

vista by placing a structure in the foreground so as to prevent the view, nor would it be incongruous with existing structures currently in the vista or viewplane.



*Photo 2: Aerial photo showing existing equipment storage at the proposed project site*

**Figure 3. Rendering of Proposed Dome Structure Adjacent to Dorm A**



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## 3.0 Natural Hazards Assessment

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### 3.1 Erosion

Construction activities may produce sediment from soil erosion during and after excavation. Construction plans and specifications would include Best Management Practices (BMPs) to minimize erosion on the project site during and after construction, as well as measures to contain runoff on-site during construction. Temporary erosion control measures would be used during construction to prevent soil loss and to minimize surface runoff.

### 3.2 Flooding

The Federal Emergency Management Agency (FEMA) creates Flood Insurance Rate Maps (FIRM) that delineate flood hazard areas. The FEMA FIRM flood zone designations include the following:

- A – Areas of 100-year flood, base flood elevations not determined
- AE – Areas of 100-year flood, base flood elevation determined
- XS – Areas of 500-year flood; areas of 100-year flood with average depths of less than one foot or within the drainage area less than one square mile, and areas protected by levees from 100-year flood
- X – Areas determined to be outside the 500-year floodplain
- D – Areas in which flood hazard is undetermined
- VE – Areas of 100-year coastal flood with velocity (wave action), base flood elevations determined (Coastal High Hazard District)

The Proposed Action is located in Flood Zone D, an area in which flood hazard is undetermined. However, flooding is not known to occur at the Halepōhaku Mid-Level Support Facility.

### 3.3 Slope

The ground surface at the proposed educational telescope site is generally unpaved and is slightly sloping down from north to south. Based on the topographic survey map provided, the existing ground surface elevations at the site range from approximately 9,286 to 9,289 feet above msl.

### 3.4 Volcanic Hazards

Thousands of earthquakes occur every year in Hawai'i, most on and around the island of Hawai'i. Many of these earthquakes are directly related to volcanic activity. Mauna Kea is a shield volcano in the post-shield stage; it last erupted about 4,600 years ago.

The island of Hawai'i is divided into nine lava zones with Lava Zone 1 being the most at risk from volcanic activity. The proposed educational telescope site is located in Lava Zone 7.

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## 4.0 Best Management Practices During Construction

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### 4.1 Requirements Under the Maunakea CMP

The BLNR-approved management plan for the CMP contains a set of management actions designed to protect the natural and cultural resources of Maunakea. As required by the BLNR when it approved the CMP, the CMS submits annual reports on the status of the implementation of the CMP. Contractors, through their construction contracts, must comply with the applicable requirements of the CMP. The following would be implemented as part of the construction of the new educational telescope:

- **Maunakea Use Orientation.** Prior to working on the mountain, all personnel associated with any construction project are required to attend a mandatory 45- to 60-minute Maunakea User Orientation to inform them on the natural and cultural resources of Maunakea as well as the hazards of working on the mountain. All work would be performed in accordance with the principles and frequency established in the Maunakea User Orientation. Any person not behaving in a manner consistent with the principles established in the Maunakea User Orientation would be required to leave the project site.
- **Best Management Practices.** All construction requires the implementation of BMPs approved by both CMS and applicable permitting agencies. The BMPs outlined for the Proposed Action are a combination of the following:
  - BMPs promulgated by CMS for all projects within UH Management Areas on Maunakea and includes both construction and post-construction practices
  - Construction BMPs prepared pursuant to the National Pollutant Discharge Elimination System (NPDES), building, and grading permits.
- **Maunakea Invasive Species Plan.** All construction requires compliance with the MKMB-approved *Maunakea Invasive Species Management Plan* (ISMP) (Vanderwoude et.al., 2015). The ISMP details measures to be taken to avoid the introduction and spread of invasive species, such as cleaning and inspection procedures for machinery and materials, maintenance of the construction staging areas, monitoring and control for invasive species, and trash removal. For example, prior to arriving at the UH Management Areas, all construction materials, equipment, crates, and containers carrying materials and equipment would be inspected by a trained biologist selected by CMS and approved by the DLNR.
- **Construction Monitoring.** All construction requires an on-site construction monitor whose responsibility would be to monitor compliance with the terms and conditions of any CDUP as related to construction activities, as well as any terms and conditions agreed to between the constructing entity and CMS. The construction monitor would have the authority to order that any or all construction activity under a CDUP cease if there has been a violation of the terms or conditions of the CDUP, or if it is determined that the construction activity would unduly harm historic, natural, or cultural resources or burials.
- **Archaeological Monitoring.** An archaeological monitor is required during all ground-disturbing activities to monitor any impacts, real or potential, of construction activity on archaeological or historic resources. The monitor shall be a trained archaeologist selected by the CMS and approved by DLNR.

