerequisite studies or analysis prior to approval of Conservation District Use Permit.	Ongoing	Areas previously mapped as off-limits for future land use through plans such as the Master Plan or CMP are used to limit any proposed activity. UH President Lassner confirmed that TMT was the last telescope to be built on undisturbed land. Resource data must be part of any proposal for major land use requests. HAR 13-5 allows for different types of land uses with each having its own requirements for preparing a land use application. Thus a single pre-prepared map cannot possibly address all potential scenarios.
FLU-3	Require cataloguing of initial site conditions for use when conducting site restoration.	Ongoing	TMT project was example (photo documentation received)
FLU-4	Require project specific visual rendering of both pre- and post-project settings to facilitate analysis of potential impacts to view planes.	Ongoing	TMT project was example (photo documentation received)
FLU-5	Require an airflow analysis on the design of proposed structures to assess potential impacts to aeolian ecosystems.	Ongoing	TMT project was example
FLU-6	Incorporate habitat mitigation plans into project planning process.	Ongoing	TMT project was example
FLU-7	Require use of close-contained zero-discharge waste systems for any future development in the summit region, from portable toilets to observatory restrooms, if feasible.	Ongoing	TMT project was example

COMPONENT PLAN: MANAGING OPERATIONS			
		Implementation Schedule	Comments
OPERATION AND IMPLEMENTATION			
OI-1	Maintain OMKM, MKMB, and Kahu Kū Mauna in current roles, with OMKM providing local management of the UH Management Areas, and MKSS providing operational and maintenance services.	Ongoing	The MKMB meets regularly, holding numerous public meetings; which includes consultation with Kahu Kū Mauna Council. OMKM continues to submit CMP management actions (such as the OMMP) to MKMB. MKSS continues to maintain the road and public services, financially supported by the Maunakea Observatories.
OI-2	Develop training plan for staff and volunteers.	Completed	OMKM requires all staff and volunteers to attend the Maunakea orientation. A training plan was submitted and approved by the MKMB; bi-monthly trainings of all staff is being conducted.
OI-3	Maintain and expand regular interaction and dialogue with stakeholders, community members, surrounding landowners, and overseeing agencies to provide a coordinated approach to resource management.	Ongoing	OMKM has frequent contact in particularly with its neighbor, DLNR on resource management issues. OMKM rangers report unusual or suspicious behavior observed on DLNR lands to DLNR including DOCARE.
OI-4	Establish grievance procedures for OMKM, to address issues as they arise.	In Progress	OMKM is currently designing a grievance process.
OI-5	Update and implement emergency response plan.	Ongoing	Emergency response plan is reviewed annually.
MONITORING, EVLUATION AND UPDATES			
MEU-1	Establish a reporting system to ensure that the MKMB, DLNR, and the public are informed of results of management activities in a timely manner.	Ongoing	Reports are provided at the publicly held MKMB Meetings.
MEU-2	Conduct regular updates of the CMP that reflect outcomes of the evaluation process, and that incorporate new information about the resources.	In Progress	Five-year CMP revision interval was initiated in 2014 and is now pending the "Envision Maunakea" community input process and execution and resolution of the Governor's 10-point plan, including the return of a substantial portion of land to DLNR.
MEU-3	Revise and update planning documents, including the master plan, leases, and subleases, so that they will clearly assign roles and responsibilities for managing Mauna Kea and reflect stewardship matters resolved with DLNR.	In Progress	Updates to the Master lease has been initiated, but requires the preparation of an EIS.

Appendix B

Cumulative Annual Progression of CMP Implementation Status

Management Action	Description	CMP Implementation Timeframe	Annual Implementation Status 2010	2011	2012*	2013	2014	2015	2016	2017	Comment
Native Hawaiian Cultural Resources											
Management											
CR-1	Kahu Kū Mauna shall work with families with lineal and historical connections to Maunakea, cultural practitioners, and other Native Hawaiian groups, including the Maunakea Management Board's Hawaiian Culture Committee, toward the development of appropriate procedures and protocols regarding cultural issues.	Immediate	Ongoing		In Progress	In Progress	Ongoing				
CR-2	Support application for designation of the summit region of Maunakea as a Traditional Cultural Property, per the National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470 et seq. in consultation with the larger community.	Short-term							Ongoing		
CR-3	Conduct educational efforts to generate public awareness about the importance of preserving the cultural landscape.	Immediate	Ongoing		In Progress	In Progress	Ongoing				
Cultural Practices											
CR-4	Establish a process for ongoing collection of information on traditional, contemporary, and customary cultural practices.	Short-term									
CR-5	Develop and adopt guidelines for the culturally appropriate placement and removal of offerings.	Immediate			In Progress*						
CR-6	Develop and adopt guidelines for the visitation and use of ancient shrines.	Immediate			In Progress				Ongoing		
CR-7	Kahu Kū Mauna shall take the lead in determining the appropriateness of constructing new Hawaiian cultural features.	Immediate			In Progress*						
CR-8	Develop and adopt a management policy for the UH Management Areas on the scattering of cremated human remains.	Immediate	Ongoing		In Progress*						
CR-9	A management policy for the culturally appropriateness of building ahu or "stacking of rocks" will need to be developed by Kahu Kū Mauna who may consider similar policies adopted by Hawai'i Volcanoes National Park.	Immediate	Ongoing		In Progress*						
Historic Properties											
CR-10	Develop and implement a historic property monitoring program to systematically monitor the condition of the historic district and all historic properties, including cultural sites and burials.	Immediate	Ongoing		In Progress	In Progress	Completed	Completed	Completed	Completed	
CR-11	Complete an archaeological survey of the portions of the Summit Access Road corridor that are under UH management	Completed									

Management		CMP	Annual Implementation Status								
Action	Description	Implementation Timeframe	2010	2011	2012*	2013	2014	2015	2016	2017	Comment
CR-12	Consult with Kahu Kū Mauna about establishing buffers (preservation zones) around known historic sites in the Astronomy Precinct, to protect them from potential future development	Immediate		As needed	As needed	As needed	Ongoing				
CR-13	Develop and implement a burial treatment plan for the UH Management Areas in consultation with Kahu Kū Mauna Council, MKMB's Hawaiian Culture Committee, the Hawai'i Island Burial Council, recognized lineal or cultural descendants, and SHPD.	Immediate		Ongoing	In Progress	In Progress	Completed				A burial treatment plan was approved by SHPD in July 2014. This was incorrectly reported as 'In Progress' in the previously submitted 2014 and 2015 narrative reports.
CR-14	Immediately report any disturbance of a shrine or burial site to the rangers, DOCARE, Kahu Kū Mauna Council, and SHPD	Ongoing									
Natural Resources											
Threat Prevention and Control											
NR-1	Limit threats to natural resources through management of permitted activities and uses	Short-term			In Progress	In Progress	In Progress	In Progress	Ongoing		
NR-2	Limit damage caused by invasive species through creation of an invasive species prevention and control program	Immediate		Ongoing	In Progress		Ongoing				
NR-3	Maintain native plant and animal populations and biological diversity	Mid and Long-term								Ongoing	
NR-4	Minimize barriers to species migration, to help maintain populations and protect ecosystem processes and development.	Mid and Long-term								Ongoing	
NR-5	Manage ecosystems to allow for response to climate change	Long-term								Ongoing	
NR-6	Reduce threats to natural resources by educating stakeholders and the public about Maunakea's unique natural resources.	Immediate		Ongoing							
Ecosystem Protection, Enhancement & Restoration											
NR-7	Delineate areas of high native diversity, unique communities, or unique geological features within the Astronomy Precinct and at Halepōhaku and consider protection from development.	Short and Mid-term					In Progress	In Progress	Ongoing		
NR-8	Consider fencing areas of high native biodiversity or populations of endangered species to keep out feral ungulates (applies to areas below 12,800 ft elevation).	Mid-term					Ongoing	Ongoing	Ongoing	Ongoing	
NR-9	Increase native plant density and diversity through an outplanting program.	Long-term							Ongoing		

