MASTER PLAN FOR THE UNIVERSITY OF HAWAIʻI MAUNAKEA LANDS
E Ō I NĀ LEO (LISTEN TO THE VOICES)*
VOLUME 1



* *The name of this plan, E Ō I Nā Leo, and its translation was provided by noted Native Hawaiian scholar Larry Kimura, Associate Professor at UH Hilo. The authors express their deep gratitude for this gift.*

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University of Hawaiʻi

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ACRONYMS AND ABBREVIATIONS

Acronyms	Meaning
AURA	Association of Universities for Research in Astronomy
BLNR	Board of Land and Natural Resources
BOR	UH Board of Regents
CDUA	Conservation District Use Application
CDUP	Conservation District Use Permit
CFHT	Canada-France-Hawaii Telescope
CIP	Capital Improvement Project
CMP	Comprehensive Management Plan[1]
CMS	Center for Maunakea Stewardship
CRMP	Cultural Resources Management Plan
CSO	Caltech Submillimeter Observatory
DESI	Dark Energy Spectroscopic Instrument
DHHL	Department of Hawaiian Home Lands
DLNR	Department of Land and Natural Resources
DOFAW	Division of Forestry and Wildlife (DLNR)
EA	Environmental Assessment
EDD	Environmental Due Diligence
EIS	Environmental Impact Statement
EISPN	EIS Preparation Notice
ESA	Environmental Site Assessment
General Lease	General Lease S-4191 from BLNR to UH, which expires December 31, 2033
GRACES	Gemini Remote Access to CFHT ESPaDOnS Spectrograph
GRP	Grouted rubble pavement
HAR	Hawai‘i Administrative Rules
HDOT	Hawai‘i Department of Transportation
HECO	Hawaiian Electric Company
HRS	Hawai‘i Revised Statutes
HVAC	Heating, ventilation, and air conditioning
IfA	Institute for Astronomy
‘Imiloa	‘Imiloa Astronomy Center of Hawai‘i
IR	Infrared
IRTF	NASA Infrared Telescope Facility
JCMT	James Clerk Maxwell Telescope
KKM	Kahu Kū Mauna

[1] Unless stated otherwise, the term “CMP,” as used in this document, is inclusive of (*i*) the *Mauna Kea Comprehensive Management Plan, UH Management Areas* dated April 2009; (*ii*) the *Natural Resources Management Plan for the UH Management Areas on Mauna Kea, A Sub-Plan of the Mauna Kea Comprehensive Management Plan* dated September 2009; (*iii*) *A Cultural Resources Management Plan for the University of Hawai‘i Management Areas on Mauna Kea, Ka‘ohe Ahupua‘a, Hāmākua District, Hawai‘i Island, State of Hawaii, TMK: (3) 4-4-015: 09, 12, A Sub-Plan for the Mauna Kea Comprehensive Management Plan* dated October 2009; (iv) the *Public Access Plan for the UH Management Areas on Mauna Kea* dated January 2010; and (*v*) the *Decommissioning Plan for the Mauna Kea Observatories, a Sub-Plan of the Mauna Kea Comprehensive Management Plan* dated January 2010.

MKMB	Mauna Kea Management Board
MKO	Maunakea Observatories
MKSR	Mauna Kea Science Reserve
MKSS	Maunakea Observatories Support Services
MOA	Memorandum of Agreement
MSE	Maunakea Spectroscopic Explorer
MUTCD	Manual on Uniform Traffic Control Devices
NAR	Natural Area Reserves (DLNR)
NET	New Educational Telescope
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRMP	Natural Resources Management Plan (a sub-plan of the CMP)
OCCL	Office of Conservation and Coastal Lands (DLNR)
OMKM	Office of Maunakea Management
PV	Photovoltaic
RFI	Radio Frequency Interference
SDP	Site Decommissioning Plan (a sub-plan of the CMP)
SHPD	State Historic Preservation Division (DLNR)
SMA	Submillimeter Array
TMK	Tax Map Key
TMT	Thirty Meter Telescope
UC	University of California
UH	University of Hawai‘i
UH Hilo	University of Hawai‘i at Hilo
UKIRT	United Kingdom Infrared Telescope
VIS	Visitor Information Station
VLBA	Very Long Baseline Array
VPA	Vice President for Administration

Randolph G. Moore
Chair

David Lassner
President

THE UNIVERSITY OF HAWAIʻI COMMITMENT TO COLLABORATIVE MAUNAKEA STEWARDSHIP

Aloha:

In preparing this Master Plan, we have been enlightened by the insights of Native Hawaiian cultural experts, humbled by the criticisms from disappointed community members as well as past audits, and blessed with the knowledge from painful lessons learned from prior missteps. We have been informed through community engagement during our decade-long rulemaking process and initiatives such as Envision Maunakea.

Consequently, this Master Plan gives special attention not only to the astronomy programs on which the University of Hawaiʻi (UH) focused its attention for the first three decades of our stewardship, but also to the place of honor and renown that Maunakea has in the history, culture, and hearts of the Hawaiian people.

This Master Plan incorporates this broadened focus and the major changes UH has made over the past two decades in the way we manage the Maunakea lands we are honored to steward. It differs markedly from the *Mauna Kea Science Reserve Master Plan* (2000) that it supersedes. Key guidance in place today was absent when the previous Master Plan was prepared, including the *Mauna Kea Comprehensive Management Plan* (CMP) and its subplans and the Maunakea administrative rules entitled *Public and Commercial Activities on Mauna Kea Lands* (HAR Chapter 20-26). These will better equip the managers to steward Maunakea in a way that balances the impacts of astronomy on cultural practices and the environment while amplifying community, educational, and research benefits for all.

From what we have heard from the community, it is clear that we have more work to do in seeking, considering, and acting on community input, particularly from the Native Hawaiian community, as we make decisions. In accordance with guidance from the Board of Regents, in 2019 through Resolution 19-03, the UH has reorganized the existing Maunakea management structure and addressed other long-standing issues. On-the-ground authority now resides with the Center for Maunakea Stewardship (CMS) based on Hawaiʻi Island. The restructuring, which covers all operating and advisory units associated with Maunakea, established clearer lines of accountability and improved transparency within UH's management operations. The restructuring was shaped by input received during more than 90 meetings with advisory groups, staff,

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faculty, community members, representatives of the Maunakea observatories, elected representatives, government agencies, and partners. A concerted, but ultimately unsuccessful, effort was made to discuss the restructuring alternatives with Hawai‘i Island *kia‘i* (guardians).

Our new CMS and the entire UH are fully committed to continuing this journey of deep listening, particularly in the Native Hawaiian community, as we make management and land use decisions. This Master Plan and concurrent updates to the CMP management actions are critical steps in demonstrating our commitment to continuous improvement and collaborative stewardship of Maunakea.

Efforts already underway to elevate culture and education as key priorities alongside astronomy and land stewardship have begun with the assignment of responsibility to the ‘Imiloa Astronomy Center of Hawai‘i. ‘Imiloa is developing additional necessary and appropriate educational programming for those who work on and visit Maunakea and improving the interpretive experience at the Maunakea Visitor Information Station at Halepōhaku.

With the work and aid of Rangers, natural and cultural resource experts, and community volunteers, such as those who have served on the Maunakea Management Board, Kahu Kū Mauna Council, and the Environment Committee, we have addressed and corrected nearly all the deficiencies that were identified in past audits and reviews. UH is in the process of addressing those that remain such as updating plans, improving our education programs, and actively decommissioning telescopes from the mauna. The Department of Land and Natural Resources’ relatively recent independent evaluation reported that Maunakea and its natural and cultural resources are now among the best managed and protected lands in the State. The awards that we have received from the Historic Hawai‘i Foundation and the Kona Kohala Chamber of Commerce are further affirmation of the substantial progress UH has made over the last 20 years since we began to respond in earnest to the criticisms of our early stewardship. With the approval of the Maunakea administrative rules and the internal management reorganization, UH is better prepared today to care for Maunakea.

Just as UH is committed to outstanding stewardship of Maunakea, we remain committed to ensuring that our astronomy program is one of the best in the world, offering world-class opportunities for Hawai‘i students and faculty while driving economic activity that helps diversify Hawai‘i’s economy and creates employment opportunities for our residents. With significant presence on three islands, UH’s Institute for Astronomy is one of the nation’s largest and finest university astronomy programs, a source of pride to Hawai‘i, due in no small measure to the astronomy facilities on Maunakea that are the most respected and scientifically productive in the world.

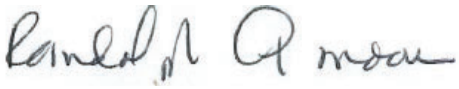
We believe that the lessons we have learned and the strides we have made uniquely position UH to provide balanced stewardship of Maunakea lands. As such, we are seeking a new land authorization that will, if granted, allow UH to continue along our path of continuous improvement in collaborative stewardship and management while supporting a world-class astronomy program, with fewer astronomy facilities, in a manner that honors the mauna.

If UH is removed from our overall stewardship responsibilities, whatever entity assumes control may adopt a different plan with different priorities and goals. In that case, until a new steward is selected, and a new plan adopted, we are confident that this Master Plan will continue to guide balanced and beneficial land use decisions on Maunakea, just as the CMP will continue to guide management decisions until such time as that plan may be replaced. UH is hopeful that we can maintain a role in ensuring a respectful astronomy program with the excellence that Maunakea deserves.

In closing, we wish to thank the many people who have helped and continue to help us fulfill our responsibilities to Maunakea. They include the Rangers who protect everyone's safety on the mountain, the CMS staff and many volunteers who have helped to restore and preserve the environment, the researchers who continue to deepen our understanding of the Universe, and our faculty, students, and alumni, especially Native Hawaiians, who have all taught us important lessons. We appreciate the voices of those within the UH and in the community, including those who have disagreed with our decisions and positions; even when we are not aligned, we learn from their beliefs and their passion. Finally, we are grateful to the many individuals and groups who have shared their input and ideas with us; we look forward to their continuing engagement throughout the Master Plan's implementation.

UH stands firmly behind the statement in the August 24, 2017, Board of Regents' resolution expressing UH's "commitment to the collaborative stewardship of Maunakea's cultural, natural, educational and scientific resources, and … to move forward to collaboratively build a global model of harmonious and inspirational stewardship that is befitting of Maunakea."

Sincerely,



Randolph G. Moore
Chair, Board of Regents



David Lassner
President

E Ō I NĀ LEO (LISTEN TO THE VOICES) FOREWORD

Mauna Kea, kuahiwi kū ha'o i ka mālie.

Mauna Kea, standing alone in the calm.[2]

This *'ōlelo no'eau* (Hawaiian proverbs and poetic sayings) recognizes and expresses the sentiment that Maunakea is a source of inspiration to many people. Steadfast always, the *mauna* (mountain) compels us to gaze upward in search of the unknown, thereby engendering a sense of wonderment and hope.

Maunakea is linked to the culture and cosmology of Native Hawaiian people, and for many the mauna is sacred. Its resources serve as the source for a diverse range of spiritual, research, educational, recreational, and subsistence experiences that define the significance of the mauna. Its extraordinary blend of topographic and atmospheric qualities make Maunakea the most desirable location for ground-based astronomy in the Northern Hemisphere, and the exceptional combination of alpine and subalpine ecosystems in a tropical environment make it ecologically unique as well. If there is truth to the idea that the nature of "place" shapes who we are as a community, Maunakea certainly stands alone as a preeminent example of this.

The quest to understand our beginnings is an inherent drive in all humans, and it has led virtually all cultures to develop rich stories and beliefs regarding their origins. In Hawaiian cosmology, Maunakea is considered the origin – the first-born island. For astronomers, the astronomy facilities on Maunakea represent a window to the origins of the Universe. Integrating these diverse and rich perspectives is both the purpose of and challenge for this plan, and thus its name, *E Ō I Nā Leo* (Listen to the Voices), for it is in listening deeply to the many values attached to Maunakea that the knowledge of who we are will be revealed, and our humanity affirmed.

The mauna stands alone, calm in the midst of all forms of storm. It reminds us that our varied interests, as diverse and sometimes divisive as they may be, are in fact woven as *lei* (garland) through the innate human drive to understand our beginnings, and it is that lei which connects us all as one community.

[2]Pukui, 1983, No. 2147.

Strengthening Connections to Place

> *He aliʻi ka ʻāina; he kauwā ke kanaka*.
>
> The land is a chief; man is its servant.[3]

Foundational values that guide UH's stewardship and inform E Ō I Nā Leo derive from key tenets of the Native Hawaiian worldview, which holds that cultural and natural landscapes are one and the same. In this worldview, land is not a commodity but rather an esteemed elder in the Native Hawaiian family system. The Native Hawaiian relationship to the land is one of reciprocity and kinship; people serve the land/elder which in turn provides for the people. In this view, it is the collective responsibility of UH, Native Hawaiians, the Hawaiʻi Island community, and the international astronomy community who benefit from Maunakea's remarkable viewing conditions, to behave in ways that sustain Maunakea's gifts of spirit, life, discovery, learning, and connection for future generations. The purpose of E Ō I Nā Leo is to help all fulfill their responsibilities to the mauna and to one another.

Part of this responsibility is to integrate the knowledge and traditions of the ancestors into our present plans and practices wherever we can. For example, Native Hawaiian tradition describes Maunakea as the first-born mountain son of *Wākea* (sky father) and *Papa* (earth mother), who were also progenitors of the Hawaiian race. Maunakea is symbolic of the *piko* (umbilical cord) of the island-child, Hawaiʻi, and that which connects the land to the heavens (Maly, Piko Kaulana:v).

Paupaniākea is another name for Wākea referenced in the Kumulipo. The name may mean "End of the closing up of light" or "Opening up of light" (Beckwith, Hawaiian Mythology:294) which in either case accurately describes some of the unique spiritual and astronomical qualities associated with the summit area. Further, as Pukui and Elbert note, *ʻĀpapalani* refers to the "Legendary upper stratum and abode of the gods [or] chiefs of the highest rank, as nīʻaupiʻo." (Pukui-Elbert:28). In researching these names, Pualani Kanahele notes:

> "'Āpapalani is the space above the earth's atmosphere where the oxygen is thinner. On the mountain it is where the greenery subsides and disappears, thins out like the oxygen. The space below where the daily rain clouds meet the mountain is ʻĀpapanuʻu. Therefore, we have two nomenclatures, the very top is Paupaniākea and ʻĀpapalani below".

It is UH's intent that this Master Plan serve as a framework for aligning land use decisions, management actions, and educational programs in a way that strengthens everyone's connections to this special place by integrating traditional and contemporary knowledge and practice where possible. Achieving balance in the development and management of the resources can be accomplished only when there is a greater understanding and appreciation of the many values held by the community regarding Maunakea.

[3]Pukui, 1983, No. 531.

History, Voice, and Vision

I ka `olelo no ke ola, i ka `olelo no ka make.

In language there is life, in language there is death.[4]

Words can heal, words can destroy.

Historians write from a worldview that is shaped by their backgrounds, experience, and values. In Hawai‘i, for many years this meant that American historians often neglected and even denigrated traditional Native Hawaiian values and culture. That has changed substantially in recent decades with Native Hawaiian voices increasingly expressed and heard. As a result, historical events are better documented and more fully understood than was once the case and the impact on the Native Hawaiian diaspora more fully appreciated. The broadened discussion by voices of indigenous peoples has given rise to a movement that seeks to rectify past harm.

The ongoing conflict surrounding the development of the Thirty Meter Telescope (TMT) reflects the collision between different views. One of the views holds that astronomy on Maunakea is already over-developed and has been developed with too little regard for Native Hawaiian values and should therefore be scaled back or eliminated. Another view holds that the study of the heavens from Maunakea is both consistent with a traditional Hawaiian world view and practices and a worthy and important element of Hawai‘i island’s current and future economic and educational base. Those that share the latter view tend to also desire a decrease in the island’s dependence on tourism by encouraging the kinds of research, educational, and technological opportunities that accompany astronomy. There is legitimacy to all visions for Maunakea.

UH believes that whether one supports or opposes astronomy on Maunakea in general and/or TMT in particular, and regardless of whether one believes that UH is the most appropriate agency to manage the upper reaches of the mountain, if Hawai‘i is to achieve its goals of building a more diverse and sustainable future for this and subsequent generations, the path forward is through a knowledge-based economy inclusive of disciplines grounded in science and technology guided by the values of the community. A central question for Maunakea then becomes “do the values of our community allow for Maunakea to be a place where a component of this future (astronomy) is pursued beyond 2033 when conducted under both a land use and comprehensive management plan that seek to balance these diverse views?”

How one answers that question is a function of the diverse and sometimes conflicting views one holds regarding land use, governance, and stewardship. This diversity of opinion was most recently observed in the findings of the Department of Land and Natural Resources’ evaluation of UH’s implementation of the Maunakea Comprehensive Management Plan,[5] which stated that “…the opinions of members of the public regarding UH stewardship of Maunakea has often depended upon whether they support or oppose telescope development on the mauna.”

[4] Pukui, 1983, No. 1191.

[5] Ku‘iwalu, 2020.

Unfortunately, E Ō I Nā Leo cannot change past actions nor eliminate their consequences for Native Hawaiians. Neither can it resolve the fundamental question of whether State and Federal policy should continue to endorse astronomy on Maunakea. While both are critical topics for the State, these are policy issues that UH alone cannot decide, and their resolution is beyond the scope of this Master Plan. What E Ō I Nā Leo attempts is to incorporate the diverse values held by the community into a framework that supports discourse and decisions leading to a balance of interests and responsibilities and a unifying vision for Maunakea as a unique source of learning.

Extending the Reach

> *ʻAʻohe pau ka ʻike i ka hālau hoʻokahi*.
>
> All knowledge is not taught in the same school.[6]
>
> One can learn from many sources.

In 2016, UH collaborated with the astronomy community in sponsoring the Envision Maunakea Initiative, a series of conversations led by its community partner, Friends of the Future. These conversations identified the aspirations of community members regarding what Maunakea means to them and how they would like to see it stewarded. The intent was to improve UH's understanding of why Maunakea is important to people and to use this feedback to inform UH and the astronomy community's plans for the future. The conversations were intimate and, in many instances, deeply personal, with the shared experiences documented in *The Report of the Hui Hoʻolohe*.[7]

Two key insights revealed by that collaboration have informed this plan. First, all groups agreed that it is a privilege to experience Maunakea, whether that be as a cultural practitioner, recreationalist, tourist, astronomer, commercial tour operator, or other. Maunakea uniformly is described as moving minds and spirit, and lives have been changed because of one's relationship to the mauna even if from only a single experience. Second, the mauna is the teacher. While each of us brings with us a set of values, a knowledge base, and tools that shape our experience of it, in the end it is the mauna that teaches us both what we came to learn and that which it decides we need to learn.

Maunakea is not just a valuable astronomical resource, it is a unique natural, biocultural, and social ecosystem that has much to teach us about our origins, future, human nature, history, *ʻike Hawaiʻi* (traditional knowledge), climate, and so much more. E Ō I Nā Leo proposes to broaden the focus of UH's facilities and resources at Halepōhaku to support the educational and research opportunities that Maunakea offers in fields other than astronomy. The exact nature of the educational opportunities that will be offered are still to be developed, but in concept would be supported by Halepōhaku serving as a Multidisciplinary Field Station for research and teaching. Facilities and programs offered there would serve as a venue for focused, customized, high-touch, educational programming for college and secondary school students; community, professional,

[6] Pukui, 1983; #203.

[7] Envision Maunakea, 2018.

affinity groups; and the general public. It would be a place for integrating multiple disciplines and addressing diverse topics.

Foundational to future educational programming and field work would be building a solid cultural base of ʻike Hawaiʻi and *nohona Hawai'i* (traditional practices) underpinning all offerings and opportunities. CMS and ʻImiloa are partnering to develop this programming in collaboration with other Native Hawaiian cultural resources across UH and in the community with a common goal of inspiring the intellectual and personal growth of all those who are privileged to visit, learn, and work there.

Ancestral Ways, New Beginnings

> *Hahai no ka ua i ka ululāʻau*.
>
> Rains follow the forest.[8]
>
> Knowing this, Hawaiians hewed only what was needed.

Native Hawaiian traditions and contemporary views recognize how special Maunakea is as both a source of inspiration and for the value of its unique natural resources. Guided by this perspective, this plan helps demonstrate UH's relationship to Maunakea as a significant cultural and historical landscape where the State's policy supporting astronomy on Maunakea is upheld, commitments are honored, and use of its resources are balanced in order to achieve a sustainable future for the diverse values our community ascribes to this special place.

In recognition of this, E Ō I Nā Leo seeks to *ʻāwili* (weave) the diverse values Maunakea represents, striving to find balance amongst the community's many approaches to understanding our origins and encouraging people to collaboratively protect this special place. Finding balance is a never-ending, constantly evolving journey that aligns well with UH's overall purpose. Accordingly, E Ō I Nā Leo establishes a framework for moving forward with the understanding that, as with all sail plans, the navigators must constantly be aware of, adapt, and adjust to changing winds and seas that we encounter during our journey.

[8] Pukui, 1983, #405.

PART 1: FOUNDATIONS

1 MISSION, VISION, VALUES, GOALS, OBJECTIVES, AND STRATEGIES

Maunakea is important to diverse communities on Hawai‘i Island, on the other islands that make up the state, and beyond. Part 1 of this plan describes the University of Hawai‘i’s (UH):

- **Mission and Purpose on Maunakea** – the reason for its presence on Maunakea.
- **Vision for Maunakea** – what it seeks to accomplish as a result of its actions on Maunakea.
- **Core Values** – the precepts that guide the way people behave as they try to implement the vision and carry out UH’s mission on Maunakea.
- **Goals and Objectives** – concise statements of what needs to be done to accomplish the mission, fulfill the vision, and promote the core values.
- **Strategies** – the overall approach that UH will use in attempting to reach the identified goals and objectives.

These are the foundations upon which UH’s Master Plan for Maunakea, *E Ō I Nā Leo* (Listen to the Voices), rests and which have guided the decisions that are reflected in it. Part 2 of this Master Plan discusses the facilities and land uses that UH believes should be accommodated within the UH Maunakea Lands over the period of this Master Plan. Part 3 of this Master Plan presents the review process and design guidelines that facility and land use proposals will need to navigate.

The content of this Master Plan, including UH’s mission, vision, and goals, were informed by discussions with diverse parties over a period of many months, which is summarized in Appendix A and Appendix B. Implementation of the plan will help UH succeed in its primary mission and achieve its intended purpose in a way that is consistent with its core values.

1.1 UH’S MISSION AND PURPOSE ON MAUNAKEA

UH’s mission and purpose on Maunakea, and therefore CMS’ mission, is to:

> *Sustainably steward Maunakea for the benefit of our communities, Hawai‘i, and the world, as a publicly-accessible learning landscape where all who visit learn, and those who seek something more discover through rich multi-cultural experiences and engaging multi-disciplinary discourse. Provide equal opportunities across the schools of the UH system and community partners to engage with the mauna in ways that perpetuate and advance knowledge, wisdom, and values while fostering mutual understanding and respect.*

As mentioned above, this mission statement captures why UH operates on Maunakea. It draws on existing mission statements of those UH programs and units that directly oversee and/or engage in actions on Maunakea and whose direction, interests, and concerns this plan supports. Appendix C provides a summary of the existing mission statements of those UH programs and units.

1.2 UH'S VISION FOR MAUNAKEA

Upon adoption of this Master Plan by the BOR, UH's vision for the lands that it manages on Maunakea will be:

> *Maunakea, a revered mountain, where landscape, community, and culture combine to inspire discovery, renewal, and world-class education and research.*

Astronomy was the original motivation for UH's involvement with Maunakea, and we anticipate that it will remain central to our activities on Maunakea. At the same time, the decades-long relationship has deepened and evolved to the point where today its Vision is much broader than was initially the case. At the heart of its Vision for the UH Maunakea Lands is the recognition that being allowed to carry out research on Maunakea requires one to mālama Maunakea, a place deeply rooted in culture and rich in ancestral knowledge. Accordingly, UH's renewed Vision recognizes that Maunakea's cultural landscape and natural resources must receive the same respect as scientific research if astronomy is to continue and that preservation, education, and research should reinforce, rather than conflict with, one another. It also recognizes that UH must continue to observe the rights of cultural practitioners and be sensitive to the unique importance and symbolism that these lands have to Native Hawaiians.

In managing this precious area, UH recognizes that it must protect the area's value as:

- A culturally significant landscape and a recognized historic district with many contributing historic properties; which for some is a *wahi pana* (storied/legendary place) and for others is a *wao akua* (realm of the gods).
- The premier location for astronomy in the Northern Hemisphere due to its unique topographic, weather, and astronomical conditions.
- Rare subalpine and alpine ecosystems in a tropical zone where species have uniquely evolved and adapted deserving of understanding and protection against human and environmental threats.
- A place for Hawai‘i residents and visitors seeking cultural, educational, recreational, and exploration experiences.

This Master Plan and the Comprehensive Management Plan (CMP) reflect and contribute to the achievement of the vision by creating the physical and administrative environment that supports exploration of humanity's most basic of questions: "who are we" and "where did we come from?" The plan seeks balance among the diverse views that various members of society and culture hold regarding this question. The plan provides a framework for the people of Hawai‘i to benefit from worldwide resources while sustainably stewarding Maunakea for everyone's benefit.

1.3 CORE VALUES ASSOCIATED WITH MAUNAKEA

The specific core values, i.e., precepts, that guide UH's actions on the lands that it manages on Maunakea, are:

- *Mālama* (care for). Maunakea is a significant cultural and natural landscape. Access to these lands shall be managed in a manner that balances the public's right to access with UH's

obligation to: (*i*) protect and conserve their natural, cultural, and scientific resources; (*ii*) responsibly manage actions and activities; and (*iii*) protect public health and safety.

- *Kuleana* (responsibility or privilege). The UH Maunakea Lands are held in trust by the State for the benefit of Hawai‘i’s people. The summit region is wahi pana and, to many, wao akua where traditional Native Hawaiian cultural practices are exercised. It is where species have evolved to adapt to the unusual conditions existent on the mauna and where geography and climate come together to create unmatched astronomical viewing conditions. It is also where residents and visitors come to recreate. UH respects cultural practice and honors its privilege, commitment, and responsibility to support access to and use of resources that is balanced across the many values ascribed to Maunakea.
- *‘Ike Hawai‘i; Nohona Hawai’i* (traditional knowledge; traditional practices). Our stewardship and educational programming will integrate traditional knowledge and practice to strengthen our care for Maunakea’s resources and people’s understanding and connection to place.
- *Mau loa* (a long view). UH will responsibly steward the physical, scientific, and biological resources present on Maunakea so that their vital ecosystem functions continue for future generations.
- *Laulima* (cooperation). As a public institution, UH is committed to broadening participation of Native Hawaiians and the larger community in its planning and programs for Maunakea. We encourage all people to come together in shared responsibility to collaboratively protect and learn from this special place.
- *Kūpono* (trustworthiness). Stewardship of the mauna and ensuring that Maunakea’s unique resources remain available for the continued advancement of science, education, and astronomy requires organizational and economic stability. UH will seek to maintain a level of trust and decision-making certainty that allows the continuation of responsible stewardship in partnership with the community.

These core values were developed with consideration for the values of other UH programs and units that either oversee actions on Maunakea, conduct actions on Maunakea, or are otherwise tied to UH activities on Maunakea. These include the values expressed in various UH System, UH Hilo, and ‘Imiloa plan documents (Appendix C).

1.4 GOALS AND OBJECTIVES

The goals and objectives described below are concise statements of what needs to be achieved to fulfill the vision expressed in Section 1.2, accomplish the mission and purpose expressed in Section 1.1, and promote the core values in Section 1.3. Importantly, no goal has precedence over the others; they are equally important. Nor should they be thought as being exclusive of each other; in fact, UH views each as a strand that needs to be woven together to fulfill its vision.

1.4.1 RESPONSIBLY STEWARD MAUNAKEA FOR PRESENT AND FUTURE GENERATIONS

Referred to as the “Stewardship Goal,” it commits UH to stewarding Maunakea by implementing the CMP in coordination with the community to further a collective understanding of, respect for,

and protection of Maunakea's cultural landscape and diverse natural and astronomical resources. UH recognizes that Maunakea is a distinctive and revered mountain and acknowledges that some Native Hawaiians feel they hold unique responsibilities to the care of the mountain through their religious and cultural practices. Accordingly, in carrying out the astronomical research that is the single most important reason for its position on the mountain, UH:

1. Embraces its responsibilities to Native Hawaiians, respecting their religious and cultural practices;
2. Dedicates itself to the protection of the landscape and the flora and fauna that have evolved in its isolated ecosystems in a manner consistent with the CMP and that honors Maunakea's recognition as a National Natural Landmark;
3. Dedicates itself to the pursuit of the many non-astronomy research and educational activities for which Maunakea is especially well-suited; and
4. Will limit astronomical research facilities and projects to those for which Maunakea is particularly well-suited.

Objectives under this Stewardship Goal include:

- Continue to implement CMP management actions, which protect, maintain, and restore the cultural landscape and natural resources.
- Affirm and protect Maunakea as a wahi pana and wao akua.
- Provide educational and other programs to ensure that, when in the UH Maunakea Lands, the public and those engaged in achieving this Master Plan's goals act in a manner that respects Native Hawaiian traditional practices, does not unduly impact the environment, protects and sustains resources, and maintains human health and safety.
- Build relationships between the mauna, its special caretakers, and the broader community.
- Limit permitted commercial activities to those which support the stewardship of Maunakea's resources.

UH commits itself to doing its utmost to ensure that present and future generations can reach their own understanding of the connections and complexities of Maunakea's cultural landscape and natural resources. Accordingly, it will strive to protect these rich resources. UH will not work alone in pursuing these commitments. Instead, it will continue to develop community partnerships that support *hō'ihi* (respect) by all who visit, work, and engage in cultural practices on Maunakea. It will also continue to support the integration of Hawaiian knowledge and ways of knowing into our research frameworks, educational programs, and CMP actions. Increasing the engagement of Native Hawaiian students, Hawai'i Island residents, and residents of the State of Hawai'i in stewardship is a primary means for broadly sharing the many lessons Maunakea has to offer our community, and UH will proactively seek the funding and other support needed to do that.

1.4.2 MAINTAIN THE UNIVERSITY'S & MAUNAKEA OBSERVATORIES' STATUS AS WORLD LEADERS IN ASTRONOMY

Referred to as the "Astronomy Goal," it entails UH endeavoring to maintain its and the Maunakea Observatories' (MKOs) status as world leaders in astronomy. Maunakea is an extraordinary site

for ground-based astronomical observations, arguably the single best site on Earth. This was what first brought UH to Maunakea and allows UH to support stewardship of the mauna, provide a range of benefits to the community, and enhance our educational outreach and offerings.

The astronomers who conduct research with the existing Maunakea astronomy facilities, in partnership with UH, are world-leading sources of scientific knowledge about the Universe, and UH seeks to ensure the continuation of astronomy on Maunakea for years to come so that its students, faculty members, and associated scientists have the greatest opportunity to participate in research that is critical to fully understanding humanity's place in the cosmos. UH's efforts will enable Maunakea to continue to be a place where researchers from diverse cultures and institutions collaborate and extend the boundaries of discovery. UH is confident this goal can be achieved while reducing the impact from astronomy facilities, including reducing the number of facilities in the MKSR, so long as the area is administered in a way that allows existing facilities to be modified to accommodate changing technologies or the sites are recycled for use by more advanced astronomy facilities from time to time.

Objectives under the Astronomy Goal include:

- Facilitate UH's attraction and retention of leaders in the field of astronomy by providing continued access to their own and their partners' facilities on Maunakea.
- Maintain UH's leadership position in astronomy on Maunakea through its cooperative agreements with the MKOs and its own facilities.
- Facilitate an appropriate mix of observational and support facilities that are able to help answer important scientific questions.
- Support diverse representation within astronomy by encouraging support for a broad range of students, researchers, and staff seeking to learn and work on Maunakea.
- Maintain the physical and administrative environment necessary to continue cutting-edge astronomy on Maunakea.
- Protect astronomical viewing resources by avoiding, minimizing, or mitigating land uses that directly conflict with astronomical research.
- Guide the location, character, size, mass, color, and other physical attributes of astronomical facilities in ways that minimize potential adverse effects on the environment while optimizing their productivity.
- In partnership with the MKOs, foster community relationships that strengthen engagement and contribute to building a shared vision for astronomy on Maunakea.

This goal and associated objectives recognize that Maunakea's astronomical viewing conditions are a resource worthy of preservation and utilization and that observations made using Maunakea astronomy facilities consistently generate widely recognized discoveries that are beneficial to all humankind. UH will continue supporting the vision of a knowledge-based economy sought by the

elected leaders of the State and County for more than 50 years, and that continues to be a part of Hawai‘i’s economic future.[9]

1.4.3 DIVERSIFY EDUCATIONAL PURSUITS AND EXPAND RESEARCH OPPORTUNITIES

Referred to as the “Education Goal,” it entails UH working to diversify its educational pursuits and to expand research opportunities on Maunakea beyond astronomy for UH, for partner institutions and groups, and for the broader community. In addition to being an exceptional site for astronomy, Maunakea’s landscape, resources, and infrastructure provide opportunities for researchers in a myriad of physical and social sciences, including indigenous knowledge. UH will actively encourage and invite researchers and students to use its facilities at Halepōhaku in support of their research and teaching so that they may learn from the natural, cultural, and social environment within and surrounding the UH Maunakea Lands.

Specific objectives under the Education Goal are to:

- Maintain the physical and administrative environment necessary to grow research and learning in diverse fields on Maunakea.
- Foster collaborations between leaders and researchers from diverse fields, cultures, institutions, and the community to enrich and extend the knowledge gained from work on Maunakea though multidisciplinary research and cross-cultural discourse.
- Facilitate the foregoing by repurposing the Halepōhaku facilities as a Multidisciplinary Field Station to support a broader range of education and research.
- Impart an understanding of Maunakea to all who work and visit there of the historical, cultural, and environmental context of the mauna, so that they may see the mauna as a teacher and understand their role in contributing to the stewardship of this special place.

The Education Goal and associated objectives recognize that the UH System is the state’s primary higher education provider and that creating greater opportunities for educational and research programs on Maunakea can benefit and unite the System’s three universities, seven community colleges, and community-based learning centers across the state. Further, these Maunakea-specific objectives support UH’s overall efforts to expand its support of the science- and knowledge-based economy that is sought by Hawai‘i’s elected leaders.[9]

While UH will continue its strong support for and involvement in astronomy on Maunakea, it will simultaneously strengthen its support of research and educational programs in indigenous, natural, and social sciences. UH also recognizes that *kanaka maoli*’s (Native Hawaiian) timeless knowledge regarding Maunakea, reflected in their observations shared in *mo‘olelo* (narrative story) and *mele* (song or chant), are no less significant than other knowledge, and these will be

[9] In 1964 the Hawai‘i State Legislature passed Senate Concurrent Resolution 16 (SCR 16) stating that the “State of Hawai‘i and its citizenry are most desirous and willing to co-operate and aid in the promotion of our nation’s space program and research to the benefit of the County of Hawai‘i, the state and the nation.”

The *Hawai‘i 2050 Sustainability Plan* (2021) and *Hawai‘i Statewide Comprehensive Economic Development Strategy* (2016), which draw on HRS § 226-10, 226-103, and 226-108, emphasize that it is the State’s policy to promote economic diversification and innovation to retain a workforce educated in science, technology, engineering, and mathematics (STEM).

acknowledged, protected, and expanded within UH's management and curriculum. UH will incorporate Maunakea into its programming across departments within UH Hilo and across schools in the UH System.

1.4.4 SEEK BALANCE AND MUTUALLY BENEFICIAL RELATIONSHIPS AMONG THOSE WHO COME TO MAUNAKEA

Referred to as the "Balance Goal," it involves seeking balance and mutually beneficial relationships among those learning from, practicing on, and visiting Maunakea. UH firmly believes that astronomy, education, cultural practices, science-based environmental management, research, and responsibly conducted public activities can coexist. There will inevitably be a need for trade-offs and consideration of impacts to the environment, but UH believes these can be done in ways that advance mutual respect and sustainable stewardship.

Specific objectives under the Balance Goal are as follows:

- Maintain a physical and administrative environment that considers, provides for, and invites all manner of exploration, discovery, learning, cultural practices, and science on the mountain.
- In partnership with the Native Hawaiian community, determine the feasibility of, and develop plans for, establishing a hālau for ceremony and education on the mauna.
- Offer opportunities for cultural, educational, scientific, and recreational activities and programs that are consistent with enhancing human health and safety, promoting proper stewardship, and preservation of resources.
- Seek opportunities for mutually respectful and beneficial collaboration among cultural practitioners, educators, and scientists.
- Involve community members and organizations in planning, policy development, and evaluation of UH's stewardship of Maunakea.

The Balance Goal and associated objectives acknowledge that a wide range of purposes and practices are possible and that the cultural, educational, and scientific value of Maunakea extends far beyond astronomy. UH will continue to provide for and integrate cultural practitioners, scientists, educators, and the public through its collaborative, cooperative, and community-based stewardship program.

1.5 STRATEGIES

To achieve the goals and objectives set forth above, UH will pursue the following strategies with respect to its Maunakea Lands:

1. Involve the community in the decision-making process early and often through the CMS volunteer advisory groups (e.g., Mauna Kea Management Board (MKMB), Kahu Kū Mauna Council (KKM), and Environment Committee (EC)) and diverse community engagement and outreach activities.
2. Seek diverse community representation on the CMS volunteer advisory groups.

3. Strive to build community confidence and trust so that UH may be provided the opportunity to continue and improve its management, stewardship, and research beyond 2033.
4. Allow the establishment of only those new facilities that address the Phase 1 screening and assessment criteria (Section 6.2), including (*i*) consistency with the mission, vision, goals, and objectives of this Master Plan; (*ii*) consistency with the CMP; (*iii*) adequately benefit from and/or increase our understanding of Maunakea's conditions, landscape, and resources; (*iv*) consistency with applicable rules regulations, and permits; and (*v*) avoid, minimize, or mitigate adverse effects to Maunakea's resources.
5. Continue to sustainably steward Maunakea through the implementation of the CMP and this Master Plan, including ecosystem and habitat restoration efforts.
6. Manage access to the UH Maunakea Lands in a phased and adaptive manner that (*i*) protects and conserves the cultural landscape, natural resources, and astronomical viewing conditions; (*ii*) responsibly manages activities to minimize potential adverse effects on the landscape and resources; (*iii*) protects public health and safety; and (*iv*) preserves the feeling of wilderness and sanctity in the summit region.
7. Work with the Native Hawaiian community to identify measures, policies, and facilities that will further reduce adverse effects to the cultural landscape and cultural practices and perpetuate *'ike Hawai'i* (traditional knowledge) and *nohona Hawai'i* (traditional practices).
8. Decommission a sufficient number of existing astronomy facilities to ensure that the number of operating astronomy facilities in the MKSR is no more than nine (9) by December 31, 2033, and does not exceed that number throughout the remainder of the time covered by this Master Plan.
9. Execute agreements between UH and the entities that operate Maunakea astronomy facilities so that the parties to those agreements collectively provide their fair share of financial support and other resources needed to (*i*) provide public benefits for the community and state, with a focus on the Native Hawaiian community; (*ii*) implement the CMP and this Master Plan; (*iii*) provide education regarding Maunakea's cultural landscape and natural resources; (*iv*) support the UH astronomy programs; and (*v*) maintain necessary infrastructure.
10. Facilitate over the 20-year period of this Master Plan: (*i*) the development of an astronomical facility on Astronomy Site 13, and (*ii*) the modification or recycling of up to three (3) existing astronomy facilities in the MKSR.

