Environmental Assessment

(DRAFT)

for the

Hakalau Forest National Wildlife Refuge

2021 Station Master Plan

December 2023

Prepared by the U.S. Fish and Wildlife Service

Pacific Region

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Draft Environmental Assessment for the Hakalau Forest National Wildlife Refuge 2021 Station Master Plan

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The National Environmental Policy Act of 1969, as amended (Pub. L. 91–190, 42 U.S.C. 4321 et seq.) (NEPA) is a procedural statute intended to ensure federal agencies consider environmental impacts of their actions in the decision-making process. This Environmental Assessment (EA) has been prepared to evaluate the effects associated with the proposed action outlined below, in accordance with the Council on Environmental Quality (CEQ) regulations (40 CFR 1500-1509) and the Department of the Interior (43 CFR 46; 516 DM 8) and U.S. Fish and Wildlife Service (Service or USFWS) (550 FW 3) regulations and policies.

This EA also aligns with the goals stated in Executive Order (EO) 13990, "*Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis,"* to listen to the science; improve public health and protect our environment; ensure access to clean air and water; reduce greenhouse gas emissions; bolster resilience to the impacts of climate change; and restore and expand the Nation's treasures and monuments.

Proposed Action

The Service is proposing to adopt the 2021 Hakalau Forest National Wildlife Refuge (Refuge) Station Master Plan (SMP, attached as Appendix 5) in accordance with the Refuge's Comprehensive Conservation Plan (CCP), adopted in 2010 (76 FR 29782).

The SMP details existing conditions and suitability of the Hakalau Field Station (HFU Station); outlines a new Station site plan (Appendix 3, Figure 2) for relocation or addition of utilities, future buildings, and infrastructure improvements; and provides high-level cost estimation for future Station improvements. The plan may be implemented in stages, in part, or in whole and elements of the plan may be slightly modified in a manner that would not significantly alter the impacts identified in this EA.

A proposed action is often iterative and may evolve during the NEPA process as the agency refines its proposal and gathers feedback from the public, Native Hawaiian Organizations (NHOs), and other agencies. Therefore, the final proposed action may be different from the original. The proposed action would be finalized at the conclusion of the public comment period for the EA.

Background

National Wildlife Refuges are guided by the mission and goals of the National Wildlife Refuge System (NWRS), the purposes of an individual refuge, Service policy, and laws and international treaties. Relevant guidance includes the National Wildlife Refuge System Administration Act (NWRSAA) of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, Refuge Recreation Act of 1962, and selected portions of the Code of Federal Regulations and the USFWS Manual.

The mission of the NWRS, as outlined by the NWRSAA, as amended by the National Wildlife Refuge System Improvement Act (16 U.S.C. 668dd et seq.), is to:

"... administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

The NWRSAA mandates the Secretary of the Interior in administering the NWRS to (16 U.S.C. 668dd(a)(4)):

- Provide for the conservation of fish, wildlife, and plants, and their habitats within the NWRS;
- Ensure that the biological integrity, diversity, and environmental health of the NWRS are maintained for the benefit of present and future generations of Americans;
- Ensure that the mission of the NWRS described at 16 U.S.C. 668dd(a)(2) and the purposes of each Refuge are carried out;
- Assist in the maintenance of adequate water quantity and water quality to fulfill the mission of the NWRS and the purposes of each Refuge; and
- Monitor the status and trends of fish, wildlife, and plants in each Refuge.

CCPs are developed to operationalize the NWRS mission and NWRSAA mandates at the refuge level by codifying planning unit-specific purposes, vision, and goals. Step-Down Management Plans (SDMPs) are developed to identify the objectives and strategies to be used to achieve a refuge's purposes, vision and goals. The SMP is one such SDMP developed and used at refuges throughout the NWRS.

The Refuge was established in 1985 to protect and manage endangered Hawaiian forest birds and their forest habitat (USFWS 1985). Located on the windward slope of Maunakea, the HFU supports a diversity of native birds and plants unequaled by other areas in the State of Hawai'i. It consists of over 48,000 acres in Hawai'i County, Hawai'i, divided into the 32,733-acre HFU and the 15,450-acre Kona Forest Unit. The Kona Forest Unit is not addressed in the SMP. The HFU (Appendix 3, Figure 1) was established in 1985 under the authority of the Endangered Species Act (ESA) to protect and manage endangered forest birds and 32,733 acres of rainforest habitat (USFWS 2010). The primary purpose of the HFU is "… to conserve (A) fish or wildlife which are listed as endangered species or threatened species... or (B) plants... (C) the ecosystems upon which endangered species and threatened species depend..." (Endangered Species Act of 1973, as amended, 16 U.S.C. 1534).