Management		CMP	Annual Implementation Status								
Action	Description	Implementation Timeframe	2010	2011	2012*	2013	2014	2015	2016	2017	Comment
NR-10	Incorporate mitigation plans into project planning and conduct mitigation following new development.	As needed					Ongoing				
NR-11	Conduct habitat rehabilitation projects following unplanned disturbances.	As needed					Ongoing				
NR-12	Create restoration plans and conduct habitat restoration activities, as needed.	As needed							In Progress	Ongoing	
Program Management											
NR-13	Increase communication, networking, and collaborative opportunities, to support management and protection of natural resources.	**Immediate**		Ongoing	In Progress	Ongoing					
NR-14	Use the principles of adaptive management when developing programs and methodologies. Review programs annually and revise any component plans every five years, based on the results of the program review.	Short-term / As needed					In Progress				'In Progress' designation reflects Envision Maunakea process and is dependent upon exact scope of Governor Ige's directive to return 10,000 acres.
Inventory, Monitoring and Research											
NR-15	Conduct baseline inventories of high-priority resources, as outlined in an inventory, monitoring, and research plan.	**Immediate**		Ongoing							
NR-16	Conduct regular long-term monitoring, as outlined in an inventory, monitoring, and research plan	Ongoing			In Progress	Ongoing					
NR-17	Conduct research to fill knowledge gaps that cannot be addressed through inventory and monitoring.	**Immediate**		Ongoing							
NR-18	Develop geo-spatial database of all known natural resources and their locations in the UH Management Areas that can serve as baseline documentation against change and provide information essential for decision-making.	Ongoing			In Progress		Ongoing				
Education and Outreach											
Program Development											
EO-1	Develop and implement education and outreach program	**Immediate and Short-term**				Ongoing					
Education											
EO-2	Require orientation of users, with periodic updates and a certificate of completion, including but not limited to visitors, employees, observatory staff, contractors, and commercial and recreational users.	Long-term			In Progress	Ongoing					

Management Action	Description	CMP Implementation Timeframe	2010	2011	Annual Implementation Status 2012*	2013	2014	2015	2016	2017	Comment
EO-3	Continue to develop, update, and distribute materials explaining important aspects of Maunakea.	Ongoing			In Progress	Ongoing					
EO-4	Develop and implement a signage plan to improve signage throughout the UH Management Areas (interpretive, safety, rules and regulations).	Immediate							In Progress	Ongoing	
EO-5	Develop interpretive features such as self-guided cultural walks and volunteer-maintained native plant gardens.	Mid-term							In Progress		
EO-6	Engage in outreach and partnerships with schools, by collaborating with local experts, teachers, and university researchers, and by working with the 'Imiloa Astronomy Center of Hawai'i.	Mid-term					Ongoing				
Outreach											
EO-7	Continue and increase opportunities for community members to provide input to cultural and natural resources management activities on Maunakea, to ensure systematic input regarding planning, management, and operational decisions that affect natural resources, sacred materials or places, or other ethnographic resources with which they are associated.	Ongoing									
EO-8	Provide opportunities for community members to participate in stewardship activities.	Ongoing									
Astronomy Resources											
Protection of Astronomical Resources											
AR-1	Operate the UH Management Areas to prohibit activities resulting in negative impacts to astronomical resources.	Ongoing			In Progress						
AR-2	Prevent light pollution, radio frequency interference (RFI) and dust.	Ongoing									
Activities and Uses											
General Management											
ACT-1	Continue and update managed access policy of 1995 Management Plan.	Short-term			In Progress						
ACT-2	Develop parking and visitor traffic plan.	Immediate		Ongoing	In Progress						
ACT-3	Maintain a presence of interpretive and enforcement personnel on the mountain at all times to educate users, deter violations, and encourage adherence to restrictions.	Ongoing									
ACT-4	Develop and enforce a policy that maintains current prohibitions on off-road vehicle use in the UH Management Areas and that strengthens measures to prevent or deter vehicles from leaving established roads and designated parking areas.	Ongoing									
Recreational											

Exhibit 3
2017 Annual Report on the Maunakea CMP

Management Action	Description	CMP Implementation Timeframe	2010	2011	2012*	2013	2014	2015	2016	2017	Comment
ACT-5	Implement policies to reduce impacts of recreational hiking	Short-term			In Progress						
ACT-6	Define and maintain areas where snow-related activities can occur and confine activities to slopes that have a protective layer of snow	Ongoing									
ACT-7	Confine University or other sponsored tours and star-gazing activities to previously disturbed ground surfaces and established parking areas.	Ongoing									
ACT-8	Coordinate with DLNR in the development of a policy regarding hunting in the UH Management Areas.	Immediate		Ongoing	In Progress						
Commercial											
ACT-9	Maintain commercial tour permitting process; evaluate and issue permits annually.	Ongoing									
ACT-10	Ensure OMKM input on permits for filming activities	Ongoing									
ACT-11	Seek statutory authority for the University to regulate commercial activities in the UH Management Areas.	Completed									
Scientific Research											
ACT-12	Ensure input by OMKM, MKMB, and Kahu Kū Mauna on all scientific research permits and establish system of reporting results of research to OMKM.	Ongoing									
Permitting and Enforcement											
Laws and Regulations											
P-1	Comply with all applicable federal, state, and local laws, regulations, and permit conditions related to activities in the UH Management Areas.	Ongoing									
P-2	Strengthen CMP implementation by recommending to the BLNR that the CMP conditions be included in any Conservation District Use Permit or other permit.	As needed			Ongoing						
P-3	Obtain statutory rule-making authority from the legislature, authorizing the University of Hawai'i to adopt administrative rules pursuant to Chapter 91 to implement and enforce the management actions.	Completed									
P-4	Educate management staff and users of the mountain about all applicable rules and permit requirements.	Immediate		Ongoing							
Enforcement											
P-5	Continue coordinating with other agencies on enforcement needs.	Ongoing									
P-6	Obtain legal authority for establishing, and then establish, a law enforcement presence on the mountain that can enforce rules for the UH Management Areas on Maunakea.	Completed / As needed		Completed							

Annual Implementation Status

Management Action	Description	CMP Implementation Timeframe	2010	2011	2012*	2013	2014	2015	2016	2017	Comment
P-7	Develop and implement protocol for oversight and compliance with Conservation District Use Permits.	Ongoing									
P-8	Enforce conditions contained in commercial and Special Use permits.	Ongoing									
Infrastructure and Maintenance											
Routine Maintenance											
IM-1	Develop and implement an OMMP.	Ongoing			In Progress				Completed/Ongoing		
IM-2	Reduce impacts from operations and maintenance activities by educating personnel about Maunakea's unique resources.	Immediate		Ongoing	In Progress	Ongoing					
IM-3	Conduct historic preservation review for maintenance activities that will have an adverse effect on historic properties.	Short-term			In Progress						
IM-4	Evaluate need for and feasibility of a vehicle wash station near Halepōhaku, and requiring that vehicles be cleaned.	Short-term					In Progress				
IM-5	Develop and implement a Debris Removal, Monitoring and Prevention Plan.	Immediate		Ongoing							
IM-6	Develop and implement an erosion inventory and assessment plan.	Long-term					In Progress				
IM-7	Prepare a plan, in collaboration with the Department of Defense, to remove military wreckage from a remote area of the UH Management Areas, while ensuring protection of natural and cultural resources.	Mid-term							Ongoing		
Infrastructure											
IM-8	Assess feasibility of paving the Summit Access Road.	Long-term			In Progress				Completed/Ongoing		
IM-9	Evaluate need for additional parking lots and vehicle pullouts and install if necessary.	Mid-term								In Progress	
IM-10	Evaluate need for additional public restroom facilities in the summit region and at Halepōhaku, and install close-contained zero waste systems if necessary.	Immediate			In Progress				Ongoing		
Sustainable Technologies											
IM-11	Encourage existing facilities and new development to incorporate sustainable technologies, energy efficient technologies, and LEED standards, whenever possible, into facility design and operations.	As needed					Ongoing				
IM-12	Conduct energy audits to identify energy use and system inefficiencies, and develop solutions to reduce energy usage.	Immediate							Ongoing		
IM-13	Conduct feasibility assessment, in consultation with Hawaii Electric Light Company, on developing locally-based alternative energy sources.	Mid-term							In Progress	Ongoing	