    Strategy 10 recognizes that there is some uncertainty regarding the Thirty Meter Telescope (TMT) project, which is permitted for Astronomy Site 13. Mauna Kea Access Road was blocked from July 16 through December 26, 2019, and construction of the TMT project was paused indefinitely. The U.S. National Science Foundation (NSF) is now considering funding that project; their funding would trigger federal review of the project prior to construction restarting. Should the TMT project not proceed on Maunakea, this Master Plan will continue to guide UH decisions on Maunakea including the future of Astronomy Site 13.
11. Actively pursue ideas and interest within and beyond the UH System for (*i*) the establishment of educational pursuits and curriculum that would utilize Maunakea as a

learning laboratory; and (*ii*) ways the facilities, interactions, and resources on Maunakea can be leveraged to provide for and support those diverse educational opportunities.

12. Repurpose substantial portions of Halepōhaku as a Multidisciplinary Field Station that supports diverse environmental and cultural educational activities.
13. Transition from temporary and ad hoc visitor facilities and uses (e.g., portable restrooms and undesignated parking) in the MKSR to appropriately sized, dedicated facilities for these purposes.
14. Develop flexible, minimal-impact night sky viewing capabilities at Halepōhaku that support UH Hilo education programs and community outreach.
15. Facilitate the conversion of all wastewater facilities in the MKSR to zero-discharge per the terms of new MKO operating agreements being negotiated which are anticipated to be in place prior to 2033.

2 BACKGROUND AND CONTEXT

2.1 PURPOSE OF THIS MASTER PLAN

The purpose of this Master Plan is to guide UH's consideration and prioritization of proposed land uses within the UH Maunakea Lands in a manner that is consistent with UH's mission and purpose, promotes its vision for the lands that it manages, and contributes to the achievement of UH's goals and objectives. Specifically, this Master Plan is intended to guide:

1. The planning, siting, and design of new facilities and improvements;[10]
2. Alterations and other material changes to existing facilities that will cause a permanent change to the land; and
3. Decisions that UH may be involved in regarding which existing astronomy sites will remain operational.

It consolidates and clarifies UH's use and development policies for the subject lands and is intended to guide UH's decision-making related to them over a 20-year period.[11]

As stressed throughout this document, this Master Plan is intended to work in concert with, not to replace or override, the CMP. The CMP will remain the guiding document with respect to management of the cultural landscape and natural resources on Maunakea while this Master Plan speaks to the specific nature of the land uses that UH anticipates will be discontinued, continued, or established. The provisions of this plan:

- Are consistent with commitments UH has made regarding facility siting, decommissioning, and other matters, and comply with the provisions of existing permits, leases, and subleases that DLNR and UH have granted.
- Provide clear guidelines for those proposing new or modified uses and facilities within the UH Maunakea Lands.
- Support UH's efforts to protect and conserve natural and cultural resources and processes, which are a function of its implementation of the CMP.
- Promote public health, safety, and welfare.
- Are consistent with applicable components of the CMP.

[10] Proposed uses within UH Maunakea Lands that disturb the land, such as installing, recycling, modifying, or decommissioning facilities, structures, infrastructure (e.g., roads and utilities), and other improvements fall under the definition of "land use" under Hawai'i Administrative Rules (HAR) § 13-5-2, *Conservation District*.

[11] UH presently holds a General Lease from BLNR under which it grants rights to non-profit entities to construct, operate, and maintain astronomy facilities within the MKSR, in exchange for, among other things, access to world class facilities and research coordination. The General Lease expires at the end of 2033, before this Master Plan's 20-year planning horizon. This Master Plan is essential to the University's management efforts at least until 2033. After 2033, if the University is not granted a land authorization that includes the MKSR, whatever entity takes the University's place might adopt some, all, or none of this Master Plan in its planning efforts.

UH will evaluate all new proposals for facilities and uses for their consistency with this Master Plan. The programs and projects identified and discussed in this Master Plan are concepts that UH is considering but has not approved, adopted, or funded. The approval of this Master Plan by the BOR does not constitute the approval or permitting of any programs or projects discussed herein. Any future programs or projects are also subject to additional applicable government approval(s) and environmental review(s).

Proposed facilities and developments within UH Maunakea Lands, which will be concepts when first proposed to UH, will be evaluated using the following criteria:

- Compliance with applicable University policies, as amended, related to real property held by UH, such as RP 10.201.
- Consistency with the mission, vision, goals, and objectives of this Master Plan (Part 1, Chapter 1).
- Consistency with the CMP and promotion of resource conservation and sustainability.
- Extent to which the proposal has the potential to adequately:
    - Benefit from the conditions present within the UH Maunakea Lands;
    - Increase our understanding of Maunakea's resources;
    - Avoid, minimize, or mitigate reasonably foreseeable adverse impacts to Maunakea's resources;
    - If applicable, employ world-class technology, research techniques, and design;
    - If applicable and based on input from experts in the proposed field of study, the proposal addresses critical needs and has a high likelihood of contributing important information over its design life; and
    - Honor and benefit the Hawai'i Island community, particularly with regard to their educational, cultural, social, environmental, and economic needs.
- Consistency with:
    - The requirements of the HRS Chapter 183C, and HAR Chapter 13-5, regarding land uses within the State Conservation District;
    - The terms and conditions of CDUPs that have been issued that are relevant to the proposal; and
    - The Design Guidelines set forth in Part 3, Chapter 7, or, where inconsistent, provide adequate justification for any variance from those guidelines that is being sought.

2.2 LAND AREA OVER WHICH THIS MASTER PLAN APPLIES

This Master Plan covers "Mauna Kea lands," which are subsequently referred to as "UH Maunakea Lands." As defined under Hawai'i Revised Statutes (HRS) § 304A-1901, the term "UH Maunakea Lands" means:

> … the lands that the University of Hawaii is leasing from the board of land and natural resources, including the Mauna Kea Science Reserve, Hale Pohaku, the connecting roadway corridor between Hale Pohaku and the Mauna Kea Science

> Reserve, and any other lands on Mauna Kea that the University of Hawaii leases or over which the University of Hawaii acquires control or jurisdiction.

The UH Maunakea Lands presently consist of two parcels that UH leases and the portion of a third parcel over which UH holds an easement (Figure 2-1):

- Parcel TMK 4-4-015:009 via General Lease S-4191, which expires December 31, 2033. This parcel is 11,287.854-acre and is called the Mauna Kea Science Reserve (MKSR).
- Parcel TMK 4-4-015:012 via General Lease S-5529, which expires in 2041. This 19.261-acre parcel is known as Halepōhaku.
- Portion of parcel TMK 4-4-015:012, which is part of the Mauna Kea Forest Reserve, under a non-exclusive roadway easement. This easement, which encompasses 70.798 acres, contains the roadway between the two leased parcels listed above.

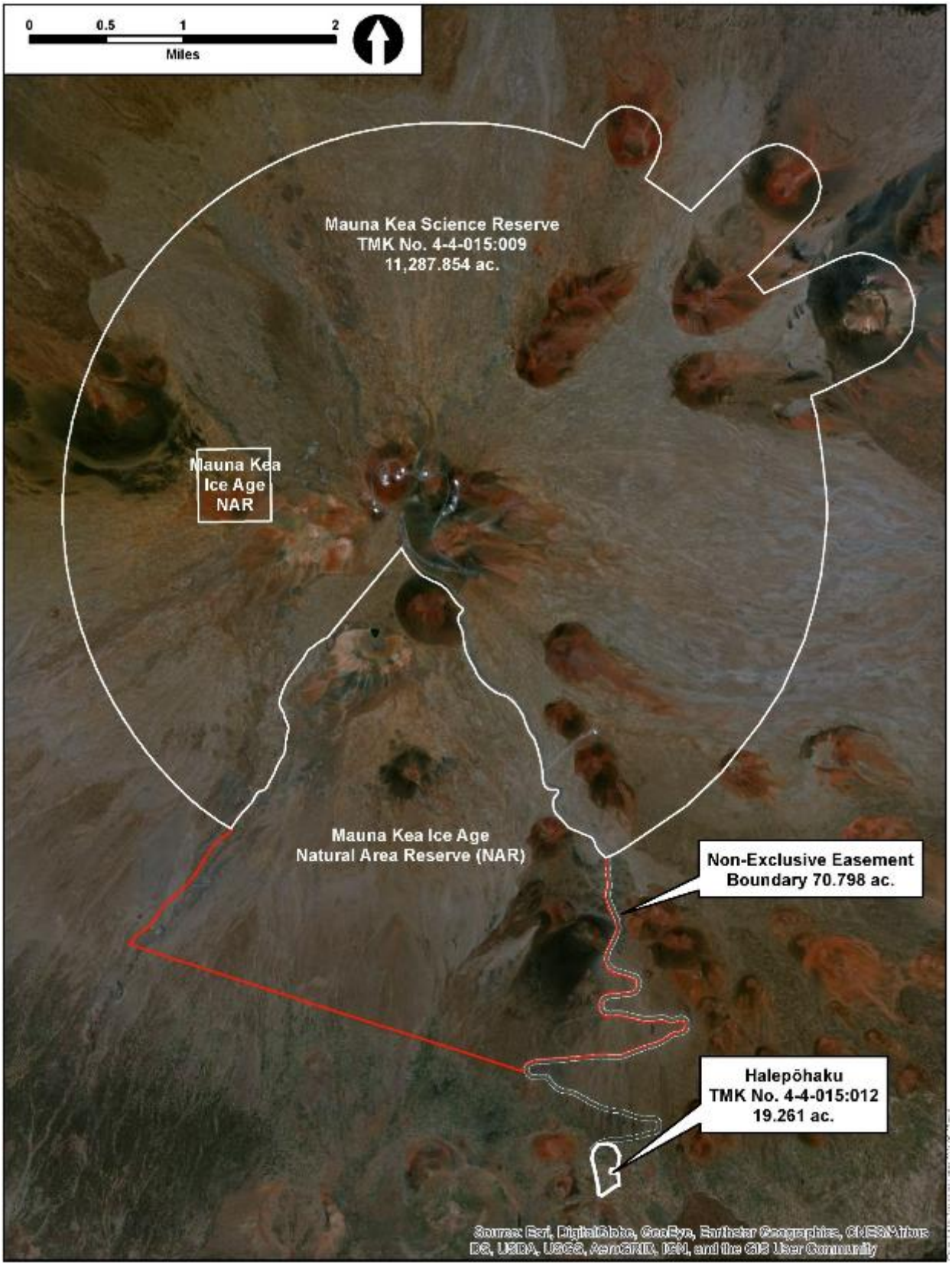
Over the life of this Master Plan the specific area that falls within UH Maunakea Lands may change. This Master Plan is only binding on those UH Maunakea Lands that remain under the authority of UH. For example, if UH Maunakea Lands were reduced, this Master Plan would govern only those lands still authorized for use by UH, without the need to amend this Master Plan.

The UH Maunakea Lands are considered "ceded" lands. Ceded lands are those crown, public, and government lands that were once held by the Kingdom of Hawai‘i. The Republic of Hawai‘i took control of these lands after the overthrow of the Hawaiian monarchy. The United States annexed Hawai‘i in 1898 and the Republic of Hawai‘i ceded 1.8 million acres of public lands to the Federal government. In March 2009, the United States Supreme Court noted that when Hawai‘i joined the Union in 1959 as the 50th state, the Federal government granted title to the ceded lands to the State.

These lands, together with the proceeds from the sale or other disposition and income there from, are held by the State as a public trust.

The State holds the ceded lands in a public trust for (*i*) the support of the public schools and other public educational institutions, (*ii*) the betterment of the conditions of Native Hawaiians, as defined in the Hawaiian Homes Commission Act, (*iii*) the development of farm and home ownership on as widespread a basis as possible, (*iv*) for the making of public improvements, and (*v*) the provision of lands for public use (The Admission Act Section 5(f)).

Figure 2-1: UH Maunakea Lands

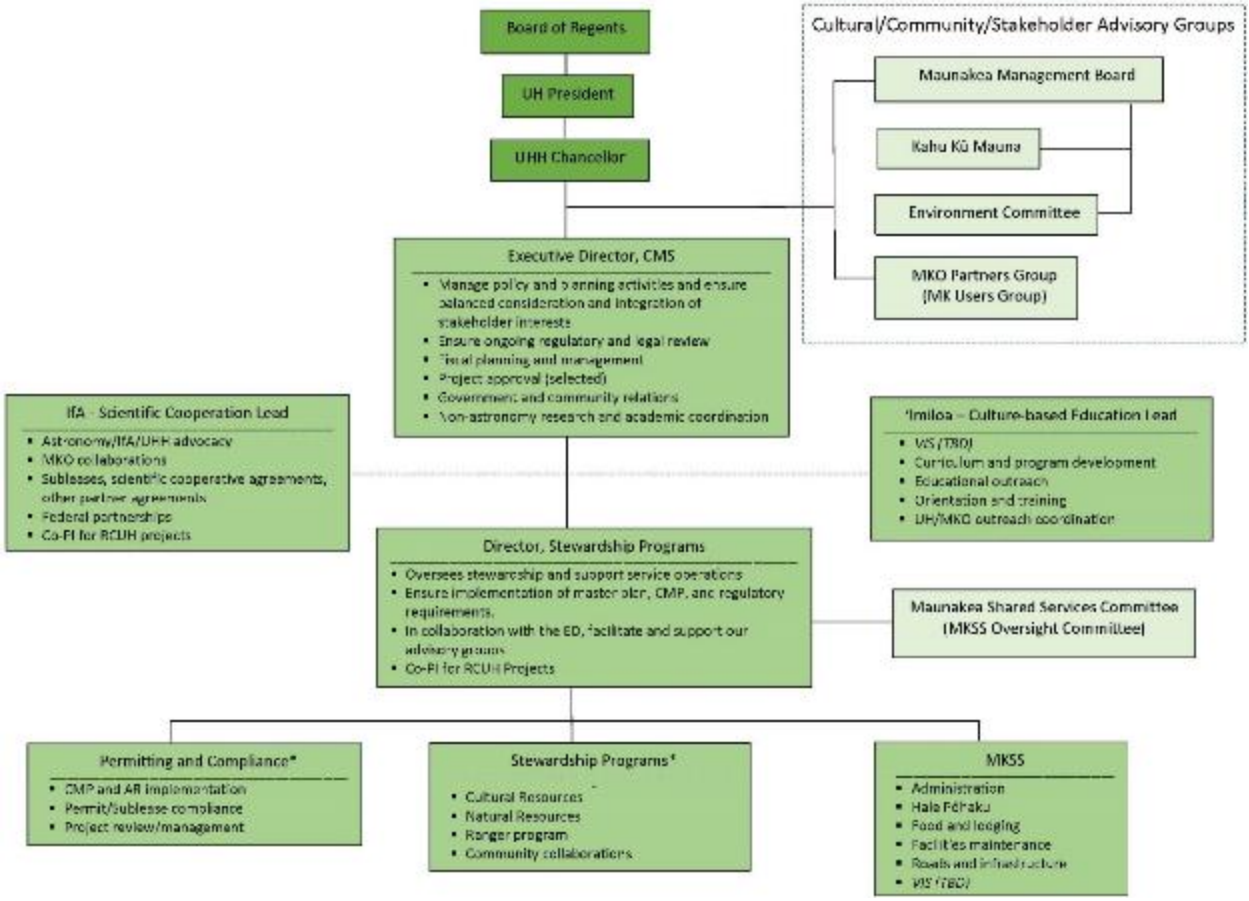


Source: Planning Solutions, Inc. (PSI)

2.3 MASTER PLAN IMPLEMENTATION

This Master Plan will be implemented through the governance structure approved via a motion by the BOR. The BOR delegated responsibility for the governance and management of UH Maunakea Lands to UH Hilo, which is advised by the Mauna Kea Management Board (MKMB) and Kahu Kū Mauna Council (KKM).[12] UH Hilo has, in turn, created the Center for Maunakea Stewardship (CMS) to administer the lands. This governance structure is established through BOR motions and is outside the scope of this Master Plan. The governance structure at the time this plan was adopted is illustrated in Figure 2-2. The structure may be modified from time to time over the life of this Master Plan without requiring this plan to be amended.

Figure 2-2: CMS Governance Structure, Established in 2020



Notes: * Shown here for descriptive purposes. Organization of these functions to be finalized by Director of Stewardship Programs. The structure may be modified from time to time over the life of this Master Plan without triggering a need to amend this plan.
Source: CMS

UH's General Lease No. S-4191 for the Mauna Kea Science Reserve expires December 31, 2033; UH is seeking a new land authorization, but there is no guarantee one will be awarded prior to the

[12] Under the 2000 Master Plan, MKMB was "encouraged to establish special committees on culture, environment and education, as needed, to assist it in its functioning." A long active, and currently active, special committee is the Environment Committee, which provides expertise to MKMB on environmental issues.

expiration of the General Lease. If UH does not obtain a land authorization that allows for its management and use of the UH Maunakea Lands beyond 2033, then under the General Lease UH must surrender and deliver possession of the land to BLNR and any improvements on the lands must be removed or disposed of by UH or, with the approval of the BLNR chair, improvements may be abandoned in place. Once the lands under the General Lease are surrendered, among other possibilities, BLNR and the Governor may consider issuance of a new entitlement (whether by lease, executive order, or other authorization) to UH or another entity. The Mauna Kea Working Group, created by House Resolution No. 33, H.D. 1 in 2021, issued a report during the development of this Master Plan entitled, *He Lā Hou Kēai Ma Mauna a Wēkea: A New Day on Mauna a Wākea*. The report discusses the creation of a new entity. UH's response to the Working Group's report is included in Volume 2. However, unless and until such a change occurs, the provisions of this Master Plan will guide land use decisions on Maunakea.

2.4 RELATIONSHIP BETWEEN THIS PLAN AND OTHER PLANS

The only active plans relevant to UH decision-making regarding its Maunakea Lands are: (*i*) this Master Plan, which is approved and adopted by the BOR; and (*ii*) the CMP, which is approved and adopted by the BOR and the BLNR. This Master Plan supersedes all previous Master Plans.

This Master Plan does not replace the CMP, which may be amended from time to time. On the contrary, it and the CMP are consistent with and complement one another and are intended to be implemented together. All the uses and facilities that are envisioned in this Master Plan can be designed and implemented so that they are fully consistent with the management actions described in the CMP.

This Master Plan addresses the planning, siting, and design of new facilities and significant material changes to existing facilities. The CMP addresses management of activities and resources. Examples of the differences between the elements addressed in the two plans are shown in Table 2-1. Specific information concerning recreational, commercial, and astronomy activities are presented in subsections 2.4.1 through 2.4.3.

Table 2-1: Examples of Distinction between Master Plan and CMP Content

Master Plan	*CMP*
▪ New uses/facilities within the UH Maunakea Lands ▪ Exterior modification of astronomy facilities ▪ Recycling of astronomy sites ▪ Roadway improvement/modification ▪ Facility design standards ▪ Project review process	▪ Management actions ▪ Natural resource management ▪ Cultural resource management ▪ Recreational activity management ▪ Access management procedures ▪ Commercial tour management ▪ Decommissioning and site restoration process

2.4.1 RECREATIONAL ACTIVITIES IN THE PLANS

Management of recreational activities is addressed in the CMP and in Hawai‘i Administrative Rules (HAR) Chapter 20-26, *Public and Commercial Activities on Mauna Kea Lands* (the UH Maunakea Rules or HAR Chapter 20-26). This includes activities such as hunting, hiking, and snow play. If UH or another party seeks to develop new facilities that support recreational activities, such as a new trail or parking lot, then the provisions of this Master Plan would apply to the proposed land use in addition to all other applicable regulations.

2.4.2 COMMERCIAL ACTIVITIES IN THE PLANS

Management of commercial activities is addressed in the CMP and HAR Chapter 20-26. This includes visits to the UH Management Area by permitted tour companies and film production activities. These activities utilize existing facilities (e.g., roads and parking areas) and do not generally result in the development of new facilities or related land uses. If UH or another party seek to develop new facilities that support commercial activities, such as parking spots for stargazing, then the provisions of this Master Plan would apply to the proposed land use in addition to all other applicable regulations.

2.4.3 ASTRONOMY FACILITY DECOMMISSIONING AND SITE RESTORATION IN THE PLANS

As detailed elsewhere in this Master Plan, by the end of the term of the current general lease (December 31, 2033), UH is committed to limiting the total number of operating astronomy facilities to nine (9) in the MKSR should a new land authorization allow for the continuation of astronomy on Maunakea beyond the end of the current lease. This Master Plan addresses how astronomy facilities that will continue beyond the end of 2033 will be identified (Section 4.3.2.2 and Appendix E); those facilities that will not continue beyond the end of 2033 will need to be decommissioned before the end of 2033. The CMP provides for the site decommissioning process to be followed once an astronomical facility decides to cease operation. Specific steps related to decommissioning a facility and the restoration of the astronomy site on which it was erected, if that is the path selected, are outlined in the CMP.[13]

2.5 CAPITAL IMPROVEMENT APPROVALS AND FUNDING

This Master Plan provides a framework within which to consider the concepts discussed and also future proposals that could achieve the same goals and objectives of this Master Plan. The implementation of the capital improvements (the facilities) envisioned in this Master Plan will require additional planning and then investments. This Master Plan does not make any final decisions on any facilities or land uses. The programs and projects identified and discussed in this Master Plan are concepts that UH is considering and/or may be proposing but which it has not approved, adopted, or funded. The approval of this Master Plan by the BOR does not constitute the approval or permitting of any programs or projects discussed herein. There are many ways to contribute to achieving this plan's goals; the facilities and projects mentioned in this plan are but one concept of how UH and other entities, e.g., astronomical research organizations, may proceed. All facilities and land uses suggested herein, or that may be considered in the future, may need additional applicable government approval(s) and environmental review(s).

Investments in and funding for facilities on Maunakea typically come for a variety of partners. Similarly, operating and management resources are derived from a wide variety of sources. It is the astronomy facilities that provide significant resources, not just to operate and maintain their facilities, but to implement the CMP and operate and maintain shared infrastructure, such as the Mauna Kea Access Road and the Visitor Information Station. Many of the astronomy facilities on

[13] Decommissioning involves the facility owner selecting and implementing (*i*) one of two levels of facility (infrastructure) removal, and (*ii*) one of three levels of site restoration.

Maunakea are multinational partnerships, and any new astronomy facilities (e.g., modification and recycling projects) are likely to be multinational partnerships.

UH will continue to seek innovative methods to fund non-astronomy capital improvements and the operation and maintenance of public areas in the UH Maunakea Lands. The astronomy facilities and UH will provide certain resources while other potential resources include (*i*) commercial tour and film fees, (*ii*) entrance fees for non-Hawai‘i residents,[14] (*iii*) federal, state, and/or private grants, (*iv*) federal and/or state expenditures, and (*v*) other opportunities.

[14] As outlined elsewhere in this Master Plan (Sections 3.1.1 and 5.3), UH's intent is not to increase the number of visitors to the UH Maunakea Lands through the implementation of this Master Plan. In fact, the intent is that the number of vehicles (and thereby people) present at any one time would be less than the numbers present during peak periods prior to 2020; 2020 was anomalous due to the significant changes during the COVID-19 pandemic. Those that do enter may be required to pay a fee (HAR § 20-26-6).

PART 2: PHYSICAL PLAN

INTRODUCTION

Part 2 of this Master Plan discusses the facilities and land uses that UH believes may occur within the UH Maunakea Lands over the period of this Master Plan. Part 1 of this Master Plan provides important context for understanding the scope of facilities and land uses discussed in Part 2. Part 3 of this Master Plan presents the review process and design guidelines that facility and land use proposals will need to navigate.

Any project proposed within the UH Maunakea Lands that meets the definition of "land use" under DLNR's Conservation District Rules (HAR Chapter 13-5) will need to obtain certain approvals (from UH, DLNR, and perhaps others);[15] proposals that are not a land use may also require approvals (from UH and perhaps others), but are not the subject of this Master Plan. In general, cultural practices and recreational activities do not involve land uses and are therefore not subject to the framework outlined in this Master Plan.[16]

The proposals that are "land uses" and that UH believes may be advanced over the period of this Master Plan are discussed in Part 2 of this Master Plan. Only facilities and developments that UH believes are consistent with its mission, vision, goals, and objectives as outlined in Part 1, Chapter 1 are included. To that end, conservation-related actions, facilities to support public access and activities, astronomy facilities, and equipment to collect data and conduct research are the principal land uses presented in this Master Plan for the UH Maunakea Lands.[17] The inclusion of a facility or land use in this Master Plan does not mean that it will be officially proposed during the period of this Master Plan. This Master Plan also includes a framework for UH to consider proposals not identified in this Master Plan (see Part 3).

Proposals considered land uses will first need to be reviewed and approved by UH (see Part 3, Chapter 6 of this Master Plan). In addition, common requirements for such proposals include satisfying environmental disclosure requirements (e.g., HRS Chapter 343), obtaining regulatory approvals (e.g., HRS Chapter 6E), and acquiring the appropriate type of Conservation District Use approval.

Proposed facilities and developments within UH Maunakea Lands, which will be concepts when first proposed to UH, will be evaluated using the following criteria:

- Compliance with applicable University policies, as amended, related to real property held by UH, such as RP 10.201.
- Consistency with the mission, vision, goals, and objectives of this Master Plan (Part 1, Chapter 1).

[15] The Conservation District Rules apply because UH Maunakea Lands are within the State of Hawai'i Conservation District, Resource subzone.

[16] Activities within the UH Maunakea Lands are governed by HAR Chapter 20-26 entitled "Public and Commercial Activities on Mauna Kea Lands" and may be subject to other regulatory requirements. All facilities, land uses, and activities also need to consider the CMP.

[17] As defined in the current Conservation District Rules, these types of facilities and developments would fall into the following land use categories: Land and Resource Management, Astronomy, Public Purpose, Data Collection, and Signs.

- Consistency with the CMP and promotion of resource conservation and sustainability.
- Extent to which the proposal has the potential to adequately:
  - Benefit from the conditions present within the UH Maunakea Lands;
  - Increase our understanding of Maunakea's resources;
  - Avoid, minimize, or mitigate reasonably foreseeable adverse impacts to Maunakea's resources;
  - If applicable, employ world-class technology, research techniques, and design;
  - If applicable and based on input from experts in the proposed field of study, the proposal addresses critical needs and has a high likelihood of contributing important information over its design life; and
  - Honor and benefit the Hawai'i Island community, particularly with regard to their educational, cultural, social, environmental, and economic needs.
- Consistency with:
  - The requirements of the HRS Chapter 183C, and HAR Chapter 13-5, regarding land uses within the State Conservation District;
  - The terms and conditions of CDUPs that have been issued that are relevant to the proposal; and
  - The Design Guidelines set forth in Part 3, Chapter 7, or, where inconsistent, provide adequate justification for any variance from those guidelines that is being sought.

An overarching requirement for any proposal is outreach to impacted communities and interested persons, including Native Hawaiian practitioners, the Hawai'i Island community, and existing users.

The following Part 2 chapters discuss the facilities and developments that UH believes may occur on UH Maunakea Lands over the period of this Master Plan by area and topic.

The facilities and land uses identified and discussed in this Master Plan are possible future programs and projects that UH is considering but has not approved, adopted, or funded. The approval of this Master Plan by the UH Board of Regents (BOR) does not constitute the approval or permitting of any land use discussed herein.

3 HALEPŌHAKU

This chapter addresses Halepōhaku (TMK No. (3) 4-4-015:012), which is officially named the Onizuka Center for International Astronomy but is now more commonly known as Halepōhaku. This 19.261-acre parcel, which ranges in elevation from ~9,100 to ~9,300 feet above sea level on the southern flank of Maunakea, is home to the facilities that UH uses to manage and support activities in Maunakea's high-elevation areas. Figure 3-1 illustrates the facilities that are presently located there.

The facilities at Halepōhaku are essential to UH's ongoing astronomy program and implementation of the CMP. Those facilities contribute significantly to the achievement of UH goals and objectives. Specifically, Halepōhaku facilities will continue to house support services, be the basepoint for stewardship activities, provide office space for entities with activities on the mountain, and provide short-term lodging for individuals whose work calls for them to spend more than short periods in the summit area. UH intends to repurpose and reassign existing underutilized facilities to support expanded education and research focused on Maunakea resources beyond astronomy. The range of education, research, and cultural activities that could benefit from the resources and conditions at Halepōhaku is broad.

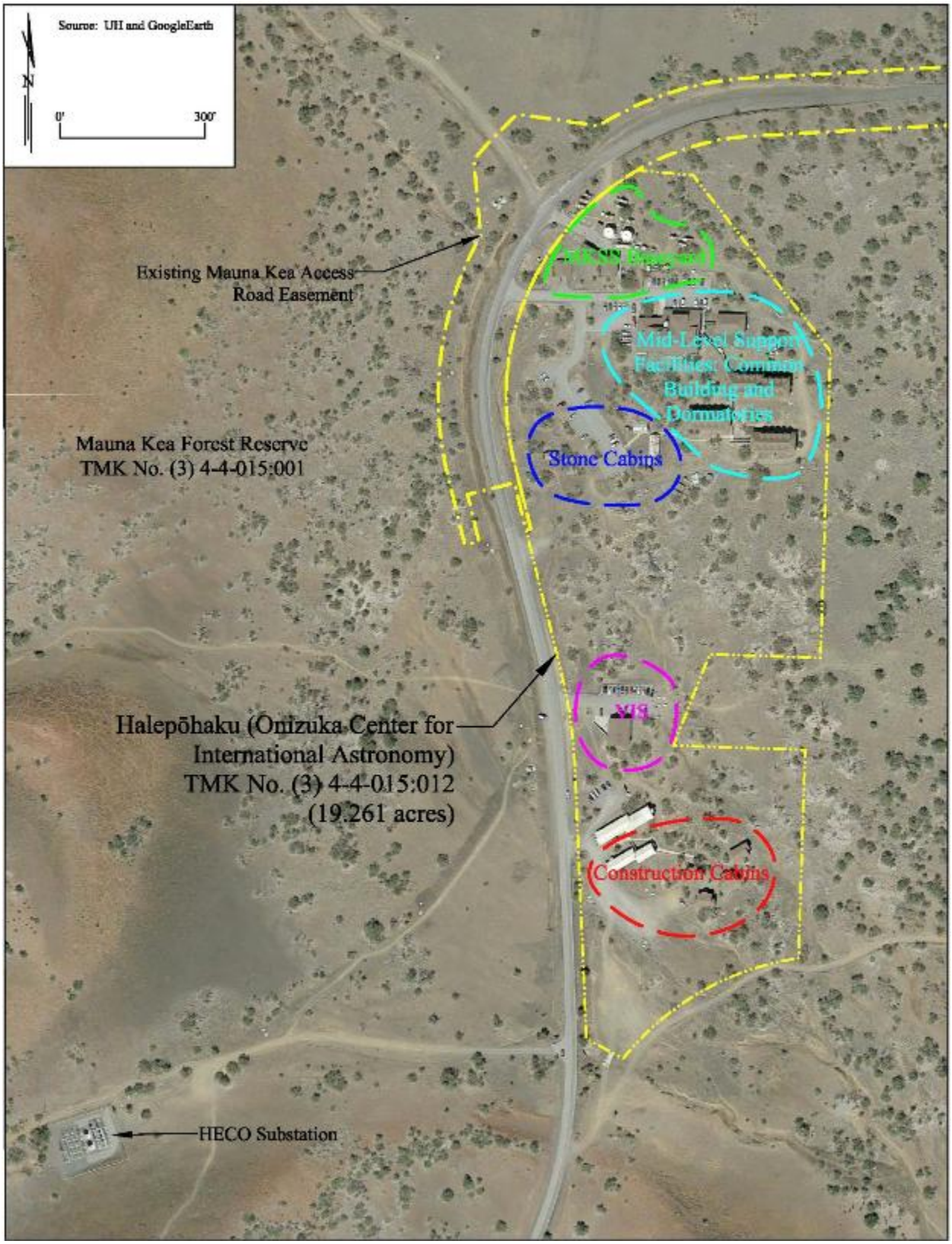
3.1 PLANNING CONTEXT

3.1.1 BACKGROUND

The UH-developed facilities at Halepōhaku were originally designed to serve three purposes: (*i*) as a mid-elevation support center for astronomy activities situated in the MKSR; (*ii*) as a central point for management of astronomy facilities and support services on Maunakea; and (*iii*) as a day-use destination point for visitors where they could learn about astronomy, natural resources, and the cultural landscape. These facilities were designed and constructed to accommodate the amount and type of activity that could be foreseen in the closing decades of the 20th century, and they have served their purpose well. However, technological changes in the way astronomical observations are made, the evolution of visitation on the mountain, and the greatly increased interest in learning about and sustainably managing Maunakea's cultural landscape and natural resources mean that adjustments are needed.

While some of the Halepōhaku facilities, principally those at the MKSS baseyard (Figure 3-1), continue to be appropriately sized and configured for current and anticipated needs, others are not. Some, primarily the Visitor Information Station (VIS), are too small to meet demand if visitation continues as it has in the past, i.e., with large numbers of visitors arriving in small groups in private vehicles. In addition, the size of the dormitories and common area exceed what is needed to support astronomy and management in the foreseeable future. Finally, the existing spaces are not configured to accommodate the diversified educational activities that are envisioned. Additional detail regarding this follows below.

Figure 3-1: Halepōhaku Overview



Source: PSI

VIS. The VIS building is woefully inadequate to support the number of visitors it has been called upon to serve in recent years. Beyond a continued fascination with high-elevation locations, it is believed that contributing factors include an increase in out-of-state travel to Hawai‘i, an increase in the number and mobility of Hawai‘i Island residents, easier access to Maunakea brought about by the completion of the Daniel K. Inouye Highway, the Kilauea eruption temporarily closing other visitor attractions, and social media. Whatever the cause, there is no evidence that the number of persons, both Hawai‘i Island residents and off-island visitors wishing to experience the mountain, will decrease; if anything, the demand is likely to grow.

‘Imiloa on the UH Hilo campus is another facility that serves as an astronomy interpretive center and provides information about the cultural and natural history of Maunakea. ‘Imiloa offers education opportunities related to those topics across a wide age range, including young students who are encouraged to consider the health risks before visiting the higher elevations of the UH Maunakea Lands.

Mid-Level Support Facilities. In contrast to the VIS, the facilities that were developed in the 1980s to accommodate management and astronomy personnel are now over-sized relative to that demand.[18] There are several reasons for this, but the two principal ones are the advent of remote observing as a practical alternative to working at the summit and the ease of commuting to the astronomy facilities from either Hilo or Waimea via the Daniel K. Inouye Highway (Saddle Road). The trend toward remote observing, the decommissioning of some facilities in the MKSR, and a likely continuing shift toward remote operation of telescopes will likely further decrease demand for lodging, meals, and office space by astronomy facility personnel.[19] The exact level of such usage is difficult to predict, and it will be variable. Some personnel will always need to work at the astronomy facilities, and they will continue to use the Mid-Level Support Facilities as a place to rest, eat, work, and sometimes sleep. There will also continue to be short-term projects at the astronomy facilities, and the Mid-Level Support Facilities will need surge capacity[20] to support those. However, based on current and past usage, UH’s expectation is that no more than a third of the space designed for these purposes will be required going forward.

Over the last several decades, the Mid-Level Support Facilities have increasingly been utilized by stewardship personnel (e.g., Rangers and other CMS personnel) as a place to work and store their equipment and materials. Since the approval of the CMP, the level of management necessary to maintain safety and minimize impacts to the cultural landscape and natural resources has consistently increased. UH has learned many lessons regarding its stewardship obligations and is dedicated to continual improvement. As the use of these facilities by astronomy personnel decreases, their use by stewardship personnel will increase, but at a much slower rate.

[18] The Mid-Level Support Facilities are currently designated by CDUP 1430 (condition 25) for the exclusive use of astronomy facility staff and those whose work, research, or provide technical support directly related to activities in the MKSR.

[19] Remote operation is when the telescope operators work remotely. The telescope operators are the people that open and close the dome, manipulate the telescope and its instruments to collect the observational data requested by the astronomer. Astronomers have been using “remote observing” for years; remote operation is being developed and is expected to become more prevalent over the period of this Master Plan.

[20] Surge capacity would support, for example, temporary construction, maintenance, installation of new instruments, or repair projects. Personnel involved in long-term construction or decommissioning projects are not expected to regularly stay at Halepōhaku.

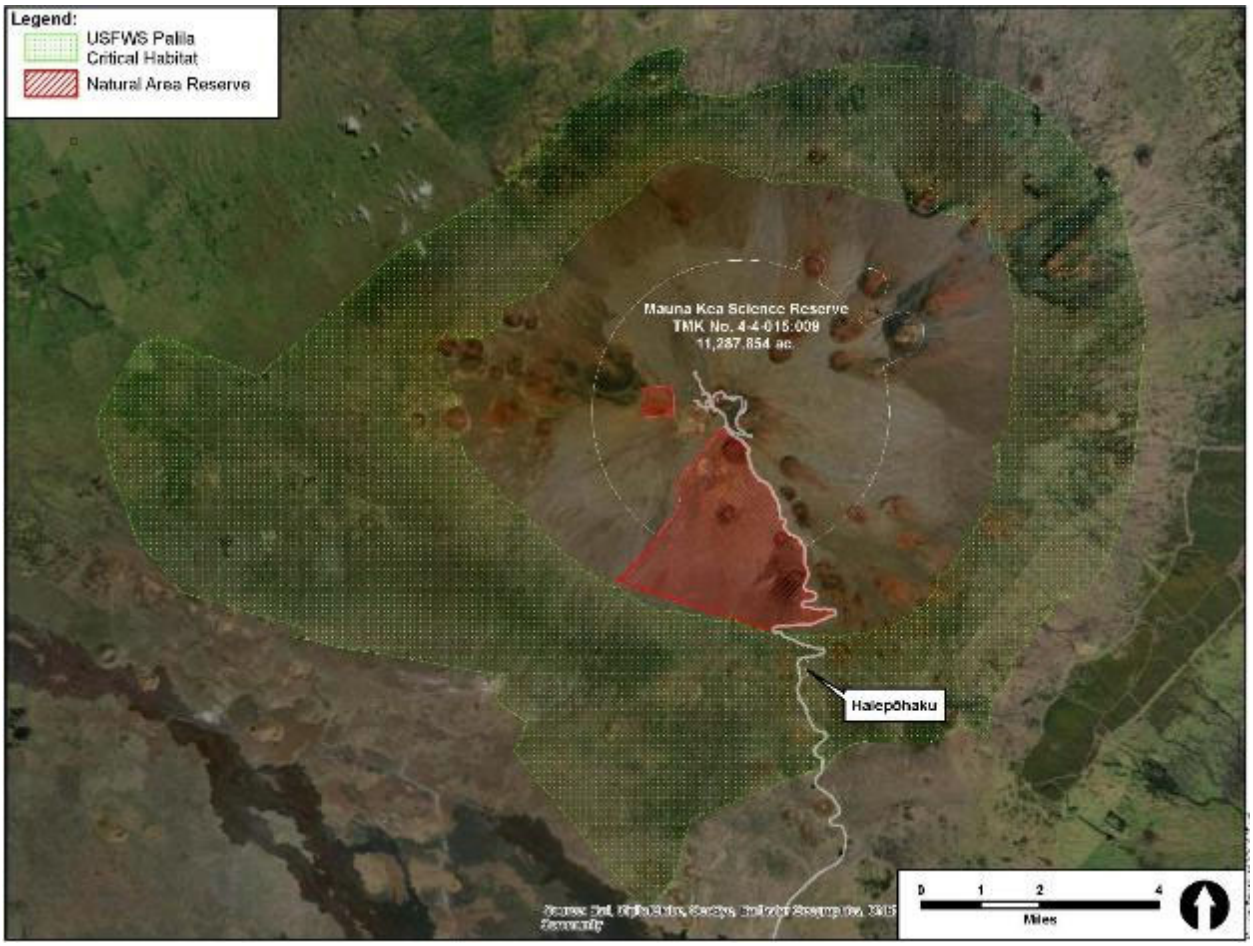
Educational Facilities. At present, what public educational activity there is at Halepōhaku occurs at the VIS, and it is focused on day-trippers, many of whom reside off-island, and volunteers. The work that has been done on this Master Plan has revealed a need and desire to greatly expand the extent to which educational programs based on Maunakea's cultural landscape and natural resources are made available to the public.