- **Inadvertent Discovery of Human Burials.** If an inadvertent discovery of any human burial is discovered in the course of construction, operation, or maintenance activities, the person making the discovery shall seek the advice and recommendation of either the Hawai'i Island Burial Council or KKM, or a recognized lineal or cultural descendent, for treatment of the inadvertently discovered burial consistent with Hawai'i Revised Statutes (HRS) Chapter 6E and the SHPD's implementing rules.
- **Materials Storage.** All materials for construction of the Proposed Action would be stored either within the project site or in an approved construction staging area.

## 4.2 Measures Identified in the Environmental Assessment

### 4.2.1 Biological Resources

#### Invasive Species

The following measures detailed in the ISMP (Casper, et.al, 2015) would be implemented to minimize the spread of invasive species:

- All vehicles would be externally cleaned at least monthly, and the interior always maintained in a clean condition prior to arrival at the Saddle Road and Mauna Kea Access Road junction. (Standard Operating Procedure (SOP) #1)
- All vehicles with three or more axles and heavy equipment would be thoroughly cleaned prior to arrival at the Saddle Road and Mauna Kea Access Road junction and inspected by a DLNR-approved biologist. (SOP #1)
- Aggregate and fill materials would be inspected by a DLNR-approved biologist for plant, animal, and earthen materials. Both the load and the site where aggregate and fill materials were extracted or stored would be inspected. (SOP #2)

In addition, vehicles would be restricted to existing roads to minimize the potential spread of invasive species.

#### Special-Status Species

Although Hawaiian hoary bats are not known to regularly occur within the vicinity of the Proposed Action, the following measures would be implemented to minimize potential impacts:

- There would be no disturbance, removal, or trimming of woody plants greater than 15-feet-tall during the bat birthing and pupping season (June 1 through September 15).

### 4.2.2 Cultural Resources

The following measures would be implemented, as required by the CMP and the CRMP to minimize potential impacts to cultural practices and beliefs:

- All persons involved with construction activities shall attend a mandatory training about the cultural and historical resources on Maunakea.

### 4.2.3 Archaeological and Historic Resources

The following measures would be implemented, as required by the CMP and the CRMP, to minimize potential impacts to archaeological and historic resources:

- All persons involved with construction activities shall attend a mandatory training about the cultural and historical resources on Maunakea.
- An independent qualified archaeologist would be retained by the contractor to monitor all ground disturbing activities for historic features such as artifact concentrations of shell or charcoal.
  - The archaeological monitor would have the authority to order that any or all construction activity cease in the event that any historic properties or human remains are encountered.
  - Per HRS Chapter 6E, if the contractor encounters possible or suspected historical features, all work would immediately be suspended and CMS would be notified, who in turn would notify SHPD.
  - In addition, the KKM Council would be consulted.
  - If the feature is deemed significant, an appropriate mitigation plan (which may include recovery) would be developed jointly by SHPD and UH Hilo.
- A Rock Movement Plan, developed by the contractor and approved by CMS, would be included in the construction BMPs.
- The procedures detailed in the SHPD-approved Long-term Historic Property Monitoring Plan for the University of Hawai'i Management Areas on Mauna Kea would be followed (Gosser et al., 2014).
- In the unlikely event that any human remains or any burial goods over 50 years old are uncovered at any time after construction commences, the procedures set out in HRS Section 6E-43.6 and HAR Section 13-300-40 would be followed.
  - This includes immediately suspending all work in the area and notifying CMS, who in turn would notify SHPD.
  - Work shall not commence until a treatment and disposition plan has been developed by SHPD in consultation with the Hawai'i Island Burial Council, OHA, CMS, and any recognized descendants.