Management Action	Description	CMP Implementation Timeframe	2010	2011	Annual Implementation Status 2012	2013	2014	2015	2016	2017	Comment
IM-14	Encourage observatories to investigate options to reduce the use of hazardous materials in telescope operations.	Short-term							Ongoing		
Construction Guidelines											
General Requirements											
C-1	Require an independent construction monitor who has oversight and authority to insure that all aspects of ground based work comply with protocols and permit requirements.	As needed					Ongoing				
Best Management Practices											
C-2	Require use of Best Management Practices Plan for Construction Practices.	As needed					Ongoing				
C-3	Develop, prior to construction, a rock movement plan.	As needed					Ongoing				
C-4	Require contractors to provide information from construction activities to OMKM for input into OMKM information databases.	As needed					Ongoing				
C-5	Require on-site monitors (e.g., archaeologist, cultural resources specialist, entomologist) during construction, as determined by the appropriate agency.	As needed					Ongoing				
C-6	Conduct required archaeological monitoring during construction projects per SHPD approved plan.	As needed					Ongoing				
C-7	Education regarding historical and cultural significance.	As needed					Ongoing				
C-8	Education regarding environment, ecology and natural resources.	As needed					Ongoing				
C-9	Inspection of construction materials.	As needed					Ongoing				
Site Recycling, Decommissioning, Demolition and Restoration											
SR-1	Require observatories to develop plans to recycle or demolish facilities once their useful life has ended, in accordance with their sublease requirements, identifying all proposed actions.	As needed					Ongoing				
SR-2	Require observatories to develop a restoration plan in association with decommissioning, to include an environmental cost-benefit analysis and a cultural assessment.	As needed					Ongoing				
SR-3	Require any future observatories to consider site restoration during project planning and include provisions in subleases for funding of full restoration.	As needed					Ongoing				
Considering Future Land Use											
Facility Planning Guidelines											
FLU-1	Follow design guidelines presented in the 2000 Master Plan	As needed			Ongoing						

Management Action	Description	CMP Implementation Timeframe	2010	2011	2012	2013	2014	2015	2016	2017	Comment
			Annual Implementation Status								
FLU-2	Develop a map with land-use zones in the Astronomy Precinct based on updated inventories of cultural and natural resources, to delineate areas where future land use will not be allowed and areas where future land use will be allowed but will require compliance with prerequisite studies or analysis prior to approval of Conservation District Use Permit	Short-term								Ongoing	
FLU-3	Require cataloguing of initial site conditions for use when conducting site restoration.	As needed					Ongoing				
FLU-4	Require project specific visual rendering of both pre- and post-project settings to facilitate analysis of potential impacts to view planes.	As needed					Ongoing				
FLU-5	Require an airflow analysis on the design of proposed structures to assess potential impacts to aeolian ecosystems.	As needed					Ongoing				
FLU-6	Incorporate habitat mitigation plans into project planning process.	As needed					Ongoing				
FLU-7	Require use of close-contained zero-discharge waste systems for any future development in the summit region, from portable toilets to observatory restrooms, if feasible	As needed					Ongoing				
Operations and Implementation Management											
OI-1	Maintain OMKM, MKMB, and Kahu Kū Mauna in current roles, with OMKM providing local management of the UH Management Areas, and MKSS providing operational and maintenance services.	Ongoing									
OI-2	Develop training plan for staff and volunteers	Ongoing			In Progress				Completed		
OI-3	Maintain and expand regular interaction and dialogue with stakeholders, community members, surrounding landowners, and overseeing agencies to provide a coordinated approach to resource management.	Ongoing									
OI-4	Establish grievance procedures for OMKM, to address issues as they arise.	Short-term							In Progress		
OI-5	Update and implement emergency response plan.	Ongoing									
Monitoring, Evaluation, and Updates Management											
MEU-1	Establish a reporting system to ensure that the MKMB, DLNR, and the public are informed of results of management activities in a timely manner.	Immediate		Ongoing							

Exhibit 3
2017 Annual Report on the Maunakea CMP

Management Action	Description	CMP Implementation Timeframe	Annual Implementation Status 2010	2011	2012*	2013	2014	2015	2016	2017	Comment
MEU-2	Conduct regular updates of the CMP that reflect outcomes of the evaluation process, and that incorporate new information about the resources.	Short-term / As needed					In Progress		In Progress		'In Progress' designation reflects Envision Maunakea process and is dependent upon exact scope of Governor Ige's directive to return 10,000 acres.
MEU-3	Revise and update planning documents, including the master plan, leases, and subleases, so that they will clearly assign roles and responsibilities for managing Maunakea and reflect stewardship matters resolved with DLNR.	As needed					In Progress				

*In 2012 the **Ongoing** category was divided into two groups, **Ongoing** and **In Progress**.

* A lawsuit was filed in federal court which was dismissed without prejudice; the plaintiff may still seek further judicial relief

Exhibit 3
2017 Annual Report on the Maunakea CMP

UNIVERSITY OF HAWAI‘I SYSTEM

ANNUAL REPORT

REPORT TO THE 2007 LEGISLATURE

Annual Report on
Long-term development of observatory sites on the summit of Mauna Kea

HCR 314 HD1, 2006

December 2006

Response to

HCR 314, Regular Session of 2006

Report on long-term development of observatory sites on the summit of Mauna Kea

by

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Director, Institute for Astronomy
University of Hawaii

December 1, 2006

Summary. **A report on the long-term future development of observatory sites on the Summit of Mauna Kea is given. A conceptual plan is presented that proposes a much smaller number of future projects than foreseen in the University of Hawaii Master Plan of 2000. The long-range goal is to have eventually fewer observatories than now, but still the very best in the world in this way securing continued world leadership in astronomical research and education in Hawaii for the next decades.**

1. Introduction.

This report is submitted in response to the request by the House of Representatives of the Twenty-third Legislature of the State of Hawaii, Regular Session of 2006, the Senate concurring, "that the University of Hawaii Institute for Astronomy prepares a report on the long-term development of observatory sites on the summit of Mauna Kea, including a conceptual plan that consolidates the number of observatory sites, to enhance the quality of astronomy research and limit the size of the geographical area on which to situate new observatories."

The report is structured as follows. We first describe the present situation of astronomical research and education in Hawaii and its important role for the State and the University. Then, we discuss the concept for long-term astronomical development, as it is described in the comprehensive and detailed "Mauna Kea Science Reserve Master Plan", which was approved by the Board of Regents in June 2000. Since the development of the Master Plan, the scientific priorities of astronomy for the new century have become much clearer, and a new more concise concept for future astronomical development has emerged that will guarantee Hawaii's continued world leadership in astronomical research and education, while at the same time being well balanced with the needs for cultural and environmental protection of Mauna Kea. This concept will be introduced in section three of this report.

1. The role of astronomy in Hawaii.

To appreciate the role of astronomy in our state, one first needs to understand the history of astronomy development in Hawaii; the basic philosophy behind that development; the essential role played by the Institute for Astronomy; and the educational, scientific and economic benefits that accrue from astronomy.