3.1.2 LIMITATIONS ON NEW DEVELOPMENT AT HALEPŌHAKU

3.1.2.1 Critical Habitat

Halepōhaku is within the federally designated critical habitat for the endangered Palila (*Loxioides bailleui*) (Figure 3-2). Palila are only found on the island of Hawai'i, with over 95 percent of the population restricted to the southwest slopes of Maunakea. They occur only in the dry māmane and māmane-naio forest between 6,500- and 9,250-foot elevation. Māmane (*Sophora chrysophylla*) is endemic to the Hawaiian Islands and are present throughout Halepōhaku. Māmane is not listed as threatened or endangered but is a critical food source for the Palila. Palila have been observed at Halepōhaku occasionally but are not frequently present and Halepōhaku is not considered preferred nesting habitat for Palila due to the relatively constant human activity.

Figure 3-2: Federally Designated Critical Habitat for Palila



Source: State GIS

Any development at Halepōhaku on previously undisturbed land that results in the removal of māmane trees could cause an adverse impact to the Palila's designated critical habitat and thus would be minimized and mitigated. CMS has an ongoing program to propagate and outplant māmane trees within Halepōhaku and takes additional actions to improve the habitat for Palila and other native species, but it is too early to evaluate how successful that program will be. DLNR, which is leading Palila recovery efforts, has asked that new disturbances and developments at Halepōhaku be avoided.

3.1.2.2 Cost Considerations

Because of its elevation and isolation, it is costly to build and operate facilities at Halepōhaku. Factors that contribute to high costs include: (*i*) all water and other supplies must be trucked up the mountain; (*ii*) there is no central wastewater treatment system; and (*iii*) all maintenance and food service must be accommodated by UH-provided facilities and personnel. The high construction and operational costs make the development of non-mission critical facilities at Halepōhaku unattractive.

3.1.3 UH COMMITMENTS REGARDING USE OF HALEPŌHAKU

In view of the limitations outlined above, UH will adhere to the following precepts in making decisions related to facilities, developments, and disturbances at Halepōhaku:

- Existing structures will be repurposed and utilization of existing space maximized before new facilities are proposed.
- If additional facilities are proposed, they will be sited in previously disturbed areas devoid of native vegetation to the maximum extent practicable.
- The only astronomy facility that will be proposed at Halepōhaku is the UH Hilo New Educational Telescope (NET) (Section 3.3). The only other telescopes that will regularly be present at Halepōhaku will be small portable stargazing telescopes that are set up and then removed and stored after use.
- UH will manage vehicular access in a way that forestalls the need to expand parking within Halepōhaku beyond the locations where it presently exists.
- UH will continue its habitat restoration efforts within Halepōhaku and utilize Halepōhaku to assist and/or support conservation efforts by others on the upper slopes of Maunakea to contribute to the State's pledge to conserve, restore, or grow 100 million trees (DLNR, September 25, 2021).

3.2 MKSS BASEYARD

As illustrated in Figure 3-1, the uppermost part of Halepōhaku contains the MKSS baseyard, which contains structures, equipment, and storage areas utilized for logistical services and support. These are used to maintain the Mauna Kea Access Road above Halepōhaku and in support of operations of other Halepōhaku facilities. The MKSS baseyard provides sufficient space to accommodate MKSS' current and forecast needs.

Because the size and location of the existing baseyard facilities are deemed by MKSS to be adequate for the foreseeable future, no fundamental changes to it are likely to be proposed during the life of this Master Plan. However, refurbishment, updating, and modest enhancements that would improve the function and/or extend the operating life of some of the existing facilities were identified during the master planning process and may be undertaken over the term of this Master Plan. Examples include:

- Upgrading fuel storage by July 15, 2028, to comply with new regulations requiring double-walled tanks.
- Paving portions of the baseyard that now have only a gravel base-course cover to improve efficiency and safety while also reducing the potential for the establishment of invasive species.
- Improving portions of the baseyard area, currently in limited use, for the storage of material and equipment associated with resource maintenance and management on Maunakea and making minor improvements (e.g., vegetation clearance or rough grading) needed to allow that.

3.3 UH HILO NEW EDUCATIONAL TELESCOPE

3.3.1 BACKGROUND

The Department of Physics and Astronomy at UH Hilo offers two programs, the Bachelor of Science degree in Astronomy and Bachelor of Arts degree in Physics. Both degrees have their own mission statements, which are closely aligned with the mission of UH Hilo at large. The UH Hilo astronomy program aims to: (*i*) develop the science knowledge and analytic skills of students, whether they be majors or not, through a focus on the field of astronomy and (*ii*) instill an appreciation of science, particularly astronomy, in students. The programs provide students with transferable skills so they can excel in a wide range of STEM-related fields. UH Hilo presently offers astronomy courses every semester that are designed to build expertise in data acquisition and analysis and to provide hands-on experience handling the necessary hardware and software. Skills acquired through both programs position graduates for operations-related employment at the Maunakea Observatories (MKOs), employment in other STEM-related fields, or, for those who are committed to making a career of advanced research in the field of astronomy, graduate-level education in astronomy. Five of the courses have laboratory components that would use a telescope if it were available, and even more might be initiated if the telescope is available at Halepōhaku; educational material (e.g. celestial object pictures or spectra) produced during these laboratories could also be used during lecture-based courses. At one time, facilities at Astronomy Site 9 (Hōkū Kea) were used for this purpose, but those became unusable in 2006. UH Hilo has since acquired a state-of-the-art PlaneWave Instruments CDK700 (PIC700) telescope system, a suite of instruments, and a AstroHaven "clamshell" 18-foot dome for the laboratories. With an aperture of 0.7 meter (28 inches) and a focal ratio of F/6.5 (Figure 3-3), the PIC700 is currently stored in a room on the UH Hilo campus. While it can be/is being used to train students on the purely mechanical aspects of telescope operations, at its current location it cannot be used to train students in real observing sessions.

Figure 3-3: PlaneWave Instruments CDK700



Source: PlaneWave™ Instruments

3.3.2 NEW EDUCATIONAL TELESCOPE AT HALEPŌHAKU

Both programs described above have identified a need for access to a working modern, small-aperture telescope on Maunakea as an important component of their desired educational programs. After an extensive search for a suitable site for the New Educational Telescope (NET) (about 16 different locations were considered), UH Hilo identified an area at Halepōhaku as an excellent location for such an instrument. Skills acquired through the operation of such an educational telescope, along with visits to astronomy facilities in the MKSR, would better position the students for employment at the MKOs and elsewhere in the world astronomical research community. In addition, faculty and students at both UH Hilo and UH Mānoa would use it for laboratory courses and research projects. An educational telescope at Halepōhaku could also be employed for outreach events and for programs involving the Big Island community that would help UH build a stronger bond between astronomy on Maunakea and the community. It is expected that telescope time will be made available to students and the community interested in astronomy or for educational purposes.

The UH BOR Resolution 19-03 dated November 6, 2019 (Appendix D), directed that Astronomy Site 9 (Hōkū Kea) be decommissioned and that "*...a new educational telescope facility for the University of Hawai'i at Hilo shall be established at Halepōhaku or elsewhere*." UH's present intent is to site the educational telescope within Halepōhaku, and it has commissioned a planning and design team for the proposed NET project that will lead the project review process, prepare an

HRS Chapter 343 environmental document, and prepare a Conservation District Use Application (CDUA) for the facility that UH will submit to DLNR.

More specifically, UH Hilo has identified one primary and one backup location at Halepōhaku to date. The primary location is adjacent to the smallest of the four dormitories (Dormitory A) in the upper portion of Halepōhaku (Figure 3-4). This site offers limited light pollution, good sky visibility, and is near power and communication infrastructure. The site has been tested using a smaller, portable telescope and was found to be suitable. An already identified backup location is land adjacent to one of the four Subaru-built construction cabins in the lower portion of Halepōhaku. This site is also believed to be suitable, but less so due to light pollution from passing vehicles on the main road. The proposed structure is comparatively much smaller than the astronomy facilities on the MKSR, with a profile that is no taller than existing Halepōhaku structures and taking up a small portion of a previously disturbed area. Additional and more refined alternatives may be identified as UH coordinates with the community as part of the planning and design team's work.

Figure 3-4: Conceptual Illustration of NET by Dormitory A



Source: http://hokukea.uhh.hawaii.edu/news.html

UH Hilo has passed the following NET milestones:

- In February, 2020, it displayed the PlaneWave 0.7-meter telescope at the ʻImiloa Center. This was the first time that it was displayed to the public, and hundreds of persons stopped by, including many young people who experienced moving the telescope using the control interface.
- In mid-2020, a project was formally initiated by UH Hilo for the NET.
- In September, 2020, UH Hilo initiated a community outreach campaign regarding the possible installation of the NET. The effort included a virtual open house website, where

diverse pieces of information were presented and where members of the public could record their questions and comments.

An EA is currently being developed.

3.4 OTHER HALEPŌHAKU FACILITIES

As described in Section 3.1, there have been dramatic changes over the past two decades in demand for facilities at Halepōhaku. Moreover, further changes are anticipated as UH implements access management that is called for in the CMP and that has been discussed in previous planning documents. UH seeks to accommodate current and anticipated future needs by re-aligning usage of the existing facilities with limited physical modifications to yield better outcomes for those who come to Maunakea.

3.4.1 REPURPOSING OVERVIEW

UH is deeply committed to diversifying research and educational opportunities on Maunakea to fields beyond world-class astronomy. UH seeks to engage scholars, students, and the public in a broad range of disciplines related to understanding, preserving, and enhancing the cultural landscape and natural resources of Maunakea. To support this broadened range of activity, UH envisions that portions of the facilities at Halepōhaku will evolve into an integrated "Multidisciplinary Field Station" that will support field studies and learning experiences across disciplines and will encourage opportunities for formal and informal collaboration and interaction. Beyond the educational benefit of field learning, the diverse educational and research programs sought would also increase the potential for applied research that would support and inform management actions called for in the CMP.

UH Hilo will be the lead UH campus for the broadened Halepōhaku mission. However, educational and research opportunities will be available throughout the UH System, and perhaps beyond. This will allow facility use (and associated costs) to be shared by multiple departments and schools within the UH System and perhaps others, together with the MKOs. Importantly, this broadened mission and facility repurposing is not intended to substantially increase the number of people entering the UH Maunakea Lands. An intended byproduct is that a broader segment of the community gains an understanding of and appreciation for Maunakea. Programs that utilize the facilities, including new education programs, will continue to be required to comply with the CMP and applicable rules, which specify that all who enter must receive an orientation.

The Maunakea astronomy community, as a key user and primary funder of the Halepōhaku facilities, will be a participant in this evolution. Existing services for the astronomy community will continue, including food, lodging, and office space capable of supporting surge-levels when necessary, but downsizing will almost certainly be undertaken given the reduced level of astronomy-related use of the mid-level support housing and related space. UH managers (i.e., Rangers, CMS staff, etc.) will similarly retain the office space and other facilities they need to manage UH's activities on Maunakea. CMS will seek opportunities for interaction and synergy between users of the Halepōhaku facilities to enhance scholarship, education, and mutual understanding. CMS will coordinate with various user groups to identify and mitigate potential conflicts arising due to differing needs and desires.

The extent and specifics of the diversified educational programs are yet to be fully defined, but to achieve its goals and optimize the usage of facilities that it continues to operate and maintain, UH anticipates the need to reconfigure, modify, repurpose, and/or remove certain facilities at Halepōhaku. If the field station concept does not require all the underutilized existing facilities, UH would prefer that the unused facilities be removed and the environment restored rather than transfer them to the VIS to expand its offerings in a manner that would generate a greater number of visitors. Limited new facilities, such as the NET, may also be developed. CMS and UH Hilo will continue to seek input from the community and consider alternatives for the Multidisciplinary Field Station. Examples of possible repurposing concepts include:

- Expanding access to the "common building" and dorms (Figure 3-1) to non-astronomy faculty, researchers, students, and other UH-affiliated or -sponsored programs for food service, meetings, and overnight stays. It is envisioned that students from high schools age and older could utilize the lodging facilities while participating in resource-based educational programs.
- Repurposing existing facilities to accommodate classrooms, offices, laboratory facilities, and other Multidisciplinary Field Station needs.
- Repurposing the stone cabins (Figure 3-1) and associated water tanks to create additional space for visitor information and education and Ranger functions as well as water sources for conservation projects.
- Repurposing the construction cabins (Figure 3-1) to create additional space for visitor information and education and Ranger functions.

To the extent that re-purposing proves impractical, removal of some of the buildings may be appropriate.

3.4.2 SPECIFIC PROJECTS

In addition to the general repurposing concepts discussed above, several specific proposals for projects at Halepōhaku have already been identified. They include, but are not limited to, the following:

- Grading and paving the currently unpaved parking area immediately to the west of the Halepōhaku "common building." This may involve structural components and drainage components that incorporate lessons learned from similar infrastructure improvements at the VIS that were completed in 2019.
- Conducting habitat rehabilitation or restoration projects as called for in the CMP.
- Producing and outplanting native species as called for in the CMP.
- Erecting educational, safety, and interpretive signs as called for in the CMP.
- Improving pedestrian connectivity between existing and future trails in the neighboring Forest Reserve that are sanctioned by DLNR, the "common building," stone cabins, VIS, and/or construction cabins.
- Building new facilities or adding to existing facilities to support (*i*) the Multidisciplinary Field Station, (*ii*) the VIS and stargazing, and (*iii*) access management.

In addition to those projects listed above within Halepōhaku, access management facilities may be placed along the access road adjacent to Halepōhaku. These facilities would likely occur outside the boundaries of Halepōhaku (TMK No. (3) 4-4-015:012), and so are discussed in Section 5.3.

4 MAUNA KEA SCIENCE RESERVE

This chapter lays out the land use plan for TMK No. (3) 4-4-015:009, the area known as the Mauna Kea Science Reserve (MKSR). It discusses all facilities and projects likely to be proposed in the MKSR that may be deemed land uses under DLNR's Conservation District Rules, except those related to roadways, utilities, and managed access (which are discussed in Chapter 5).

UH expects there to be few new facilities developed within the MKSR over this Master Plan's duration. Nearly all land uses will occur in previously disturbed areas and where facilities exist today. Very little new ground disturbance will occur within the MKSR over the 20-year period; the vast majority of the MKSR will remain wilderness. Excluding roads and utilities, less than half of one percent of the approximately 11,288-acre MKSR has been disturbed/developed.

This Chapter is divided into the following main parts:

- Section 4.1 presents the MKSR planning context.
- Section 4.2 discusses facilities and developments that UH expects will be needed to carry out its management responsibilities, ensure responsible stewardship, and facilitate public activities.
- Section 4.3 discusses astronomy-related facilities and other research and educational facilities and developments.

4.1 PLANNING CONTEXT

4.1.1 BACKGROUND

Maunakea was first identified as a highly desirable location to site astronomy facilities in the early 1960s, and subsequent testing and long experience with multiple astronomy facilities have confirmed that astronomical viewing conditions on Maunakea are second to none in the Northern Hemisphere. Those natural conditions and the now well-developed infrastructure make Maunakea a highly desirable location for astronomical research that attracts scientists from around the world. The collaborative work that it fosters is at the heart of many of the most important discoveries that have been made about the Universe over the past several decades.

As discussed in Part 1 of this Master Plan, Maunakea is not solely a unique astronomical resource; it is a special natural, biocultural, and social ecosystem that has much to teach us about our origins, future, human nature, history, *ʻike Hawaiʻi* (traditional knowledge), climate, and so much more. This Master Plan envisions proposals that expand scientific inquiry on Maunakea beyond astronomy. Future educational opportunities are still to be developed, but UH has heard from researchers in numerous fields that believe study within the MKSR will be informative and fruitful, and provide insights in other fields. It will be a place for integrating multiple disciplines and addressing diverse topics.

For the first several decades of its management of Maunakea, UH's charge from the legislature and executive branch led it to prioritize astronomy-related goals. Since then, UH has been increasingly responsive to changing community and governmental priorities that place a much greater emphasis on the stewardship, conservation, and study of Maunakea's cultural landscape

and natural resources. Stewardship, conservation, and non-astronomy education goals have not required the establishment of new facilities or developments to date; therefore, nearly all the vertical facilities[21] in the MKSR in 2021 are related to astronomy. Table 4-1 and Figure 4-1 summarize the existing astronomy sites and facilities within the MKSR. Additional detail for selected sites is provided on a larger drawing provided in Appendix F.

"Astronomy Sites" are the specific locations, typically defined by sublease areas, where astronomy facilities have been or may be developed. The astronomy sites are numbered generally clockwise from Astronomy Site 1 (Subaru) to Astronomy Site 13 (TMT); Astronomy Site 14 (VLBA) is removed from the others on the southern slope of Maunakea (Figure 4-1). The astronomy site boundaries are based on the following:

- For astronomy sites that have, or had, subleases, the boundary is based on descriptions and depictions in the sublease and the CDUP for each astronomy facility.[22]
- For astronomy sites that never had a sublease (the two astronomy facilities, Site 7 (UH 2.2m) and Site 9 (Hōkū Kea), always owned by UH), the boundary was drawn based on the extent of the existing facilities, disturbed areas, their relationship/proximity to adjacent uses, and topography.

Table 4-1: Astronomy Sites and Facilities in the Mauna Kea Science Reserve

Astronomy Site #	*Facility Name*	*CDUP Number & Year Approved*	*Year of First Light*
1	Subaru	HA-2462, approved in 1992	1999
2	Keck I	HA-1646, approved in 1984	1990
3	Keck II	HA-2509, approved in 1992	1996
4	IRTF	HA-653, approved in 1975	1979
5	CFHT	HA-527, approved in 1974	1979
6	▪ Planetary Patrol ▪ Gemini	▪ HA-954, approved in 1977 (post facto,[23] removed in 1994) ▪ HA-2691, approved in 1994	▪ 1968 ▪ 2000
7	UH 2.2m	HA-954, approved in 1977 (post facto), (aka UH 88inch)	1970
8	UKIRT	HA-653, approved in 1975	1979
9	▪ Air Force ▪ Hōkū Kea	▪ HA-954, approved in 1977 (post facto, removed in 2008) ▪ HA-3406, approved in 2007	▪ 1968 ▪ NA
10	CSO	HA-1492, approved in 1982	1986
11	JCMT	HA-1515, approved in 1983	1987
12	SMA	HA-2728, approved in 1994	2002
13	TMT	HA-3568, approved in 2017	NA
14	VLBA	HA-2174, approved in 1989	1992

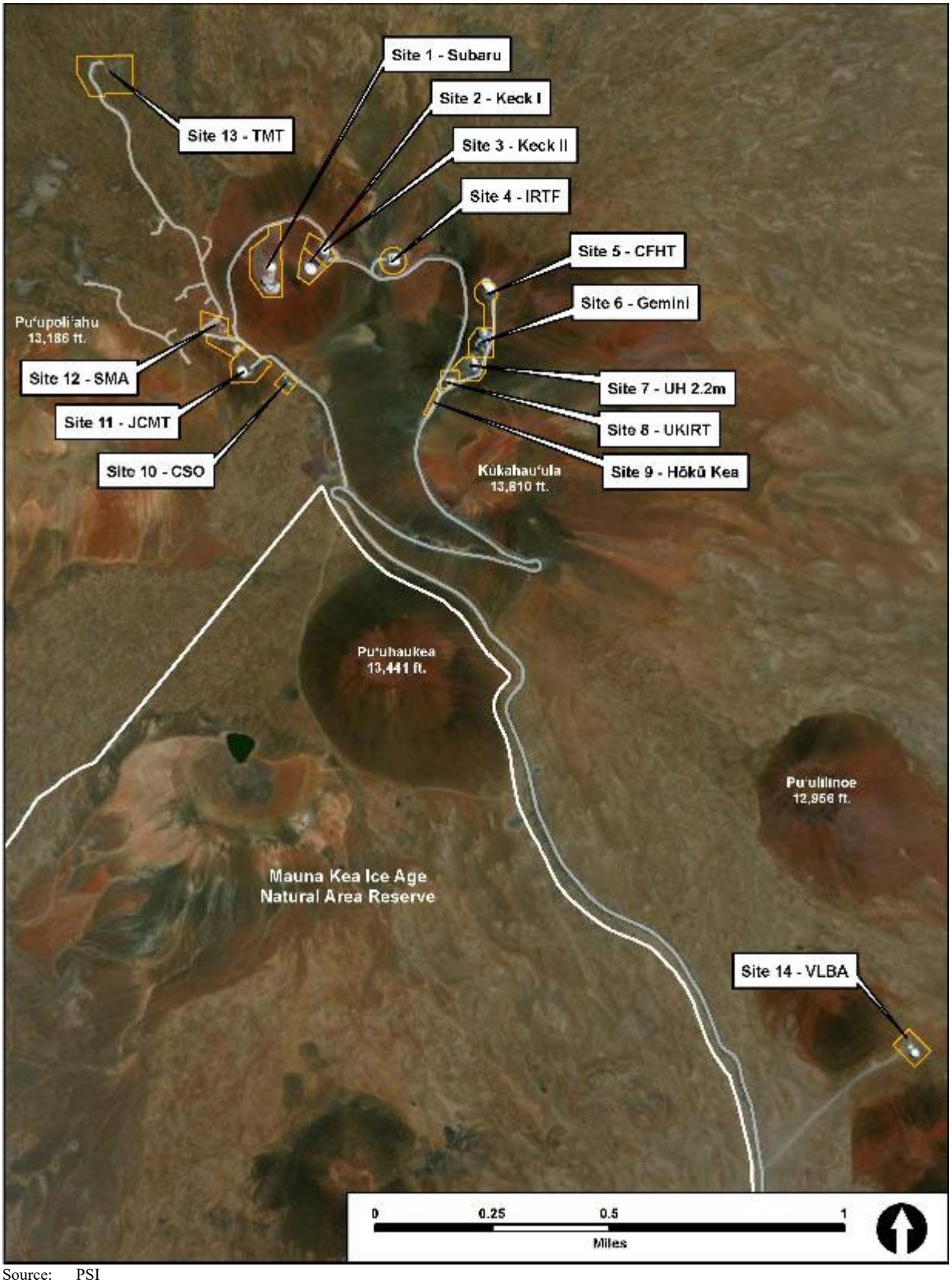
Source: UH and DLNR

[21] Vertical facilities are those that rise substantially higher than the natural ground surface and include all buildings, but do not include roads and utilities.

[22] The extents of Astronomy Sites 2 and 3 (Keck I and Keck II) are based on dividing the single Keck sublease area into two sites based on drawings included in CDUP applications for the two facilities (HA-1646 and HA-2509).

[23] Astronomy facilities developed prior to 1971 were permitted *post facto* by CDUP HA-954. As outlined in DLNR's staff report for that CDUP (DLNR, 1977), participants in the MKSR master lease (e.g., UH) likely did not seek additional approvals when the pre-1971 facilities were built because they assumed that the lease and purposes of the MKSR permitted the construction of observatories. The report states, "It is felt that the failure to obtain the approval of the Board for the use of State-owned conservation lands may well be based on assumption rather than outright omission."

Figure 4-1: Mauna Kea Science Reserve Astronomy Sites



Source: PSI

4.1.2 UH COMMITMENTS

UH's vision and goals recognize that astronomy on Maunakea can only continue to the extent that (*i*) it is sensitive to and respectful of Maunakea's cultural landscape and natural resources, and (*ii*) it contributes to the area's stewardship, preservation, and utilization by others. Accordingly, UH has committed to reducing the number of operating astronomy facilities. Although a reduction in the number of astronomy facilities may adversely affect UH's astronomy program and the MKOs in the short-term, UH believes it is likely to contribute substantially to the achievement of non-astronomy goals and objectives while also allowing the State and its residents to continue to reap the substantial scientific, cultural, and economic benefits that astronomy facilities in the MKSR provide.

This Master Plan reflects UH's specific commitments, which include:

- By December 31, 2033, and throughout the remainder of the time covered by this plan, there will be not more than nine (9) operating astronomy facilities in the MKSR.[24]
- Astronomy sites where existing uses are proposed for decommissioning or former uses have been decommissioned will be prioritized for reuse over previously undisturbed lands when new astronomy or ~~Five of the 14 astronomy sites that existed in 2020 will be ineligible for future astronomy facility use once the existing astronomy facilities on them have been decommissioned.[25] They may be considered for~~ non-astronomy uses consistent with this Master Plan's framework are proposed.[26]
- Astronomy Site 13 will be the last new site developed for an astronomy use in the MKSR. All future astronomy facilities will remain within the astronomy sites described in this Master Plan (Appendix F) ~~that remain eligible for future astronomy facility use~~.
- No land uses will be considered on major undeveloped cinder cones (pu'u) in the MKSR; this includes Pu'uala, Pu'uhoaka, Pu'ulīlīnoe, Pu'umāhoe, Pu'umākanaka, Pu'upoepoe, and Pu'uula.[27]

These commitments will support UH's compliance with existing permits, legislation, and governmental approvals. Which nine facilities continue to operate beyond 2033 in compliance with the first commitment will be established via the process outlined in Appendix E. Those not selected to continue will be decommissioned prior to the end of 2033.

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[24] UH presently holds a General Lease from BLNR under which it grants rights to non-profit entities to construct, operate, and maintain astronomy facilities within the MKSR, in exchange for, among other things, access to world class facilities and research coordination. The General Lease expires at the end of 2033, before this Master Plan's 20-year planning horizon. This Master Plan is essential to UH's management efforts at least until 2033. After 2033, if UH is not granted a land authorization that includes the MKSR, whatever entity takes UH's place might adopt some, all, or none of this Master Plan in its planning efforts. It is possible that, per the General Lease and subleases, that all the existing astronomy facilities will need to decommission by the end of 2033 if UH or another entity is not granted a land authorization for all or portions of the MKSR.

~~[25] As described in Section 4.3.4.3, a portion of Astronomy Sites 7 and/or 8 may continue to be utilized for astronomy if one of those sites is decommissioned and the other is selected for recycling.~~

[26] When the VLBA on Astronomy Site 14 is decommissioned, Astronomy Site 14 will not be available for future astronomy use unless the Management Plan in force at that time does not expressly prohibit its reuse (in 2026, the in force CMP's Decommissioning Plan (2010) states in Section 5.3: "The VLBA … will not be replaced by another telescope once it is decommissioned").

[27] Pu'upoli'ahu and Pu'ukūkahau'ula are not included in this list, although they were mentioned in CMP management action FLU-2, because they are not undeveloped and land uses, including habitat restoration, may be proposed on those pu'u.

Two astronomy facilities, Hōkū Kea (Astronomy Site 9) and Caltech Submillimeter Observatory (Astronomy Site 10), have already self-selected cessation of operations and have made substantial progress toward decommissioning.[28] In addition, the Very Long Baseline Array (Astronomy Site 14) will not be among the facilities selected to continue operation beyond 2033.[29] ~~Those three sites, Astronomy Sites 9, 10, and 14, will be among the five ineligible for future astronomy facility use once the existing astronomy facility is removed.~~ One or two additional astronomy facilities, depending on whether an astronomy facility is operating on Astronomy Site 13, will not be selected to continue operation beyond 2033 and therefore be decommissioned before December 31, 2033.[30] ~~Astronomy uses, including continued operation, modification, and recycling described in Section 4.3, will continue on eligible Astronomy Sites.~~[25]

UH believes that the scheduled reduction in astronomy facilities between now and 2033 will make an important contribution towards achieving the goals stated in Part 1, Section 1.4 of this Master Plan. When realized, it will allow a sufficient number of astronomy facilities to remain on Maunakea to maintain its and Hawai‘i’s position as a world center of astronomical research. At the same time, it will provide space, facilities, and encouragement for non-astronomical research, education, and other activities that will foster the responsible stewardship and sustainable use of Maunakea and a balance among those seeking their place on the mountain.

[28] Since adoption of the 2022 Master Plan, Hōkū Kea and Caltech Submillimeter Observatory have fully implemented all removal and restoration tasks per their UH-approved and DLNR-approved site decommissioning plans. The only remaining decommissioning tasks are associated with restoration monitoring.

[29] Among the reasons the VLBA is specified for decommissioning in this Master Plan are (*i*) it was identified in the Decommissioning Plan (2010) that VLBA would be decommissioned prior to the end of the current lease term and not be replaced by another telescope, and (*ii*) Condition 11 of CDUP HA-3568 (2017) states that the VLBA is to be decommissioning by December 31, 2033.

[30] Since adoption of the 2022 Master Plan, UKIRT on Astronomy Site 8 has submitted its Notice of Intent (NOI) to decommission, making it the third astronomy facility to submit a NOI. UH has accepted the NOI and UKIRT has begun to prepare its Site Decommissioning Plan.

4.2 MANAGEMENT & STEWARDSHIP-RELATED FACILITIES & PROJECTS

This section is divided into two parts. The first addresses facilities and projects related to UH's management and stewardship responsibilities. The second part describes facilities and projects intended to support and facilitate public activities.

4.2.1 ADDRESSING STEWARDSHIP MEASURES IN THE CMP

The CMP specifically calls for several stewardship measures that involve facilities and actions typically governed by the Conservation District Rules. These management actions and projects may entail the construction of minor facilities and land modifications within the MKSR. They may include, but are not limited to, the following:

- *Producing and outplanting native species, which is called for by CMP Management Actions NR-3 and NR-9*. The focus of these management actions is Halepōhaku because producing and outplanting is unlikely to occur in the MKSR's alpine ecosystem.[31]
- *Fencing areas of high native biodiversity or populations of endangered species, which is called for by CMP Management Action NR-8*. Fencing is unlikely to occur within the MKSR given the fencing of Maunakea at lower elevations by DLNR and the conditions within the alpine ecosystems.[31]
- *Conducting habitat rehabilitation or restoration projects, which is called for by CMP Management Action NR-12*. Rehabilitation or restoration projects may occur where the land was previously disturbed (e.g., the Pu'upoli'ahu access trail) or land is accidentally disturbed in the future. The likelihood of implementing such projects may increase if such projects, including astronomy site restoration efforts, prove to be successful.

Such stewardship measures will be undertaken where they are biologically appropriate; biological conditions inherently required for them will dictate the range of options available. When selecting a site, consideration will be given to potential adverse impacts, including impacts to the cultural landscape, natural resources, visual resources, and proposal-specific concerns.

4.2.2 FACILITATING PUBLIC ACTIVITIES

Given the expected continued growth in demand for experiences on Maunakea, UH believes that public facilities such as restrooms, shelters, signs, designated parking areas, and trails aimed at non-astronomical visitors to the summit area will be necessary to manage activities in a way that minimizes their adverse effect on the cultural landscape, protects natural resources, and improves safety. Storage spaces and ranger offices needed to aid in facilitating public activities may be incorporated into the public facilities or will utilize existing space in astronomy facilities.

[31] This is included in this section to ensure that it is provided for should conditions and priorities change over the 20-year plan period (e.g., climate change has been shown to affect the elevation at which species are successful). The likelihood of these actions increases if outplanted silversword can tolerate conditions in the MKSR.

The public facilities considered in this section will be sited, designed, and sized in a manner that is consistent with UH's commitment to manage access to Maunakea. UH intends to manage the number of vehicles (Section 5.3), and thereby people, ascending above Halepōhaku in a manner that preserves the ambiance and feeling of the cultural landscape and minimizes adverse effects on the alpine ecosystem and other resources. Therefore, the facilities and projects discussed in this section will be sited and designed to accommodate fewer vehicles and people than were present in the recent, pre-pandemic, past. More specifically, they will be sized to accommodate only the number of vehicles and visitors expected with active access management as described elsewhere in this plan (Section 5.3) and designed to provide a safe and rewarding experience for those who do enter.

Proposed facilities will be confirmed to be scientifically, culturally, and site-appropriate through the UH project review process described in Part 3 of this Master Plan. Consideration will be given to potential adverse impacts, including impacts to the cultural landscape, natural resources, and visual resources. When possible, proposed facilities will be co-located and programmed for multiple purposes with other existing or proposed facilities to minimize impacts and encourage beneficial relationships among all those visiting the UH Maunakea Lands. Facilities will be preferentially sited in locations that have been previously disturbed, unless the proposal requires undisturbed lands or where essential for safety or other considerations, in which case these facilities may be sited in undisturbed areas.

The facilities that UH has already determined it may consider within the MKSR over the term of this Master Plan are described in the following subsections. However, other uses may be proposed by UH or other parties as well, and their absence from this Master Plan does not exclude them from consideration under the framework laid out under this Master Plan.

4.2.2.1 Restrooms and Shelters

The portable toilets that are now located within the summit area provide a great improvement over the "no public toilet" situation that existed for many years in the MKSR. Despite the presence of these portable toilets, rangers and/or astronomy facility personnel are still regularly called upon to clean up human waste. This continuing burden is due to: (*i*) parking in undesignated parking areas within the MKSR, (*ii*) the type and limited number of toilets provided, (*iii*) the fact that visitors are not always aware the facilities exist, and (*iv*) the facilities' excessive distance from some locations where visitors congregate.

To mitigate this issue, UH will designate public parking areas as provided for in the UH Maunakea Rules (HAR Chapter 20-26) and maintain, reposition, and increase the number of portable toilets in the MKSR until improved permanent facilities can be developed. The repositioning of existing and future portable toilets may be necessary during construction and decommissioning projects as well. UH will investigate the extent to which it may be able to provide permanent public restrooms and shelters that can serve the MKSR. Once improved permanent restrooms are available, nearby portable toilets will be removed.

Those who come to the mountain, including BLNR, have also identified the need for shelter, particularly shelter that would be helpful to cultural practitioners, the public, and the Rangers. Shelters to provide a place where cultural practitioners and others could assemble and Rangers could store safety equipment and have office space will be considered.

Siting considerations for these facilities include:

- Proximity to where people, including the public and cultural practitioners, presently or are likely in the future to congregate, such as near designated public parking areas, shuttle stops, popular sunset viewing areas, and trailheads.
- Preference for areas that:
  - Have been previously disturbed, including the adaptive reuse of decommissioned or recycled astronomy sites and facilities. Astronomy sites where it may be more likely to consider this include Astronomy Sites 9 (Hōkū Kea) and 14 (VLBA), plus Astronomy Sites 7 (UH 2.2) and 8 (UKIRT), should they be decommissioned.
  - Are next to or near existing improvements, including astronomy facilities.[32]
  - Minimize visual impacts.
  - Provide a buffer from areas with high native species diversity, unique biological communities, unique geological features, or sensitive cultural sites.
  - Provide a buffer, established in consultation with SHPD, from archaeology sites (Figure 4-2).
- Ease of access by maintenance vehicles and personnel.
- Proximity to existing utility lines if utility connections are required.

[32] Facilities could be attached to existing UH-owned astronomy facilities, but placement of public facilities on astronomy sites subleased to other entities would require modification of agreements. Public facilities would need to avoid or minimize impacts to astronomy facility operations and safety hazards related to falling ice and other hazards.

Figure 4-2: Archaeology Sites in the UH Maunakea Lands



Source: PCSI.

4.2.2.2 Public Parking

HAR § 20-26-28 provides that parking a motorized vehicle outside designated parking areas is prohibited. Currently there are three designated public parking areas along the Mauna Kea Access Road, which are listed below.

- Parking Area 1 with 12 stalls at roughly 11,860 feet elevation.
- Parking Area 2 with 22 stalls at roughly 12,815 feet elevation.
- Parking Area 3 (aka the Batch Plant Parking Area) which is permitted for six stalls at roughly 13,250 feet elevation.

There are no officially designated public parking areas along the road that serves the summit ridge. The siting, design, and size considerations listed in Section 4.2.2.1 also apply to new public parking.