### 4.2.4 Geological Resources

The following measures would be implemented to minimize impacts to geology and soils:

- All work would comply with the requirements of the CMP and other construction-related plans, including, but not limited to, the following:
  - During all periods of construction, including but not limited to, the delivery of construction materials, there shall be an on-site construction monitor whose primary responsibility shall be to monitor compliance with the CDUP as related to construction activities, as well as any terms and conditions agreed to between the constructing entity and CMS. The construction monitor shall be selected by the CMS with concurrence of the DLNR.

- A *Best Management Practices Plan for Construction Practices* shall be prepared that covers a range of topics and incorporates sustainable practices, including those related to disturbance of the ground surface and dust generation.
- All construction activities would comply with the provisions of HAR Chapter 11-60.1, Air Pollution Control, and HAR Section 11-60.1-33, Fugitive Dust. A dust control plan would be developed and implemented to minimize fugitive dust during construction, to be approved by the State Department of Health (DOH). Measures to control fugitive dust during construction may include, but not be limited to, the following:
  - Watering of active work areas and project access roads, as needed
  - Screening piles of materials from wind, if appropriate
  - Covering open trucks carrying construction materials
  - Limiting areas to be disturbed at any given time
- A geotechnical engineer would monitor the site work operations to observe whether undesirable materials are encountered and confirm whether the exposed subsurface conditions are similar to those anticipated.
- All excavated material not used on-site would be stockpiled on Maunakea and be available for future use. Stockpile locations would be identified in consultation with SHPD and CMS prior to the start of construction.
- All grading would be in conformance with the Hawai'i County Grading Ordinance.
- Installation of a silt fence or equivalent to prevent runoff from the site to adjacent areas.
- All construction would conform to the 2018 International Building Code and the latest State of Hawai'i amendments and ordinances.
- All work would be confined to the designated area of work. Any damage caused by the contractor would be repaired by the contractor.
- Upon completion of construction, it is expected that CMS would plant native vegetation in the area to stabilize the soil.

#### 4.2.5 Water Resources

The following measures would be implemented to minimize potential impacts to water resources:

- Construction plans and specifications would include BMPs to minimize erosion on the project site during and after construction, as well as measures to contain runoff on-site during construction.
- Temporary erosion control measures would be used during construction to prevent soil loss and to minimize surface runoff.

#### 4.2.6 Air Quality

The following measures would be implemented to minimize impacts to air quality:

- All work would comply with the requirements of the CMP and other construction-related plans, including, but not limited, to the following:
  - A *Best Management Practices Plan for Construction Practices* shall be prepared that covers a range of topics and incorporates sustainable practices, including those related to disturbance of the ground surface and dust generation.

- All construction activities would comply with the provisions of HAR Chapter 11-60.1, Air Pollution Control, and HAR Section 11.60.1-33, Fugitive Dust. A dust control plan would be developed and implemented to minimize fugitive dust during construction, to be approved by the DOH. Measures to control fugitive dust during construction may include, but not be limited to, the following:
  - Watering of active work areas and project access roads, as needed
  - Screening piles of materials from wind, if appropriate
  - Covering open trucks carrying construction materials
  - Limiting areas to be disturbed at any given time
- Contractors would be required to maintain equipment with emissions controls.

#### 4.2.7 Noise

The following measures would be implemented to minimize noise impacts associated with the Proposed Action:

- Noise generated from short-term construction activities and the use of machinery would be minimized by requiring contractors to adhere to State and County noise regulations, including HRS Chapter 342F, Noise Pollution, and HAR Chapter 11-46, Community Noise Control.
- The construction contractor would coordinate with CMS to anticipate, identify, and mitigate potential noise issues that could adversely impact dormitory residents.

#### 4.2.8 Traffic and Transportation

The following measures would be implemented to minimize impacts to traffic and transportation systems:

- Equipment and materials would be transported to and from the project site during non-peak hours.
- The construction contractor would comply with all provisions of the HDOT permit to transport oversized and/or overweight materials and equipment on State highways.
- All construction vehicles would be maintained in proper operating condition and loads would be properly secured to prevent dust, debris, leakage, or other adverse conditions from affecting public roadways.
- The construction contractor would be required to repair any damage to existing pavement, markings, roadways, parking, or walkways damaged due to construction activities.

#### 4.2.9 Solid and Hazardous Waste

The following measures would be implemented to minimize potential solid and hazardous waste impacts:

- All project construction-related debris would be removed and disposed of at an approved site.
- A contingency plan for accidental spills of petroleum products would be developed and retained on site. Absorbent pads and other applicable spill containment materials would be stored on site to facilitate with clean-up of accidental petroleum releases.