The Institute for Astronomy (IfA) is 38 years old and is by far the youngest among top-ranked astronomy programs in the U.S. In this short time, the Institute has grown to become one of the most visible of UH's scientific research programs and one of the most respected astronomy institutes in the world. The IfA plays in the same league as Caltech, Harvard, Princeton, Berkeley, and Cambridge. It attracts the best faculty and the best students from around the world. It has become a pillar of academic excellence and certainly an engine of economic growth in the State. Where once school kids in the world learned that the center of astronomy was Mount Palomar in California, now they learn it is in Hawaii. How has this story of scientific success been possible in such a short time?

The answer to this question is the superior quality of Mauna Kea and Haleakala as the world's best observatory sites and the concept developed by the IfA, the University and the State to build up the most capable observatory in the world. The astronomers of the IfA were the first in the world to dare to build a technologically very challenging and complex observatory with small, but very efficient, telescopes at the extreme elevation and thin air of 13,796 ft. With their exciting astronomical detections they were able to demonstrate to the world that Mauna Kea is unique as an astronomical site.

Scientifically, the logical consequence for UH would have been to use this enormous advantage to build the next generation of most powerful telescopes on its own, as the universities in California, Texas, Arizona and on the East Coast did before. However, UH was (and is) a medium size State University with a very limited budget, and Hawaii is a small state with limited resources. Thus, a different concept was developed—the concept of scientific partnerships.

Within this concept the national and international partners contribute the capital funding for the facility, carry most or all of the operational costs, and contribute to the infrastructure development. The University, through the IfA, provides the leadership and know-how to operate an observatory at extreme altitude, the management of the physical and operational infrastructure (roads, power, fiber-optics communications, food, lodging) and ongoing protection from adverse intrusions such as light pollution and radio frequency interference. The University also provides the land for the observatory site from its lease from the State, along with assistance in planning and permitting. The University and its partners collaborate in the scientific use of the telescopes including development of technologically advanced instrumentation. Most importantly, they share the scientific observing time on the facilities with no cost to the University.

In this way, the University and the State did not have to contribute the enormous capital costs to design and build the extremely powerful new telescopes, but were still able to provide researchers with access to these unique facilities and give them the opportunity to build up one of the best research and education programs in the world. The benefits, both economic and otherwise, are substantial as indicated below.

1. Astronomy facilities on Mauna Kea and Haleakala represent a capital investment of close to $1 billion. The economic impact of astronomy to the State amounts to $150 million per year. New projects for Haleakala and Mauna Kea have the potential to double these numbers.

2. The observatories and other astronomy-related activities on Mauna Kea and Haleakala provide 600 quality jobs in a clean high-tech industry on the neighbor islands. It is important to note that only a small fraction of these jobs are for astronomers. Most of them are for technical, administrative and logistic services. This number will increase if we continue to follow the sound policies that have been in place for nearly 30 years. Beyond the simple numbers, there is the fact that astronomy as a high-tech science diversifies the Hawaii economy and gives local young people with scientific and technical talents a wealth of opportunities to realize their potential without having to leave their family and friends in Hawaii to pursue employment elsewhere. Unlike some high-tech industries, astronomy is fundamentally rooted in Hawaii. Once established, an astronomy facility cannot be easily relocated to the mainland or overseas.

3. The IfA has developed into one of the world's preeminent centers for astronomical research. The Institute receives extramural awards totaling between $20 to $25 million annually for astronomical research, for development of new astronomical instrumentation, for improving its own old telescopes and for operating telescopes, such as the NASA Infrared Telescope Facility on Mauna Kea and the Mees Solar Observatory on Haleakala. Its graduate program belongs to the best in the world and about 1,000 undergraduate students per year participate in astronomy courses in Manoa. In addition, UH Hilo has recently developed a very successful astronomy undergraduate program. Astronomy is one of UH's most successful programs.

4. The Mauna Kea Observatories are the world's largest observatory complex, and will remain so for the foreseeable future. Hawaii and its State University are recognized around the world for this outstanding achievement—a source of tremendous prestige for the State. Approximately 1,500 scientists come to work at the Observatories each year; most add some vacation time to their trip. Hundreds of others come to Hawaii each year to participate in astronomy-related conferences. Several small companies make a business of providing quality tours to Mauna Kea. The observatories' base facilities in Hilo, Waimea and on Maui are a major addition to those communities and contribute in many ways.

5. Over the years, the observatories have made significant monetary contributions to the infrastructure, much of which is of benefit to the general community. This includes $2 million for road improvements on Mauna Kea and another $2 million to assist GTE Hawaiian Tel to install a fiber optics cable across the Saddle from Waimea to Hilo. This cable provides state-of-the-art service for both the Big Island telephone system and the observatories.

6. The observatories operate the Visitor Information Station at Hale Pohaku, which provides free public star gazing seven nights a week and welcomes about 100,000 visitors each year.

7. The observatories pay the entire cost of maintenance and snow removal for the road and they pay for emergency services. The public can use the road all the time. The costs for this service and the Visitor Station amount to $700,000 a year.

Although the economic benefits are substantial, it is important to keep in mind that the primary mission of astronomy is not to generate revenue. Astronomy is basic science and concentrates on the scientific exploration of the universe. Astronomy is the mother of all sciences and has changed our understanding of the world and our thinking as humans like no other science. The telescopes on Mauna Kea and Haleakala have contributed fundamentally to the advancement of modern astronomy. They are world-class research facilities, and the best window our planet provides on the strange and wonderful universe we live in.

2. Long-term astronomical development in the 2000 Master Plan.

The 2000 Master Plan is a comprehensive document, which was approved by the Board of Regents in June 2000 after an arduous, two-year process with input from all sectors of the community, and supervised by a community-based advisory committee chaired by two faculty members at UH Hilo's College of Hawaiian Language, Dr. Pila Wilson and Mr. Larry Kimura. It was accompanied by a State Environmental Impact Statement signed by the Governor of the State. The Master Plan has been submitted to the Legislature on many occasions and is available on the Institute for Astronomy's website. The scope of the Master Plan is much broader than future development of astronomy. It addresses the cultural and environmental aspects of the University's use and responsibility for the Mauna Kea Science Reserve and proposes a new organizational structure, which has been implemented by establishing the Office of Mauna Kea Management, based at the University of Hawaii at Hilo, and two important community-based advisory bodies, the Mauna Kea Management Board, and Kahu Ku Mauna, the Office's and Board's cultural advisory council. Within the new organizational structure the Institute for Astronomy’s responsibility on Mauna Kea is limited to astronomical operation, research and education, whereas the Office has the responsibility for the cultural and environmental protection and all other aspects of land management. In this report we will not discuss these latter aspects. It is our understanding from the 2006 hearings that the objective of HCR 314 is to obtain information on the prospects and

plans for future astronomical development on Mauna Kea, and we have restricted the report accordingly.

The scientific progress in modern astronomy is intimately related to the development of new technologies, new instrumentation, and new and more powerful telescopes. Without such development it is impossible to stay at the forefront of astronomical research. It is therefore natural that the Master Plan also contains a section about very ambitious future astronomical development. However, this development together with all but one of the existing facilities is confined to the "Astronomy Precinct", a very small fraction of less than five percent (4.65% or 525 acres) of the existing Mauna Kea Science Reserve of 11,288 acres in order to maintain a close grouping of astronomy facilities, roads and support infrastructure. This approach minimizes the potential impact to the natural and cultural resources of the summit region. The criteria to be followed for new facilities proposed in the Astronomy Precinct include:

- Emphasize recycling of existing sites when possible so as not to disturb existing habitat areas, archeology and landforms;
- Limit visual impact and scattering of facilities by clustering within the existing development areas;
- Utilize the natural forms in the summit area to shield views of built facilities;
- Implement design measures to allow facilities to blend better with the existing landscape;
- Minimize infrastructure development by locating near the existing roadway and utility network;
- Minimal impact on existing facilities;
- Minimum impact of Wekiu bug habitat;
- Avoidance of archeological sites;
- Suitability for observations.