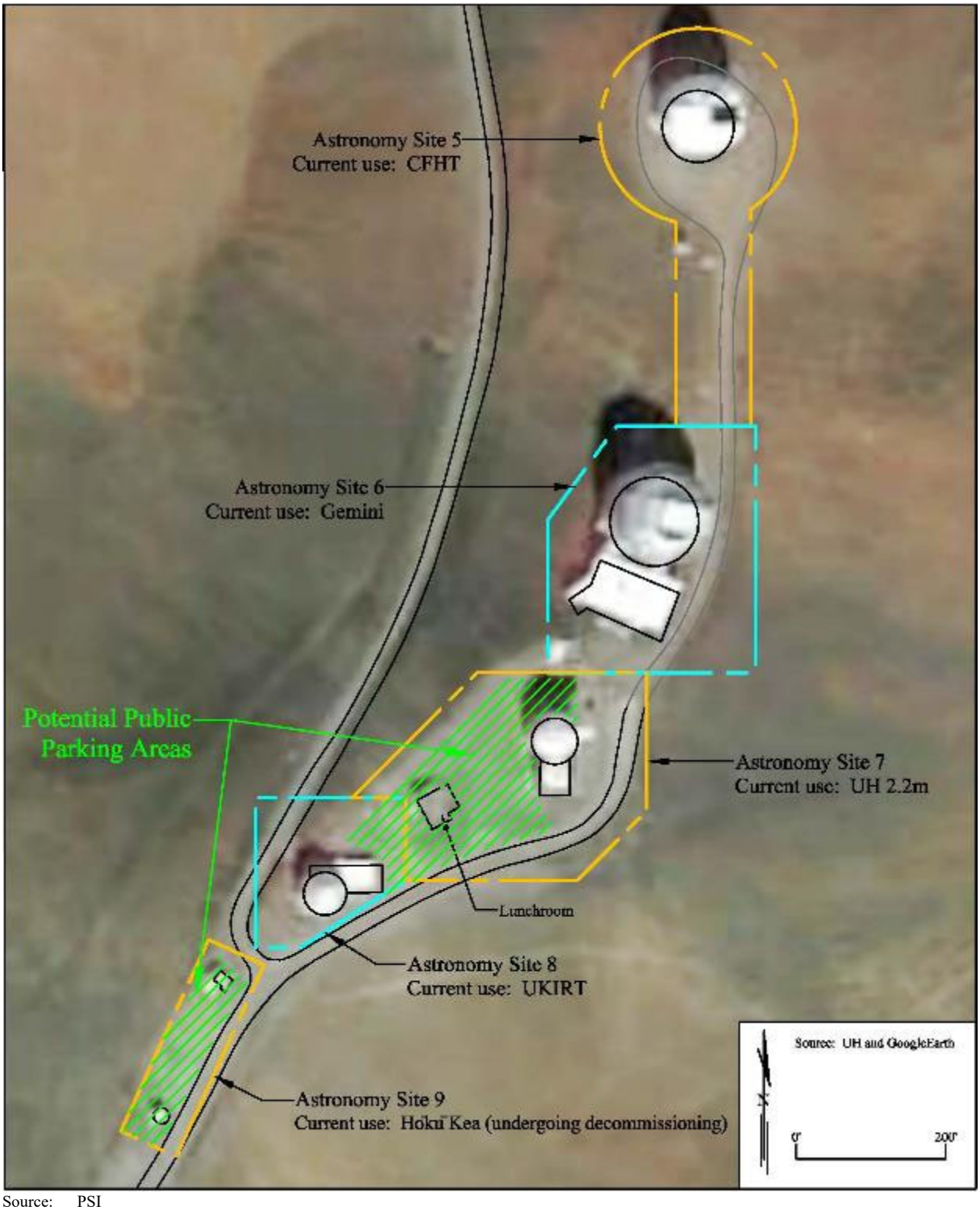
UH has identified and is continuing to evaluate public parking needs and the potential need for improvements. The parking area improvement projects that it believes are most likely to be pursued include, but are not limited to, those shown on Figure 4-3. They include: (*i*) designating and improving areas in the summit region for visitor and commercial tour parking; (*ii*) installing informational and regulatory signs; and (*iii*) placing safety devices (e.g., barriers preventing runaway vehicles and off-road driving) in those areas currently used for parking on an *ad hoc* basis. As depicted in Figure 4-3, these public parking areas are situated on portions of Astronomy Site 7 (UH 2.2), Site 8 (UKIRT), and Site 9 (Hōkū Keʻa). Because members of the public and commercial tour operators have been parking their vehicles and viewing the sunset or conducting other activities from these areas for many years, this amounts to a continuation of present use. However, the Astronomy Site decommissioning that is scheduled, the planned establishment of a shuttle service, and the preparation of this Master Plan provide an opportunity to formalize and improve on what has until now been an *ad hoc* practice. Other areas will be considered and may also be designated and improved following community outreach.

4.2.2.3 Signs

UH will install and maintain all signs within the MKSR in accordance with the *Maunakea Sign Plan* (Office of Maunakea Management (OMKM), February 2017), which was prepared to address CMP management action EO-4. These will include educational, safety, and interpretive signs. In addition to making users aware of safety and conservation issues, the signs will identify unique geologic features and inform them of the best ways to conserve them. The plan provides policy concerning sign standards, types, design, siting, approval, and maintenance.

The types of stand-alone signs that may be installed in the MKSR include signs related to traffic control and the location of designated public parking areas, temporary traffic control warnings, and visitor information. The latter category includes such things as interpretive and wayside exhibits (e.g., historic site interpretation, exhibits regarding geologic features), trailhead signs, and signs related to resource protection (e.g., outline protection afforded to historic sites). Signs complying with the Maunakea Sign Plan may also be installed as components of other approved land uses. In addition to compliance with the sign plan (Section 7.5.3), signs may be multilingual and utilize iconography, when appropriate.

Figure 4-3: Potential Parking Project Locations in Summit Region



Source: PSI

Signs will be placed only where they are biologically and culturally appropriate, where necessary for safety purposes, and/or where people can or do congregate to appreciate the landscape and resources in the area. During site selection, consideration will be given to potential adverse

impacts, including impacts to the cultural landscape and natural resources. The proximity of utilities will also be considered in the unlikely event signs require utility connections. Signs will preferentially be sited in locations that have been previously disturbed and collocated with restrooms, shelters, public parking, and trailheads. Where appropriate for safety or other considerations, these minor facilities can be sited in undisturbed areas.[33]

4.2.2.4 Trails

The great majority of the trails on Maunakea are outside the MKSR on land that is either within the neighboring Mauna Kea Ice Age NAR or within the Mauna Kea Forest Reserve. These areas are managed by and under the jurisdiction of DLNR. Nevertheless, hiking is a relatively common recreational activity in the MKSR; it is concentrated on the few better-known trails in the MKSR (e.g., summit trail and Lake Waiʻau trailheads). Hiking near the summit of Maunakea is challenging and potentially hazardous for two main reasons.

- First, because the amount of oxygen in the air is only about 65 percent of what it is at sea level, individuals must breathe faster to compensate for the oxygen shortfall, and the heart must beat faster too.
- Second, the temperature, wind, snowfall, and ice in the summit region can be dangerous for those who are caught outside without the proper clothing because it leads to hypothermia, which can be life-threatening.

For health and safety reasons, hiking in areas that are not visible to Rangers and first responders is not advisable. For this reason, UH does not advocate the establishment of any new public trails within the MKSR. Instead, UH will continue to coordinate with DLNR regarding the establishment of trails at lower elevations on NAR or Forest Reserve land and will make areas under UH jurisdiction needed to support or complement such trails available for trail purposes as requested.

Notwithstanding its desire to minimize the amount of hiking across the high-elevation lands within the MKSR, UH recognizes that hiking on some routes is so well established that it will continue and be made consistent with HAR Chapter 20-26. The trail to the summit of Maunakea from Astronomy Site 9 (Hōkū Kea) will be considered for improvement. Accessing the highest point in the Pacific will continue to lure visitors, and some cultural practitioners also access the summit. It is a short trail, and people are always visible to the Rangers and other first responders on the road, provided they remain on the trail. Adverse impacts observed associated with use of this trail include erosion, trail widening, trail realignment, and wandering off the trail. To reduce erosion and more clearly delineate the trail, UH may consider hardening the trail while respecting the design guidelines in Chapter 7. The most appropriate techniques and materials to carry out this concept would be informed by working with Native Hawaiians that have ties to the Kaʻohe Ahupuaʻa.

[33] Undisturbed areas are those areas outside of the astronomy sites that have not been visually affected by human activity. All areas within the astronomy sites, including decommissioned and restored astronomy sites, are considered disturbed.

In addition to the concept described above for the summit trail, UH will continue to maintain the road access and parking utilized by those hiking on the two trails that lead from the Mauna Kea Access Road to Lake Waiʻau, in coordination with DLNR to remain consistent with DLNR's management efforts within the NAR.

4.3 EDUCATION, RESEARCH, AND ASTRONOMY FACILITIES

This section addresses facilities and projects related to education, research, and astronomy facilities within the MKSR. As discussed in Part 1, astronomy has been the driving force behind UH's involvement with Maunakea, and UH anticipates that this will continue to be the case. In addition to astronomy, UH is focused on diversifying the education and research opportunities on Maunakea. As stated at the beginning of this chapter, UH is also committed to retaining the wilderness characteristics of the MKSR. The MKSR is a natural laboratory and learning space; Halepōhaku is the classroom and support facility. Most research within the MKSR will not require large instruments or structures; astronomy is the exception, not the rule.

In this section, we first discuss facilities and developments associated with non-astronomy education and research (Section 4.3.1), then we focus on astronomy sites and facilities.

4.3.1 DIVERSE EDUCATION AND RESEARCH FACILITIES AND DEVELOPMENTS

As with astronomy, which has always sought to keep its facilities within the MKSR compact and used Halepōhaku and headquarters facilities in Hilo and Waimea to support astronomy facility operations, other education and research pursuits will also restrict their footprint within the MKSR. For instance, classrooms and meeting rooms will not be built within the MKSR; the facilities at Halepōhaku, UH Hilo, and elsewhere will provide those functions.

Researchers occasionally propose data gathering efforts in the MKSR that involve equipment and facilities occurring on the landscape for a period of time. Maunakea's unusual resources, including its elevation, location, and access, provide unique research and data gathering opportunities. Proposals can be expected from UH staff, students, and/or researchers from other institutions and would be funded by those proposing them (some may receive grants from CMS). UH will carefully consider data gathering proposals and only permit those that require Maunakea's unusual assets to proceed within the UH Maunakea Lands, consistent with the UH Maunakea Rules.

Some data gathering programs do not constitute land uses (as the term is used in this Master Plan) because they do not involve the alteration of the land or the erection of solid material that remains for more than 30 days. Similarly, activities such as archaeological research, arthropod monitoring, and geologic mapping do not constitute land uses.[34] Examples of data gathering efforts that may qualify as land uses include the installation and long-term operation and maintenance of instruments to measure environmental conditions (e.g., weather, snow-depth, earth movements, sound, vehicular traffic, etc.).

[34] Although they are not land uses and, therefore, not a subject of this Master Plan, research activities may require different approvals from UH and DLNR.

Data gathering land uses would be sited as necessary to support the research goals of individual programs. Achieving those goals may require measurements at different elevations, data from various sides of Maunakea, or the collection of information from locations similar to other locations around the world where the same sorts of data are being gathered. UH will evaluate siting alternatives to ensure that data gathering activities, facilities, and equipment avoid and/or minimize potential impacts by, for example:

- Considering previously disturbed areas, including active and decommissioned astronomy sites, when program research goals do not require undisturbed areas.
- Siting equipment outside of buffers established in consultation with SHPD around archaeology sites (Figure 4-2).
- Considering visual impacts.

Actual site selection criteria will be proposal specific, based on type and longevity of use, and other factors. They will be established via the appropriate proposal review process (see Part 3). A proposed data gathering use will not be approved if it cannot avoid and/or minimize impacts to the extent deemed appropriate by UH and DLNR.

4.3.2 ASTRONOMY DECOMMISSIONINGS

This Master Plan calls for there to be no more than nine (9) astronomy sites with operational astronomy facilities in the MKSR by the end of 2033 (Section 4.1.2). This section outlines the process by which UH will accomplish this commitment.

4.3.2.1 Ongoing Decommissioning of Two Astronomy Sites

As summarized below, the sponsors of the CSO (Astronomy Site 10) and Hōkū Kea (Astronomy Site 9) have each already submitted a decommissioning Notice of Intent (NOI), MKMB and DLNR have approved their NOIs, and they are fully engaged in the decommissioning process laid out in the CMP.[35] They have also both issued Draft Environmental Assessments detailing their proposed decommissioning efforts and associated impacts (Caltech 2021, UH Hilo 2021). The decommissioning of these two facilities partially fulfills CDUP HA-3568 Special Condition #10, which states "The University will decommission three telescopes permanently, as soon as reasonably possible."[36]

~~UH has decided that these two sites will not be available for future astronomy use, including recycling. As discussed in Section 4.2 of this Master Plan, some non-astronomical use of portions of Astronomy Site 9 may be considered during or after the decommissioning process.~~

[35] Since adoption of the 2022 Master Plan, Hōkū Kea and Caltech Submillimeter Observatory have fully implemented all removal and restoration tasks per their UH-approved and DLNR-approved site decommissioning plans. The only remaining decommissioning tasks are associated with restoration monitoring.

[36] Since adoption of the 2022 Master Plan, UKIRT on Astronomy Site 8 has submitted its Notice of Intent (NOI) to decommission, making it the third astronomy facility to submit a NOI. UH has accepted the NOI and UKIRT has begun to prepare its Site Decommissioning Plan.

4.3.2.2 Upcoming Decommissioning of Additional Astronomy ~~Sites~~Facilities

Which astronomy facilities ~~and sites~~ will continue beyond 2033 and which shall be decommissioned will be established via the process outlined in Appendix E. Per this Master Plan, CDUP HA-3568 Condition 11, and the Decommissioning Plan (2010), ~~It is known that~~ VLBA, on Astronomy Site 14, ~~will be~~ is programmed to be decommissioned prior to the end of 2033. One or two additional facilities, depending on if an astronomy facility is developed on Astronomy Site 13, will not be selected for continued operation via the process outlined in Appendix E. Selections are expected by the end of 2025, allowing seven years for the owners/operators of any not selected to completely decommission prior to the end of 2033.[36]

~~UH has decided that the sites once occupied by those facilities not selected to continue operation via the process outlined in Appendix E will not be available for future astronomy use, including recycling. However, as discussed in Section 4.2 of this Master Plan, some non-astronomical use of portions of decommissioned astronomy sites may be considered during or after the decommissioning process. In addition, as described in Section 4.3.4.3 and shown in Figure 4-4, a portion of Astronomy Sites 7 and/or 8 may continue to be utilized for astronomy in the event that one of those sites is decommissioned and the other is recycled.~~

4.3.3 CONTINUED OPERATION, MODIFYING, AND/OR RECYCLING ASTRONOMY SITES AND FACILITIES

4.3.3.1 Continued Operation of Existing Facilities

Over the 20-year period of this Master Plan most astronomy facilities not decommissioned will likely continue to operate in their current general configuration. Internal alterations (e.g., installing new instrumentation, replacing mechanical and electronic equipment, etc.) are likely to be made in virtually all of these at the discretion of the facility owner and operator. Work needed to maintain the exterior of the facilities (e.g., resurfacing the dome or parking areas) and minor alterations that affect the exterior of the facility may also occur. External maintenance and alteration projects will need to follow the project review process described in Part 3 of this Master Plan. Examples of possible alterations may include such things as the attachment of equipment such as cameras, weather equipment, or adaptive optics equipment to the exterior of a dome to aid observing or attaching photovoltaic (PV) panels to the roof of support buildings.[37]

4.3.3.2 Potential Modification and Recycling Projects

As used in this Master Plan:

- "Modification" of an astronomy facility entails changes to an existing facility that are made to modernize or improve its capabilities that go beyond the alterations discussed in Section 4.3.3.1. Examples of possible modifications include enlarging or reconfiguring a dome to accommodate a larger telescope or constructing additional building space to accommodate more equipment or support infrastructure.

[37] PV panels have been added to the Keck and Gemini support buildings. Other astronomy facility operators are also likely to add them to support buildings in the coming years.

- "Recycling" an astronomy site involves the complete removal of an existing astronomy facility and the construction of a new astronomy facility in its place. Recycling is consistent with preserving nine operating astronomy facilities at any one time and ~~keeping facilities on existing, previously disturbed~~ restricting future astronomy uses to the astronomy sites identified in this plan (Appendix F).

Modification and/or recycling will be considered only at astronomy sites ~~not eliminated from consideration for future astronomy facilities~~ per the commitments outlined in Section 4.1.2. They will also need to address the design guidelines outlined in Part 3, Chapter 7, which, among other things, require astronomy facilities be confined to the defined astronomy sites. Other than the possible adjustment to Astronomy Site 7 and Astronomy Site 8 boundaries outlined in Section 4.3.4.3 (which would result in a site roughly equivalent in size to the average of the two), modification and recycling projects will not involve a change in the size or boundaries of the astronomy sites.

UH's assessment of the likelihood that facilities at each of the astronomy sites will be modified or recycled over the life of this plan is summarized in Table 4-2. As indicated in Table 4-2, the only presently known potential modification or recycling project in the MKSR is the modifications to CFHT (Astronomy Site 5) that is under discussion to accommodate the Maunakea Spectroscopic Explorer (MSE) project. If implemented, the MSE project, which has not yet been evaluated or approved by UH, would transform the CFHT 3.6-meter telescope into a 10-meter class dedicated multi-object spectroscopic facility with an ability to simultaneously observe more than four thousand objects. It is not yet known if the MSE project will be officially proposed to UH. If it is, it will most likely be considered a modification project because, as envisioned now, it would retain the existing CFHT foundation and base structure.

Table 4-2: Probability of Modification or Recycling of Astronomy Uses by Astronomy Site

Astronomy Site	*Modification and Recycling Probability*	*Discussion*
Site 1: Subaru	Highly unlikely	Japan sets funding of the facility in 10-year increments and does not show any signs of shifting priorities away from Subaru, its principal astronomy asset. Subaru is likely to complement the MSE project, which will add to its long-term utility if the MSE project becomes a reality.
Sites 2 and 3: Keck I & II	Highly unlikely	Keck is the single most impactful astronomy facility in the world. Investments in internal instrumentation by Keck will enable it to continue its leadership.
Site 4: IRTF	Slight	The IRTF provides critical support for NASA's exploration of the Solar System. There is no evidence that NASA's priorities will change in a way that would substantially reduce the need for IRTF. However, this astronomy site is one of the few that hosts a relatively small telescope (4-meter class) and is of sufficient area and remoteness from other facilities that it could be recycled with a larger facility (10-meter class, perhaps a facility similar to the Vera C. Rubin Observatory facility in Chile).
Site 5: CFHT	Moderate	CFHT has been working on the MSE concept for a decade and continues to pursue partners to make that a reality; therefore, it has the highest probability of modification or recycling.

Astronomy Site	*Modification and Recycling Probability*	*Discussion*
Site 6: Gemini North	Highly unlikely	The AURA manages this facility in concert with the Gemini South facility in Chile. Continued investment by NSF and other Gemini partners is anticipated, as well as technology sharing among the two Gemini telescopes and other NSF-supported facilities.
Site 7: UH 2.2m (88")	Slight to moderate	UH considered this site for recycling when the Pan-STARRS project was being planned. The size and geometry of the site and its proximity to Gemini North and other resources mean that this site is unlikely to be recycled to host a facility substantially larger than the existing structure. See Section 4.3.4.3 regarding possible recycling once site boundary is altered.
Site 8: UKIRT	Slight to moderate	UKIRT has been one of the most impactful facilities in recent years due to its wide-field camera and ability to engage in time-domain astronomy. As its efforts with the wide-field camera wind down over the next decade, the likelihood of modification or recycling may increase. The size of the site and proximity to other resources suggest that its recycling would not yield a facility substantially larger than the existing one. See Section 4.3.4.3 regarding possible recycling once the site boundary is altered.
Site 9: Hōkū Kea	Highly unlikely~~None~~	This facility has~~will~~ been decommissioned, and the area is now used for public parking. ~~and the site will not be~~ Astronomy Site 9 is available for future astronomy use, but no use has been proposed, and the prospect of a future proposal is considered highly unlikely due to the small size, location, and shape of this astronomy site.
Site 10: CSO	Moderate~~None~~	This facility ~~will~~ has been decommissioned~~, and the site will not be~~ . Astronomy Site 10 is available for future astronomy use, but no use has been proposed.
Site 11 – JCMT	Highly unlikely	JCMT continues to be very impactful and is part of the Event Horizon Telescope, which is a long-baseline submillimeter interferometer. Maunakea will continue to play an important role in such efforts due to its latitude. However, it is unlikely that modification or recycling will occur due to the large and ongoing investment in submillimeter facilities in the southern hemisphere. Located in "submillimeter valley," this site is not attractive for recycling to an optical or infrared facility.
Site 12 – SMA	Highly unlikely	Factors discussed above related to JCMT apply to the SMA as well, and the Smithsonian has not indicated any change in priorities or funding.
Site 13 – TMT	Highly ~~Extremely~~ unlikely	The TMT has a CDUP to build on this site during the term of this Master Plan. If constructed, it will have an operating life of at least 50 years.
Site 14 – VLBA	Highly unlikely~~None~~	~~This facility will be decommissioned, and the site~~ Following the decommissioning of VLBA, Astronomy Site 14 will not be available for future astronomy use per UH's CMP and CDUP-3568; Astronomy Site 14 could only be reused for astronomy purposes if CDUP-3568 is not exercised and the Management Plan does not expressly prohibit its reuse.

Source: UH and the MKOs

Although the current MSE project concept involves the facility at Astronomy Site 5 (CFHT) becoming slightly taller (no change to building footprint at ground level), it is not a foregone conclusion that all modification or recycling projects will result in larger facilities. Instead, technological advances could result in larger aperture telescopes being developed on astronomy sites in ways that require minimal disturbance and result in minimal height and size increases, or even allow existing facilities to be replaced with smaller ones. Moreover, not all astronomical research requires large-aperture telescopes. There will always be demand for 2- and 4-meter class

telescopes, and it is possible that an astronomy site that presently has a 2- or 4-meter class telescope could be modified or recycled with a similar size facility that takes advantage of the many technical advances that have occurred since the mid-1980s when telescopes of this size were last installed in the MKSR. Such recycling could substantially increase the scientific power of a site without increasing (and potentially decreasing) the footprint, bulk, and impacts of the facilities that are present.

4.3.4 OTHER POTENTIAL ASTRONOMY-RELATED PROJECTS

4.3.4.1 Optical Hawaiian Array for Nanoradian Astronomy Project

The astronomy facilities on Maunakea are experimenting with the use of fiber optics for two different purposes.

- The first is to transmit the visible light or infrared radiation collected while observing a celestial object at one facility to another facility so that instruments in the other facility can analyze the radiation (the GRACES project).[38]
- The second is a concept to combine the light from up to seven existing telescopes, the so-called Optical Hawaiian Array for Nanoradian Astronomy project. The project would interconnect some or all the optical/IR facilities on Maunakea (Subaru, Keck, IRTF, CFHT, Gemini, UH2.2m, and UKIRT) to create an interferometer capable of providing ultra-high-resolution images of the near-infrared Universe. The image that could be produced by the linked facilities would be up to 80 times sharper than the image from one of the 10-meter Keck telescopes. The project would be challenging and, if it moves forward, it would probably be implemented in phases and take decades to implement fully. However, this highly collaborative undertaking would greatly expand the capability and utility of the existing facilities.

The project would require fiber-optic cables between the facilities and a large laboratory space for the "delay line" that is an essential component of interferometers. Sufficient laboratory space for the project is already available within one of the existing facilities. Converting the area within the facility for this use might require some internal modifications, but it is unlikely to require modifications that would change the exterior of the facility. However, interconnecting the facilities would involve the installation and maintenance of underground cables. These cables would likely follow the alignments of other utilities (electrical and communication) that already run between the astronomy sites. Implementing the project might require the installation of additional underground conduit along those routes between the astronomy sites. Because they are common infrastructure improvements comparable to existing roadways, electrical power feeds, and communication lines, the conduits and cables would not be required to comply with Master Plan guidelines regarding the confinement of astronomy improvements to astronomy sites. The project, or similar connections between the astronomy sites, would likely be developed in phases as the concept is proven and resources become available.

4.3.4.2 Joint Development of Astronomy Sites

Astronomy Sites 2 and 3 (which contain the W. M. Keck Observatory) were developed jointly by a consortium consisting of the University of California and the California Institute of Technology (Caltech) between 1984 and 1996. These two astronomy sites lent themselves to joint development as they are contiguous, share a long border, and the ground is relatively level across the two sites.

[38] The ongoing Gemini Remote Access to CFHT ESPaDOnS Spectrograph (GRACES) project is the result of a cooperation between the Canada-France-Hawaii Telescope (CFHT), Gemini, and NRC-Herzberg (Canada). It combines the large collecting area of the Gemini North telescope with the high resolving power and high efficiency of the ESPaDOnS spectrograph at CFHT to deliver high resolution spectroscopy across the optical region.

Should Astronomy Sites 2 and 3 be recycled in the future (which is considered highly unlikely, Table 4-2), they could be jointly developed again.

While IfA considers it unlikely that other astronomy sites will be jointly developed, the possibility cannot be completely dismissed. Astronomy Sites 5, 6, 7, and 8 are contiguous, and it is conceivable that two of them (e.g., 6/7 or 7/8) could be jointly developed. While their different elevations and geometry make that challenging, it is conceivable that new technology, materials, and/or design concepts may create an opportunity for this over the term of this Master Plan.

4.3.4.3 Potential Combination and Boundary Amendment of Astronomy Sites 7 and 8

A more likely alternative to joint development is combining and amending the administrative boundary of Astronomy Sites 7 and 8 so that a single new state-of-the-art astronomy facility could be developed on a portion of the area where two facilities (UH 2.2 and UKIRT) currently exist. This would make it possible to: (*i*) address proximity issues with Astronomy Site 6 (Gemini), (*ii*) mitigate erosion risks at Astronomy Site 8, and (*iii*) maintain an astronomy site of sufficient size for recycling. Each of these items is discussed below:

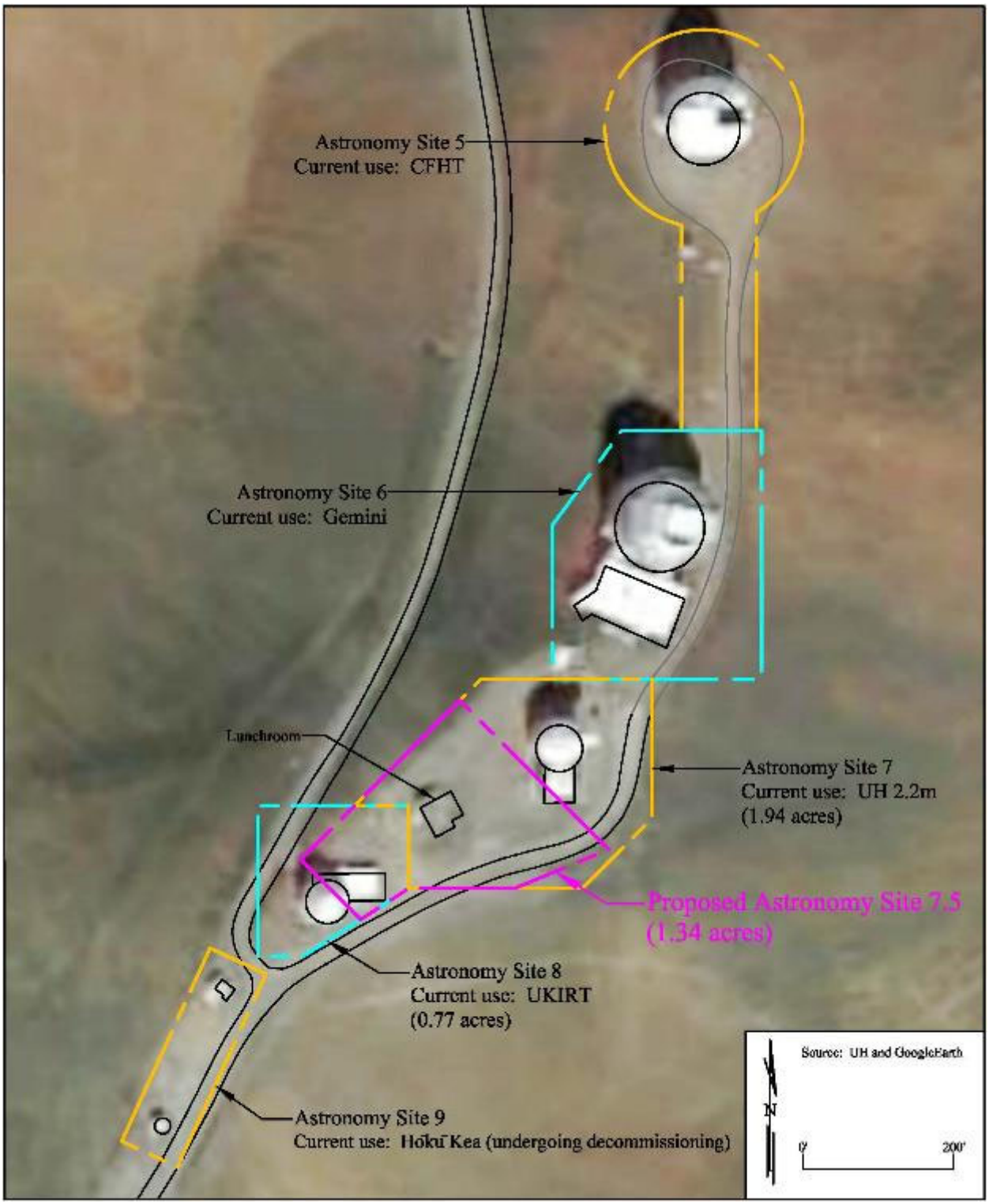
- Proximity issues are created when one astronomy facility dome creates air turbulence that adversely affects astronomical seeing conditions at a nearby facility. Currently, the UH 2.2 dome on Site 7 is roughly 300 feet from the Gemini dome on Site 6 (measured from the center of one dome to the center of the other). Ideally, the two domes would be separated by 500 feet to minimize the potential for proximity issues.
- Erosion issues at Astronomy Site 8 (UKIRT) are related to the proximity of the road located to the northwest and at a lower elevation than the facility. Grouted rubble pavement (GRP) has been installed on the slope in this area to address the erosion. Additional measures may be needed to address the erosion if Astronomy Site 8 (UKIRT) continues to be utilized.
- Astronomy Site sizes on the subject ridge (Astronomy Sites 5, 6, 7, and 8) range from 0.77 acres (UKIRT on Site 8) to 1.96 acres (Gemini on Site 6). A site of roughly 1.5 acres is considered the minimum necessary to support a modern optical/IR facility that would most likely be developed through the recycling of a site on this ridge, and closer to 2.0 acres would be preferable.

Figure 4-4 illustrates the amendment of the Astronomy Site 7 and 8 boundaries that would allow this; the resulting site would be referred to as Astronomy Site 7.5. A reconfiguration along this line would address each of the points above by allowing the development of a new facility with a dome that is roughly 500 feet from the Gemini dome that is setback from the erosion problems and has a size of roughly 1.5 acres. The total area of the site that is delineated in Figure 4-4 for site 7.5 is roughly 1.34 acres, which is equal to the average size of existing Sites 7 and 8, substantially less than the combined areas (2.7 acres) of Sites 7 and 8, and is completely within areas that are already permitted for astronomy facilities.

This amendment of Astronomy Site 7 and 8 boundaries would only occur if: (*i*) one, but not both, of Astronomy Sites 7 and 8 were to be decommissioned; and (*ii*) the Astronomy Site that does continue is recycled. It is possible that both required events could occur during the 20-year term of this Master Plan. If it does come to pass, it would result in the continuation of one astronomy site where there are now two. The design guidelines (Part 3 of this Master Plan) that are considered

in relation to the existing facility on the subject astronomy site (i.e., dome height) would be calculated on the basis of the UH 2.2 facility currently on Astronomy Site 7.

Figure 4-4: Potential Amendment of Astronomy Site 7 and 8 Boundaries



Source: PSI

4.3.4.4 Multiple Small Telescopes on One Astronomy Site

All astronomy sites on Maunakea currently host a single telescope.[39] It is becoming more common for modern astronomy facilities to have multiple similar-sized telescopes in a single dome (e.g., the original PanSTARRS concept). As astronomy sites on Maunakea are recycled, it is possible that future facilities may host multiple telescopes of similar aperture. If such changes are made these will continue to be treated as a single astronomy facility.

[39] Astronomy Site 12 (SMA), is a single interferometer telescope comprised of multiple antennas. Most of the existing facilities have secondary telescope(s) that are used for spotting and other purposes. The secondary telescopes are typically much smaller than the primary telescope and, in some cases, are mounted on the exterior of the dome.

5 ROADWAYS, UTILITIES, AND MANAGED ACCESS

The discussion in this chapter addresses only those roadways, utilities, and managed access facilities located outside astronomy sites and beyond the previously disturbed portions of Halepōhaku. Roadways, utilities, and managed access facilities are discussed separately from the uses specific to Halepōhaku (which are discussed in Chapter 3) and the MKSR (which are discussed in Chapter 4) because they cross boundaries and are independent from, but provide interconnections between, those areas and their land uses.

5.1 ROADWAYS

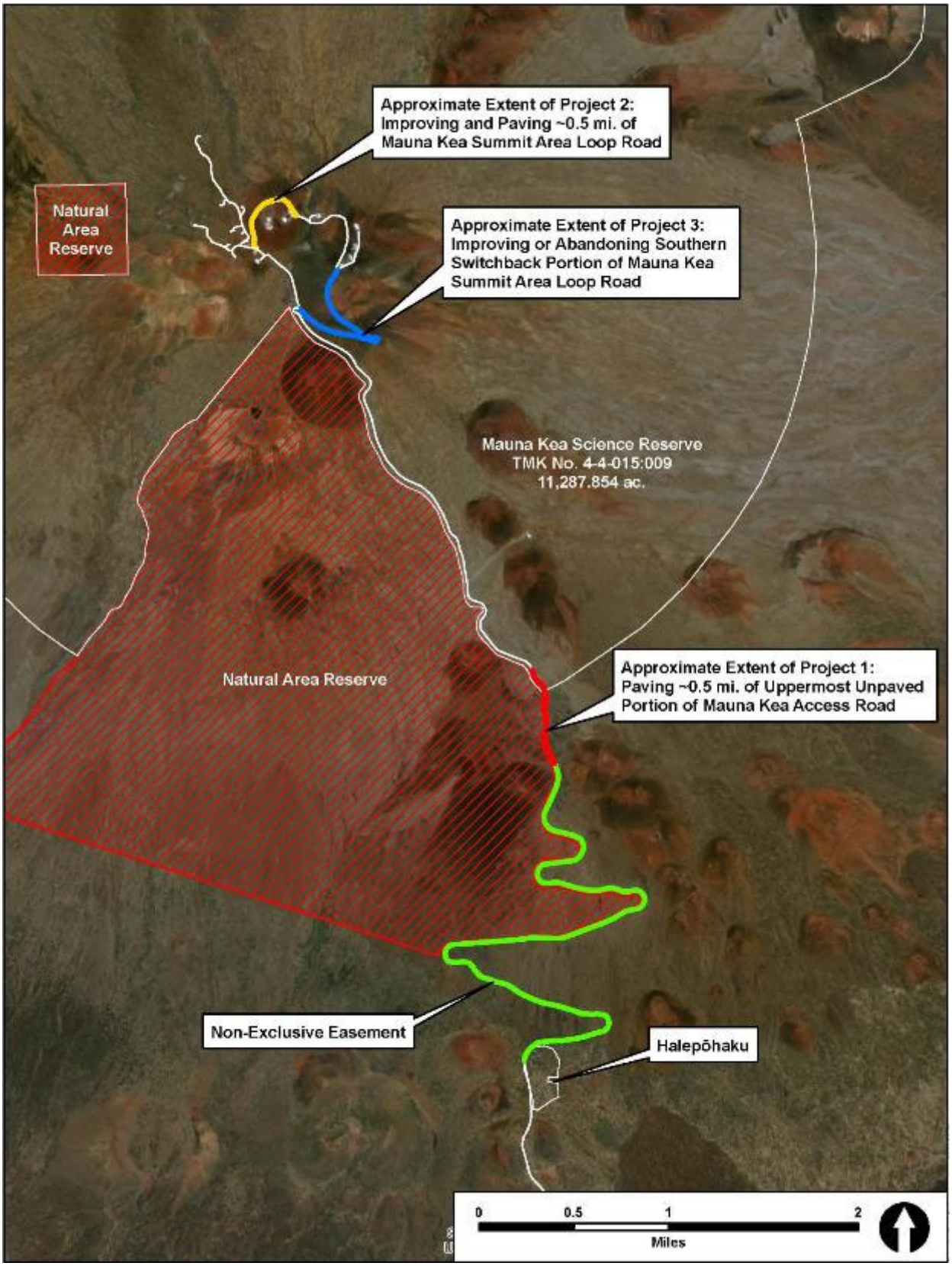
At one time, the Hawai‘i Department of Transportation (HDOT) anticipated making improvements to the 4.7-mile-long portion of the Maunakea Access Road above Halepōhaku that remains unpaved. However, that paving project is no longer in the HDOT’s budget. Hence, this segment of the Mauna Kea Access Road will continue to require frequent maintenance, and the use of two-wheel-drive vehicles north of/above Halepōhaku will continue to be prohibited, consistent with HAR § 20-26-28.

Should the existing and approved roads be damaged by natural process (e.g., erosion, earthquake) to the point that they cannot reasonably be restored in their current location, they will be replaced with infrastructure of similar capacity nearby.

Maunakea Observatories Support Services (MKSS) has identified the following potential access road projects (see Figure 5-1) and is presently evaluating them.

1. Project 1. Paving a roughly 0.5-mile-long segment at the upper end of the currently unpaved portion of the Mauna Kea Access Road. This work has been recommended because the segment has historically required much more frequent grading and other maintenance than have other unpaved road segments.
2. Project 2. Improving and paving the roughly 0.5-mile unpaved portion of the Mauna Kea Access Loop Road from Astronomy Site 12 (SMA) past Astronomy Site 1 (Subaru) to Astronomy Site 3 (Keck II). This would eliminate roadway-related dust, reduce the effort required to maintain the roadway, and make it easier to clear snow. In addition to paving, retaining walls could be modified and the travelway widened in the vicinity of Astronomy Site 3 (Keck II).

Figure 5-1: Potential Road Project Locations



Source: PSI

3. Project 3. Improving or retiring the older, southern, switchback portion of the Mauna Kea Access Summit Area Loop Road. This portion of the Summit Area Loop Road has proven to be less stable than the more recently built, northern, currently partially unpaved, portion of the Summit Area Loop Road. The southern, switchback portion of the Loop Road has been damaged by erosion and has required more maintenance than the northern route. This does not appear to be due to age alone. Therefore, if the northern portion of the loop is fully paved (Item 2 above), the southern switchbacks may be either improved or retired.
    - Improvement would consist of drainage, subsurface structural modifications, and grading modifications and would likely not noticeably change the character of the roadway. This option may be preferred because reliance on a single access route would: (*i*) reduce resilience in the event of damage from a natural event (e.g., storm, earthquake, etc.) or accident that resulted in the closure of a portion of the Loop Road; and (*ii*) eliminate the option of operating the Summit Area Loop Road as a one-way route on snow days when there are more non-astronomy vehicles in the summit area.
    - Retirement would consist of removing the hardened surfaces and retaining walls and then allowing the area to naturalize without further human intervention unless permits require additional measures. This option may be preferred if conditions continue to worsen and improvements, repairs, and/or maintenance become prohibitively expensive or other factors lead UH to this approach.
4. Project 4. Safety improvements as deemed appropriate throughout the extent of the road network; improvements such as additional guardrails, pullouts, and runaway truck ramps will be considered.

If the results of its evaluation studies indicate that they are cost-effective, UH will seek funding and project-level approvals for the projects listed above and other roadway needs as they become apparent.

5.2 UTILITIES

No expansion of or major modifications to utility infrastructure beyond that already approved is foreseen. Electrical, telecommunication, and related equipment and facilities will, however, require periodic maintenance and/or replacement to ensure that they remain fully functional and able to meet the changing needs of the facilities.

Should a non-UH entity propose and be authorized to install and operate new facilities or equipment that requires utility connections, it will be the responsibility of the project proponents to obtain approval for and install the necessary utility connections. UH will work with the project proponents and with the utility providers to provide the necessary services. This Master Plan does not address the siting, design, or other aspects of such utility extensions. These issues will be addressed through the project review process described in Part 3 of this Master Plan.

5.2.1 ELECTRICAL POWER

The approved electrical power supply facilities to the UH Maunakea Lands, including Halepōhaku and the upper slopes of Maunakea, are adequate to serve existing, approved, and all foreseeable

loads and demands over the life of this Master Plan.[40] No expansion of the power transmission and distribution system is likely to occur over the 20-year period of this Master Plan, except those required to serve new land uses that are approved in areas outside the astronomy sites, if any. Small data gathering land uses will likely not require electric power connections because they will be encouraged to run on batteries, PV panels, and/or other off-the-grid methods. Bathrooms and other facilities may require a power connection if their demand cannot be met by solar panels and batteries.