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## 5.0 Best Management Practices During Operation

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The telescope would generally be operated remotely from the UH Hilo campus to accommodate students in the classroom, which would minimize impacts to resources during operation. The following BMPs would be employed during operation of the project:

- All persons involved with operation and/or maintenance of the telescope shall attend a mandatory training about the cultural and historical resources on Maunakea and what constitutes respectful and sensitive behavior.
- The procedures detailed in the SHPD-approved Long-term Historic Property Monitoring Plan for the University of Hawai'i Management Areas on Mauna Kea would be followed.
- All persons involved with operation and/or maintenance of the telescope shall attend a mandatory training program about invasive species prevention and control that will outline steps to be taken to avoid the potential impacts associated with invasive species.
- Vehicles would be restricted to existing roads to minimize the potential spread of invasive species.
- All visitors to the telescope would park in the existing parking area at the Mid-Level Support Facility to minimize dust around the telescope.
- The telescope would generally be operated remotely from the UH Hilo campus to accommodate students in the classroom. In cases where student groups are getting on-site training, they would be transported to the site via van or bus.
- All visitors to the telescope would access the telescope via the walkway to and from Dorm A.
- Solid waste would be collected and placed in secured and covered storage containers and would be carried off-site for proper disposal at an off-site disposal facility.
- Any personnel on site during telescope operations would respond to any emergency messages or alerts, as appropriate, to ensure their safety during construction activities.

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## 6.0 Conservation Methods and Applications

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### 6.1 Short-term

The proposed project is not anticipated to result in any significant short-term environmental or conservation impacts. In the short-term, construction would be limited to daylight hours. The construction contractor would coordinate with CMS to anticipate, identify, and mitigate potential noise issues that could adversely impact dormitory residents.

### 6.2 Long-term

The proposed project has been designed to be limited in size and scope to mitigate potential impacts to the surrounding area. For the life of the project, regular maintenance would be conducted by a limited number of authorized personnel to limit foot traffic to the project site.

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## 7.0 Operation and Maintenance

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### 7.1 Project Construction and Completion

The design phase for the Proposed Action started in August 2020 and is expected to extend through March 2023. Permitting would extend through February 2024. Construction is expected to begin in August 2024 and last approximately four months until December 2024.

Construction would include site work consisting of excavations and backfills approximately one- to two-foot-thick to achieve the design finished grades. Backfill materials required would consist of select granular fills that are non-expansive. The excavated on-site materials may be reused as a source of select granular fill materials if particles greater than three inches in maximum dimension are removed. Due to the relatively low moisture content of the ground surface, moisture-conditioning of the on-site materials may be required to achieve proper compaction during construction. Compaction would be accomplished by sheepsfoot rollers, vibratory rollers, or other types of acceptable compaction equipment. Construction plans for the Proposed Action are provided in **Appendix A**.

### 7.2 On-going Maintenance Plan

On-going maintenance would include the following:

- Weekly filter change and inspection
- Clean mirrors using compressed air as needed
- Annual dome maintenance to include cleaning the joints and coating the fiberglass
- Computer upgrades or replacement as needed
- Remove and ship mirrors every one to two years to be re-aluminized

Access road use would be limited to heavy equipment and Maunakea Observatories Support Services (MKSS) who would continue to maintain the road as needed.

### 7.3 Natural Resource Monitoring and Maintenance Plans

CMS currently monitors natural resources in developed areas and facilities on UH managed lands on Maunakea. The monitoring plan includes the following with regard to natural resources:

- Invasive Invertebrate Early Detection Surveys of Facilities
- Annual Alien Invertebrate Detection and Wēkiu Bug Monitoring
- Maunakea Vertebrate Threats, Identification, Collection, and Processing
- Maunakea Invertebrate Threats, Identification, Collection, and Processing
- Maunakea Plant Threats, Identification, Collection, and Processing

Although not specific to the proposed project, these monitoring activities will continue.