A vigorous UH approval process for new project has been introduced, which includes reviews by the Office of Mauna Kea Management, the Kahu Ku Mauna Council, the Mauna Kea Management Board, the Chancellor of UH Hilo, the UH President and finally the Board of Regents. In addition, new projects have to carry out an environmental analysis in the form of either an Environmental Assessment or an Environmental Impact Statement and they have to go through the State process with the Department of Land and Natural Resources to obtain a Conservation District Use Permit. In the whole process each new facility will be required to present a detailed justification addressing the following questions

(1) Why is the facility needed?
(2) Why is Mauna Kea the best site for the facility?
(3) What other location options are available?
(4) What are the expected benefits with regard to research and education, employment and economy
(5) What is the expected facility lifetime and term of sublease agreement?

There are currently 12 observatories on Mauna Kea. The Master Plan identifies five of those (the UH 0.6m, the UH 2.2m, the Canada-France-Hawaii Telescope, the United Kingdom Infrared Telescope, and the NASA Infrared Telescope Facility) as older facilities, several of which could be upgraded or replaced within the next 20 years. The expectation is that the new or upgraded telescopes would come in a range of sizes from 2 to 15 meter mirror sizes (note that the 10m-class mirrors of the existing Keck, Gemini and Subaru Telescopes represent the current state-of-the art observatory facilities), however there are clear restrictions in terms of the height and volume for these facility redevelopments. The Master Plan also assumes that the other seven existing facilities would remain as is over the next 20 years.

In addition, the Master Plan envisages the expansion of two existing facilities. For the Keck Observatory it proposes the addition of four to six 1.8m outrigger telescopes to create a very powerful infrared interferometer, which would study cosmic objects for spatially resolved fine details, for instance the motion of stars caused by the presence of Jupiter-like planets orbiting around them. For the existing Harvard-Smithsonian Submillimeter Array (SMA) – an array of 12 movable radio telescope antennas distributed over 24 fixed concrete pads – the plan foresees an extension by 12 more antennas and 24 additional pads to increase the sensitivity and efficiency.

Three new projects at three new sites are proposed in the Master Plan. The first is the UH Hilo instructional telescope, a relatively small (1m mirror) telescope planned for a site adjacent to the existing UH 0.6m telescope. This facility is planned to be used for the education and training of undergraduate students in UH Hilo's Department of Physics and Astronomy program. The second is a new optical/infrared telescope comparable in size and capability to the existing Keck or Gemini telescopes. For environmental and cultural reasons a site below the summit ridge on the north shield is proposed.

The third new facility proposed is a revolutionary new telescope with a very large mirror of 25m to 50m diameter. This would be the largest telescope in the world. The site foreseen for this telescope is on the north-west lava plateau below the summit. This location minimizes visibility of the new facility from Hilo and Honokaa and would not affect Wekiu bug habitat.

The future astronomical development on Mauna Kea as foreseen in the University's Master Plan gives very high priority to the protection of natural and cultural resources, but at the same it also proposes a considerable expansion of future astronomical activity on Mauna Kea. If all facilities discussed in the Master Plan were built, the number of observatories would increase from 12 to 15 and two of the existing ones would be expanded.

In the next section we will introduce a modified plan, which proposes significantly less future development.

3. A modified plan for long-term astronomical development on Mauna Kea.

When future development for the next 20 years was discussed in the Master Plan of the year 2000, the goal was to be as comprehensive as possible in order not to exclude potentially important scientific options for the future. However, now six years later and after detailed scientific discussion within the Institute for Astronomy it has become clear that the number of future projects envisaged for the next 20 years is much smaller than anticipated in the Master Plan. The long-range goal is to have eventually fewer observatories than now, but certainly still the very best in the world.

After six years of successful operation under the Master Plan in coordination and collaboration with the Office of Mauna Kea Management and its community-based advisory boards it is well recognized that future plans for Mauna Kea require balanced management to preserve, protect and enhance the cultural and natural resources as well as providing a world-class center for education and research in astronomy. As laid out in the Master Plan and also described in the previous section, all major future development will be subject to stringent review by the Office of Mauna Kea Management, Mauna Kea Management Board, and Kahu Ku Mauna Council, as well as the community-based Hawaiian Culture and Environment committees, which report to the Board. In addition, as also already described in the section before, all major developments require a Conservation District Use Permit from the State Board of Land and Natural Resources. As the leaseholder for the Science Reserve, UH is responsible for submitting the use application. In conjunction with this process, UH must satisfy State and Federal environmental impact requirements (Chapter 343 and NEPA). The Institute for Astronomy is committed to sponsor only projects that are considered the best in the world, and not simply to add projects for the sake of adding another telescope to the mountain.

The goal of our new plan is to keep Hawaii's world leadership in ground-based astronomy. This achievement and recognition as a world leader will benefit not only UH as an educational and research institution but the entire state. The advancing and leading edge technologies associated with astronomy research and development will aid Hawaii's efforts to boost its technology industry, including software and instrument development.

In the following, we will discuss the new modified plan in detail. We will also compare it with the development as proposed in the Master Plan. We will start with the two observatories, for which significant expansion was proposed, the Keck Observatory and the Submillimeter Array (SMA). For the Keck Observatory the addition of six Outrigger telescopes was planned. In our new plan we do not foresee adding any more telescopes to the Keck Observatory.

For the SMA, the Master Plan proposed 12 more antennas and 24 new concrete pads for the array; however in our new plan, we consider only the very moderate expansion of two

more antennas and two pads. UH is also working on the relocation of two existing antenna pads located at the base of Pu'u Poliahu, a culturally significant site.

In the Master Plan a new observatory site on the summit ridge was proposed for the UH Hilo instructional telescope. In order not to increase the number of observatory sites on the summit ridge, the Institute for Astronomy has agreed to give its UH 0.6m telescope and the site to UH Hilo so that the instructional telescope can be built there with only little if any modification of the existing site. This minimizes cultural and environmental impact for this important educational project, which was described in the previous section. An Environmental Assessment of the project by UH Hilo has been completed.

Another redevelopment of an existing site in our new plan is the use of the UH 2.2m site for the Institute for Astronomy's new Pan-STARRS observatory. Pan-STARRS uses completely new technology being developed by the Institute to detect killer asteroids which threaten to impact the Earth. It will detect the majority of the most dangerous objects about 30 years before their potential impact giving some time to develop protection for mankind in case of a serious threat. This project is federally funded. The Institute for Astronomy is preparing a federal EIS in collaboration with the federal funding agency. In addition, UH will submit a comprehensive Mauna Kea management plan to the State Board of Land and Natural Resources for review and approval, before applying for a Conservation District Use Permit for this project.

In addition to the UH Hilo instructional telescope the Master Plan proposes two new telescopes at two new sites, as described in the previous section. One of them, the optical/infrared telescope of Keck or Gemini size, is not pursued any further in our new plan. With the enormously increased efficiencies of Keck, Gemini, and Subaru we do not believe that there is a scientific need anymore for another telescope of this size. It is worth mentioning at this point that the observatories on Mauna Kea are experimenting with the use of new fiber optics technology to combine the light from the already existing telescopes, the so-called Ohana Project. This is a challenging project, which will probably take decades to be successful, but it will greatly expand the capability and utility of the existing observatories.