Individual astronomy sites may add PV panels to their rooftops, as Keck and Gemini did in early 2020, to produce electricity. Where PV panels are installed, they will reduce the amount of electrical power each facility draws from the Island's electrical grid, and that must pass through the transmission and distribution facilities on Maunakea. However, because the output of these panels will be a fraction of the amount of power required, they will not dramatically reduce the amount of electrical power that will be needed from the HECO system.

Ongoing maintenance of the existing electrical power system will continue throughout the UH Maunakea Lands during the term of this Master Plan. Maintenance is likely to include activities such as transformer, switchgear, relay, and conductor replacement as part of regularly scheduled maintenance or to replace failed equipment. Maintenance may include the replacement of sections of underground conduit and cable should they be damaged, become exposed, or fail. When replacement is necessary, it may result in minor changes to the equipment to comply with the then-current electrical code requirements.

5.2.2 COMMUNICATION AND DATA

MKSS and the astronomy facilities have confirmed that the existing fiber-optic lines that provide communication and data service to the UH Maunakea Lands are adequate to serve existing, planned, and foreseeable loads and demands at their facilities over the life of this Master Plan. New facilities, most likely data gathering projects beyond the astronomy sites, may require connections to the fiber-optic lines to provide real-time communications, remote operation, and data downloads. Efforts will be made to avoid the need for new hard-wire connections; however, if new connections are required, cabling will be placed underground in previously disturbed areas to the extent feasible.

The existing communication and data transmission facilities will continue to be maintained at a high level during the term of this Master Plan. Existing telecommunications equipment such as switches and routers will be replaced and upgraded as needed to ensure its continued reliability and to improve the data transfer rate along the existing fiber-optic system. These upgrades will support the continued trend toward remote observing, remote operation, and increased data production by new telescope instrumentation. It is possible that some of this maintenance may result in small changes to the system to comply with ever-evolving electrical codes and standards. UH anticipates that the vast majority (and quite likely all) of these will involve internal equipment

[40] The upgrade of the existing electrical power supply that has been approved as part of the TMT Project (CDUP HA-3568) is considered part of the "approved" electrical power system.

changes that will not affect the external appearance of the system or require substantial construction work.

Related to communications and data, the Optical Hawaiian Array for Nanoradian Astronomy project (described in Section 4.3.4.1) would involve the installation of fiber-optic cables between the optical/IR astronomy facilities. The project's fiber-optic cables would be placed within previously disturbed alignments, such as existing roadways or existing utility corridors. Furthermore, should the project advance, UH may take the opportunity to replace, maintain, or improve other utility infrastructure (e.g., electric, communication, and data) that is aging and, in a few locations, being exposed by erosion, in conjunction with that work to minimize ground disturbance.

5.2.3 WATER SUPPLY

Over the term of this Master Plan, potable water will continue to be provided as it is today – trucking water obtained from municipal sources in Hilo to Halepōhaku and the astronomy sites as necessary to satisfy demand.

The continued trend toward remote observing and operation along with the decommissioning of certain astronomy sites has reduced, and is likely to reduce even further, the use of water in the MKSR. Because remote observing and increased automation have reduced the number of people staying at Halepōhaku, water use is substantially lower than when the facility was fully utilized by the astronomy community. The future level of water use at Halepōhaku and the public facilities within the MKSR will depend largely on how access is managed and the extent to which educational and other uses become established. However, most of the alternatives that are being considered would leave water use below historical levels, and none would increase demand beyond that which could be readily satisfied by continuing to truck in water as needed to resupply the existing storage tanks.

All water supply facilities will be maintained regularly over the term of this Master Plan. As with all systems, tanks and piping may need to be refurbished and/or replaced over time. When replaced, minor changes may be necessary to comply with then-current codes and to facilitate the use of products that are available at the time the work is done.

5.2.4 WASTEWATER MANAGEMENT

There is no centralized wastewater collection system in the UH Maunakea Lands, and there is no plan to develop one over the term of this Master Plan. Accordingly, wastewater will continue to be handled as described below.

MKSR. Wastewater generated at each of the astronomy sites will be managed by each facility through permitted individual wastewater treatment systems. Those facilities that continue operation beyond 2033 will be required to properly abandon their existing wastewater treatment system and replace it with a zero-discharge wastewater system if they had not already done so.

Halepōhaku. All wastewater will be routed to permitted individual wastewater systems (septic tanks or holding tanks) or handled by an alternative method in compliance with applicable regulations.

5.3 FACILITIES TO MANAGE ACCESS

It is UH's policy to manage access to its Maunakea Lands in a manner that balances public access with UH's obligation to: (*i*) protect and conserve the cultural landscape, natural resources, and astronomical viewing conditions; (*ii*) responsibly manage activities to minimize potential adverse effects on the landscape and resources; and (*iii*) protect public health and safety. The CMP and the UH Maunakea Rules are consistent with and reflect this policy. All plans and regulations implemented by UH will be consistent with Article XII, Section 7 of the Hawai'i Constitution, which provides that "[t]he State reaffirms and shall protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by ahupua'a tenants who are descendants of native Hawaiians who inhabited the Hawaiian Island prior to 1778, subject to the right of the State to regulate such rights." The CMP, building on prior plans that addressed access, provides guidance and identifies many access management methods. After the CMP was approved, the UH Maunakea Rules were adopted; the rules provide authority for UH to implement many CMP provisions related to access management, including, but not limited to, the following:

- Requiring that all persons entering the UH Management Area have completed an "*orientation regarding cultural and natural resources, safety matters, and other relevant information*" (HAR § 20-26-5).
- Charging fees for entrance and parking (HAR § 20-26-6).
- Installing a gate or other access control structure to manage vehicular access to portions of the UH Management Area (HAR § 20-26-38(a)).
- Closing or limiting access to all or portions of the UH Management Area, when necessary to protect the public from hazardous conditions (HAR § 20-26-38(b)(1)).[41]
- Managing access by private vehicles "*...for public safety and welfare, for the protection of resources, and to reduce congestion*" (HAR § 20-26-38(b)(2)).
- Mandating public access by shuttle vehicles in lieu of private vehicles (HAR § 20-26-38(b)(2)).
- Establishing public access hours for the UH Management Area, provided that hunting shall be allowed pursuant to DLNR's hunting rules (HAR § 20-26-38(c)).

UH is moving forward on multiple fronts to exercise the authority that the adoption of HAR Chapter 20-26 granted. Two conceptual phases of managed access are envisioned at this time. The first is described in Section 5.3.1 and the second, which would likely involve the establishment of a shuttle system, is discussed in Section 5.3.2. UH will continue to gather input on its proposed managed access procedures and facilities, adjust them as necessary, and then seek the necessary approvals prior to their implementation. Input was sought during the review of the draft of this Master Plan. Input will continue to be sought from the CMS advisory boards and committees and the community.

[41] "Hazardous conditions" are defined as including but not limited to inclement weather conditions, construction or maintenance activities on or near the roadway or at astronomy sites, transportation of wide, heavy, or otherwise hazardous loads, or roadway congestion." The Rules further provide that notice of road closures or usage limitations must be provided through signage, roadblocks, closed gates, or other means reasonably calculated to provide public notice of the location and extent of closure.

UH will manage the number of vehicles, and thereby people, entering the UH Maunakea Lands in a manner that preserves the ambiance and feeling of the cultural landscape and minimizes adverse effects on the alpine and subalpine ecosystems and other resources.[42] The concepts presented below would achieve this by providing UH the means to manage access so that the number of vehicles (and thereby people) present at any one time would be less than the numbers present during peak periods prior to 2020; 2020 was anomalous due to the significant changes during the COVID-19 pandemic.

5.3.1 CONCEPTUAL INITIAL PHASE ACCESS MANAGEMENT FACILITIES

As presently conceptualized, the initial phase of managing vehicular access to UH Maunakea Lands above Halepōhaku will consist of the installation and operation of the modest facilities required to implement the fundamental access-related provisions of the UH Maunakea Rules (e.g., visitors must complete orientation, may park only in designated areas, may not use two-wheel-drive vehicles, etc.). In addition, during the peak visitor demand portion of the day, which has been sunset viewing, the number of certain vehicles able to proceed above Halepōhaku would be capped.[43]

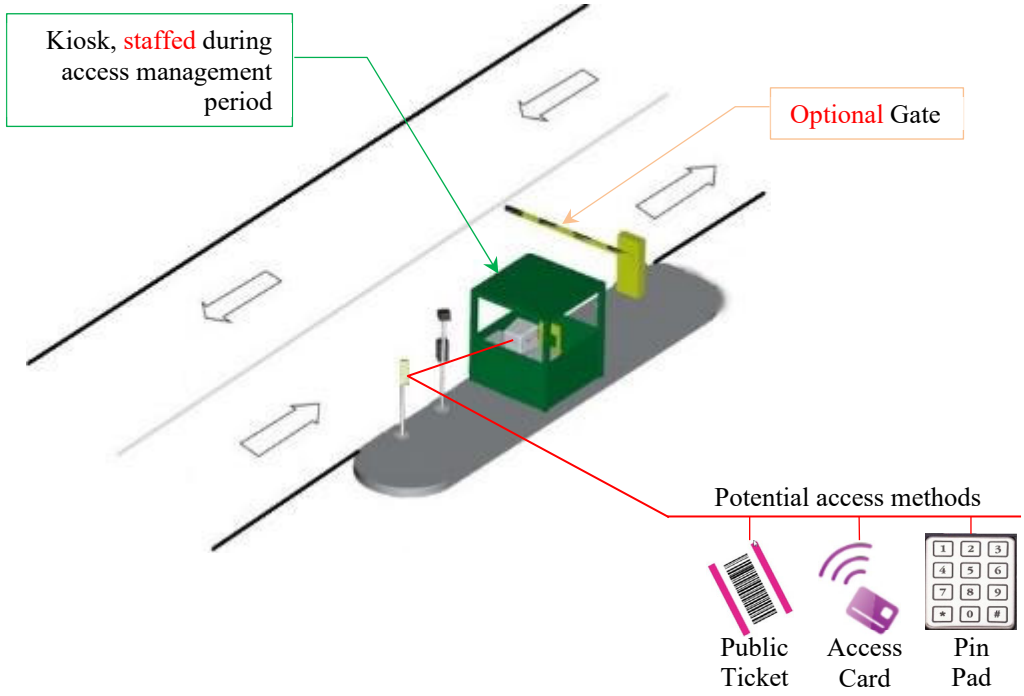
To effectively manage the number of vehicles advancing above Halepōhaku and increase compliance with the UH Maunakea Rules, certain facilities will be needed. The primary new facility may be a kiosk (Figure 5-2) on Mauna Kea Access Road adjacent to Halepōhaku. A gate may also be placed near the staffed kiosk. The portion of the Mauna Kea Access Road currently considered appropriate for these facilities includes where the road is adjacent to Halepōhaku (Figure 5-3). Several operational processes are under consideration as well (Figure 5-2). The location, scope, and design of the facilities, and the operation plan will be established following a detailed assessment of engineering and operational considerations, additional community input, and completion of the appropriate project review process (Part 3 of this Master Plan). Access management prior to completion of these facilities may be accomplished by stationing authorized personnel on the roadway to ensure that those vehicles and people proceeding above Halepōhaku are doing so in compliance with the applicable rules.

[42] It is envisioned that as access management concepts are further developed a number of CMP management actions components can be integrated and enhanced, such as the orientation and invasive species program. This will be one component of how access management will enable UH to further minimize adverse effects on the alpine and subalpine ecosystems and other resources.

[43] Current concepts include capping the number of non-2WD vehicles driven by nonresidents during the sunset viewing period (and requiring advance ticket purchase for access), and capping or not capping the number of non-tour, non-2WD vehicles driven by Hawai‘i residents during the sunset viewing period (and requiring free registration).

It is UH’s goal to have the outcome of this concept in place by the end of 2023.

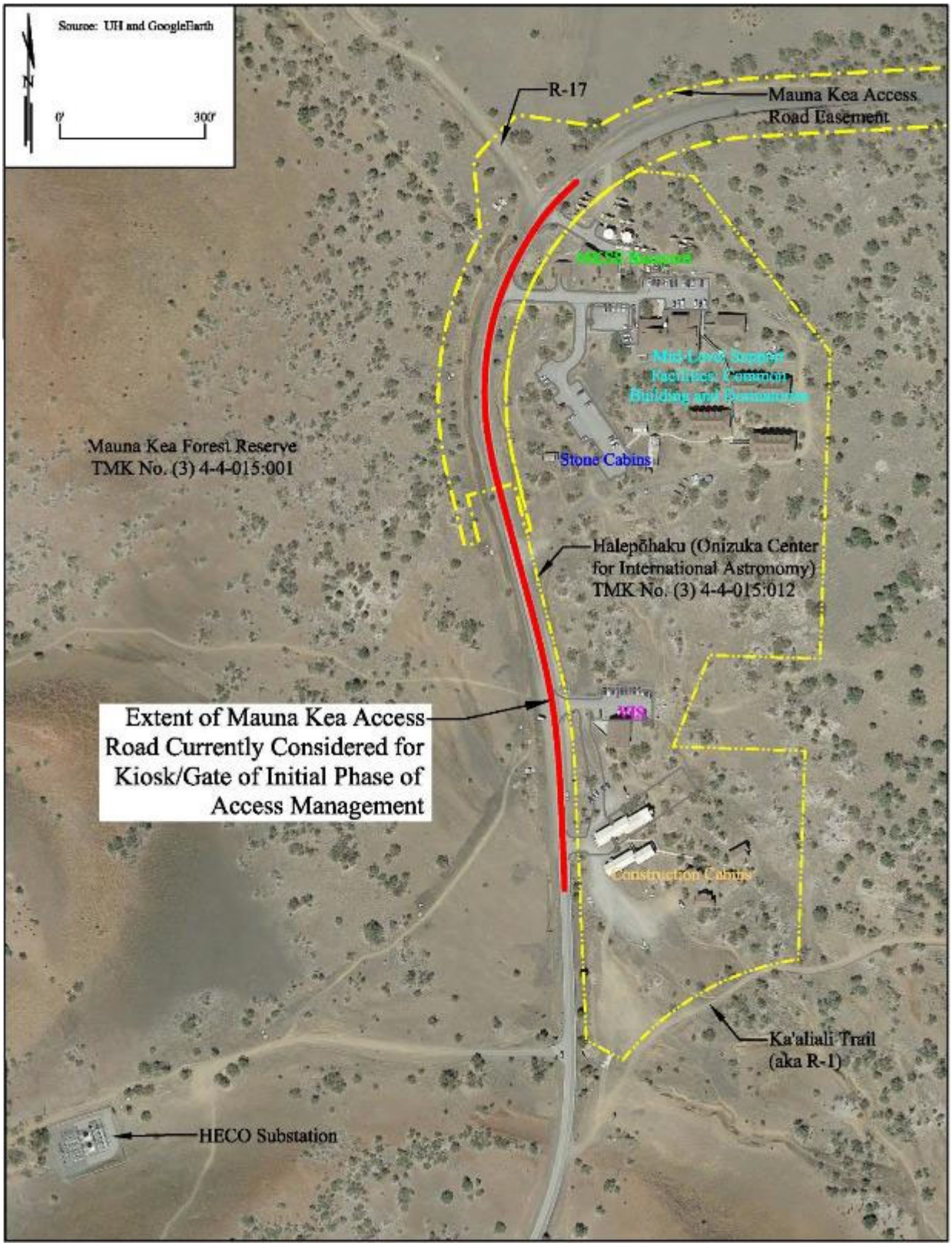
Figure 5-2: Schematic Illustrating Conceptual Initial Phase Facility Operation



Source: PSI

Accessory facilities would be needed wherever the kiosk, and potentially a gate, is built. These may include, but may not be limited to: (*i*) road/intersection improvements to enable "U" turns (this is needed to afford those who approach the kiosk, but are not allowed to proceed up the mountain, to safely turn around); (*ii*) lighting to provide safety in the vicinity of the access management facilities; (*iii*) utility connections to provide communications links and electrical power; (*iv*) signs to provide warnings and instructions to vehicle drivers; and (*v*) boulders or other barriers to inhibit circumventing the management facility.

Figure 5-3: Conceptual Schematic Indicating Area for Managed Access Initial Phase Facilities



Source: PSI

5.3.2 PHASE 2 ACCESS MANAGEMENT FACILITIES CONCEPT

As presently conceptualized, the second phase of managing public access to UH's Maunakea Lands involves the establishment and operation of a shuttle system. The specific new facilities on UH Maunakea Lands that would be needed to support a shuttle system are not yet well-defined because the shuttle concept has not yet been fully developed. However, they are likely to include, the following:

- The relocation of the facilities installed in Phase 1 or the installation of additional gates and/or kiosks within Halepōhaku or the adjacent portion of the Mauna Kea Access Road.
- Additional parking areas and/or shuttle storage/maintenance space at Halepōhaku, in the unlikely event that the shuttle terminal was located there.
- Shuttle stops, with shelter and signs, at various locations at Halepōhaku and in the MKSR, likely in areas used for visitor parking prior to the start of this phase.
- Accessory improvements such as lighting, utilities, and signs.

In addition to those facilities listed above that would be on UH Maunakea Lands, a new visitor parking area and shuttle base facility would likely be necessary on non-UH land somewhere along the Mauna Kea Access Road between Saddle Road and Halepōhaku. Signs and other accessory improvements would also likely be necessary on non-UH land below Halepōhaku. UH presently anticipates that it would seek to cooperate with the Department of Hawaiian Home Lands (DHHL) or another organization to operate the shuttle, especially if the base facility is on DHHL land. The cooperating organization, along with others in the community, would play a significant role in identifying and siting the facilities required to implement the shuttle phase.

Public input will continue to be sought and the economic viability of a shuttle system will continue to be evaluated and only implemented when warranted.

PART 3: IMPLEMENTATION

INTRODUCTION

Part 3 of this Master Plan discusses the implementation of this Master Plan, including the proposal review process, design guidelines, and amendment procedure. Part 1 of this Master Plan provides important context for the understanding of the facilities and land uses that may be proposed over the life of this Master Plan. Part 2 of this Master Plan discusses the facilities and land uses that UH believes may be proposed within the UH Maunakea Lands over the period of this Master Plan.

Any project proposed within the UH Maunakea Lands that meets the definition of "land use" under DLNR's Conservation District Rules (HAR Chapter 13-5) will need to obtain certain approvals (from UH, DLNR, and perhaps others);[44] proposals that are not a land use may also require approvals (from UH and perhaps others), but are not the subject of this Master Plan. In general, cultural practices and recreational activities do not involve land uses and are therefore not subject to this Master Plan.[45]

The proposals that are "land uses" and that UH believes may be advanced over the period of this Master Plan are discussed in Part 2 of this Master Plan. Only facilities and developments that UH believes are consistent with its mission, vision, goals, and objectives outlined in Part 1 are included. To that end, conservation-related actions, facilities to support public access and activities, astronomy facilities, and equipment to collect data and conduct research are the principal land uses presented in this Master Plan for the UH Maunakea Lands.[46] The inclusion of a facility or land use in this Master Plan does not mean that it will be officially proposed during the period of this Master Plan. Part 3 of this Master Plan includes a framework for UH to consider all proposals, whether they were identified in this Master Plan or not.

Proposals that are considered land uses will first need to be reviewed and approved by UH (Chapter 6). In addition, common requirements for such proposals include satisfying environmental disclosure requirements (e.g., HRS Chapter 343), obtaining regulatory approvals (e.g., HRS Chapter 6E), and acquiring a Conservation District Use permit or approval.

[44] The Conservation District Rules apply because UH Maunakea Lands are within the State of Hawai'i Conservation District, Resource subzone.

[45] Activities within the UH Maunakea Lands are governed by HAR Chapter 20-26 entitled "Public and Commercial Activities on Mauna Kea Lands" and may be subject to other regulatory requirements. All facilities, land uses, and activities also need to consider the CMP, which is about the management of the UH Maunakea Lands.

[46] As defined in the current Conservation District Rules, these types of facilities and developments would fall into the following land use categories: Land and Resource Management, Astronomy, Public Purpose, Data Collection, and Signs.

6 PROPOSAL REVIEW PROCESS

The University of Hawai‘i (UH) will only allow a project proposed on UH Maunakea Lands to proceed to subsequent planning steps after it has gone through a vigorous review for consistency with all applicable UH policies, plans, procedures, and other considerations outlined in Part 3 of this Master Plan. This rigorous review is necessary due to the area's sensitive environment and public interest in proposals on UH Maunakea Lands.

All proposals that represent new land uses[47] on UH Maunakea Lands, or that would substantially alter previously approved land uses on these lands, must complete the internal UH review and approval process described below before proceeding. These include but are not limited to: (*i*) work on any astronomy site, roadway, utility line, building, or other type of structure; (*ii*) excavation, filling, or change to surface topography; and (*iii*) planting or removal of vegetation. Proposals that are limited to interior work in an existing structure (e.g., projects that do not alter the exterior of an existing facility, such as installing a new instrument on a telescope) are typically not land uses; consequently, this review and approval process would not apply.

The internal UH review process outlined in this chapter is a framework for how UH determines whether a land use proposal within the UH Maunakea Lands may proceed with seeking permits and approvals from other regulatory authorities. The process begins with an entity submitting a proposal (Section 6.1) and then one or more phases of review depending on the proposal's suitability, scope, and scale. During the Phase 1 review (Section 6.2), the proposal is screened and assessed to establish whether it is appropriate for the UH Maunakea Lands. All proposals considered appropriate then advance to the phase 2 review (Section 6.3) and potentially other phases of review.

The process laid out here is separate from other applicable agency permits and approvals. After UH approves a particular land use proposal, the proposal proponent will need to obtain a permit or approval from DLNR or BLNR under DLNR's Conservation District Rules (HRS Chapter 183C/HAR Chapter 13-5) since all UH Maunakea Lands are also within the Conservation District. Because UH Maunakea Lands are state lands, the State environmental review process is triggered (HRS Chapter 343/HAR Chapter 11-200.1). Consultation with DLNR's State Historic Preservation Division is usually required, given the potential effects on historic property and Native Hawaiian burials (HRS Chapter 6E). These are just a few examples of the permits and approvals that may be required from other regulatory agencies. The UH review process laid out here does not replace any subsequent required approvals. However, the UH review process is intended to complement and support subsequent requirements and ensures early planning, community outreach, and agency coordination before a proposal is advanced.

[47] For purposes of this Master Plan, "land use" has the same meaning as defined under DLNR's Conservation District Rules at HAR § 13-5-2, which provides as follows: ""Land use" means: (1) The placement or erection of any solid material on land if that material remains on the land more than thirty days, or which causes a permanent change in the land area on which it occurs; (2) The grading, removing, harvesting, dredging, mining, or extraction of any material or natural resource on land; (3) The subdivision of land; or (4) The construction, reconstruction, demolition, or alteration of any structure, building, or facility on land." As further provided under HAR § 13-5-2, the term land use "does not include the taking of . . . wildlife that is regulated by state . . . hunting laws nor the gathering of natural resources for personal, non-commercial use or pursuant to Article 12, Section 7 of the Hawaii State Constitution or section 7-1, HRS, relating to certain traditional and customary Hawaiian practices."

6.1 SUBMITTING A PROPOSAL

A project proponent can officially submit its proposal by completing and submitting the most recent version of a Project Proposal Form, which will be available online after this Master Plan is finalized. UH and entities that have existing facilities within the UH Maunakea Lands submit their proposals via a Five-Year Outlook Plan, which they submit annually. The Five-Year Outlook Plan describes all the projects that each entity anticipates undertaking over the next five years.

The required content and format of the Project Proposal Form and the Five-Year Outlook Plan may change over the period of this Master Plan. At minimum, it is expected that these documents will always require the following information:

- Proposal name and purpose;
- Proposal location, if known;
- Proposal description, including: (*i*) square footage of new interior space (if any), (*ii*) necessary infrastructure requirements, (*iii*) construction crew and equipment likely required, and (*iv*) need for/estimate of area and volume of ground disturbance (if any); and
- Anticipated start date and duration.

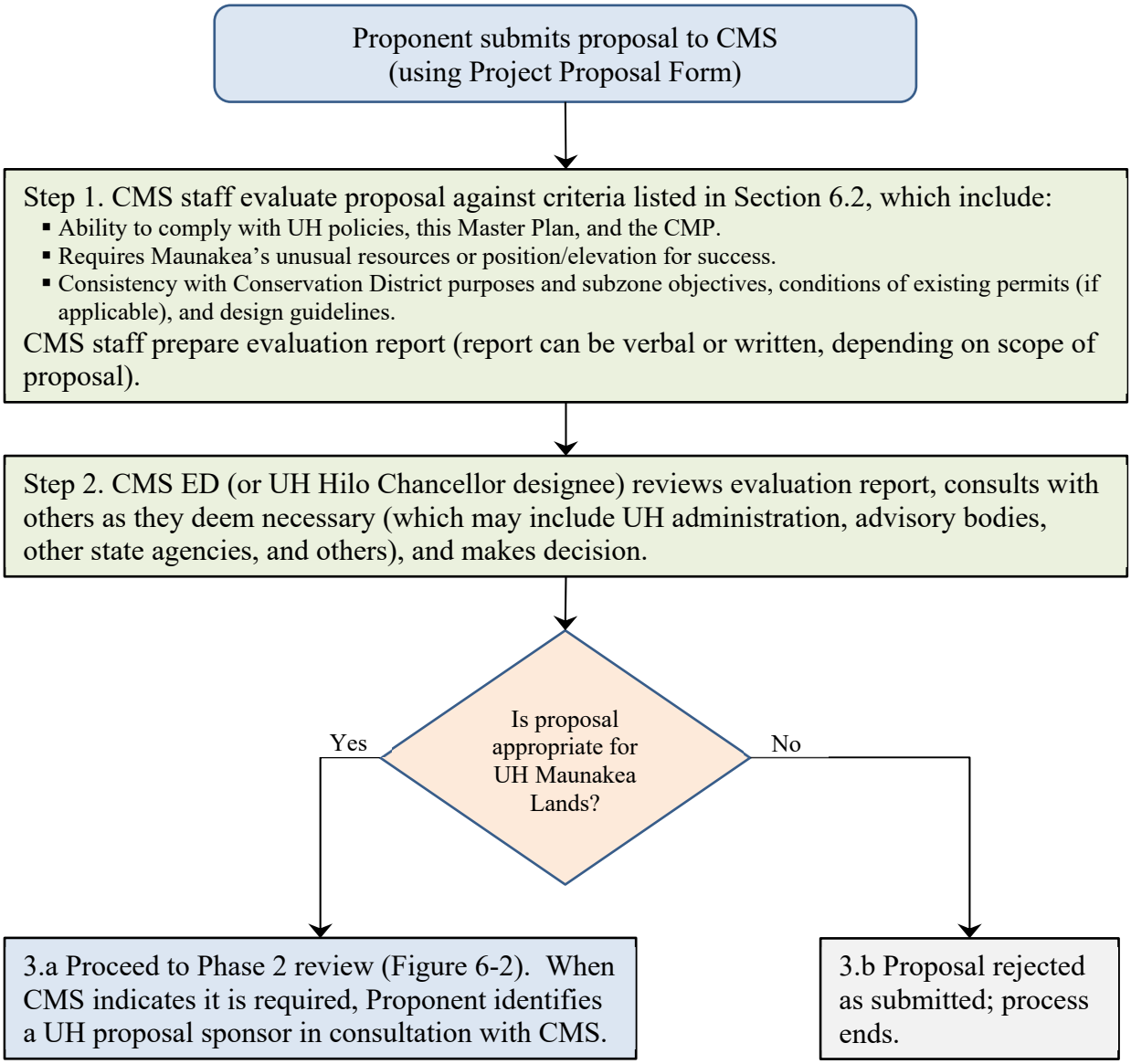
6.2 PHASE 1 SCREENING AND ASSESSMENT

The first phase of UH's review process involves the screening and assessment of a proposal to determine if it is appropriate for siting on UH Maunakea Lands. This phase of review is conducted after a proponent officially submits their proposal; the process is illustrated in Figure 6-1. The Phase 1 screening and assessment centers on the proposal's ability, based on the concepts provided, to address and/or comply with the following criteria:

- Compliance with applicable University policies, as amended, related to real property held by UH, such as RP 10.201.
- Consistency with the mission, vision, goals, and objectives of this Master Plan (Part 1, Chapter 1).
- Consistency with the CMP and promotion of resource conservation and sustainability.
- Extent to which the proposal has the potential to adequately:
    - Benefit from the conditions present within the UH Maunakea Lands;
    - Increase our understanding of Maunakea's resources;
    - Avoid, minimize, or mitigate reasonably foreseeable adverse impacts to Maunakea's resources;
    - If applicable, employ world-class technology, research techniques, and design;
    - If applicable and based on input from experts in the proposed field of study, the proposal addresses critical needs and has a high likelihood of contributing important information over its design life; and
    - Honor and benefit the Hawai‘i Island community, particularly with regard to their educational, cultural, social, environmental, and economic needs.

- Consistency with:
  - The requirements of the HRS Chapter 183C, and HAR Chapter 13-5, regarding land uses within the State Conservation District;
  - The terms and conditions of CDUPs that have been issued that are relevant to the proposal; and
  - The Design Guidelines set forth in Part 3, Chapter 7, or, where inconsistent, provide adequate justification for any variance from those guidelines that is being sought.

Figure 6-1: Phase 1 Screening and Assessment Process Flowchart



Source: UH

UH will only entertain proposals that it believes meet the criteria listed above. CMS staff will be the first to assess the proposal and prepare a written and/or verbal report (Step 1). The CMS Executive Director (ED) (or UH Hilo Chancellor designee) will consider the staff's report and may seek input from others (Step 2). Those sought out for early input will depend on the scope of the

proposal and may include affected units within UH, members of the CMS advisory bodies, regulatory agencies with jurisdiction or expertise, Hawai‘i Island community, Native Hawaiian cultural practitioners, or other interested persons. In general, input will be sought from people that (*i*) have expertise in the field of research or endeavor being proposed, (*ii*) have expertise concerning potential impacts, and (*iii*) operate facilities or conduct activities near the proposed location, if a specific location has been identified. Once a decision has been reached, CMS will prepare a letter to the proposal proponent (Step 3) outlining if the proposal is appropriate for UH Maunakea Lands or not, and if not, why.

At the discretion of the CMS Executive Director, UH may require that the proponent identify a UH sponsor. The input process described above may aid in identifying the proposal sponsor if one has not already been identified.[48] The UH sponsor should be knowledgeable and supportive of the proposal and should assist CMS with future proposal review steps, if necessary. The sponsor should be project specific; for example, an IfA astronomer might sponsor an astronomy project, or the UH Hilo Department of Geography and Environmental Science might sponsor a weather station proposal.

6.3 PHASE 2 PROPOSAL REVIEW

Most proposals found to be appropriate for UH Maunakea Lands during the Phase 1 screening and assessment will advance to Phase 2 review with no action required by the proposal proponent. However, there are a few exceptions: (*i*) if the proposal proponent was directed to identify a UH sponsor during Phase 1, then the Phase 2 review will only commence once the UH sponsor has been selected; and (*ii*) if the proposal is a decommissioning, then the proposal proponent shall prepare and submit a Notice of Intent (NOI) and a Phase 1 Environmental Site Assessment (ESA), prior to the commencement of the Phase 2 review.

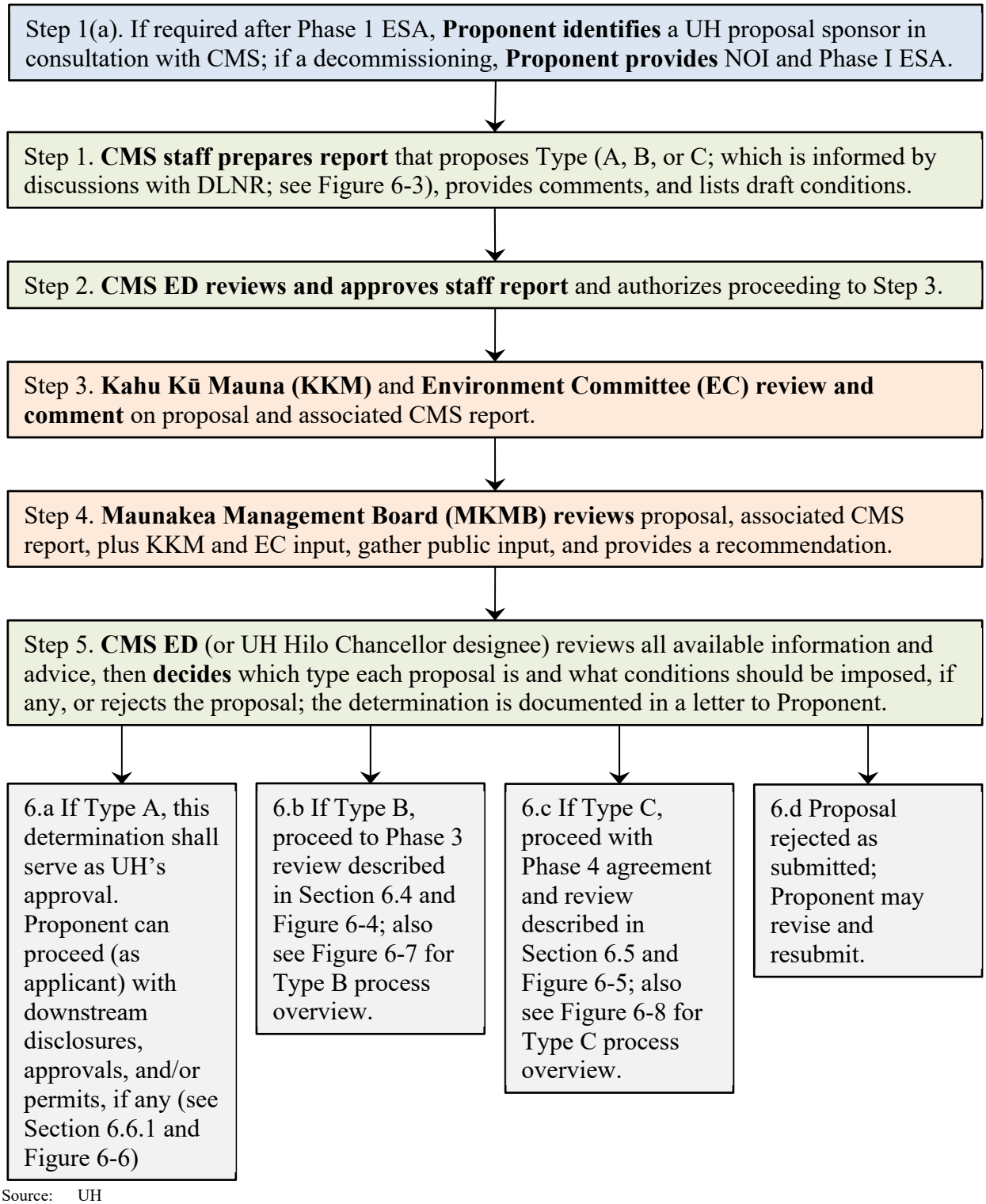
Figure 6-2 provides a flowchart illustrating the Phase 2 review process. The process involves CMS staff, the CMS Executive Director, CMS advisory bodies, and culminates in a determination by the CMS Executive Director (or UH Hilo Chancellor designee). The primary purposes of the Phase 2 review include:

- *Establishing the proposal type*. There are three proposal types (Type A, Type B, and Type C); Figure 6-3 illustrates the considerations associated with establishing the proposal type. Proposal types are generally determined based on project complexity and impacts, requiring more intense review as we move from Type A to Type C.
- *Obtaining public input*. During this phase of proposal review (and subsequent phases, where applicable), information regarding the proposal will be made available to the public with the MKMB agenda and public input will be sought prior to and during the MKMB meeting. The availability of the proposal information and MKMB’s agenda will be announced via

[48] Project proponents are encouraged to plan their project and work with a UH sponsor before and after the review process. However, any relationship between the proponent and sponsor before or after the project review process is beyond the scope of the review process. In the case of projects proposed by CMS, the project proponent will be the CMS project manager and that individual will not be involved in drafting the staff report in this or subsequent project review processes.

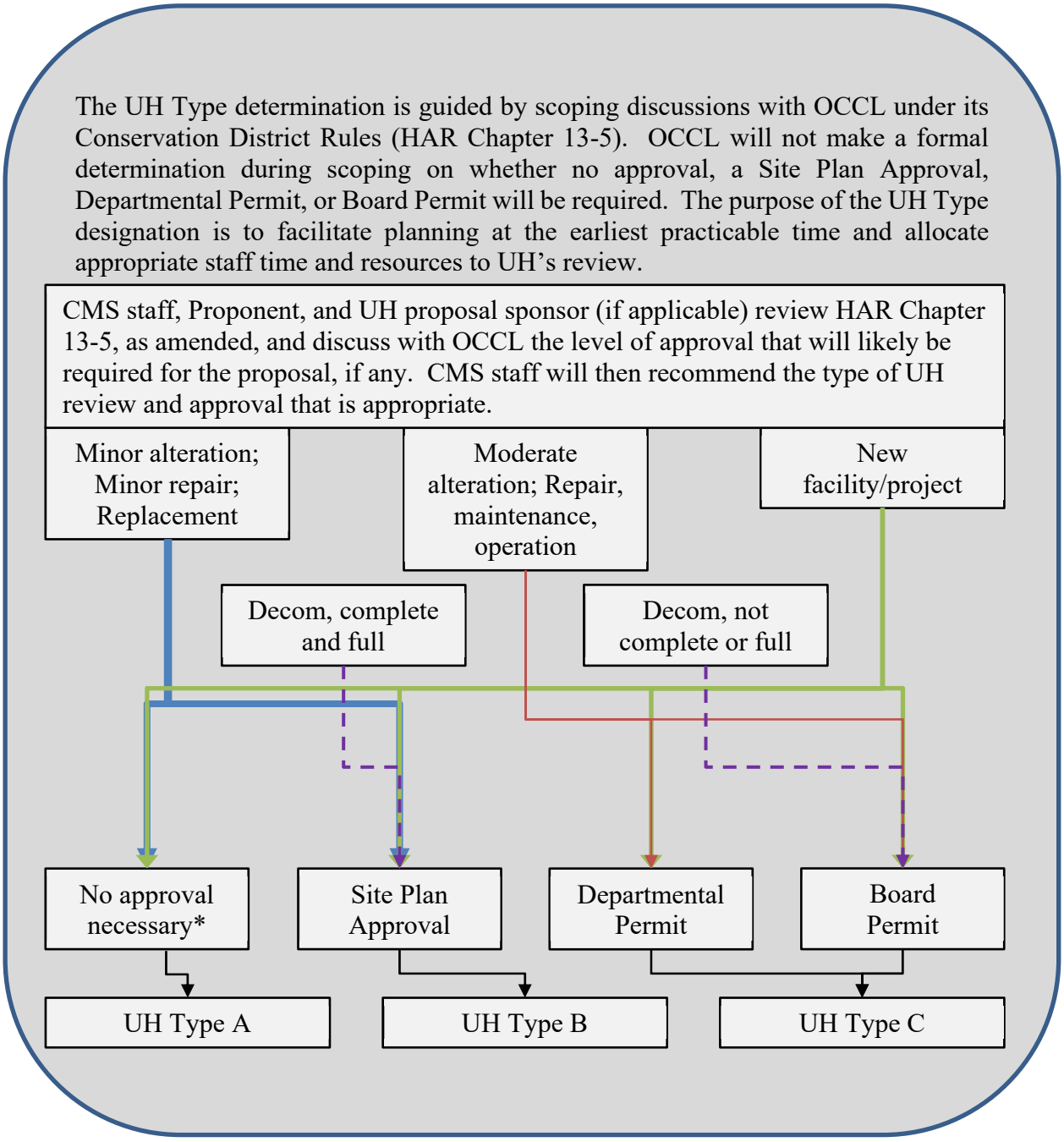
CMS newsletters and/or other means, including measures to inform and involve the Native Hawaiian community.