Since the establishment of the Refuge in 1985, additions, improvements, and updates to Station facilities and infrastructure have been implemented without the benefit of a SMP. The following issues were identified during the assessment of existing Station facilities and infrastructure, part of the Refuge's recent station master planning process:

- Staff housing - The Refuge is located approximately 40 road miles northwest of Hilo, Hawai'i and requires between one and two hours to be reached. Portions of the Refuge access roads are marginally improved, poorly maintained, and slow to travel, which necessitates staff overnight use of Station housing for routine management maintenance activities and presents recruitment and retention challenges for the Refuge. Existing housing and workspace is inadequate for the current and projected future levels of staff and volunteers at the Station.
- Station roads – Internal access roads are poorly constructed in general and subject to erosion, requiring ongoing maintenance. Improvements are needed to better facilitate movement within the station headquarters area.
- Station planning - Current facility conditions illustrate that the Station has grown incrementally over time, without planning for collective operation and integrated systems. Existing facilities and infrastructure (i.e., transportation routes and utilities) have varying levels of condition and appropriateness to their current uses.

- Station utilities – Existing utilities, including water, sewer, electrical, and communications, are currently serviceable but require planning for upgrade and maintenance for long-term usage, off-grid reliability, and efficiency as described in the SMP.
- Storage - The Station has a recently constructed Maintenance Building that has significantly enhanced operations and maintenance activities; however, there are still a number of temporary, portable structures used for storage and equipment protection throughout the Station. Some of these structures have already, or will soon reach the end of their useful life.
- Pedestrian safety improvements - Vehicle and pedestrian circulation are intermixed and undifferentiated, resulting in a vehicle-centric functional aesthetic. Separated pathways are needed to improve safety for pedestrians.

Purpose and Need for the Proposed Action

The Service needs to take action per the following statutory obligations in order to:

- continue to meet the priorities and mandates outlined by the NWRSAA;
- maintain steadfast support of the NWRS mission as described at 16 U.S.C. 668dd(a)(2);
- protect and manage endangered forest birds and rainforest habitat consistent with the HFU establishing purposes;
- and realize the Refuge vision through achievement of public use and wildlife/habitat management goals listed in the CCP (USFWS 2010).

Action is also needed to address the issues identified during the station master planning process, which hinder the ability of the Service to effectively implement objectives and strategies to meet statutory obligations, CCP goals, and the purpose for which the HFU was established.

The purpose of the proposed action is to:

- provide safe and effective long-term Station living and working quarters for Refuge staff, contractors, and volunteers in order to facilitate Refuge CCP goals for research and protection of sensitive species and their habitats, reliance on volunteer and local resident experience, and protection of cultural resources (USFWS 2010);
- guide and streamline phasing and sequencing of Station projects and improvements to demonstrate cost-effectiveness and promote efficient use of Refuge resources;
- reduce the frequency of maintenance required for Station infrastructure due to existing condition and vulnerability to daily use and storm events;
- improve transportation and circulation infrastructure to reduce user conflicts and minimize risk to pedestrians and drivers;
- upgrade utilities to ensure reliable service and minimize potential for release of contaminants due to failure of existing infrastructure.

Alternatives Considered

Alternative A —USFWS adopts the SMP – [Proposed Action Alternative]

Under the Proposed Action Alternative, the Hakalau Forest National Wildlife Refuge 2021 SMP would be adopted by the Service and individual projects described therein would be implemented in phases, as budget allows. The Refuge has prepared the SMP (Appendix 5) in accordance with the CCP (USFWS

2010); both are incorporated here by reference to provide additional detail regarding the Proposed Action Alternative (Appendix 3, Figures 1 and 2).

By adopting the SMP and implementing the individual projects, the Refuge can assess current facilities and infrastructure, implement a new site plan identifying recommended facilities and infrastructure, and design an operations yard that consolidates facilities to streamline maintenance and operations. Adoption of the SMP would allow the assessment of costs of proposed improvements and provide a consistent facility naming convention. Recommended phasing is included in the SMP to provide sequencing and prioritization of improvements. Adoption of the SMP would also ensure that the Station provides adequate housing and workspace for the staff and volunteers that carry out the Service's mission now, and into the future. The Proposed Action would include the following work elements:

- Demolition and removal of existing buildings, outbuildings, and associated infrastructure
- Construction of new buildings and outbuildings
- Realignment and reconstruction of entrance road
- Construction of new roadways, walkways, and parking areas
- Replacement of septic system
- Replace and/or upgrade existing water treatment system and extend to new buildings/infrastructure
- Upgrade and extend electrical systems to new buildings/infrastructure
- Installation of new rooftop- and/or ground-based solar panels
- Removal of vegetation
- Revegetation of areas disturbed by construction activities

Each of these work elements are described in detail in the remaining portions of this section.