The only project at a new site proposed in our new plan is the Thirty Meter Telescope (TMT). With its mirror of 30m diameter it will be the largest telescope in the world, and will be ten times more powerful than the Keck telescopes. It will be able to image planets orbiting around other stars and to analyze the light coming from these planets and, thus, to ascertain whether the conditions exist for the formation of life in planetary systems around other stars. It will also be able to detect the most distant galaxies in the universe and will see them in stage when the universe was still very young after its birth in the Big Bang.

As described in the previous section a site is foreseen for this observatory on the northern plateau below the summit ridge. This new site is preferable to a replacement of one of the existing telescopes, because the facility would be less visible and the environmental

and cultural impact would be smaller. The Institute for Astronomy is currently carrying out site testing and atmospheric characterization measurements at this site.

The TMT is a $1 billion project and the most ambitious project of modern astronomy. It is the dedicated goal of the Institute for Astronomy and UH to attract this unique project to Hawaii. It will have an enormous scientific, educational and economic impact and it will secure leadership of Hawaii in astronomical science for the next decades. This is the key project for the future of astronomy in Hawaii.

In summary, our new plan does not propose any further extension of the Keck Observatory with Outrigger telescopes and only a very small expansion of the SMA. It proposes two new projects, the UH Hilo instructional telescope and Pan-STARRS, which will use existing sites and will stay within the footprints of the existing facilities. As the most important project it proposes the TMT on a new site on the northern plateau below the summit ridge.

While the Master Plan of the year 2000 assumed that all existing facilities, which would not be replaced by new ones would continue to exist for the next 20 years, we do not make this assumption for the new plan. It is clear that newer facilities such as Keck, Gemini, Subaru, Pan-STARRS, the UH Hilo telescope and the SMA will certainly continue to operate over the next 20 years. However, some of the others will not continue with their operation, because other aspects of astronomical observations will become more important. In such cases our plan is not to refurbish all of them but only a few and only in cases where an extremely important scientific case can be made. Otherwise, our new plan is to demolish the old facility, to clean the site and to recreate the site in a stage as it was, before the facility had been built. (It is important to note that Operating and Site Development Agreements – the contracts between UH and the telescope partners on Mauna Kea – require that the costs for such reestablishment of the site in its original status have to be paid by the telescope partners.) We are confident that in this way the number of observatories on Mauna Kea in 20 years from now will be smaller than now. But with all the new facilities, in particular the TMT, Hawaii will still have the very best in the world.

Follow-Up on Recommendations from Report No. 14-07, *Follow-Up Audit of the Management of Mauna Kea and the Mauna Kea Science Reserve*

A Report to the Governor
and the Legislature of
the State of Hawai‘i

Report No. 17-06
July 2017

OFFICE OF THE AUDITOR
STATE OF HAWAI‘I

OFFICE OF THE AUDITOR
STATE OF HAWAIʻI

Constitutional Mandate

Pursuant to Article VII, Section 10 of the Hawai'i State Constitution, the Office of the Auditor shall conduct post-audits of the transactions, accounts, programs and performance of all departments, offices and agencies of the State and its political subdivisions.

The Auditor's position was established to help eliminate waste and inefficiency in government, provide the Legislature with a check against the powers of the executive branch, and ensure that public funds are expended according to legislative intent.

Hawai'i Revised Statutes, Chapter 23, gives the Auditor broad powers to examine all books, records, files, papers and documents, and financial affairs of every agency. The Auditor also has the authority to summon people to produce records and answer questions under oath.

Our Mission

To improve government through independent and objective analyses.

We provide independent, objective and meaningful answers to questions about government performance. Our aim is to hold agencies accountable for their policy implementation, program management and expenditure of public funds.

Our Work

We conduct performance audits (also called management or operations audits), which examine the efficiency and effectiveness of government programs or agencies, as well as financial audits, which attest to the fairness of financial statements of the State and its agencies.

Additionally, we perform procurement audits, sunrise analyses and sunset evaluations of proposed regulatory programs, analyses of proposals to mandate health insurance benefits, analyses of proposed special and revolving funds, analyses of existing special, revolving and trust funds, and special studies requested by the Legislature.

We report our findings and recommendations to the Governor and the Legislature to help them make informed decisions.

For more information on the Office of the Auditor, visit our website:
http://auditor.hawaii.gov

PHOTO: THINKSTOCK.COM

Follow-Up on Recommendations from Report No. 14-07, *Follow-Up Audit of the Management of Mauna Kea and the Mauna Kea Science Reserve*

Section 23-7.5, Hawai‘i Revised Statutes, requires the Auditor to report to the Legislature annually on each audit recommendation more than one year old that has not been implemented by the audited department or agency. This report presents the results of our review of eight recommendations made to the University of Hawai‘i and the Department of Land and Natural Resources in Report No. 14-07, Follow-Up Audit of the Management of Mauna Kea and the Mauna Kea Science Reserve, *which was published in August 2014.*

Why we did the 2014 audit

In the past, the Legislature expressed concerns about the State of Hawai‘i’s management of Mauna Kea and the Mauna Kea Science Reserve. Individuals as well as community and Hawaiian organizations

also voiced concerns regarding transparency, accountability, and equity by the University of Hawai‘i (UH) and the Department of Land and Natural Resources (DLNR). In 1998 and again in 2005, the Legislature requested that this office conduct an audit of the management of Mauna Kea and the Mauna Kea Science Reserve. In response to those requests, we issued a 1998 *Audit of the Management of Mauna Kea and the Mauna Kea Science Reserve* (Report No. 98-6) and a 2005 *Follow-up Audit of the Management of Mauna Kea and the Mauna Kea Science Reserve* (Report No. 05-13). In 2014, this office initiated another follow-up audit to assess UH's and DLNR's efforts to address our previous findings and recommendations during FY2006 to FY2014. That audit was conducted pursuant to Section 23-4, Hawai‘i Revised Statutes, which requires the Auditor to conduct postaudits of the transactions, accounts, programs, and performance of all departments, offices, and agencies of the State and its political subdivisions.

The Mauna Kea Summit and Science Reserve

The Mauna Kea summit area consists of conservation district lands managed by UH and DLNR. Mauna Kea lands leased to and managed by UH encompass three areas: the Mauna Kea Science Reserve at the summit, the mid-level facilities at Hale Pōhaku, and the Summit Access Road that runs from Hale Pōhaku to the summit. In 1998, 2,033 acres of the 13,321 acres originally leased to UH were withdrawn from the Mauna Kea Science Reserve and are now part of the Mauna Kea Ice Age Natural Area Reserve. Lands adjacent to the Mauna Kea lands managed by UH, such as the Mauna Kea Ice Age Natural Area Reserve and the Mauna Kea Forest Reserve, are managed by DLNR.

PHOTO: THIRTY METER TELESCOPE (TMT)

An Eye to the Sky

PLANS TO BUILD the massive Thirty Meter Telescope (TMT) atop Mauna Kea have become a source of bitter controversy. In October 2014, Native Hawaiian protesters blocked crews from the construction site. The Hawai‘i Supreme Court later rescinded the TMT's construction permit, and the $1.4 billion project is currently in the re-permitting process. If it is completed, the TMT will be the most advanced and powerful optical telescope on Earth. There is an ongoing contested case proceeding regarding the TMT's application for a permit to build on the Mauna Kea summit.

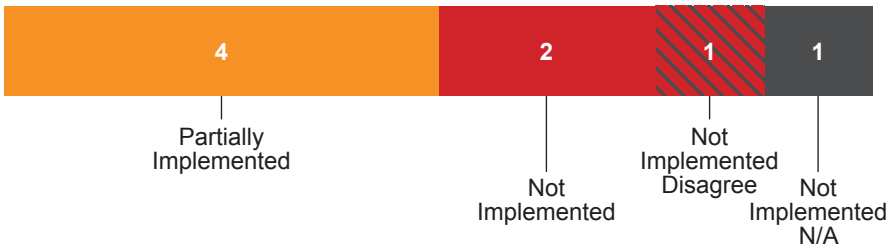
What we found in 2014

In Report No. 14-07, *Follow-Up Audit of the Management of Mauna Kea and the Mauna Kea Science Reserve*, we found that UH did not expect to adopt administrative rules until 2017, due in part to delays in the rulemaking process. In the absence of rules, UH was managing and assesssing fees on commercial tour activities with permits and informal agreements unauthorized by the UH Board of Regents. We also found that contractual terms and other requirements precluded UH and DLNR from updating general leases, subleases, and permits.