Figure 6-2: Phase 2 Review Process Flowchart



Source: UH

Figure 6-3: Establishing Proposal Type Flowchart



Note: * In some cases, no approval is necessary from DLNR/BLNR; however, the Chairperson of BLNR has discretion regarding whether a permit or approval is required and what type of permit or approval is appropriate.
Decom = decommissioning; "complete" refers to complete removal; "full" refers to full restoration.
Source: UH

- *Providing general comments*. During this first detailed review of the proposal, the CMS staff and advisory bodies will provide general comments typically consisting of (*i*) requests for additional information, such as more detailed descriptions of certain proposal components, field studies, and technical reports; (*ii*) advice on potential measures to avoid,

minimize, or mitigate proposal impacts; and (*iii*) if the proposal is a Type C proposal, input on the Implementation Plan content.

- *Identifying potential conditions*. For all proposal types, except Type A, this is the first of at least two UH review cycles. Therefore, the conditions identified during Phase 2 review may be dropped, modified, and/or expanded during subsequent phases of review. In the case of Type A proposals, the conditions identified during Phase 2 review will be fully developed and the only conditions placed by UH on the proposal.

CMS and the advisory bodies have latitude to identify secondary purposes of the Phase 2 review depending on the scope, scale, or type of proposal.

In Step 1 of the Phase 2 review, CMS evaluates the proposal and prepares a staff report that addresses the primary purposes listed above; this includes a recommendation regarding the proposal type – Type A, Type B, or Type C – based on the considerations outlined in Figure 6-3. CMS may confer with the proposal proponent, UH sponsor, DLNR, and others to assist and inform its evaluation. In Step 2, the CMS ED reviews and approves the staff report before it goes to the CMS advisory bodies for consideration in Steps 3 and 4. The advisory bodies review the proposal and CMS' recommendation and provide their input on the matter to the CMS ED (or UH Hilo Chancellor designee) who then, in Step 5, makes a formal determination regarding the proposal's type, the proposal comments that will be provided to the proponent, and which conditions will be attached to the proposal. Those decisions will be documented in correspondence from UH to the proposal proponent.

For proposals determined to be Type A, the UH review process ends at the completion of the Phase 2 review. For other proposal types, the UH review process proceeds to Phase 3 or Phase 4, as discussed in Sections 6.4 and 6.5.

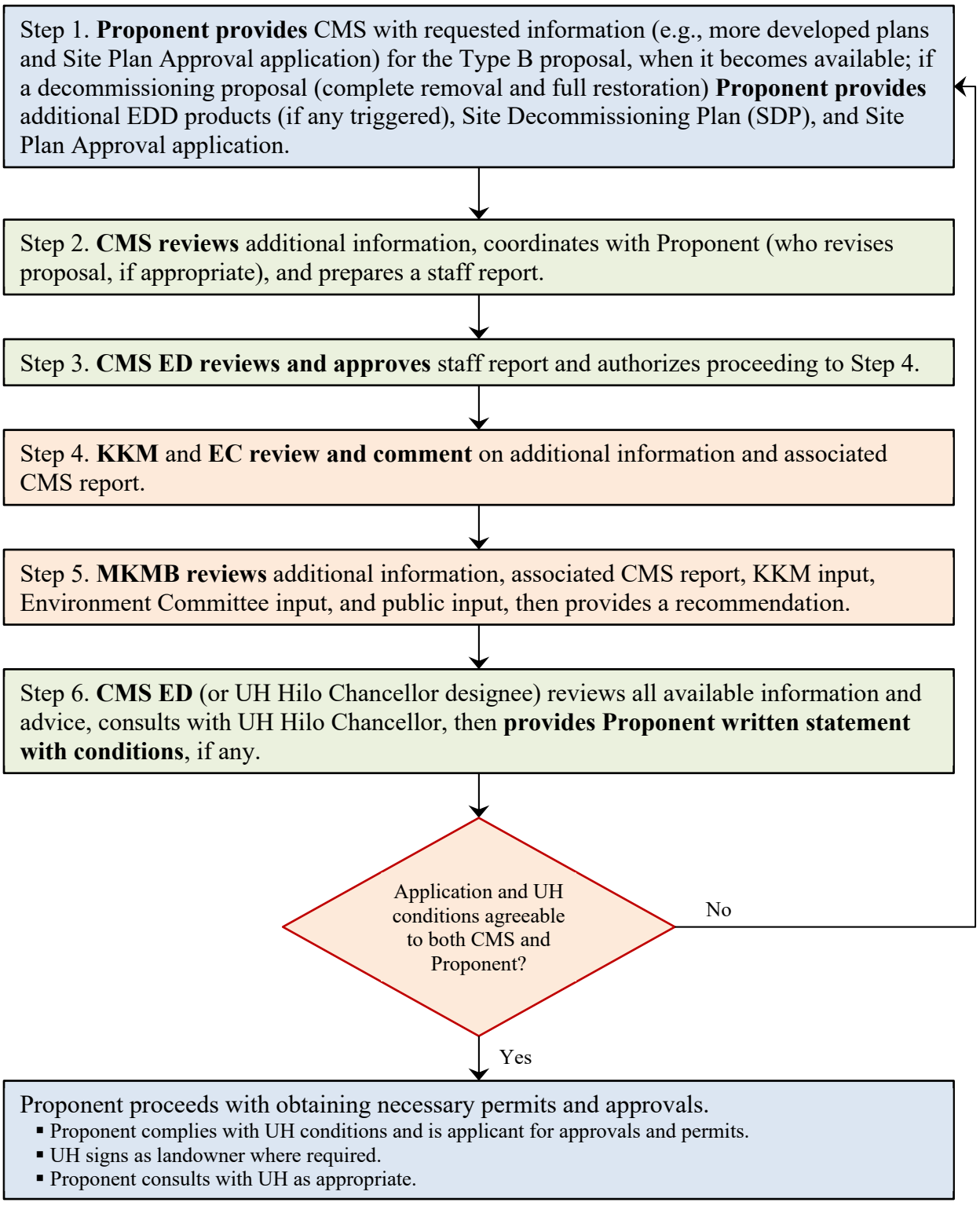
6.4 PHASE 3, TYPE B PROPOSAL REVIEW

Those proposals determined to be Type B will proceed to the Phase 3 review. The Phase 3 review will commence once the proposal proponent provides any information requested at the completion of the Phase 2 review (Step 1). In the case of decommissioning proposals that intend to completely remove their facility and fully restore the site, the proponent shall provide additional Environmental Due Diligence products (EDD), if any are required, a Site Decommissioning Plan (SDP), and a Site Plan Approval application.

Figure 6-4 summarizes the Phase 3, Type B proposal review process. The process is similar to the Phase 2 review in that the process involves a review and report by CMS staff (Step 2), the review and approval of that report by the CMS Executive Director (Step 3), review and consideration of the proposal by the advisory bodies (Steps 4 and 5) and public (Step 5), and a written statement being provided to the proponent at the completion of the Phase 3 review process (Step 6). The scope of the Phase 3 review is different from the Phase 2 review in that Phase 3 places emphasis on (*i*) advising the proponent on how best to comply with the CMP; (*ii*) advising the proponent how to avoid, minimize, or mitigate potential proposal impacts; and (*iii*) developing conditions that UH will place on the proposal. CMS and the advisory bodies have latitude to widen the scope of the Phase 3 review depending on the scope, scale, or type of proposal. It is also anticipated that

during Step 2, CMS and the proponent will work to resolve, via project clarifications, modifications, or other means, concerns raised by CMS and its advisory entities.

Figure 6-4: Phase 3, Type B Proposal Review Flowchart



Source: UH

If the proposal proponent finds the UH conditions acceptable and both the proposal proponent and UH find the Site Plan Approval application acceptable, then UH will sign the Site Plan Approval application as "landowner" and the project proponent may proceed with obtaining any and all necessary permits and approvals. Such permits and approvals are beyond the scope of the UH review process outlined in this Master Plan and may include, but are not limited to, HRS Chapter 343, HRS Chapter 6E, and building permits. The appropriate party must obtain all required approvals and permits, if any, prior to implementing the Type B proposal.

If the proposal proponent finds the UH conditions unacceptable, then the proposal proponent shall provide additional information and/or modify their proposal and return to Step 1 of the Phase 3, Type B proposal review.

6.5 PHASE 4, TYPE C PROPOSAL REVIEW

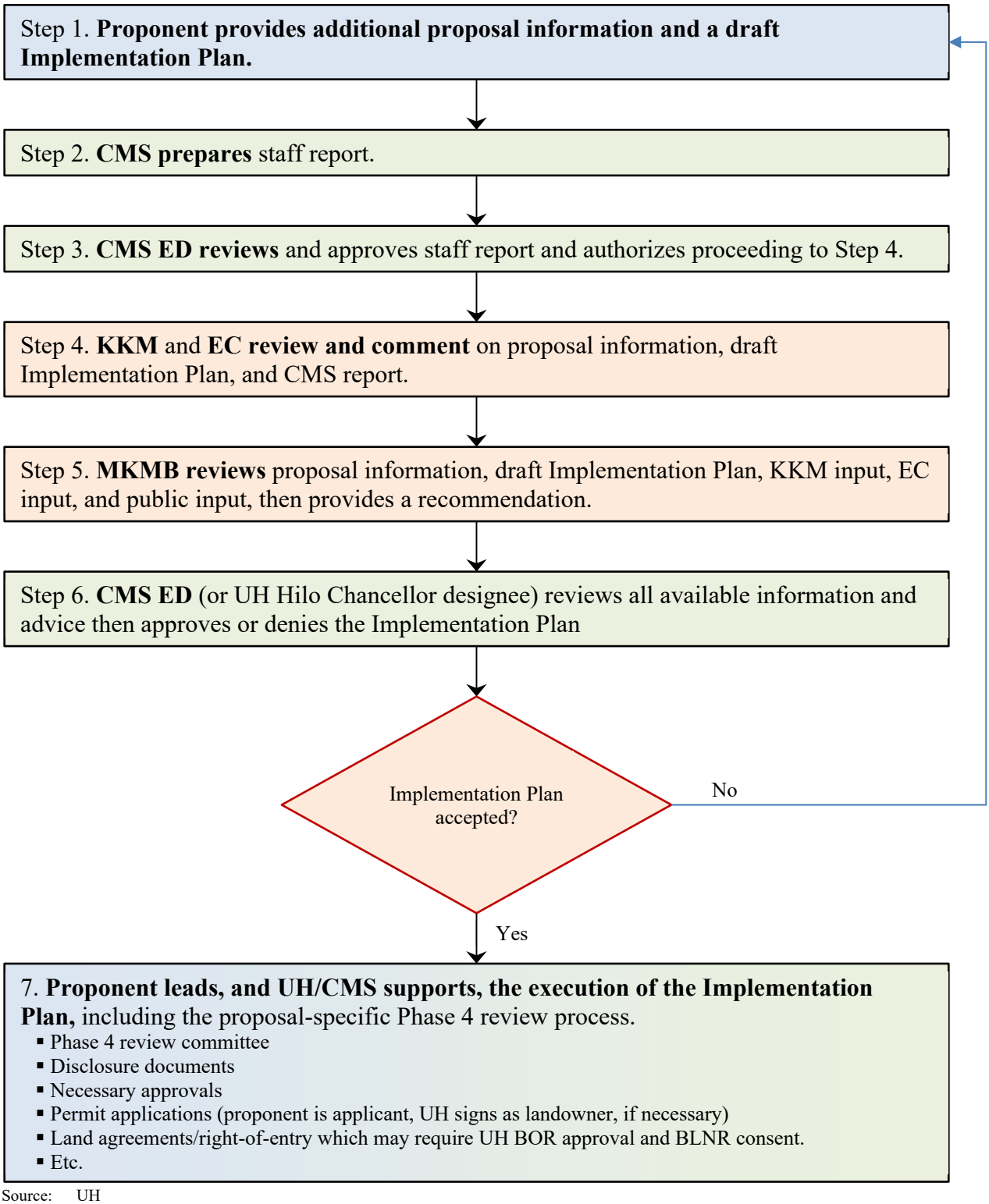
Type C proposals are those that are assessed during Phase 2 review as likely to require a departmental (i.e., DLNR) or board (i.e., BLNR) CDUP. Developing plans for and obtaining authorization to construct and operate a Type C proposal on Maunakea is a more intensive process that entails early and continuing coordination with UH, DLNR, the public (with special emphasis on the Native Hawaiian and Big Island communities), and other county, state, and federal agencies.

The Phase 4, Type C proposal review process is summarized in Figure 6-5 and consists of two parts: (*i*) the development of a proposal-specific Implementation Plan, which are Steps 1 through 6 of the Phase 4 review process; and (*ii*) the implementation of the proposal-specific Implementation Plan, which is Step 7 of the Phase 4 review process. The proponent shall draft an Implementation Plan for UH's review and approval. The draft Implementation Plan shall include the proposal's scope,[49] schedule, budget, and long-term operation and maintenance plan. The draft Implementation Plan shall be proposal specific, but should consider the following topics:

- Roles and responsibilities.
- Anticipated disclosures, approvals, and permits triggered.
- Points of UH/CMS review throughout disclosure, approvals, and permit process.
- Membership/makeup of a proposal-specific Phase 4 review committee.
- Procedure to be followed at each point of UH/CMS review.
- Schedule and review period durations.
- Other proposal specific considerations.

[49] The scope should include measures developed thus far that the proponent has incorporated into its proposal to avoid, minimize, and mitigate potential adverse effects to the cultural landscape, natural resources, and nearby facilities.

Figure 6-5: Phase 4 Type C Proposal Review Flowchart



Source: UH

Once the proponent has provided the draft Implementation Plan, CMS and its advisory bodies will review and consider it as outlined in Figure 6-5 (Steps 2 through 6), which is similar to the Phase

2 review process. If the resulting Implementation Plan is acceptable[50] to UH and the proposal proponent, the proponent will lead the implementation of that plan. If the proposal proponent or UH find the Implementation Plan unacceptable, the proposal proponent may modify their proposal and return to Step 1 of the Phase 4, Type C proposal review process.

The Implementation Plan should include a proposal-specific Phase 4 review committee that consists of members of the CMS advisory bodies and community members that are knowledgeable in various aspects of the proposal and its potential impacts, including potential impacts to Native Hawaiian cultural practices. It is further anticipated that this committee will review proposal materials, such as design drawings, environmental disclosure documents, and permit applications as the planning and review process progresses.

6.6 OVERVIEW OF REVIEW PROCESS BY PROPOSAL TYPE

The following subsections provide an overview of the review process for each proposal type.

6.6.1 TYPE A

Type A proposals are those expected to have negligible adverse impacts and are anticipated not to require a Site Plan Approval or CDUP. Between 2000 and 2020, most proposals at existing facilities on UH Maunakea Lands were classified as similar to Type A projects because they tended to consist of efforts to keep existing facilities operating efficiently and safely and did not entail structural modifications or ground disturbance.[51] This trend is expected to continue in the coming years. Proposals involving the following may be considered Type A proposals:

- Repairs to existing equipment and structures.
- Like-to-like replacement of component external parts.
- Painting and resurfacing.
- Small new external equipment additions (e.g., cameras and weather sensors mounted on existing facilities, roof-mounted solar panels, and signs).
- The installation and operation of small data gathering instruments for periods of time measured in months.

As with all proposals, these Type A proposals would need to complete Phase 1 and Phase 2 reviews (Sections 6.2 and 6.3). Given the small scale of these proposals and their negligible potential for adverse impact, the review process would be relatively short, on the order of 2 to 4 months. Figure 6-6 provides an overview of the process and timeline for Type A proposals.

[50] The only proposal items being found acceptable at this step are those in the bullet list above related to process. Although the draft Implementation Plan shall include proposal scope, schedule, budget, and other conceptual materials, those items are only included for context and shall not be considered approved or accepted by any actions at Step 6 of the Phase 4 review.

[51] The terms Type A, Type B, and Type C were not used prior to this Master Plan. The vast majority of projects at existing facilities were characterized as a "minimal" project over the last 20 years.

Despite being Type A, additional permits and approvals may be required before these projects are implemented. Such permits and approvals are beyond the scope of the UH project review process outlined in this Master Plan and may include, but are not limited to, CDUP and building permits. The proposing party must obtain all required approvals and permits, if any, prior to implementing the project.

6.6.2 TYPE B

Type B proposals are those that are likely to require Site Plan Approvals from DLNR. Between 2000 and 2020, a small proportion of the proposals at existing facilities, generally no more than one or two per year across the 13 astronomy facilities and elsewhere in the UH Maunakea Lands, would likely fit in the category of Type B projects.[52] Proposals involving the following may be considered Type B proposals:

- Modifications to an existing facility that involve a noticeable change in its outward appearance (e.g., a change to a façade or building addition).
- Reconstruction of infrastructure that involves ground disturbance.
- Decommissioning proposals that intend complete removal and full restoration and the incorporation of adaptive management lessons learned from previous decommissioning projects.
- The installation and operation of data gathering instruments for periods of time measured in single-digit years.

As with all proposals, Type B proposals would need to complete Phase 1 and Phase 2 reviews (Sections 6.2 and 6.3), then complete a UH Phase 3 review (Section 6.4) prior to proceeding with other disclosure, approval, and permit processes. Figure 6-7 provides an overview of the process and timeline for Type B proposals. It is anticipated that a Type B proposal would take from 8 months to 1.5 years to complete the UH review process if the proposal proponent provides requested information and a draft Site Plan Approval application within 3 months of the completion of Phase 2.

At the conclusion of the Type B process, the proposal proponent is responsible for obtaining all necessary permits and approvals. Such permits and approvals are beyond the scope of the UH review process outlined in this Master Plan and may include, but are not limited to, HRS Chapter 343, HRS Chapter 6E, Site Plan Approval, and building permits. The appropriate party must obtain all required approvals and permits, if any, prior to implementing the Type B project.

6.6.3 TYPE C

Type C proposals are likely to require departmental (e.g., DLNR) or board (e.g., BLNR) CDUPs. It is anticipated that Type 3 projects will be rare during the term of this Master Plan. Proposals involving the following may be considered Type C proposals:

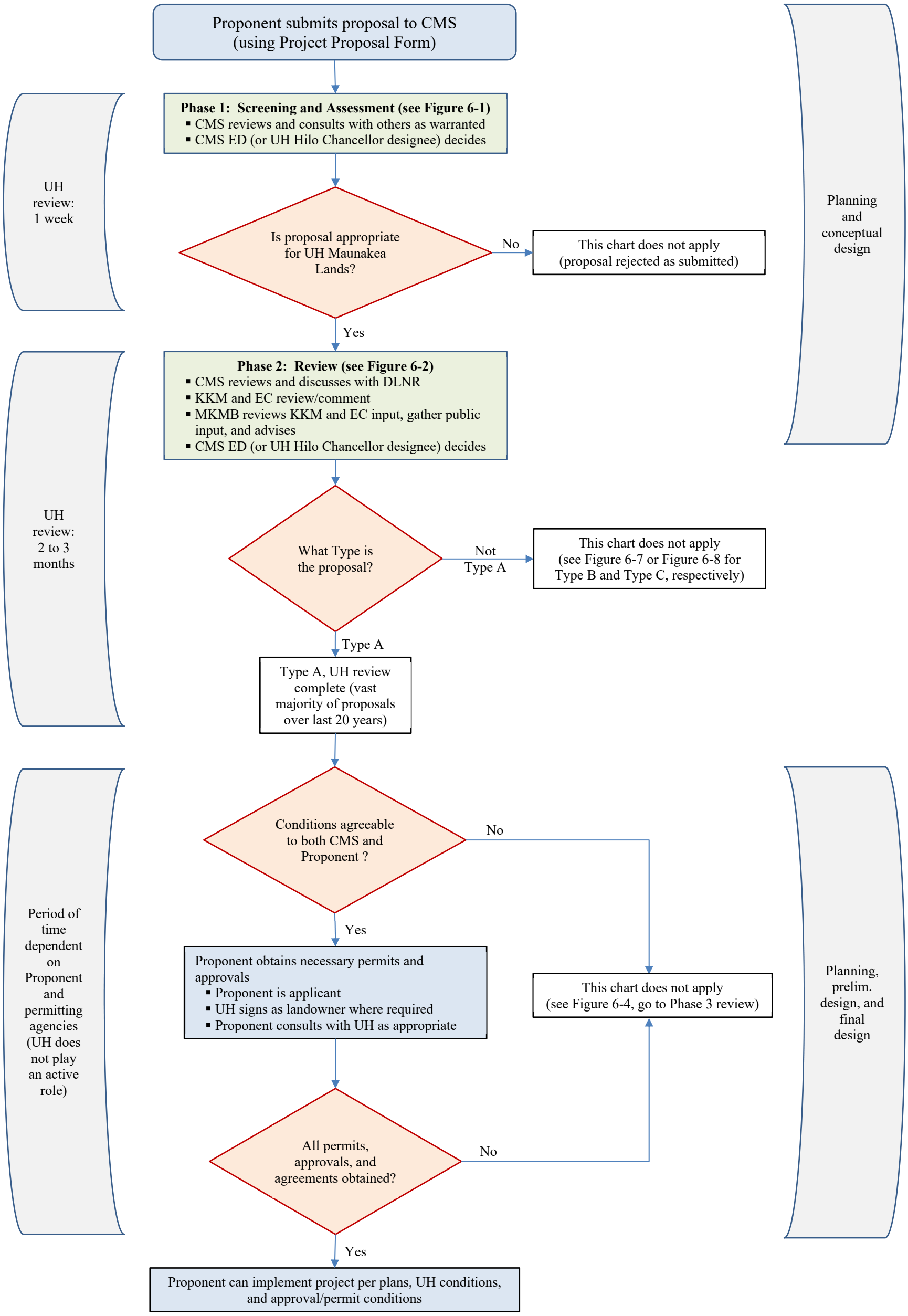
[52] The term Type B was not in use before this Master Plan. A small portion of the projects were characterized as "minor" projects of the last 20 years.

- Astronomy site modification.
- Astronomy site recycling.
- Decommissioning projects that do not intend a complete removal and full restoration.
- Proposals that require large volumes of earth movement.

As with all proposals, Type C proposals would need to complete Phase 1 and Phase 2 reviews (Sections 6.2 and 6.3), then, unlike other proposal types, gain UH acceptance of a proposal-specific Implementation Plan, which the proponent will then implement (Section 6.5). Figure 6-8 provides an overview of the process and timeline for Type C proposals. It is anticipated that Type C proposals would take from 9 months to 1.5 years to achieve approval of their proposal-specific Implementation Plan if the proponent develops a thorough Implementation Plan within three months of completing Phase 2.

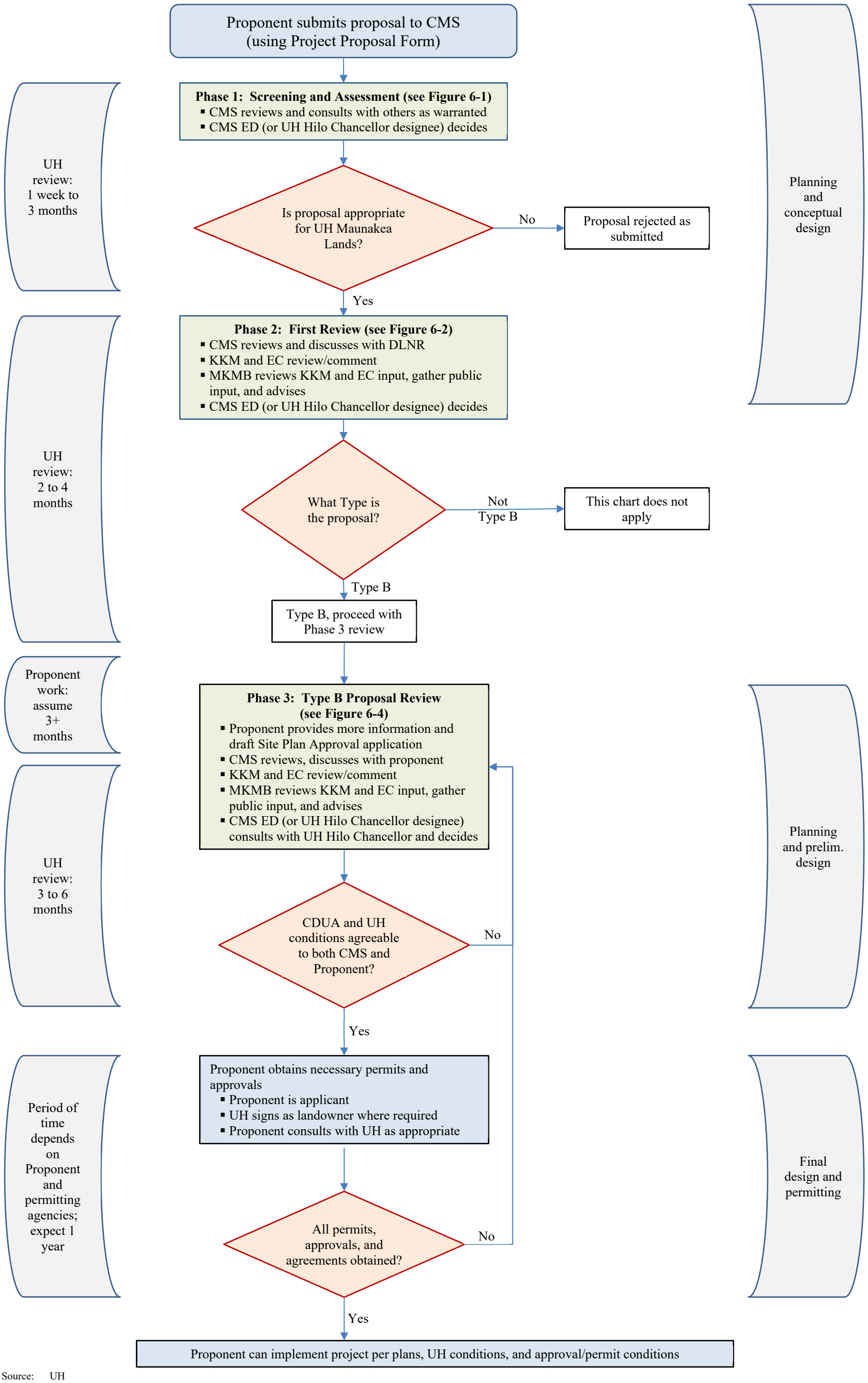
Although it is the proponent's responsibility to comply with all applicable rules and regulations, obtain necessary approvals, and acquire necessary permits, UH will remain engaged throughout the execution of the Implementation Plan so that the proponent can benefit from UH's knowledge and experience and the input from those on the Phase 4 review committee.

Figure 6-6: Review Flowchart and Timeline: Type A Proposal



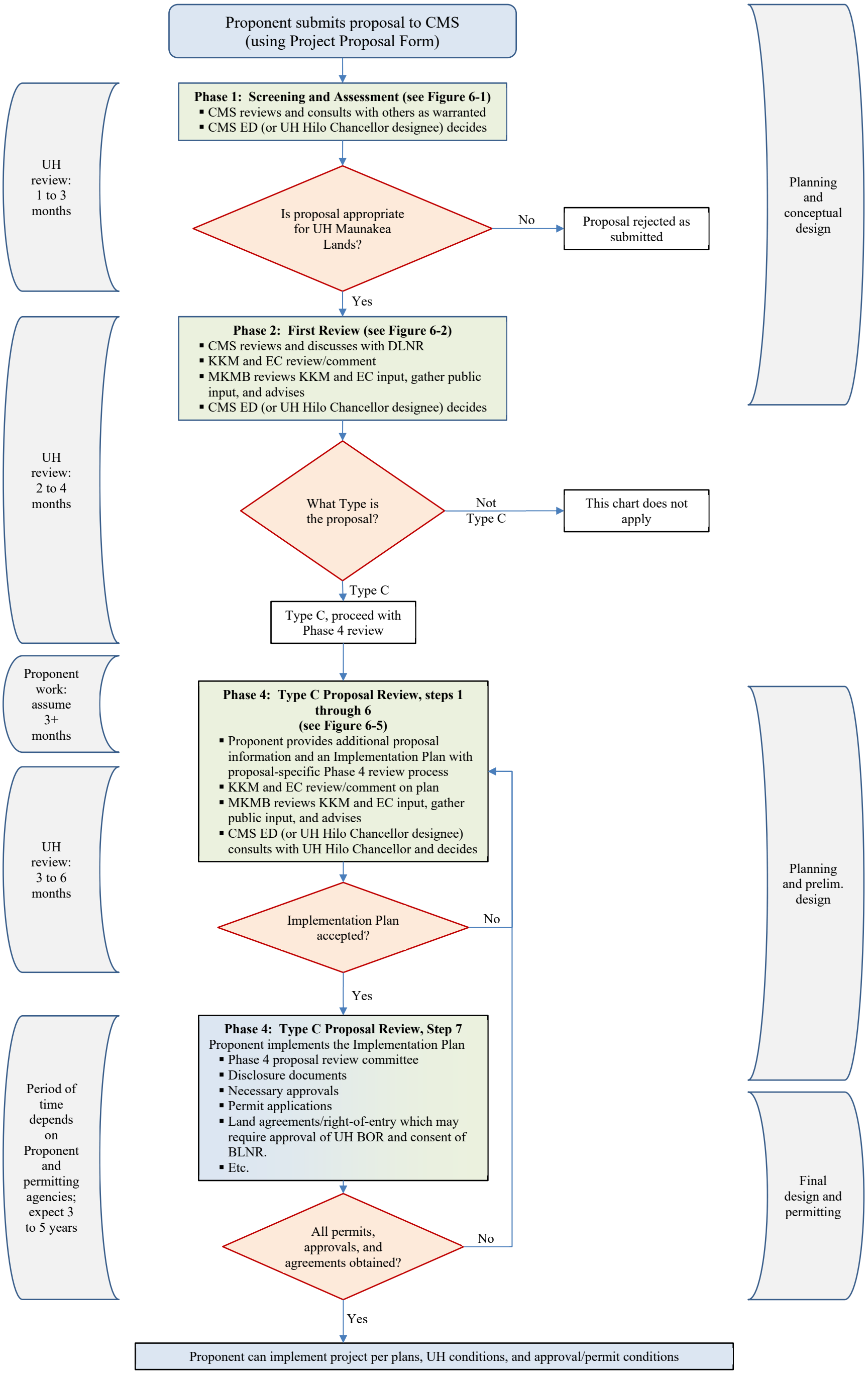
Note: If conditions are not agreeable or permits not obtained, then the proposal moves to Phase 3 review to allow for more discussions and input.
Source: UH

Figure 6-7: Review Flowchart and Timeline: Type B Proposal



Source: UH

Figure 6-8: Review Flowchart and Timeline: Type C Proposal



Source: UH

7 DESIGN GUIDELINES

This chapter provides guidelines for astronomy facilities in the MKSR, certain other facilities in the upper slopes of Maunakea, and structures in Halepōhaku. These guidelines, combined with the proposal review process in Chapter 6, are meant to provide early guidance and community input in a manner that prepares proposals for future permits and approvals by minimizing potential adverse effects, applying lessons learned to date, and encouraging consistency among current and future land uses. All proposals should also consider the Future Land Use (FLU) management actions in the CMP. UH will be actively evaluating project designs and specifications from initial concept through final design. This will be true whether a project originates within UH or is proposed by a sub-lessee or other 3rd party.

These design guidelines apply to all structures that will remain on the site once construction activities are complete; they do not apply to temporary items that are only present at the site during construction. For example, while the guidelines discourage the use of fences, during the construction phase, temporary chain-link fencing may be used to delineate and secure the construction site.

7.1 GUIDELINES APPLICABLE TO ALL PROPOSED PROJECTS

The following specific guidance regarding the management of native excavated material and imported construction material should be followed by all proposed projects within the UH Maunakea Lands unless a proponent demonstrates a compelling reason for an exception and incorporates community input via the CMS advisory groups regarding the exception.

7.1.1 MANAGEMENT OF NATIVE MATERIALS

Excavated native rock and soil material should be managed (i.e., removed and stockpiled) in a way that allows the site to be restored as nearly as possible to its original condition when the facility is decommissioned. Accordingly:

- The amount of native rock material disturbed by a project should be kept to a minimum consistent with the design requirements of the facility.
- Native material should not be crushed, or otherwise altered, more than necessary to move it to a stockpile or amended to the point where it cannot readily be used during the site restoration process unless it consists of massive lava flows and will be used as on-site fill material after it is crushed.
- All native material that is removed during the course of construction should either be used in an aesthetically acceptable way on-site, used for restoration projects elsewhere in the UH Maunakea Lands, or stored at the Batch Plant Staging Area or other location identified during the project review and approval process, if applicable. If it is stored off-site, provisions should be made for returning it to the site when the facility is decommissioned.

7.1.2 IMPORT OF AGGREGATE MATERIALS

The importing of aggregate materials shall be kept to a minimum, shall not occur unless material already present in the project area is demonstrably insufficient or of unacceptable quality, and always comply with CMP management actions. Any imported aggregate material must be removed to the maximum extent practicable when the facility is decommissioned.

Where imported aggregate material must be used, it shall not be mixed with native material or be visible at the ground surface after construction is complete, except in parking areas. Material imported for fill and parking area surfacing shall be consistent with the surrounding native material to the degree possible (i.e., have a color like that of the adjacent lava rock or cinder).

In the case of concrete batching, aggregate materials may be imported to the Batch Plant Staging Area and utilized in the production of concrete. It is required that imported aggregate be used for concrete batching instead of native rock.

7.1.3 LIGHTING

Exterior lighting on facilities shall be minimized throughout the UH Maunakea Lands. Only exterior lighting that is identified as "acceptable" by DLNR's Wildlife Lighting guidelines at the time it is specified in the final project designs shall be acceptable. Thus, all exterior lighting will be fully shielded. All exterior lighting shall also comply with County of Hawai'i rules related to Outdoor Lighting (Chapter 14, Article 9 of the Hawai'i County Code). Only Class II lighting is allowed; there will be no decorative lighting in the UH Maunakea Lands. To the extent possible, all exterior lighting will be equipped with automatic motion sensor switches and/or have switches that allow it to be turned off when human activity is not occurring in the area.

7.1.4 RADIO FREQUENCY EMISSIONS

Maunakea is a premiere location for high frequency radio astronomy. Radio frequency interference (RFI) has the potential to limit the scientific productivity of radio/submillimeter astronomy facilities and can cause interference to the sensitive instruments associated with optical/IR astronomy facilities. Regardless of the transmission frequency, all radio frequency sources can generate RFI that adversely affect the astronomy facilities. There has, therefore, always been standing policy limiting the use of radio transmitters on Maunakea. On the other hand, good communications are essential for safe technical operations. For example, line-of-sight radio transmitters are used to link road ice sensors under poor weather conditions when astronomical observing is unlikely.

Due to these RFI concerns, no radio transmitters should be part of a proposal's design if they are located in the MKSR. Radio transmitters covered by this guideline include, but are not limited to: microwave repeaters, satellite uplinks, radar, ham radios, CB radios, and wireless voice or data communications networks. Designers should also refer to the Maunakea Observatories Summit Radio Frequency Transmitter Policy, which may be updated from time to time, for additional information.

7.2 GUIDELINES APPLICABLE TO NEW ASTRONOMY FACILITIES IN THE MKSR

Unlike previous master plans, which envisioned expansion of astronomy uses within the summit region, UH has committed to: (*i*) removing astronomy uses from some of the astronomy sites on which it is presently authorized (i.e., decommissioning); and (*ii*) confining new astronomy developments (i.e., modification and recycling projects) to the ~~remaining sites on which~~ astronomy sites described in this Master Plan (Appendix F) where astronomy facilities are ~~presently authorized~~not prohibited. The design guidelines presented in this section apply only to new or substantially modified facilities; they do not apply to continued operation of existing astronomy facilities where no substantial external changes occur or sites that are decommissioned. The fundamental purposes of the guidelines are to (*i*) encourage designs and the use of materials that are appropriate to the environment and place, and (*ii*) minimize the chance that modification or recycling projects will unduly degrade the existing cultural, natural, or astronomical resources present on UH Maunakea Lands while also allowing facility sponsors the flexibility needed to modify and/or upgrade their facilities in ways that will enable them to continue to achieve their intended scientific objectives and provide excellence worthy of Maunakea.

7.2.1 ALL IMPROVEMENTS TO REMAIN WITHIN SUBJECT ASTRONOMY SITE

Any new astronomy developments (modifications or recycling) that may occur over the term of this Master Plan will take place on, and be confined to, the astronomy sites described in this Master Plan (Appendix F) where astronomy facilities are not prohibited ~~that remain available for consideration~~. One possible exception involves the potential combination of Astronomy Sites 7 and 8 in a specific situation, which is detailed in Part 2, Section 4.3.4.3, of this Master Plan.

Limited grading (i.e., the removal or addition of material that alters topography) beyond the defined astronomy site boundaries may occur only if and where off-site grading occurred when the facility was developed.[53] For instance, where associated driveways and utility connections are not within the astronomy site, grading and other work needed to maintain those appurtenant facilities and build the proposed project may occur. Similarly, limited excavation within previously disturbed areas needed to accommodate complex-level underground infrastructure such as has been proposed for the conceptual Optical Hawaiian Array for Nanoradian Astronomy project (Part 2, Section 4.3.4.1), would be allowed. Past side-casting of material does not qualify an area as having been previously graded or disturbed; only designed cut and fill qualifies an area as previously graded or disturbed.

[53] In the case of the SMA site, which accommodates dispersed and mobile facilities, no new grading in the non-exclusive easement area other than that needed to maintain existing facilities will be allowed.

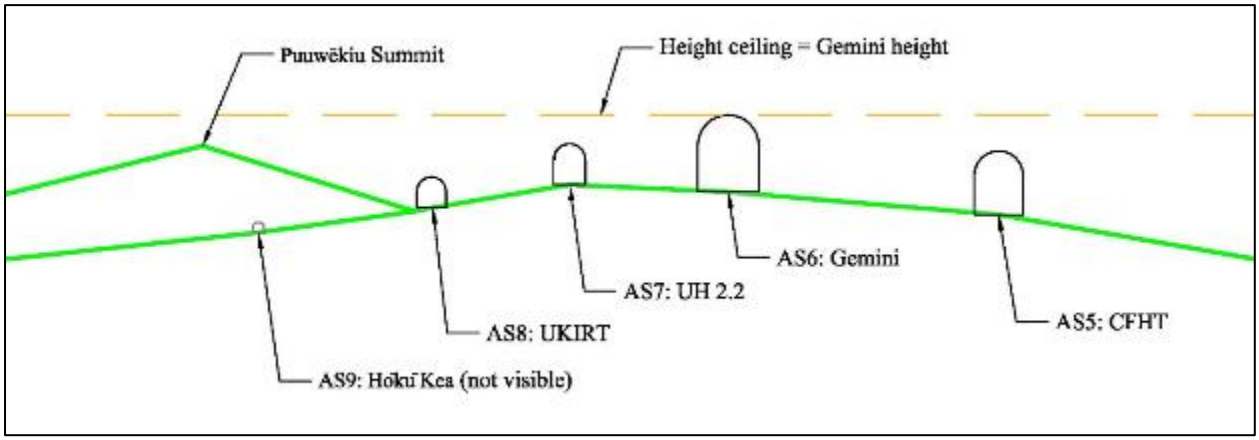
7.2.2 DOME HEIGHT

UH foresees the possibility that it may receive between one and three facility modification or site recycling requests that involve an increase in dome height during the term of this Master Plan. In all cases, the maximum height of new astronomy facility domes is to be minimized (including by utilizing improvements in technology, materials, and engineering), and project proponents must demonstrate to the satisfaction of UH that whatever dome height they propose is essential to the facilities' satisfactory performance and/or to meet the purpose and need of the project. In addition, UH will only consider project proposals where the proposed heights are in accord with the limits described in this section. The limits have been developed to minimize the potential for a new significant adverse visual impact over the life of this Master Plan.