### 7.3.1 Invasive Invertebrate Early Detection Surveys of Facilities

Priorities guiding invertebrate threat management are identified in the ISMP and is guided by the interagency Wēkiu Bug Working Group. Proper early detection survey methods allow for scientific documentation of newly established species and rapid response procedures to reduce the threat of invasive species on Maunakea. SOP #10 details five principal field components:

1. **Perimeter Search:** Walk around external areas of facility to inspect conditions including hand searching and hand pulling vegetation in search of threats.
2. **Outside Traps:** Outside attractant baited traps are left for several days to detect threats living outdoors.
3. **Outside Vials:** Vials are placed outside for a period of less than one hour, similar to attractant traps, to detect threats living outdoors.
4. **Inside Traps:** Inside attractant baited traps are left for no more than one week to detect threats living indoors.
5. **Swarm Traps:** Swarm traps are left out year-round to detect new colonies of honey bees and deflect new colonies away from facilities.

Results of the surveys are provided immediately if any targeted invertebrate threats are detected. Quarterly reporting includes a brief summary of all locations during the previous quarter, typically as an email. An annual report is prepared within the first 90 days of the new year. This report is comprehensive and emphasizes species of concern and invertebrate trends throughout the year.

### 7.3.2 Annual Alien Invertebrate Detection and Wēkiu Bug Monitoring

SOP #11 is designed to detect arthropod threats and monitor the presence/absence of wēkiu bugs (*Nysius weikiuicola*) and other established arthropod populations on UH managed lands. SOP 11 includes guidelines for trap times, locations, preparation, trapping methods, specimen processing, data entry, data analysis, and reporting. There are eight trap locations at the Halepōhaku Mid-Level Facilities. Traps include yellow pan traps; peanut butter, jelly, and spam sticks; un-baited pitfall traps; and baited pitfall traps. Traps are retrieved after a minimum of three days and a maximum of four days. Reporting procedures follow those outlined in SOP 10.

### 7.3.3 Maunakea Vertebrate Threats, Identification, Collection, and Processing

There are few native vertebrates on the UH managed lands on Maunakea with most occurring only in the vicinity of the Halepōhaku Mid-Level Facilities. SOP B guides threat characterization, identification, collection, and processing of vertebrates, including mammals, birds, reptiles, and amphibians. Priority vertebrate threats are targeted for prevention and early detection surveys. These include non-native mammals (e.g., cats, rats, mongoose, rodents, and feral ungulates), reptiles, amphibians, and any other taxonomic groups not presently known to occur on UH managed lands on Maunakea. On-mountain staff notifies OMKM in the event of the observation of dead birds, live/dead mammals, live/dead reptiles, or live/dead amphibians. Specimens of priority target species are reported to the DLNR within 24 hours of collection. OMKM reports bird collections to the DLNR Division of Forestry and Wildlife (DOFAW) only if

an unusual mortality event is suspected or observed. Any dead native or banded birds found are given to DOFAW for further review.

#### 7.3.4 Maunakea Invertebrate Threats, Identification, Collection, and Processing

The Wēkiu Bug Working Group, an informal collaboration of University, State, and Federal land managers and entomologists, periodically review potential arthropods threats for risk prioritization on Maunakea. Invertebrates with risk prioritization are those with the potential to alter the ecological functioning of the UH managed area as well as impact the integrity of cultural resources or human health. The greatest potential impacts are from “social insects” (e.g., ants, wasps, bees, termites). The following groups of arthropods are high priority target species for both early detection and ongoing monitoring: ants, wasps, spiders, beetles, horn and stable flies, centipedes, and mollusks.

#### 7.3.5 Maunakea Plant Threats, Identification, Collection, and Processing

SOP D assists staff and the public with plant identification, guides efforts in documenting invasive plant threats, and demonstrates the proper collection and processing protocol for vegetation on UH managed lands on Maunakea. Plant threats are identified using the Hawai'i Pacific Weed Risk Assessment (HPWRA) score, which is determined by 49 questions regarding the plant's biology, ecology, and invasive tendencies. There is a high concentration of alien plant species in the lower elevations; therefore, most of the feasible vegetation management occurs in the higher elevation environments in order to contain alien populations. Continued monitoring and mapping of high priority plant threats and rare native species is ongoing. Potential vegetation threats are reported to the OMKM Natural Resource Program Manager within 24 hours and identified within one week of observation.

### 7.4 Annual Reporting Requirements

As per HAR 13-5-39(c), an annual report to the DLNR is required, which shall include the status of compliance of the permit conditions and the implementation of land uses pursuant to the approved management plan schedule. UH Hilo would prepare and file an annual report with DLNR and CMS by June 30 of each year.

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# APPENDIX A

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## Construction Plans

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