What we found this year

Our follow-up on the implementation of recommendations made in Report No. 14-07, conducted between October 2016 and January 2017, included interviews with selected personnel, examining relevant documents and records, and evaluating whether UH and DLNR's actions appeared to fulfill our recommendations. We found that UH and DLNR have partially implemented four of the recommendations. Three recommendations remain open, and one is inapplicable at this time.

Exhibit 1: Audit Recommendations by Status



Source: Office of the Auditor

Our follow-up efforts were limited to reviewing and reporting on the implementation of our audit recommendations. We did not explore new issues or revisit old ones that did not relate to the original recommendations. The following details the audit recommendations made and the current status of each recommendation based on our review of information and documents provided by UH and DLNR.

DEFINITION OF TERMS

WE DEEM recommendations:

- **Implemented** where the department or agency provided sufficient and appropriate evidence to support all elements of the recommendation;
- **Partially Implemented** where some evidence was provided but not all elements of the recommendation were addressed;
- **Not Implemented** where evidence did not support meaningful movement towards implementation, and/or where no evidence was provided;
- **Not Implemented – N/A** where circumstances changed to make a recommendation not applicable; and
- **Not Implemented – Disagree** where the department or agency disagreed with the recommendation, did not intend to implement, and no further action will be reported.

ADMINISTRATIVE RULES

ADMINISTRATIVE rulemaking is one of the methods by which state agencies carry out their tasks. The purpose of rules is to implement laws, such as those relating to Mauna Kea lands, and to establish operating procedures for state agencies. Generally, statutes provide a skeleton, or superstructure, for state programs; agencies are then required to "fill in the details" and implement those programs on a day-to-day basis. Agencies have considerable discretion in applying the law, particularly where a controlling statute is expressed in general terms.

Recommendation 1

UH should adopt administrative rules governing public and commercial activities as soon as possible, but no later than 2017.

Partially Implemented

Comments

UH completed the drafting of administrative rules and was prepared to begin the necessary public hearing process. However, at the request of the governor, who must authorize the initiation of public hearings for the draft rules, UH has temporarily halted the process of finalizing such rules.

Target Date

Per UH, the estimated date of completion cannot be determined at this time.

Recommendation 2

UH should obtain the UH Board of Regents' approval for the conditions and fee schedule included in commercial tour use permits issued by UH–Hilo via a Board of Regents open public meeting pursuant to Chapter 92, HRS.

Not Implemented

Comments

UH anticipates that a proposed schedule will be prepared and approved concurrently with the approval of the final administrative rules. A draft schedule has not been prepared yet as UH wants to take into consideration feedback received during the administrative rules process.

Target Date

Per UH, the estimated date of completion cannot be determined at this time.

Recommendation 3

UH should determine whether unauthorized fees collected since FY2007 should be returned to commercial tour operators.

Not Implemented - Disagree

Comments

UH continues to assert that the issuance of commercial tour permits was authorized by the Board of Land and Natural Resources and allows enforcement of permit conditions and the ability to set and assess fines for permit violations and non-compliance.

Recommendation 4

UH should complete Comprehensive Management Plan (CMP) management actions, the implementation of which under the CMP implementation plan is scheduled as "immediate," as soon as possible, but no later than the end of 2016.

Partially Implemented

Comments

UH has implemented 20 of the 25 total CMP management actions. *(See appendix on pages 10-11 for the list of actions.)*

Target Date

Per UH, the estimated date of completion is December 2017. Feasibility of that date could not be determined based on the scope of our review.

Recommendation 5

UH should further its efforts to renew general leases for UH-managed lands on Mauna Kea by continuing to work with DLNR and proceeding with the Environmental Impact Statement (EIS) process under Chapter 343, HRS.

Partially Implemented

Comments

UH and DLNR assert that securing a new master lease would require an EIS. Such efforts were restarted at the request of the governor following protests against the TMT project, and work is ongoing.

Target Date

Per UH, the estimated date of completion cannot be determined at this time.

Recommendation 6

UH should renegotiate with existing sublessees to amend subleases to include provisions that address stewardship issues, as modeled by the provisions in the 2014 TMT sublease, following execution of the new general leases for UH-managed lands on Mauna Kea.

Not Implemented

Comments

UH asserts that a new general lease needs to be established before sublease agreements can be renegotiated.

Target Date

Per UH, the estimated date of completion cannot be determined at this time.

Recommendation 7

DLNR should continue working with UH to renew the general leases for the UH-managed lands on Mauna Kea and ensure the leases are substantially in the form DLNR's Land Division recommended for approval by the Board of Land and Natural Resources.

Partially Implemented

Comments

UH and DLNR assert that the preparation for seeking a new master lease includes preparation of an EIS. Such efforts were restarted at the request of the governor following protests against the TMT project, and work is ongoing.

Target Date

Per DLNR, the estimated date of completion cannot be determined at this time.

Recommendation 8

DLNR should use additional stewardship-related conditions contained within the TMT observatory permit as a template in all new observatory permits issued for the summit of Mauna Kea.

Not Implemented - N/A

Comments

The TMT observatory permit has been voided. As a result, this recommendation cannot be addressed until the ongoing contested TMT case is fully resolved.

Appendix

Comprehensive Management Plan (CMP) Management Actions Still Open

1. Develop and adopt guidelines for the culturally appropriate placement and removal of offerings.

2. Kahu Kū Mauna shall take the lead in determining the appropriateness of constructing new Hawaiian cultural features.

3. Develop and adopt a management policy for the UH Management Areas on the scattering of cremated human remains.

4. A management policy for the culturally appropriate building ahu or "stacking of rocks" will need to be developed by Kahu Kū Mauna who may consider similar policies adopted by Hawai'i Volcanoes National Park.

5. Develop and implement a signage plan to improve signage throughout the UH Management Areas (interpretive, safety, rules and regulations).

Implemented CMP Management Actions

1. Kahu Kū Mauna shall work with families with lineal and historical connections to Mauna Kea[1], cultural practitioners, and other Native Hawaiian groups, including the Mauna Kea Management Board's (MKMB) Hawaiian Culture Committee, toward the development of appropriate procedures and protocols regarding cultural issues.

2. Conduct educational efforts to generate public awareness about the importance of preserving the cultural landscape.

3. Develop and adopt guidelines for the visitation and use of ancient shrines.

4. Develop and implement a historic property monitoring program to systematically monitor the condition of the historic district and all historic properties, including cultural sites and burials.

5. Consult with Kahu Kū Mauna about establishing buffers (preservation zones) around known historic sites in the Astronomy Precinct, to protect them from potential future development.

[1] The spelling of the mountain changed to one word in 2014. However, "Mauna Kea" is still used for legal and historical documents, *University of Hawai'i Style Guide.*

6. Develop and implement a burial treatment plan for the UH Management Areas in consultation with Kahu Kū Mauna, MKMB's Hawaiian Culture Committee, the Hawai'i Island Burial Council, recognized lineal or cultural descendants, and State of Hawai'i Historic Preservation Division.

7. Limit damage caused by invasive species through creation of an invasive species prevention and control program.

8. Reduce threats to natural resources by educating stakeholders and the public about Mauna Kea's unique natural resources.

9. Increase communication, networking, and collaborative opportunities to support management and protection of natural resources.