A new dome may not exceed the height of the domes (as measured from the ground on which they are constructed) on nearby/adjacent astronomy facilities that house similarly-sized and similar types of telescopes. A new dome may not appear higher in the sky than does Gemini when viewed from the benchmark location in Hilo[54] (Figure 7-1) or Subaru when viewed from the benchmark location in Waimea[55] (Figure 7-2).

A modification or recycling project could substantially increase the height of the new facility relative to the existing facility on the site. For example, Astronomy Site 4 is now home to a 3.2-meter telescope (IRTF) in a dome that reaches 66 feet above existing grade. A recycling of that site to accommodate an 8- or 10-meter telescope may result in a dome height similar to nearby/adjacent astronomy facilities with that size telescope (e.g., Keck and Subaru), resulting in a dome on Astronomy Site 4 that extends from ~110 to ~150 feet above grade. However, not all modification and recycling proposals will likely substantially increase the height of the facility. For example, based on recent conceptual designs, the MSE project would not substantially increase the height of the astronomy facility on Astronomy Site 5 (currently CFHT).

Figure 7-1: Sketch of View of Maunakea Astronomy Facilities from Benchmark Location in Hilo

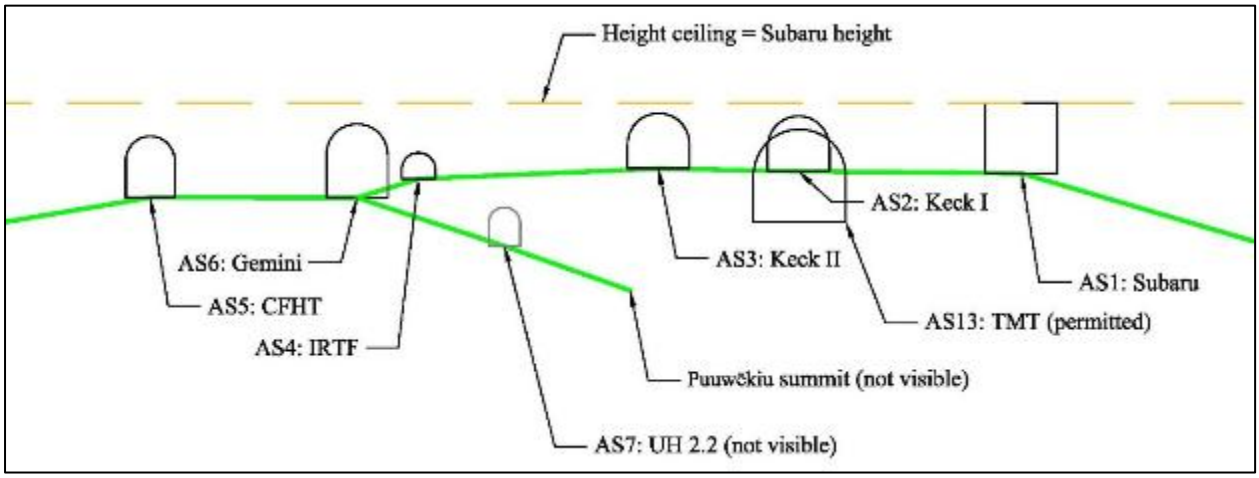


Notes: Waiakea Peninsula at Liliuokalani Park and Garden is the benchmark location in Hilo. AS = Astronomy Site
Source: PSI

[54] Waiakea Peninsula at Liliʻuokalani Park and Garden is the benchmark location in Hilo.

[55] The corner of Lindsey Road and Māmalahoa Highway is the benchmark location in Waimea.

Figure 7-2: Sketch of View of Maunakea Astronomy Facilities from Benchmark Location in Waimea



Notes: The corner of Lindsey Road and Māmalahoa Highway is the benchmark location in Waimea. AS = Astronomy Site
Source: PSI

Allowing height increases consistent with the limitations in this section minimizes the potential for new significant visual impacts. It also means that the tallest current facilities, as viewed from the benchmark locations (i.e., Gemini, and Subaru), cannot increase their dome heights.

7.2.3 HEIGHT OF STRUCTURES OTHER THAN DOMES

In general, any new structure other than domes (e.g., support buildings) constructed on an astronomy site may extend no more than 25 feet above grade. However, exceptions may be made allowing portions to reach up to 40 feet above grade if a user can demonstrate to the satisfaction of UH that: (*i*) a height greater than 25 feet is essential to the satisfactory performance of the facility, or (*ii*) the project's purpose and need requires technical components or facilities that require it to exceed a height of 25 feet. These criteria are established to limit visual impacts and the size of mountaintop facilities; it is set at 25 feet because that height allows for a two-level structure, and existing facilities generally do not exceed that height.

Equipment that can readily be placed underground (e.g., water tank) should be so located to minimize the extent of above-ground structures, provided the project can comply with the management of native materials guideline (Section 7.1.1). This does not apply to fuel storage tanks; see Section 7.2.10 below. In general, bulky exterior equipment that cannot be placed underground must be limited to a height of no more than 10 feet above ground level.[56] However, if a user can demonstrate to the satisfaction of UH that this is not technically feasible, then the equipment may be up to 20 feet above ground level

[56] This limit applies to bulky equipment like tanks, air handlers, and the like. It does not apply to less bulky equipment such as weather stations and sky cameras that may need to be higher to adequately support operations.

7.2.4 LIMIT ON OVERALL BULK OF FACILITIES ON ASTRONOMY SITES[57]

With technological improvements, an increase in remote observing and robotic operations, and design advancements, UH anticipates that the overall size of astronomy facilities, in proportion to the size of their primary mirror, will continue to decrease. The structures that are constructed as part of any modification or recycling project shall be as compact as is deemed reasonable and safe while achieving the purpose and need of the project.

7.2.5 COLOR OF FACILITIES

Color affects both the visibility and the thermal properties of the facilities. Because of this, in choosing colors for facilities, designers should select ones that minimize the visual impact while also helping to manage the thermal loads on astronomy facilities. Accordingly, based on currently available information regarding available coatings and construction materials, all modification and recycling projects are expected to conform with the guidelines in the following subsections. UH may periodically update these guidelines if new products, materials, or concepts that are more effective become available.

7.2.5.1 Color of Dome and Dome Support Structure

Based on the information that is currently available, domes and dome support structures should adhere to the following color guidelines.

- The rotating dome and shutter should have a reflective aluminum-like coating;
- The base of the dome should be lava- or cinder-colored; and
- All other visible surfaces, including concrete, should be colored with dark earth tones, colors similar to nearby lava flows, or colors similar to nearby cinder.

7.2.5.2 Support Facilities and Equipment Color

Based on the information that is currently available, support facilities and equipment structures/housings should adhere to the following color guidelines.

- The sides and rooftops of all support facilities should be lava- or cinder-colored to match the adjacent surface color; and
- Utility pull boxes and other external equipment should be lava- or cinder-colored to match the surrounding landscape. No raw, uncolored concrete surfaces should be used.

7.2.6 SNOW AND ICE CONSIDERATIONS

Given the snow and ice that is present in the summit region during a substantial portion of the year, all structures and points of ingress/egress should be designed in such a way as to: (*i*) facilitate access for snow removal equipment; (*ii*) minimize hazards related to falling snow and ice; and (*iii*)

[57] As it is used in this discussion, the term "bulk" refers to the volume (measured in cubic feet above ground level) of all structures and equipment based on external dimensions (inclusive of support building, dome, and other structures/equipment).

avoid/minimize building geometry, walls, and overhangs that are likely to produce snowdrifts that inhibit ingress/egress.

7.2.7 LANDSCAPE PLANTINGS

No landscape plantings of any type are allowed in the MKSR.

7.2.8 PARKING

Parking areas on modified and/or recycled astronomy sites should be kept to the smallest size consistent with the safe and efficient operation and maintenance of the facility which they support while complying with applicable rules or regulations, including the Americans with Disabilities Act of 1990 (ADA). They should also be designed with sensitivity to existing topographic contours so that they minimize the need for earthwork, blend in with the natural landforms, and do not stand out unnecessarily from their surroundings. Parking surfaces should not be paved and should match the surrounding landscape, as discussed in 7.1.2.[58]

7.2.9 FENCES, WALLS, AND BARRIERS

Fences, walls, and barriers should be used only where needed to protect human health and safety and, in all cases, should be designed to fit as unobtrusively as practical into the existing terrain. Where possible, fence and wall alignments should follow natural contours rather than maintaining a straight alignment without a specific operational need. The use of locally available material is required unless it is incapable of fulfilling the required function. No non-engineered material from outside of the Maunakea summit region shall be used.

Rock walls, including concrete walls with rock veneer, should be used in lieu of fences unless extraordinary circumstances make that impractical. The height of such walls should not exceed 42-inches above ground surface unless: (*i*) they serve as retaining walls, or (*ii*) are used to shield equipment, and (*iii*) do not affect view planes substantially more than the equipment would if the wall were not present.

Like rock walls, barriers, including guardrails, should be designed to minimize visual impact. Accordingly, they should not exceed a height of 42-inches above ground and should have colors and finished surfaces consistent with the surrounding landscape. Guardrails should be wire style, like existing guardrails in the summit region.

7.2.10 FUEL SYSTEM AND HAZARDOUS MATERIALS

New facilities on recycled sites that include bulk petroleum fuel storage for emergency generators will utilize only above-ground, double-walled fuel storage tanks and pipelines with spill containment systems and leak detection. If fuel facilities are relocated or modified as part of an astronomy facility's major modification project, the fuel systems should use above-ground, double-walled fuel storage infrastructure.

[58] It is expected that loading zones may need to be paved; however, paving should be limited.

Modified and new facilities will be designed to minimize the use of hazardous materials to the maximum extent feasible.

7.2.11 WASTEWATER SYSTEM

New facilities in the MKSR (i.e., astronomy facilities constructed on recycled sites) will be required to have zero-discharge wastewater systems. Facilities that continue operating beyond 2033 will also be converted to zero-discharge wastewater systems. The basis of this requirement is unrelated to water quality concerns,[59] it is a requirement to avoid impacts to the cultural landscape.

7.2.12 SOUND GENERATION

Heating, ventilation, and air conditioning (HVAC) and other non-mobile equipment with the potential to generate objectionable noise shall be designed and operated in a manner that limits the amount of sound that emanates from it. This means that, at a minimum, it should comply with the provisions of HAR Chapter 11-46, as applicable.

7.2.13 MAXIMIZE EXTENT OF REMOTE OPERATION

To the extent that it is technically, operationally, and economically feasible, any modified or new facilities should be designed to be operated remotely and/or robotically, and operators should make as full use of these features as is practicable.

7.2.14 EXCEPTIONS TO THE GUIDELINES FOR ASTRONOMICAL FACILITIES

UH may allow exceptions to any of the design guidelines in Chapter 7, except those related to the number of astronomy sites and the height and bulk of facilities on them. For this to occur, the facility designer/operator must demonstrate, to UH's satisfaction, that strict adherence to the guidelines is likely to prevent the satisfactory performance of the facility or prevent the project from achieving its purpose and need. The facility operator will also need to demonstrate that the proposed exceptions will not result in significant adverse effects.

Requests for exceptions may be approved if they are minor in nature and if the proposed project is otherwise consistent with the overall goals and objectives of this Master Plan. UH will make decisions regarding requested exceptions only after it receives and evaluates input from the Phase 4 proposal review committee, MKMB, the Environment Committee, and Kahu Kū Mauna.

7.3 GUIDELINES APPLICABLE TO OTHER FACILITIES AND USES IN THE MKSR

Other facilities and uses the UH foresees potentially being developed in the MKSR are limited in scope. Examples of other potential facilities and land uses over the life of this Master Plan include:

[59] The operation of individual wastewater systems within the UH Maunakea Lands has been permitted by the State of Hawai'i Department of Health and several experts have concluded that operation of such systems do not pose a risk to surface water quality, groundwater quality, or drinking water quality.

(*i*) fencing areas of high native biodiversity, (*ii*) public restrooms and shelters, (*iii*) public parking, (*iv*) data collection facilities or instruments, and (*v*) signs. Such proposed projects will be subject only to the design guidelines contained in Section 7.1 and whatever conditions DLNR/BLNR place on them during the CDUP approval process.

Those designing non-astronomy facilities should consider the guidelines for astronomy facilities in Section 7.2 and seek to comply with them. For instance, non-astronomy facilities should, to the extent possible: (*i*) be designed like astronomy support facilities and astronomy equipment and not exceed 25 and 10 feet in height, respectively; (*ii*) have flat or low-slope roofs; (*iii*) use lava or cinder colors (no untreated concrete); and (*iv*) have zero-discharge waste systems.

7.4 DESIGN GUIDELINES FOR HALEPŌHAKU (TMK PARCEL 12)

This Master Plan envisions the construction of very few entirely new facilities within Halepōhaku. To the extent that existing facilities are modified, or entirely new facilities are constructed, their scale, architectural style, and design motifs should be consistent with those already present within Halepōhaku's different areas. More specifically:

- The guidelines in Section 7.1 apply to projects at Halepōhaku.
- Renovations of existing facilities should seek to maintain their present size, with no increase in roofed area allowed unless specifically approved through the applicable proposal review process (Chapter 6).
- In general, any new facility constructed at Halepōhaku should have a scale like that of the facilities already present. In quantitative terms this means: (*i*) the height of new facilities should not exceed two stories and 30 feet above the finished grade and, like the existing dormitories, be designed to partially disguise that there is a second level; and (*ii*) total aggregate floor area of the structures present will increase by no more than 30 percent over the amount now present. The only exception to this is at the VIS, should it be established that a larger increase is necessary to improve visitor education and/or the visitor experience.
- The colors, textures, and materials that are used for any new construction should be consistent with those used for the existing structures that are near them, (e.g., dark earthen tones for all walls and roofs and A/C pavement and/or dark-colored concrete for all paving).
- All new plantings should be done using native species adapted to the māmane-dominated subalpine woodlands environment in which Halepōhaku is situated and follow guidance in the CMP.
- To minimize erosion, low impact development practices should be employed.
- Any new fences, walls, and barriers should be designed and constructed in accordance with the guidelines for those in the summit area laid out in Section 7.2.9.

7.5 GUIDELINES APPLICABLE TO ROADWAY, UTILITY DEVELOPMENT, AND SIGNAGE: ALL AREAS

As emphasized throughout this Master Plan, little new development is envisioned over its 20-year term. Because of that, only a small amount of roadway, utility, and other work is expected. The

design of such improvements, as needed, will be in keeping with similar existing facilities, with changes made only where needed to comply with new regulatory requirements or then-current codes. The guidelines in Section 7.1 apply to roadway, utility, and signage proposals.

7.5.1 ROADWAYS

To the extent practicable, roadway maintenance, repairs, and restoration will be accomplished without the use of extensive cut slopes or fill and with minimal change to the road right-of-way. Road improvements will be designed to maintain the character and functionality of the existing roads. Road capacity will not be increased unless necessary to address access issues and public safety. Wire style guardrails, like existing guardrails in the summit region, will continue to be used.

7.5.2 UTILITIES

Due to radio frequency interference concerns, limited telecommunication services are present in the summit region. These services pre-date radio astronomy on Maunakea and are limited to emergency response purposes, but the enhanced communications capabilities that will be needed during the term of this Master Plan can be provided simply by upgrading equipment within existing buildings.

The existing electrical service is adequate for all the existing facilities. The upgrades to the electrical power system needed to accommodate the development of the TMT project on Astronomy Site 13 have been permitted by the BLNR as part of CDUP-3568, and it is assumed that they will be installed should that facility is constructed. All power lines will be placed underground. Accessory utility structures will be screened or designed to blend into the natural terrain using surface treatments and/or finish colors.

7.5.3 SIGNAGE

The *Maunakea Sign Plan* was developed in accordance with CMP management action EO-4. The plan provides guidance for the placing and maintenance of permanent and temporary external signs on UH Maunakea Lands. This Master Plan is intended to ensure that signage does not exceed the lowest level necessary and complies with CMS policies, Conservation District Rules, and other applicable laws and policies on signage. To help implement the signage plan, CMS maintains an inventory of all signs on UH Maunakea Lands. The inventory, which includes all permanent signs, includes the following for each sign: (*i*) a photograph of the sign; (*ii*) the location of the sign (GPS coordinates); and (*iii*) the category of the sign as identified in the Sign Plan.

The *Maunakea Sign Plan* establishes guidelines for the following broad categories:

- *Traffic Control Devices*. The plan calls for signs, markings, and other devices used to regulate, warn, or guide traffic on roads or highways to follow the guidance contained in the latest edition of the *Manual on Uniform Traffic Control Devices* (MUTCD).[60]

[60] When MUTCD guidance is unavailable or does not address circumstances on Maunakea, the U.S. Forest Service "Sign and Poster Guidelines for the Forest Service" standards are to be consulted.

- *"Do Not" Signage*. Signage in this category provides information on prohibited activities such as alcohol consumption, tampering with historical sites, littering, or hiking off-trail.
- *Health and Safety Signage*. This category includes signage in the summit area to reinforce awareness of safety issues and hazards (e.g., speeding, using 4-wheel drive and low gear, underage children, pregnant women and persons in poor health, proper clothing, etc.). Health and safety signs or information posters at the VIS should be multilingual and include universal symbols for health and safety issues.
- *Interpretive Signs*. This category includes: (*i*) trail markers for primary trails; (*ii*) signage alerting people to areas of sensitive cultural and natural resources and instructing them to stay on trails; and (*iii*) educational signage providing information to the visitor on what they are seeing.

The *Maunakea Sign Plan* calls for signs to be made from materials that can withstand severe weather (e.g., wind, snow, sun) and to use traditional Hawaiian place names and, whenever possible, include the Hawaiian language along with English. It also contains specific guidance for any sign that directly or indirectly identifies a cultural site, providing that such signs will be considered only after seeking input from the Kahu Kū Mauna Council and the State Historic Preservation Division (SHPD).

The *Maunakea Sign Plan* includes several other relevant provisions, including requirements that:

- Signs be designed to convey a simple, clear message that is appropriate to the user setting.
- Signs, even temporary in nature, be professionally printed and installed.
- Unnecessary signs be removed.
- All signs be designed and installed to withstand sustained 120 mph winds, be resistant to fading from intense solar radiation, and have a finish that is resistant to the abrasion caused by wind-blown cinder.
- Visitor information signs have a brown background with white or yellow lettering and use pictograms when possible, excluding interpretive and wayside exhibits.

Finally, the plan provides detailed guidance regarding the installation and maintenance of signage within the management area. Specific provisions include the following:

- A requirement that no permanent signs be installed without prior approval by CMS (and in some cases DLNR).
- A ban on the routine installation and use of temporary barriers and signs except for emergencies or unanticipated public safety purposes.
- Diligent maintenance of all installed signage. This includes: (*i*) regular inspection of all signs; (*ii*) speedy repair or replacement of vandalized, damaged, or missing signs; (*iii*) keeping signs free of vegetation to maintain visibility; (*iv*) reviewing sign content annually to ensure continued relevance and accuracy; and (*v*) reuse of materials from obsolete, damaged, or surplus signs whenever possible.

In addition to these *Maunakea Sign Plan* guidelines, signs should be multilingual (i.e., English, Hawaiian, and perhaps others) and incorporate iconography to the extent appropriate. This especially applies to the interpretive signs.

7.6 EXEMPT FACILITIES

The construction of structures intended and used for cultural practices, e.g. ahu and other pōhaku structures resembling historic sites, may be subject to Conservation District Rules and other land use regulations. Components of the CMP address cultural practices, but no design guidelines in this Master Plan apply to such structures or facilities.

8 MASTER PLAN ADOPTION, EFFECTIVENESS, AND FUTURE AMENDMENTS

The UH BOR adopts this Master Plan to guide land use decisions by UH in the UH Maunakea Lands. It is intended to provide policy-level guidance and criteria to UH decision-makers. This is not a regulatory document. This Master Plan shall be interpreted and implemented so that it is consistent with applicable laws and agency regulations which shall prevail if there is a conflict.

It is anticipated that this Master Plan will not be amended during its 20-year life because (*i*) it will not need to be updated as individual projects advance through the project review and approval process and are developed, (*ii*) it includes, but is not limited to, the land uses most likely to be considered over the life of this Master Plan, and (*iii*) land uses not specifically identified in this Master Plan can be proposed, approved, and developed under the process adopted in this Master Plan without amending this Master Plan. If specific terms and procedures require an amendment of this Master Plan, proposed amendments would follow the Type B proposal review process (Section 6.6.2, Figure 6-7) with the amendment proponent serving as proposal proponent. Thereby, the proposed amendment would be considered by the advisory bodies, including KKM, EC, and MKMB, where public input is heard. Approval would advance beyond the CMS ED to the UH Hilo Chancellor, then UH President, and lastly the BOR, where public input is again heard.

This Master Plan replaces and supersedes past plans adopted by UH related to Maunakea, including the *Mauna Kea Science Reserve Master Plan*, adopted by the UH BOR on June 16, 2000.

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APPENDIX A. SUMMARY OF DRAFT MASTER PLAN OUTREACH, INPUT, AND RELATED PLAN REVISIONS

Public Announcements and Outreach

The efforts UH made to inform the community that the Draft Master Plan was available for review and comment are summarized in Volume II. Briefly, those efforts included:

- Announcement sent via U.S. mail to 245 individuals, groups, and agencies.
- Announcement sent via email to 596 individuals, groups, and agencies.
- Press releases on September 12, October 3, and October 25, 2021, which resulted in information regarding the Draft Master Plan and how to comment on it appearing prominently in many publicly available newspapers, radio spots, TV news stories, and website news stories. They were also posted on the UH social media feeds, websites, and CMS e-newsletters.
- Additional efforts were made to reach out to many of those that had participated in the review of earlier drafts of this Master Plan, those UH understood to be leaders of the Hawai‘i Island *kia‘i*, and others.

Those efforts followed months of lengthy discussions that the planning team had with individuals and small groups regarding the Pre-Draft Master Plan. Those discussions provided invaluable guidance in that helped shape the Draft Master Plan and are summarized in Appendix B.

Comments Received

All comment received on the Draft Master Plan is provided in Volume II. It includes input received via:

- The Konveio website commenting tool. A total of 473 comments from roughly 491 individual commentors were received via this website tool.
- The Konveio comment form. A total of 363 unique individuals submitted comment forms.
- U.S. mail and email. 17 unique entities submitted comments via either U.S. mail or email.
- Toll-free hotline recordings. 26 individuals shared their mana‘o via the hotline.
- Emails received from 123formbuilder.com, which was not established by UH. A total of 573 emails were received.

Summary of Comments, Responses, and Plan Revisions

This section summarizes the key comments that were submitted to UH during the Draft Master Plan review period (September 12 through October 26, 2021). It is not an exhaustive list and paraphrases the comments. The comments, followed by UH’s responses, and the revisions made to the Master Plan to address them, are broken down by Master Plan part below.

Related to Part 1: Foundations

- Comment: The Astronomy Goal should include an objective for the incorporation/including of Native Hawaiian astronomy traditions and learning and work for greater inclusiveness in the field of astronomy.
  - Plan revision: Added the following objective to the Astronomy Goal (Section 1.4.2): "*Support diverse representation within astronomy by encouraging support for a broad range of students, researchers, and staff seeking to learn and work on Maunakea.*"
- Comment: Although many found the Education Goal a welcome addition, others were concerned that it would result in additional, unnecessary activity within and visitation to the UH Maunakea Lands, to the point that the resources would be adversely affected.
  - Response: UH's intent is to achieve the Education Goal while not losing sight of the Stewardship Goal. It is UH's policy that land use proposals, the subject of this Master Plan, and the programs that utilize them, contribute to achieving as many of the goals as possible. They may focus on one of the goals, such as the Education Goal, but are intended to also address other goals and objectives in this Master Plan's framework. The kinds of educational activities that are envisioned involve small groups well-educated about the mountain, and carefully overseen. Those conducting the work would abide by the CMP management actions and contribute valuable data and insights that would inform conservation actions, thus contributing to the Stewardship Goal.
  - Plan revisions: The following objective has been added to the Education Goal (Section 1.4.3), "*Impart an understanding of Maunakea to all who work and visit here of the historical, cultural, and environmental context of the mauna, so that they may see the mauna as a teacher and understand their role in contributing to the stewardship of this special place.*"
- Comment: Why can't the strategy (Section 1.5) to convert to zero-discharge waste system be implemented prior to 2033?
  - Response: There is no reason why this cannot happen prior to 2033 and UH will provide incentives for astronomy facilities to make the transition well before 2033. Currently, planning and design for such a conversion at JCMT (Astronomy Site 11) is ongoing and it is anticipated that the conversion will take place prior to the end of 2022.

    This is equally true for strategy 9 regarding entering new agreements with the MKOs selected to operate beyond the end of 2033.
  - Plan revisions: None.
- Comment: The criteria listed in Section 2.1 (and elsewhere) should include consideration of how or if the proposal will benefit Native Hawaiians.
  - Response: The UH Maunakea Lands are public lands and cannot be managed in a manner that unreasonably benefits or harms a group based on age, gender, race, religion, ethnicity, or other attribute.
  - Plan revisions: The following was added to the criteria: the extent to which the proposal will adequately "*Honor and benefit the Hawai'i Island community,*

particularly with regard to their educational, cultural, social, environmental, and economic needs."

- Comment: The Master Plan should not assume that UH will received a new land authorization and some statements in the Master Plan do not adequately address what would need occur in the event that UH does not obtain a new lease.
    - Response: This Master Plan assumes a new land authorization will occur so that it can inform the community about land uses UH anticipates if a new land authorization is forthcoming. It is well understood that, if a new land authorization is not granted, then it is unlikely that substantial new land uses would be proposed and the existing facilities would need to be decommissioned or their owners obtain individual/alternative land authorizations prior to the end of 2033.
    - Plan revisions:
        - The underlined text in the following was added to Section 2.3, "*If UH does not obtain a land authorization that allows for its management and use of the UH Maunakea Lands beyond 2033, then under the General Lease UH must surrender and deliver possession of the land to BLNR and any improvements on the lands must be removed or disposed of by UH or, with the approval of the BLNR chair, improvements may be abandoned in place. Once the lands under the General Lease are surrendered, among other possibilities, BLNR and the Governor may consider issuance of a new entitlement (whether by lease, executive order, or other authorization) to UH or another entity. The Mauna Kea Working Group, created by House Resolution No. 33, H.D. 1 in 2021, issued a report during the development of this Master Plan entitled, He Lā Hou Kēai Ma Mauna a Wēkea: A New Day on Mauna a Wākea. The report discusses the creation of a new entity. UH's response to the Working Group's report is included in Volume 2*."
        - The underlined text in the following sentence was added to Section 2.4.3, "*As detailed elsewhere in this Master Plan, by the end of the term of the current general lease (December 31, 2033), UH is committed to limiting the total number of operating astronomy facilities to nine (9) in the MKSR should a new land authorization allow for the continuation of astronomy on Maunakea beyond the end of the current lease*."

Related to Part 2: Physical Plan

- Comment: More details regarding the land uses should be included in the Master Plan.
    - Response: This Master Plan is a framework for UH decision-making regarding proposed land uses over the next 20 years. It provides the same or greater level of detail regarding uses as previous approved plans. This Master Plan provides conceptual-level information regarding facilities and land uses that UH believes may occur within the UH Maunakea Lands over the period of this Master Plan. Further details cannot be provided at this time because (*i*) certain land uses, especially those regarding astronomy, are likely to be developed and proposed by non-UH entities; and (*ii*) it will take time for UH and other entities to identify opportunities and then work with the community to refine proposals, such as those related to broader education,

expanded research, and managing access. In all cases, those proposing new or different facilities, whether for astronomy or other purposes, will seek community input early in the decision-making process.

- Plan revisions: None.

- Comment: The Master Plan should call for the removal of all astronomical facilities from Maunakea and its restoration, as nearly as possible to its original state, no later than the end of 2033 (the end of the existing master lease).
  - Response: This suggestion directly conflicts with the Foundation (Part 1, Chapter 1) of this Master Plan and most specifically the Astronomy Goal (Section 1.4.2). The Foundations and the Astronomy Goal arise from the State of Hawai'i's expressed interest in astronomy and UH's broad education mission. [61]
  - Plan revisions: None.
- Comment: The Master Plan should not limit the number of astronomical facilities on Maunakea.
  - Response: This suggestion is in conflict with commitments spelled out in the Draft Master Plan (Section 4.1.2). Those commitments are based on UH's dedication to its prior statements pertaining to a reduction in the number of astronomy facilities in the MKSR, regardless of whether an astronomy facility advances on Site 13.
  - Plan revisions: None.
- Comment: The TMT project should be cancelled, and Astronomy Site 13 eliminated from future consideration for any astronomy facility.
  - Response: A next generation large telescope has been identified in UH's plans for Maunakea since the late 1990s and has been a high priority for the national[62] and international astronomical research community since then as well. To achieve the Astronomy Goal over the coming decades, a next generation large telescope will be necessary. The TMT project or the use of Astronomy Site 13 by a similar project in the future, is the only place to locate such a facility within the Master Plan's framework.
  - Plan revisions: None.
- Comment: The VLBA should not be decommissioned.

[61] In 1964 the Hawai'i State Legislature passed Senate Concurrent Resolution 16 (SCR 16) stating that the "State of Hawai'i and its citizenry are most desirous and willing to co-operate and aid in the promotion of our nation's space program and research to the benefit of the County of Hawai'i, the state and the nation."

The state's Conservation District Rules (HAR Chapter 13-5) specifically indicate that astronomy facilities are an identified land use in the conservation district.

The *Hawai'i 2050 Sustainability Plan* (2021) and *Hawai'i Statewide Comprehensive Economic Development Strategy* (2016), which draw on HRS § 226-10, 226-103, and 226-108, emphasize that it is the State's policy to promote economic diversification and innovation to retain a workforce educated in science, technology, engineering, and mathematics (STEM).

[62] National Academies of Sciences, Engineering, and Medicine. 2021. *Pathways to Discovery in Astronomy and Astrophysics for the 2020s*. Washington, DC: The National Academies Press. https://doi.org/10.17226/26141.

- Response: Decommissioning VLBA before the end of 2033 has been part of UH's plans for many years and has been a fundamental assumption in UH's decision-making process.
- Plan revisions: A note was added to Sections 4.1.2 and 4.3.2.2 that states, "*Among the reasons the VLBA is specified for decommissioning in this Master Plan are (i) it was identified in the Decommissioning Plan (2010) that VLBA would be decommissioned prior to the end of the current lease term, and (ii) Condition 11 of CDUP HA-3568 (2017) states that the VLBA is to be decommissioning by December 31, 2033.*"

- Comment: As the 2000 Master Plan and the CMP did, this Master Plan should emphasize that the bulk of the MKSR should be conserved and undeveloped with any land uses.
  - Response: The Master Plan makes it very clear that UH intends to maintain all the presently unused land within the MKSR in its natural state and will, in fact, oversee the decommissioning of certain astronomy sites. For example, the second paragraph of Chapter 4 says, "*UH expects there to be few new facilities developed within the MKSR over this Master Plan's duration. Nearly all land uses will occur in previously disturbed areas and where facilities exist today. Very little new ground disturbance will occur within the MKSR over the 20-year period; the vast majority of the MKSR will remain wilderness. Excluding roads and utilities, less than half of one percent of the approximately 11,288-acre MKSR has been disturbed/developed.*"

    Throughout the other sections of Chapter 4, this Master Plan stresses that all land uses should preferentially be sited in areas previously disturbed. Related to astronomy facilities specifically, this Master Plan has always limited future development to a subset of the 14 Astronomy Sites, which are described and depicted in Appendix F.
  - Plan revisions: The following commitment was added to Section 4.1.2: "*No land uses will be considered on major undeveloped cinder cones (pu'u) in the MKSR; this includes Pu'uala, Pu'uhoaka, Pu'ulīlīnoe, Pu'umāhoe, Pu'umākanaka, Pu'upoepoe, and Pu'uula.*"

- Comment: The new educational telescope should not be placed at Halepōhaku.
  - Response: As explained in Section 3.3, the UH BOR Resolution 19-03 dated November 6, 2019 (Appendix D), directed that Astronomy Site 9 (Hōkū Kea) be decommissioned and that "*…a new educational telescope facility for the University of Hawai'i at Hilo shall be established at Halepōhaku or elsewhere*." UH's present intent is to site the NET within Halepōhaku near complementary UH facilities and infrastructure, on previously disturbed ground where no native species are present, enhancing student/teacher access, consistent with its intended use. Other sites on Hawai'i Island were considered for this small telescope but all were deemed inferior for a range of reasons including high humidity, lack of infrastructure, and difficult access, among others. UH has commissioned a planning and design team for the proposed NET project that will lead the project review process, prepare an HRS Chapter 343 environmental document that will more fully describe the alternatives and why they were eliminated, and prepare a Conservation District Use Application (CDUA) for the facility that UH will submit to DLNR.
  - Plan revisions: None.

- Comment: The Master Plan should not include facilities that will increase the number of visitors to Maunakea. Instead, it should call for the cessation or reduction of non-Hawaiian visitor access to the summit area; it is too special a place to allow that.
    - Response: The UH Maunakea Lands are public lands and access to them cannot be managed in a manner that unreasonably benefits or excludes a group based on race, religion, or ethnicity.
    - Plan revisions: Statements have been added as follows that clarify the intent of the managed access facilities (and future managed access policies):
        - Section 3.1.1 recognizes ʻImiloa as a resource for learning about astronomy, culture, and natural resources associated with Maunakea. UH will direct people to ʻImiloa, which is on the UH Hilo campus, rather than build facilities or repurpose existing facilities in the UH Maunakea Lands that would substantially parallel ʻImiloa's.
        - Section 5.3 states "*UH will manage the number of vehicles, and thereby people, entering the UH Maunakea Lands in a manner that preserves the ambiance and feeling of the cultural landscape and minimizes adverse effects on the alpine and subalpine ecosystems and other resources.*" It goes on to say that the concepts presented in Sections 5.3.1 and 5.3.2 would "*achieve this by providing UH the means to manage access so that the number of vehicles (and thereby people) present at any one time would be less than the numbers present during peak periods prior to 2020; 2020 was anomalous due to the significant changes during the COVID-19 pandemic*."
- Comment: Many expressed concern that the access management facilities would limit access for cultural practitioners.
    - Plan revisions: A statement has been added to Section 5.3 that clarifies "*[a]ll plans and regulations implemented by UH will be consistent with Article XII, Section 7 of the Hawai'i Constitution, which provides that '[t]he State reaffirms and shall protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by ahupua'a tenants who are descendants of native Hawaiians who inhabited the Hawaiian Island prior to 1778, subject to the right of the State to regulate such rights.*"

<u>Related to Part 3: Proposal Review, Design Guidelines, and Implementation</u>

- Comment: The proposal review process does not include adequate opportunity for community input, particularly input by Native Hawaiians.
    - Response: The strategies (Section 1.5) clearly indicate that UH is and will continue to seek diverse community representation, including by Native Hawaiian organizations, on its volunteer advisory groups (e.g., KKM, EC, and MKMB). Those advisory groups have been, and will continue to be, involved in the early review and evaluation of land use proposals submitted to UH. All MKMB meetings, including those where proposals will be considered during Phase 2 proposal reviews (Section 6.3) and subsequent phases of review, will be open to the public. UH will continue to make special efforts to reach out to members of the Native Hawaiian community so that they feel more fully engaged in the review process.

In addition, public input is called out in the flow charts (Figure 6-2, Figure 6-4, and Figure 6-5) for the various phases of review whenever MKMB considers a proposal.

- Plan revisions: The following bullet has been added to Section 6.3, "*Obtaining public input. During this phase of proposal review (and subsequent phases, where applicable), information regarding the proposal will be made available to the public with the MKMB agenda and public input will be sought prior to and during the MKMB meeting. The availability of the proposal information and MKMB's agenda will be announced via CMS newsletters and/or other means, including measures to inform and involve the Native Hawaiian community.*"

- Comment: The guidelines for new astronomical facilities should be revised with more stringent limitations on size and not specify a reflective aluminum-like coating surface material/color for astronomy facility domes.
  - Response:
    - Section 7.2.1 has always indicated that any new astronomy developments (modifications or recycling) that may occur over the term of this Master Plan will take place on the defined astronomy sites where astronomy facilities are not prohibited ~~that remain available for consideration~~.
    - The guidelines concerning dome height in Section 7.2.2 are intended to limit the height of new facilities within the MKSR to the maximum extent practicable while achieving their purpose.
    - The guideline in Section 7.2.5.1 related to dome color identifies a reflective aluminum-like coating. That guideline is based on information about (*i*) the best available technologies for matching internal and exterior temperatures so as to minimize thermal distortion/degradation of viewing conditions, and (*ii*) community input regarding measures to reduce visual impacts during the development of the design for the TMT project. This section also states that UH may periodically update these guidelines if new products or materials that are more effective become available.
  - Plan revisions:
    - A commitment in Section 4.1.2 was expanded to state "*All future astronomy facilities will remain within the astronomy sites described in this Master Plan (Appendix F) ~~that remain eligible for future astronomy facility use~~.*" In this way, future users of this Master Plan will not overlook this important aspect of land use control.
    - Appendix F was added and provides descriptions and depictions of the relevant astronomy sites.
    - Section 7.2.5.1 has been revised to include that new "concepts" may become available related to dome color because comments suggested domes not be monochromatic.

Issues and Concerns Beyond the Scope of this Master Plan

Through the extensive community outreach that took place during the preparation of this Master Plan, it continued to be clear that the community has strong feelings related to past and future

activities within the UH Maunakea Lands that were beyond the scope of this Master Plan. The primary topics are listed below, and policy makers are urged to consider them in their broader decision-making related to Maunakea.

- The existing lease between UH and DLNR and/or the CDUP for the TMT project (HA-3568) should, or should not, be terminated.
- A new land authorization that would allow for astronomy to continue on Maunakea beyond 2033 should, or should not, be awarded in the future.
- UH is, or is not, the appropriate entity to manage the cultural landscape and natural resources in the summit region or access to this sensitive area.
- The UH Maunakea Lands were "stolen" from the Hawaiian Kingdom.

APPENDIX B. SUMMARY OF PRE-DRAFT OUTREACH AND SUBSEQUENT MASTER PLAN ADJUSTMENTS

Summary of Participants

This section summarizes those who participated in the review of earlier pre-draft versions of this Master Plan. Their participation typically included (*i*) reviewing of earlier versions of the entire document, summaries or outlines of the Master Plan, or components of the plan or UH's governance structure; and (*ii*) meeting with UH representatives one to three or more times. Those that participated are summarized in the table below. Their participation should not be construed to indicate that they endorsed the pre-draft plan.

UH reached out to many community members not listed below, including representatives of Native Hawaiian organizations, who either did not respond or declined to participate. Parties who declined or did not respond are not identified.

Those Who Participated in the Review of the Pre-Draft

UH System
David Lassner, President
Michael Bruno, Provost
Vassilis Syrmos, VP
Hawai‘inuiākea School of Hawaiian Knowledge, Dr. Jonathan Osorio
UH School of Ocean & Earth Science & Technology, Dr. Donald Thomas
UH School of Travel Industry Management, Dr. Daniel Spencer
UH Hilo Chancellor
UH Hilo Chancellor's Maunakea Advisory Committee
Hanakahi Council
UH Hilo Physics & Astronomy Dept.
Some members of Kuali‘i Council
‘Imiloa
Scotty Paiva, Rangers
CMS Team
MKSS Team
MKMB
KKM
Astronomy Organizations
UH Institute for Astronomy
Canada-France-Hawaii Telescope
Keck
UKIRT Observatory
NASA Infrared Telescope Facility
Subaru Telescope
Gemini North
Very Long Baseline Array
James Clerk Maxwell Telescope

Submillimeter Array
TMT
Association of Universities for Research in Astronomy
Elected Representatives
Office of Sen. Schatz
Office of the Governor
Rep. Yamane
Rep. Saiki
Rep. Tarnas
Office of the Mayor
Federal Agencies
Army PTA
Hakalau Forest, USFWS
US Forest Service, Dept. of Agriculture
NSF
State Agencies/Organizations
DLNR
Hawai‘i Tourism Authority
Department of Hawaiian Home Lands
HDOT
DLNR-Division of Forestry and Wildlife, Hawai‘i Island
Office of Planning
Mauna Kea Forest Restoration Project
Mauna Kea Watershed Alliance
Ahu Moku
Community Members/Organizations
PUEO
Anonymous
Ross Wilson
Kepa Maly
Gerald DeMello
Commercial Tour Operators
Super Vacation Hawai‘i
Arnott’s Lodge & Hiking Adventures
Taikobo Hawai‘i
Mauna Kea Summit Adventures
Hawaii Forest & Trail
Visitor, Commerce & Economic Development
Island of HI Visitors Bureau
Japanese Chamber of Commerce
Some members of the Hawai‘i Island Economic Development Board (HIEDB)

Master Plan Elements stemming from Pre-Draft Input

The Master Plan evolved dramatically based on the input received from those listed above. The following is a summary of some of the more substantial modifications made:

- The Foreword was added.
- The Education Goal and the associated objectives were added (Section 1.4.3) and highlight indigenous learning among other disciplines.
- UH committed to never reusing five of the astronomy sites decommissioned prior to the end of 2033 for astronomy in the future (previously UH had committed to never reusing three of the sites).
- UH committed that no professional research astronomy facilities will be proposed at Halepōhaku and that the only telescopes present at Halepōhaku will be the proposed NET and portable stargazing telescopes.
- Added a statement that there is some uncertainty regarding whether the TMT project will proceed on Maunakea, and if it does not proceed, this Master Plan will continue to guide UH decisions regarding how to use Astronomy Site 13.
- Adjusted the Phase 1 access management facilities and concept so that, among other things, it includes a kiosk that is staffed during periods of active access management.
- Modified the proposal review process so that, among other things, the UH proposal types are closely aligned with the likely level of Conservation District review and approval the proposal will trigger.
- Clarified the criteria that proposed facilities and developments within UH Maunakea Lands must meet. Added to the criteria that the proposal would need to greatly benefit from the conditions present within the UH Maunakea Lands.
- Added that all facilities within the MKSR will be required to convert to zero-discharge facilities if they are to continue beyond 2033.
- Stated that, beyond their educational purpose, the facilities at Halepōhaku may be available to support conservation actions on Maunakea outside of the UH Maunakea Lands.

APPENDIX C. SUMMARY OF MISSION, VISION, AND VALUES EXPRESSED IN VARIOUS UH SYSTEM, UH HILO, IFA, AND ʻIMILOA PLAN DOCUMENTS

The following subsections review the mission, vision, and values expressed in plan documents of UH units and programs that either oversee actions on Maunakea, conduct actions on Maunakea, or are otherwise tied to UH's activities on Maunakea.

UH System

As stated in the BOR Policy (RP) 4.201:

> *"The **primary mission** [emphasis added] of the university is to provide environments in which faculty, staff and students can discover, examine critically, preserve and transmit the knowledge, wisdom, and values that will help ensure the survival of present and future generations with improvement in the quality of life.*
>
> *In carrying out that mission, it is the **basic purpose** [emphasis added] of the university to afford all qualified people of Hawaiʻi an equal opportunity for quality college and university education at both undergraduate and graduate levels.*
>
> *As the only provider of public higher education in Hawaiʻi, the university embraces its unique responsibilities to the indigenous people of Hawaiʻi and to Hawaiʻi's indigenous language and culture. To fulfill this responsibility, the university ensures active support for the participation of Native Hawaiians at the university and support vigorous programs of study and support for the Hawaiian language, history, and culture.*
>
> *Within its unique geographical location, the university will serve as a leader in how it stewards the resources of the islands and the world for the benefit of all. The university shall be a global leader and model for the integration of sustainability throughout its teaching, research, operations, and public service. The university recognizes than an important knowledge base in sustainable island systems resides in the indigenous people of Hawaiʻi and all those for whom Hawaiʻi is home. The university commits to consult with local cultural practitioners and sustainability experts on best practices in sustainable resource allocation and use for the well-being of our communities, our state, and the world. Critical resources include energy, food, water, land and sea as they are integrated with the relationships of family, culture, community, justice, work, and economy in the present and future.*

In addition to this overall mission, RP 4.201 also outlines missions for four sub-units within the University: (*i*) the University of Hawaiʻi at Mānoa; (*ii*) University of Hawaiʻi at Hilo; (*iii*) University of Hawaiʻi West Oʻahu; and (*iv*) University of Hawaiʻi Community Colleges. Two of these, the University of Hawaiʻi at Hilo and Hawaiʻi Community College, are primarily involved in activities related to Maunakea.

RP 4.201 asserts that at "a minimum, the system mission incorporates the vision, purpose, and common values of the university system, emphasizing the fundamental commitment to access and quality." It emphasizes the importance of respecting and taking advantage of UH's special position and distinction in Hawaiian, Asian, and Pacific affairs. It affirms UH's commitment to diversity within and among all racial and ethnic groups served by public higher education in Hawai'i and calls upon the President and the Chancellors to ensure that the unique commitment to Native Hawaiians is fulfilled.[63]

RP 4.201, lays out minimum considerations that should be included in separate mission statements for the major units of the University system when presented to the BOR for approval. These considerations are fundamental commitments to the following: (*i*) access to and the provision of quality education; (*ii*) special advantage and distinction in Hawaiian, Asian, and Pacific affairs; (*iii*) diversity within and among all racial and ethnic groups served by public higher education in Hawai'i; (*iv*) unique commitment to Native Hawaiians; (*v*) social, cultural, environmental, and economic sustainability in operations; education, research and service; planning, administration, and engagement; and (*vi*) cultural and community connections.

UH Hilo

The University of Hawai'i at Hilo's (UH Hilo) mission statement (as expressed in Annex I to SPC 18/10) states that:

> *The University of Hawai'i at Hilo primary mission is to offer high quality undergraduate liberal arts and professional programs together with selected graduate degree programs where need warrants and the university has strong expertise. Programs at UHH are intended to include both theoretical and applied research and to benefit Hawai'i Island and the state through resource centers, community partnerships, continuing education, and distance learning programs by using Hawai'i's natural and cultural environment as a learning laboratory for teaching, research, and service activities.*

The UH Hilo vision statement is:

> *We will be acclaimed as a university community that works together across disciplines and diverse perspectives to prepare student scholars to thrive, compete, innovate and lead in their professional lives. We will engage every student in applied learning that links theory with practice in ways that are*

[63] The policy calls for that commitment to be fulfilled by: (*i*) providing positive system-wide executive support in the development, implementation, and improvement of programs and services for Native Hawaiians; (*ii*) encouraging the increased representation of Native Hawaiians at the university; (*iii*) supporting full participation of Native Hawaiians in all initiatives and programs of the university; (*iv*) actively soliciting input from the Native Hawaiian community and specifically Puko'a, the system-wide council of Native Hawaiian faculty, staff and students that serves as advisory to the president; (*v*) providing for and promoting the use of the Hawaiian language within the university; (*vi*) providing a level of support for the study of Hawaiian language, culture and history within the university that honors, perpetuates and strengthens those disciplines into the future; (*vii*) encouraging Native Hawaiians to practice their language, culture and other aspects of their traditional customary rights throughout all university campuses and providing Hawaiian environments and facilities for such activities; and (*viii*) addressing the education needs of Native Hawaiians, the State of Hawai'i, and the world at large in the areas of Hawaiian language, culture, and history through outreach.

> *collaborative with the distinctive natural and cultural environments of Hawai'i and promotes responsible participation in a global society.*[64]

The UH Hilo values statement is:

> *We value diversity and strive to be student-focused and relationship-oriented. We seek to become more collaborative, intentional, and innovative. We believe that UH Hilo's diversity offers strength, but that it is only meaningful if we focus on equity, removing barriers to opportunity, fair treatment, and access for all.*[65]

'Imiloa

Like CMS, 'Imiloa Astronomy Center of Hawai'i ('Imiloa) is a program organized under the UH Hilo Chancellor. 'Imiloa's mission is "to honor Maunakea by sharing Hawaiian culture and science to inspire exploration."[66]

'Imiloa's vision is "'Imiloa is a place of life-long learning where the power of Hawai'i's cultural traditions, its legacy of exploration, and the wonders of astronomy come together to provide inspiration and hope for generations."[67]

As expressed on its website (https://imiloahawaii.org/aboutimiloa), "'Imiloa means to seek far and is the Hawaiian word for both explore and explorer. Through a Hawai'i lens, 'Imiloa explores the people of Hawai'i's place in the genealogy of the Universe and continually seeks, learns, and adapts to the islands' ever-evolving environment that inspires discovery and innovation through the following three core values:

- *"Kama'āina*. We honor our relationship to land, sea, and sky and share this connection through personal and enlightened hospitality.
- *"Na'auao*. We steward our collective knowledge and wisdom as provisional resources that illuminate our community today and tomorrow.
- *"Hanakahi*. We work together, drawing upon individual strengths and talents to harness our collective synergy and advance the mission of 'Imiloa."

University of Hawai'i Community College at Hilo

As expressed by the Office of Vice President for Community Colleges,[68] the special mission of the UH Community Colleges within the overall mission of the University of Hawai'i, is to:

[64] https://hilo.hawaii.edu/strategicplan/2021-31/vision.php
[65] https://hilo.hawaii.edu/strategicplan/2021-31/clarity.php#core
[66] https://imiloahawaii.org/aboutimiloa
[67] https://imiloahawaii.org/aboutimiloa
[68] http://uhcc.hawaii.edu/ovpcc/mission

- Broaden access to postsecondary education in Hawai‘i, regionally, and internationally by providing open-door opportunities for students to enter quality educational programs within their own communities.
- Specialize in the effective teaching of remedial/developmental education, general education, and other introductory liberal arts, pre-professional, and selected baccalaureate courses and programs.
- Provide the trained workforce needed in the State, the region, and internationally by offering occupational, technical, and professional courses and programs which prepare students for immediate employment and career advancement.
- Provide opportunities for personal enrichment, occupational upgrading, and career mobility through credit and non-credit courses and activities.
- Contribute to and stimulate the cultural and intellectual life of the community by providing a forum for the discussion of ideas; by providing leadership, knowledge, problem-solving skills, and general informational services; and by providing opportunities for community members to develop their creativity and appreciate the creative endeavors of others.
- Build upon Hawai‘i’s unique multi-cultural environment and geographic location through efforts in curriculum development and productive relationships with international counterparts in Asia and the Pacific in ways that will prepare their students for the global workplace.

Institute for Astronomy (IfA)

The Institute for Astronomy (IfA) manages the Haleakalā observatories on Maui and the Maunakea observatories on Hawai‘i Island and carries out its own program of fundamental research into the Sun, planets, and stars, as well as interstellar matter, galaxies, and cosmology. The IfA reports to the Office of the Provost at the University of Hawai‘i at Mānoa. It has close links with the UH Mānoa Department of Physics and Astronomy through the astronomy graduate program, and IfA faculty members teach many introductory astronomy courses on the Mānoa Campus.

The IfA’s mission statement is as follows:

> *The primary mission of the Institute is the production of the highest possible quality of astronomical research; world leadership in the development of ground- and space-based instrumentation; the development and stewardship of the Mauna Kea and Haleakala Science Reserves; and provision of facilities and professional guidance to graduate students of astronomy to enable them to meet curriculum requirements and to gain hands on experience in current astronomical research techniques.*[69]

Its stated goals are as follows:

[69] http://manoa.hawaii.edu/ovcafo/neworg_charts/annualupdate/2019/Astronomy.pdf

Explore the origin and nature of the Universe, and of the galaxies, stars, planets, and other matter that it contains.

Develop new technologies for use in ground-based and space-based observatories.

Spread the understanding of astronomy through our graduate program, through undergraduate courses, and through public education.[70]

These goals collectively describe a vision that its work enhances human understanding of the Universe and broadens public understanding of the benefits that stem from the research and technological advancements that they contribute to.

CMS Management Functions

The following mission is included in the Comprehensive Management Plan (CMP) approved by the BLNR.

To achieve harmony, balance, and trust in the sustainable management and stewardship of the Mauna Kea Science Reserve through community involvement and programs that protect, preserve, and enhance the natural, cultural and recreational resources of Mauna Kea while providing a world class center dedicated to education, research, and astronomy.

[70] http://www.ifa.hawaii.edu/ifa2/goals.shtml

APPENDIX D. BOARD OF REGENTS RESOLUTIONS RELATED TO MAUNAKEA

University of Hawai‘i Board of Regents

21-02

R E S O L U T I O N

To Further Act on Items Relating to Maunakea Management and Amend Board of Regents Resolution 19-03

WHEREAS, at a special meeting on November 6, 2019, the Board of Regents ("Board") adopted Resolution 19-03, *To Act on Items Relating to Maunakea Management*, which directed University Administration to accomplish certain actions with specified timeframes, including the decommissioning of five (5) observatories; engaging in community outreach; developing historical, environmental, and cultural education programs; incorporating uses by Native Hawaiian cultural practitioners within the Maunakea Master Plan update; working with the Department of Hawaiian Home Lands to improve infrastructure and access to Maunakea; and improving the University of Hawaii's ("University") management function, structure, and operations;

WHEREAS, the Board appointed a permitted interaction group to review and investigate proposed changes to the Maunakea Master Plan and Comprehensive Management Plan (collectively, "Plans"), to follow up on the requested actions in Board Resolution 19-03 and identify any other critical issues pertaining to the Plans, and make related findings and recommendations to the Board;

WHEREAS, the Board concurs with the findings and recommendations of the permitted interaction group, and formally expresses and reiterates the University's commitment to accelerated efforts to strengthen its cultural stewardship of Maunakea, to astronomy as a cornerstone of excellence for the University and a significant contributor to the island and state economies and workforce, to maintaining high quality environmental stewardship of Maunakea, and to advocate for a management structure that is inclusive, efficient, and protective of all resources on Maunakea; and

WHEREAS, the Board recognizes that the University's proper stewardship of Maunakea is a long-term, complex, and challenging process, having its own timeframe, due in part, to anticipated and unanticipated factors outside of the University's control; and

WHEREAS, the Board remains firmly committed to accomplish the completion of all outstanding actions set forth in Board Resolution 19-03 at the earliest possible date.

NOW, THEREFORE, BE IT RESOLVED that Administration be directed to take the following actions:

1. Provide progress updates to the Board every six months regarding:
    a. Progress made towards accomplishment of action items set forth in Board Resolution 19-03
    b. The restructuring plan adopted by the Board in August 2020

2. At a future 2021 Board meeting, provide a comprehensive presentation on astronomy in the State as well as on Maunakea, and related academic programs, to be followed by a Board discussion on the role of the University in astronomy in Hawaii and the world.

NOW, THEREFORE, BE IT FURTHER RESOLVED that the timelines for action specified in Board Resolution 19-03 are amended as follows:

University of Hawai‘i Board of Regents

R E S O L U T I O N

21-02

1. Two (2) observatory sites known as the Caltech Submillimeter Observatory (CSO) and Hōku Ke‘a Observatory (HKO) shall be decommissioned; assuming no permitting, weather, and access issues the target date for CSO decommissioning is no later than April 30, 2023, and HKO no later than August 31, 2024. For purposes of this resolution, the term “decommissioning” shall mean the complete removal of all man-made structures at each respective site bringing each site to as close as feasible to its natural state prior to construction.

2. To ensure the prompt availability of a teaching telescope for the University of Hawai‘i at Hilo Physics and Astronomy Program, a new educational telescope facility shall be established on already developed land at Hale Pōhaku or elsewhere with a target date for permitting, assuming no legal issues, no later than May 30, 2024, and the project being awarded for construction, subject to funding, no later than November 30, 2024. The Board of Regents shall support the funding of the planning, design, and construction of the new educational facility.

3. In collaboration with the Center for Maunakea Stewardship, the ‘Imiloa Astronomy Center shall develop and implement a suite of educational programs regarding Maunakea including but not limited to Native Hawaiian culture, history, environmental, and biological considerations designed for tour guides and drivers, employees, contractors, recreational users, scientists and observatory workers, and visitors, as required by the Management Plans, by September 30, 2021, with implementation targeted to commence no later than December 31, 2021.

Adopted by the Board of Regents
University of Hawai‘i
May 20, 2021

University of Hawai‘i Board of Regents

R E S O L U T I O N 19-03

To Act on Items Relating to Maunakea Management

WHEREAS, the Board of Regents believes and acknowledges that Maunakea holds a special and important place in the history, culture, and hearts of the peoples of Native Hawaiian ancestry and all of Hawaii; and

WHEREAS, Maunakea has become a symbol of Native Hawaiian self-determination; and

WHEREAS, the Board of Regents recognizes that the University of Hawai‘i ("University") has been criticized for past and present management of Maunakea; and

WHEREAS, the Board of Regents realizes that any mismanagement of Maunakea is hurtful and disrespectful to the sanctity and inviolability of this place to Native Hawaiians and others; and

WHEREAS, the Board of Regents in response to past criticisms, has clarified its roles, duties, and responsibilities beginning with the adoption of the Mauna Kea Science Reserve Master Plan (2000), Mauna Kea Comprehensive Management Plan UH Management Areas (2009), A Cultural Resources Management Plan for the University of Hawai‘i Management Areas on Mauna Kea (2009), Natural Resources Management Plan for the UH Management Areas on Mauna Kea (2009), Public Access Plan for the UH Management areas on Mauna Kea (2010), and Decommissioning Plan for the Mauna Kea Observatories (2010) (collectively hereinafter referred to as "Management Plans"); and

WHEREAS, under said Management Plans, the Board of Regents was principally responsible to fulfill and to carry out all of the recommendations, obligations, and duties promulgated under said Management Plans; and

WHEREAS, the Board of Regents takes its responsibility seriously and hereby affirms its commitment to follow through with the recommendations made in the Management Plans to better manage the impacts of the astronomy facilities and operations upon the natural environment, cultural resources, recreational resources, educational resources, and upon the broader community; and

WHEREAS, the Board of Regents has determined that there remain unmet responsibilities and ongoing compliance issues that have delayed completion of certain recommendations and requirements under the Management Plans; and

WHEREAS, THE Board of Regents therefore desires to remove any delays in compliance and to complete ongoing responsibilities in an accelerated and expeditious manner.

NOW, THEREFORE, BE IT RESOLVED that University of Hawai‘i President David Lassner, University of Hawai‘i at Hilo Chancellor Bonnie Irwin, University of Hawai‘i Vice President for Research and Innovation Vassilis Syrmos, Maunakea Support Services (MKSS), Institute for Astronomy (IfA), Office of Maunakea Management (OMKM), and any other necessary, related management or operation entity be directed to cause the following action items to be accomplished in the timeframes as specified herein below:

1. Two (2) observatory sites known as the Caltech Submillimeter Observatory and Hokukea site shall be decommissioned no later than December 31, 2021. For purposes of this resolution, the

term “decommissioning” shall mean the complete removal of all man-made structures at each respective site bringing each site to as close as feasible to its natural state prior to construction. These will be the first two of five observatories to be decommissioned.

2. A schedule of decommissioning of these two sites will be laid out on a Gantt chart or other similar visual schedule for each of the above sites indicating function and timeframe for each major step in the decommissioning process to achieve completion on or by December 31, 2021. The schedule for decommissioning shall be presented to the Board of Regents on or before its February 2020 meeting.

3. A new educational telescope facility for the University of Hawai‘i at Hilo shall be established on already developed land at Hale Pohaku or elsewhere, as soon as can be permitted, with a target date no later than December 31, 2021, to ensure the prompt availability of a teaching telescope. The Board of Regents shall support the funding of the planning, design, and construction of the new educational facility.

4. On or by December 30, 2025, a determination will be made on the decommissioning of three (3) additional observatory sites based upon compliance with existing or future permits or governmental approvals. If decommissioning is required, the three (3) observatory sites will be identified and reported to the Board of Regents by January 2026.

5. In collaboration with OMKM and MKSS, the ‘Imiloa Astronomy Center shall develop a suite of educational programs regarding Maunakea including but not limited to Native Hawaiian culture, history, environmental, and biological considerations designed for tour guides and drivers, employees, contractors, recreational users, scientists and observatory workers, and visitors, as required by the Management Plans, by August 31, 2020. OMKM shall report to the Board of Regents on its plans and progress to implement said educational programs at its February 2020 meeting. Administration shall make a budget request during the 2020 legislative session to fund this action item.

6. Administration shall make a CIP request during the 2020 legislative session for monies to plan, design, and construct an educational center at Hale Pohaku and/or another appropriate site on Maunakea that will educate visitors on cultural, environmental, and astronomy related topics relating to Maunakea.

7. The Maunakea Master Plan update will accommodate uses by Native Hawaiian cultural practitioners.

8. Following consultation with the Maunakea Management Board, Kahu Kū Mauna, ‘Imiloa Astronomy Center, existing Maunakea Observatories, and other community stakeholders, a reorganization and restructuring plan shall be presented to the Board of Regents as to all advisory, operating, and funding bodies involved in the management of Maunakea by April 2020. The purpose of the plan is to improve operations and management and make it more efficient, effective, and transparent. The analysis will include consultation with the Maunakea Management Board, Kahu Kū Mauna, and appropriate members of the Hawaii Island community. The reorganization and restructuring plan shall be embodied into a governance document that is approved by the Board of Regents.

9. As part of the reorganization and restructuring plan, an in-depth analysis will be done to determine whether the management of the Maunakea Science Reserve would be better served if transferred to a governmental authority or other third party entity, or through alternate management mechanisms (e.g., conservation easement agreement, etc.). The analysis will include consultation with the Maunakea Management Board, Kahu Kū Mauna, and appropriate members of the Hawaii Island community. The results of this analysis, including input from the Maunakea Management Board, Kahu Kū Mauna, ‘Imiloa Astronomy Center, existing Maunakea Observatories, and other community stakeholders, will be presented to the Board of Regents by April 2020.

10. The University will cooperate with the Department of Hawaiian Home Lands (DHHL) to resolve any outstanding issues relating to the roadway infrastructure on Maunakea and will seek opportunities to assist DHHL in its efforts to fulfill its trust duties and responsibilities on the use of its Maunakea lands.

11. As permitted by law, the University should pursue a partnership with an appropriate agency or organization whose primary beneficiary is the Native Hawaiian community, to operate commercial shuttles and tours on Maunakea.

Adopted by the Board of Regents
University of Hawai‘i
November 6, 2019

University of Hawai‘i Board of Regents

R E S O L U T I O N

Affirming Commitment to the Collaborative Stewardship of Maunakea’s Cultural, Natural, Educational and Scientific Resources

WHEREAS, the Board of Regents believes that Maunakea can and should be a global model that provides inspiration, harmony and peaceful co-existence among culture, education, the environment and scientific discovery; and

WHEREAS, the Board of Regents for the University of Hawai‘i embraced the university’s commitment to its responsibilities to Maunakea beginning with the adoption of the Maunakea Science Reserve Master Plan in 2000, the Maunakea Comprehensive Master Plan, Cultural Resources Management and Natural Resources Management Plans in 2009, and the Public Access and Decommissioning Plans in 2010; and

WHEREAS, the board and the university administration also aspire for the university to become a model indigenous-serving university and have committed to principles of sustainability across its mission; and

WHEREAS, the board now hereby affirms the commitment of the university to fulfill its obligations under the plans that have been approved, as well as its broader commitment to the community at large; and

WHEREAS, the board wishes to additionally acknowledge the dedicated work and commitment of the Office of Maunakea Management, the Maunakea Management Board, and the Native Hawaiian Kahu Kū Mauna Council, on behalf of the University of Hawai‘i and the Board of Regents; and

WHEREAS, subsequent to the adoption of the various plans, and with the understanding that collaborative stewardship will continue to be prioritized on all Maunakea lands, the university has now agreed to return approximately 10,000 acres of land on Maunakea that it currently leases that is not used for astronomy, to the State of Hawai‘i; and

NOW, THEREFORE, BE IT RESOLVED that the university intends to return the 10,000 acres to the State of Hawai‘i if possible and pursue a new lease or land tenure for the reduced acreage that will support the continued viability of astronomical research and education in the State; and

BE IT FURTHER RESOLVED that the university work with the State, County of Hawai‘i, Native Hawaiian organizations, and the broader community to evolve collaborative and coherent management and stewardship plans that are consistent with the Comprehensive Management Plan, and that are supported by appropriate administrative rules; and

BE IT FURTHER RESOLVED that the university make it a priority, including through additional financial support, to meaningfully increase the education and engagement of Native Hawaiian students, Hawai‘i Island residents, and residents of the State of Hawai‘i in the areas of astronomy, celestial navigation and exploration; and that such initiatives include an active educational and outreach program that highlights indigenous knowledge as well as enhanced student access to and utilization of Maunakea-based astronomical resources in the field; and

The Board of Regents, through this Resolution, hereby affirms its commitment to the collaborative stewardship of Maunakea's cultural, natural, educational and scientific resources, and directs the university to move forward to collaboratively build a global model of harmonious and inspirational stewardship that is befitting of Maunakea.

Adopted by the Board of Regents
University of Hawai‘i
August 24, 2017

APPENDIX E. PROCESS TO ESTABLISH WHICH ASTRONOMY FACILITIES MAY CONTINUE AFTER 2033

In addition to the two facilities (CSO and Hōkū Kea) for which decommissioning notices have already been submitted, the VLBA Antenna (Astronomy Site 14) is also identified to be decommissioned as required by Condition 11 of the TMT CDUP. This leaves the following ten facilities with the potential to continue beyond 2033: Subaru, Keck I, Keck II, IRTF, CFHT, Gemini, UH 2.2, UKIRT, JCMT, and SMA. Of these, the 9-operating-facility restriction discussed previously means that, with the TMT occupying Astronomy Site 13 and taking up one of the slots, only eight could continue; two more would need to be decommissioned by the end of 2033.[66]

At the appropriate time, UH will send letters to each of the facilities that are not both owned and operated by UH, asking them whether they wish to continue beyond 2033 or are committed to decommissioning by that date. The letters will be addressed to the official representatives of the organizations which own and/or operate each facility. In most cases this would be the agency that entered the current sublease. The letters will articulate the expected terms that would apply if their facility were to continue operations after 2033. The organizations will be given ample time to respond. On the same time scale, UH would decide which of the UH-owned and operated facilities it wishes to continue beyond 2033.

The appropriate time for sending the letter will be after the relevant terms of the new land authorization that UH is seeking are known, along with whatever other requirements might apply, some of which could be derived from this Master Plan. UH is already coordinating with the non-UH facilities on the terms that might be applicable in the event of a new agreement, and it is expected that discussions and negotiations will be ongoing up until the time that the facility-owner responses to UH are due. Simultaneously, UH will seek input from advisory bodies, community groups (including Native Hawaiian organizations), and the wider community and will consider the input it receives from these groups and individuals in its decision-making process.

Some level of flexibility needs to be incorporated into planning processes. For example, during the period leading up to the response deadline, some organizations might merge and support only one of their facility's operations beyond 2033. It is also possible that another organization might propose to take over a facility that the current operating organization decides not to support beyond 2033. These types of arrangements could also occur at other points in the process described in this section.

Once the responses have been received from the organizations responsible for all the facilities and UH has made its own decisions, it will be known whether or not there are more than nine facilities, including TMT, that wish to continue beyond 2033. If there are nine or less, then UH would enter into the new agreements with all the non-UH-owned facilities that have expressed their intent to continue operating. The organizations responsible for the facilities that will not be continuing would begin the decommissioning process in time to complete it by the end of 2033.

[66] Without an operational astronomy facility located at Astronomy Site 13, only one, instead of two, would need to be decommissioned by the end of 2033.

If there are more than nine facilities that desire to continue operations beyond 2033, UH will develop and implement a process to determine which facilities may continue beyond 2033. Based on the goals and objectives described in this Master Plan, UH will propose alternative facility combinations for consideration, with each alternative consisting of nine facilities drawn from the up to 11 in the MKSR that may indicate an interest in operating beyond 2033. UH will also propose a decision-making process that will include consultation with the MKOs, with appropriate advisory groups, and with the wider community. This process will include consideration of the scientific value of each facility and its site, environmental considerations, and community interests. The cultural importance of each site will also be factored into UH's process to identify which facilities will continue operation beyond 2033. UH may propose an advisory committee be established to provide an independent expert assessment of the relative merits of the various facility combinations. Depending on the circumstances, UH may ask the committee for a recommendation in addition to the assessment. The selection process will end with a decision by UH on which facilities will continue after 2033. UH hopes to have this decision made by the end of calendar year 2026, to allow sufficient time for decommissioning under the Decommissioning Plan process.

UH's target date for having new agreements in place with the continuing non-UH facilities is January 1, 2027. Facilities not continuing would be expected to submit decommissioning NOIs by that date if they had not yet done so. This will allow seven years for them to complete the decommissioning process. Five of the 14 astronomy sites will no longer be eligible for future astronomy facilities, including recycling, once existing astronomy facilities on them have been decommissioned. As discussed in Section 4.2 of this Master Plan, some non-astronomical use of certain astronomy sites may be considered during or after the decommissioning process.

APPENDIX E. PROCESS TO ESTABLISH WHICH ASTRONOMY FACILITIES MAY CONTINUE AFTER 2033

As of October 2026, CSO (Astronomy Site 10) and Hōkū Kea (Astronomy Site 9) have been decommissioned, and UKIRT's (Astronomy Site 8) NOI to decommission has been accepted and work on a site decommissioning plan has begun. As a result, ten astronomy facilities (Subaru, Keck I, Keck II, IRTF, CFHT, Gemini, UH 2.2, JCMT, SMA, and VLBA) continue to operate in the MKSR. In addition, TMT has a valid permit (CDUP HA-3568) to build and operate an astronomy facility on Astronomy Site 13 in the MKSR; however, construction has been suspended and it is not known if or when construction will resume. This Master Plan states the VLBA will be decommissioned prior to 2033 because (*i*) the Decommissioning Plan (2010) states it will be decommissioned prior to the end of the current lease term and will not be replaced by another telescope; and (*ii*) Condition 11 of CDUP HA-3568 (2017) states that it is to be decommissioned by December 31, 2033. UH's commitment to have not more than nine (9) operating astronomy facilities in the MKSR by the end of 2033 will be fulfilled if UKIRT and VLBA cease operations in a timely manner and no astronomy facility is built on Astronomy Site 13. If UKIRT and VLBA do not cease operations in a timely manner or a new astronomy facility is built on Astronomy Site 13, then the process outlined below would be used to establish which nine astronomy facilities may continue to operate after 2033.~~In addition to the two facilities (CSO and Hōkū Kea) for which decommissioning notices have already been submitted, the VLBA Antenna (Astronomy Site 14) is also identified to be decommissioned as required by Condition 11 of the TMT CDUP. This leaves the following ten facilities with the potential to continue beyond 2033: Subaru, Keck I, Keck II, IRTF, CFHT, Gemini, UH 2.2, UKIRT, JCMT, and SMA. Of these, the 9-operating-facility restriction discussed previously means that, with the TMT occupying Astronomy Site 13 and taking up one of the slots, only eight could continue; two more would need to be decommissioned by the end of 2033.~~[71]

At the appropriate time, UH will send letters to each of the facilities that are not both owned and operated by UH, asking them whether they wish to continue beyond 2033 or are committed to decommissioning by that date. The letters will be addressed to the official representatives of the organizations which own and/or operate each facility. In most cases this would be the agency that entered the current sublease. The letters will articulate the expected terms that would apply if their facility were to continue operations after 2033. The organizations will be given ample time to respond. On the same time scale, UH would decide which of the UH-owned and operated facilities it wishes to continue beyond 2033.

The appropriate time for sending the letter will be after the relevant terms of the new land authorization that UH is seeking are known, along with whatever other requirements might apply, some of which could be derived from this Master Plan. UH is already coordinating with the non-UH facilities on the terms that might be applicable in the event of a new agreement, and it is expected that discussions and negotiations will be ongoing up until the time that the facility-owner

~~[71] Without an operational astronomy facility located at Astronomy Site 13, only one, instead of two, would need to be decommissioned by the end of 2033. UKIRT submitted its Notice of Intent to decommission on November 7, 2025, and UH has approved it. UKIRT's and VLBA's timely decommission and no astronomy facility on Astronomy Site 13 would fulfill UH's commitment to have not more than nine (9) operating astronomy facilities in the MKSR by the end of 2033.~~

responses to UH are due. Simultaneously, UH will seek input from advisory bodies, community groups (including Native Hawaiian organizations), and the wider community and will consider the input it receives from these groups and individuals in its decision-making process.

Some level of flexibility needs to be incorporated into planning processes. For example, during the period leading up to the response deadline, some organizations might merge and support only one of their facility's operations beyond 2033. It is also possible that another organization might propose to take over a facility that the current operating organization decides not to support beyond 2033. These types of arrangements could also occur at other points in the process described in this section.

Once the responses have been received from the organizations responsible for all the facilities and UH has made its own decisions, it will be known whether or not there are more than nine facilities, including TMT, that wish to continue beyond 2033. If there are nine or less, then UH would enter into the new agreements with all the non-UH-owned facilities that have expressed their intent to continue operating. The organizations responsible for the facilities that will not be continuing would begin the decommissioning process in time to complete it by the end of 2033.

If there are more than nine facilities that desire to continue operations beyond 2033, UH will develop and implement a process to determine which facilities may continue beyond 2033. Based on the goals and objectives described in this Master Plan, UH will propose alternative facility combinations for consideration, with each alternative consisting of nine facilities drawn from the up to 11 in the MKSR that may indicate an interest in operating beyond 2033. UH will also propose a decision-making process that will include consultation with the MKOs, with appropriate advisory groups, and with the wider community. This process will include consideration of the scientific value of each facility and its site, environmental considerations, and community interests. The cultural importance of each site will also be factored into UH's process to identify which facilities will continue operation beyond 2033. UH may propose an advisory committee be established to provide an independent expert assessment of the relative merits of the various facility combinations. Depending on the circumstances, UH may ask the committee for a recommendation in addition to the assessment. The selection process will end with a decision by UH on which facilities will continue after 2033. UH hopes to have this decision made by the end of calendar year 2026, to allow sufficient time for decommissioning under the Decommissioning Plan process.

UH's target date for having new agreements in place with the continuing non-UH facilities is January 1, 2027. Facilities not continuing would be expected to submit decommissioning NOIs by that date if they had not yet done so. This will allow seven years for them to complete the decommissioning process. ~~Five of the 14 astronomy sites will no longer be eligible for future astronomy facilities, including recycling, once existing astronomy facilities on them have been decommissioned. As discussed in Section 4.2 of this Master Plan, some non-astronomical use of certain astronomy sites may be considered during or after the decommissioning process.~~

APPENDIX F. ASTRONOMY SITE DESCRIPTIONS AND DEPICTIONS

Appendix F: Astronomy Sites 1 through 13 Descriptions and Depictions

Notes:

- Astronomy site descriptions are limited to ongoing or previously permitted use, the Conservation District Use Permit (CDUP) that permits current use, and their approximate area in acres.
- Astronomy Site 14 is currently occupied by VLBA and is much lower on the mauna (see separate drawing).
- For astronomy sites that have, or had, subleases, the astronomy site boundary is based on the sublease. The extents of Astronomy Sites 2 and 3 (Keck I and Keck II) are based on dividing the single Keck sublease area into two sites based on drawings included in CDUP applications for the two facilities.
- The boundary of Astronomy Site 7 was established based on the extent of the existing facilities, disturbed area, its relationship/proximity to adjacent uses, and topography.

Astronomy Site Boundary (colors alternative for clarity)

Topographic contour (25 foot interval, from photogrammetric methods using air photos taken 6,000 feet above mean terrain on 9/25/1996)

Source: University of Hawai'i

Astronomy Site 13
Permitted use: TMT
CDUP: HA-3568
Site Area: ~6.00 acres

Astronomy Site 1
Current use: Subaru
CDUP: HA-2426
Site Area: ~5.36 acres

Astronomy Site 3
Current use: Keck 2
CDUP: HA-2509
Site Area: ~1.97 acres

Astronomy Site 4
Current use: IRTF
CDUP: HA-0653
Site Area: ~1.62 acres

Astronomy Site 5
Current use: CFHT
CDUP: HA-0527
Site Area: ~1.87 acres

Astronomy Site 2
Current use: Keck 1
CDUP: HA-1646
Site Area: ~1.48 acres

Astronomy Site 6
Current use: Gemini North
CDUP: HA-2691
Site Area: ~1.96 acres

Astronomy Site 10
Past use: CSO
Former CDUP: HA-1492
Site Area: ~0.74 acres

Astronomy Site 7
Current use: UH 2.2
CDUP: HA-0954
Site area: ~1.94 acres

Astronomy Site 12
Current use: SMA
CDUP: HA-2728
Site Area: ~3.04 acres

Astronomy Site 9
Past use: Hōkū Kea
Former CDUP: HA-3406
Site Area: ~0.50 acres

Astronomy Site 8
Current use: UKIRT
CDUP: HA-0653
Site Area: ~0.77 acre

Astronomy Site 11
Current use: JCMT
CDUP: HA-1515
Site Area: ~2.91 acres

N

0 500'

Appendix F: Astronomy Site 14 Description and Depiction

Notes:

- Astronomy Site description is limited to ongoing permitted use, the Conservation District Use Permit (CDUP) that permits current use, and the approximate area in acres.
- The Astronomy Site 14 boundary is based on the sublease.