10. Conduct baseline inventories of high-priority resources, as outlined in an inventory, monitoring, and research plan.

11. Conduct research to fill knowledge gaps that cannot be addressed through inventory and monitoring.

12. Develop and implement education and outreach program.

13. Develop parking and visitor traffic plan.

14. Coordinate with DLNR in the development of a policy regarding hunting in the UH Management Areas.

15. Educate management staff and users of the mountain about all applicable rules and permit requirements.

16. Reduce impacts from operations and maintenance activities by educating personnel about Mauna Kea's unique resources.

17. Develop and implement a debris removal, monitoring and prevention plan.

18. Evaluate need for additional public restroom facilities in the summit region and at Hale Pōhaku, and install close-contained zero waste systems if necessary.

19. Conduct energy audits to identify energy use and system inefficiencies, and develop solutions to reduce energy usage.

20. Establish a reporting system to ensure that the MKMB, DLNR, and the public are informed of results of management activities in a timely manner.

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THIRTY METER TELESCOPE'S THINK FUND & WORKFORCE PIPELINE PROGRAM

The Hawaii Island New Knowledge (THINK) Fund was initiated in 2014 prior to the initial start of construction with a commitment of $1 million per year for Hawaii Island STEM endeavors. The Hawaii Community Foundation (HCF) and the Pauahi Foundation administer the Fund with scholarship, classroom, student and STEM programming initiatives with Pauahi focusing on Native Hawaiians recipients. Within the next few weeks TMT will have funded $4 million to the THINK Fund initiative.

THINK Fund at HCF has benefitted 26,000 students and 1,000 teachers on Hawai'i Island. Grants and scholarships seek to provide high-quality, career-connected STEM education and experiences to Hawai'i Island's most underserved youth.

Scholarships

- College scholarships totaling over $325,000 have been awarded to 54 Hawai'i Island students with financial need.
- Scholarships support students pursuing careers in STEM and future STEM educators who intend to teach in Hawai'i Island schools.

STEM Learning Grants

- THINK Fund at HCF provided more than $685,000 in grants that leveraged an additional $1,500,000 from other funders to support innovative STEM programs and activities.
- $300,000 is committed to the applications currently in process.
- Programs receiving support must demonstrate success recruiting and addressing the needs of groups underrepresented in STEM fields, which includes students in rural communities, Native Hawaiians, and those disengaged in school.

Classroom Grants through DonorsChoose.org

- $250,000 has been committed to providing immediate funding for high-quality, ready-to-go STEM projects in Hawai'i Island classrooms.
- High need schools received 78% of the funding.
- 39 out of 55 public and public charter schools on Hawai'i Island have received grants, schools with high need students received 78% of the funding.

Program for Children of Incarcerated Parents

- Hawaii Community Foundation will solicit proposals to fund programs serving this target group for at least $5,000 per year, beginning this year.

Applications are open for all HCF scholarships, including THINK Fund at HCF. The deadline is January 31st.
www.hawaiicommunityfoundation.org/scholarships/scholarshipfaqs

Applications are also open for Career Connected Learning – this is the new name for the redesigned STEM Learning Partnership. HCF is encouraging all previous STEM Learning Partnership grantees to review the request for proposals and apply if they have great programs that fit the parameters. The parameters are very similar to the previous parameters, with a stronger emphasis on how the STEM education activities help participants explore and move into local STEM careers. The deadline is February 15th. www.hawaiicommunityfoundation.org/career-connected-learning

THINK Fund at Pauahi Foundation

- The TMT THINK Fund at Pauahi has funded thirty-three scholarships to date, with all students funded for their entire academic career. Total of $568,000. Fifteen scholarships planned for 2018.
- Twenty-three students had full scholarships to Science Camps; total of $55,000. Fourteen more Science Camp scholarships will be awarded in 2018.
- All students were Native Hawaiian.

TMT's Workforce Pipeline Program

Through the TMT-funded and managed Workforce Pipeline Program, more than $2,500,000 has been disbursed to Hawaii Island. Among the key programs that have been supported are:

- Akamai Workforce Initiative – TMT is the cornerstone funder of internship program that has provided internships to 356 students from Hawaii. 24% have been Native Hawaiian and 47% underrepresented minorities. To date TMT has provided over $700,000.
- TMT has also funded a Mentor Training Program for three years.
- TMT has increased Akamai funding to $300,000 for 2018 and support ten additional college interns from Hawaii Island.
- TMT has funded high school, middle school, and elementary school robotics for seven years, with a total funding in excess of $250,000. The funding has made it possible for schools and communities throughout Hawaii Island, including many with underserved/underrepresented students to participate in robotics.
- TMT has also been a major sponsor of the Girls Engaged in Math and Science Program, Hawaii County and State Science Fairs, Journey through the Universe, and other similar programs, including several at the 'Imiloa Astronomy Center.
- TMT is funding a new TMT UH Hilo Physics and Astronomy computer laboratory, and will be the major funder of the UH Hilo 2018 Science Olympiad.

MAUNAKEA ONLINE DOCUMENTS LIBRARY

Documents referred to in this report can be found at dlnr.hawaii.gov/occl/maunakea-management

TABLE 1: MANAGEMENT PLANS AND ANNUAL REPORTS

Comprehensive Management Plan Annual Reports, 2010-2017
Decommissioning Plan for the Mauna Kea Observatories
Public Access Plan for the UH Management Areas on Mauna Kea
A Cultural Resources Management Plan for the University of Hawaii Management Areas on Mauna Kea
Natural Resources Management Plan for the UH Management Areas on Mauna Kea
Board of Land and Natural Resources approval of Mauna Kea Comprehensive Management Plan
Mauna Kea Comprehensive Management Plan

TABLE 2: REPORTS FROM THE STATE OFFICE OF THE AUDITOR

Report No. 17-06	Follow-Up on Recommendations from Report No. 14-07, *Follow-Up Audit of the Management of Mauna Kea and the Mauna Kea Science Reserve* (2017)
Report No. 14-07	Follow-Up Audit of the Management of Mauna Kea and the Mauna Kea Science Reserve (2014)
Report No. 05-13	Follow-Up Audit of the Management of the Mauna Kea Science Reserve (2005)
Report No. 98-6	Audit of the Management of Mauna Kea and the Mauna Kea Science Reserve (1998)

TABLE 3: CONSERVATION DISTRICT USE PERMITS AND APPLICATIONS

CDUA 3812	Infrastructure improvements at the Maunakea Visitor Center (application) (2018)
CDUP 3568	Thirty Meter Telescope (Decision and Order) (2017)
HA-16-118	Notice of Intent to Decommission the Hoku Kea Telescope (2016)
HA-16-118	Notice of Intent to Decommission the Caltech Submillimeter Observatory (2016)
CDUP 2728	Smithsonian Submillimeter Array (1994)
CDUP 2691	Gemini North (1994)
CDUP 2509	Keck II (1992)
CDUP 2462	Subaru Telescope (1991)
CDUP 2174	Very Long Baseline Array (1989)
CDUP 1819	Hale Pohaku subdivision and construction workers camp (1986)
CDUP 1646	Keck I (1984)
CDUP 1515	James Clark Maxwell Telescope (1983)
CDUP 1492	Cal Tech Submillimeter Observatory (1982)
CDUP 1430	Hale Pohaku Midlevel Facilities and Visitor Center
CDUP 0954	Air Force Telescope, Planetary Patrol Telescope, 2.2 Meter Telescope (1977)
CDUP 0895	Hale Pohaku dormitories (1977)
CDUP 0781	UKIRT dormitory at Hale Pohaku (1976)
CDUP 0653	United Kingdom Infrared Telescope; NASA InfraRed Telescope Facility (1975)
CDUP 0537	Mauna Kea Access Road (1974)
CDUP 0527	Canada-France-Hawaii Telescope (1974)