Construction Activities

The SMP provides an overview of building locations and their expected footprints, and describes various construction methods that may be used during phased implementation. Construction methods, materials, and final design would generally follow the methods described herein.

Demolition and Removal of Existing Structures

A total of ten structures and five water tanks have reached the end of their useful life and would be removed, including the existing volunteer bunkhouse, cabin, garage, outhouse, and storage shed (see Appendix 5). One modular chemical unit would be relocated to a proposed new operations yard. Removal of structures would be phased to maintain the function of needed structures, such as housing, until new structures could replace their function once completed. Considerations for project timing would be with respect to maintaining the usability of required utilities and avoidance and minimization of impacts to resources in the project area (see Table 3).

Buildings would be deconstructed by crews using hand tools, mechanically demolished using a hydraulic excavator, or removed using a combination of both methods. Occupational Safety and Health Administration (OSHA) standards would be followed to identify and safely remove hazards associated with demolition. Unwanted or unsalvageable material would be loaded into trucks or dumpsters to be properly disposed of at a licensed landfill. Salvaged material (for example pipes, fixtures, or lumber) would be stored and reused for new construction or other projects as needed.

Construction of New and Replacement Structures

Site preparation for new construction would entail vegetation removal, grading, and excavation. Large concrete pads and foundations would be poured from a cement truck, while foundations requiring small amounts of concrete could be mixed by hand. Once cured, foundations would be backfilled with appropriate fill material. Some buildings may be installed on pier blocks or jacks, which would minimize site grading and excavation requirements and be a significant cost-savings over steel-reinforced, poured-concrete foundations.

Structures would either be conventionally constructed onsite or be prefabricated in modules that can be transported to the site and erected in-place. Conventional construction would require delivery of bulk materials to the site, and removal of excess or scrap material. Prefabricated structures would be delivered ready-to-install with all structural members complete and would be erected on prepared foundations by small cranes. After erection, prefabricated structures would require minor finishing such as siding, trim, interiors, plumbing, and electrical. Site finishing following construction would consist of final grading and revegetation. Table 1 identifies potential vehicles and equipment that could be used for construction and demolition. Actual equipment used for construction would be determined during project bidding.

Construction of Roadways, Walkways, and Parking Areas

Roadway improvement, realignment, and reconstruction would be needed along approximately 2,000 feet of the existing Station entrance road. New roadway construction and the improvement, realignment, reconstruction, and removal of existing roadways would occur along approximately 3,200 feet of the existing internal access roadway network and parking lots. Proposed roadway and parking lot work would provide safer ingress and egress for vehicles transporting staff, volunteers, and equipment.

Improvements to the entrance road and internal access road network could involve removal of portions of existing surfacing aggregate; blading and grading to shape road surfaces and turnouts; placement of surfacing aggregate and asphalt to maintain or restore existing road surfacing; cleaning existing ditches and culverts; and replacing or installing culverts as needed to manage stormwater runoff.

Realignment and reconstruction of the entrance road and internal access road network could involve removal of portions of existing asphalt and surfacing aggregate; blading and grading to shape road surfaces and turnouts; placement of road sub-base, surfacing aggregate, and asphalt; installation or replacement of drainage structures such as culverts and drain dips to manage stormwater runoff; reshaping of roadway ditches and culvert inlets and outlets; and vegetation maintenance or removal.

Construction of new internal access roads and parking lot could include clearing of vegetation within the roadway prism or along the proposed roadway; grading operations consistent with establishing a road base; placement of road sub-base, surfacing aggregate, and asphalt; installation of new drainage structures such as culverts and drain dips to manage stormwater runoff; and construction of new roadway ditches and culvert inlets and outlets.

Most roads would be constructed to a finished 20-foot driving surface width, with widening at some locations to allow vehicles to negotiate curves or bends in the road and to accommodate cut and fill slopes associated with the improvements. The analysis in this EA assumes a potential disturbance width of 50 feet for all proposed new road construction and the improvement, realignment, reconstruction, and removal of existing roads. Table 1 provides a list of vehicles and equipment that could be used for roadway work. Actual equipment used for construction would be determined during project bidding.

TABLE 1 - ANTICIPATED HEAVY EQUIPMENT FOR PROJECT CONSTRUCTION

Equipment Type	Caterpillar® Equivalent Model	Fuel Type	Activities
Bulldozer	D1, D2, D3	Diesel	Road Construction, Clearing, Grading
Excavator	304, 320, 335	Diesel	Excavation, Trenching, Vegetation Clearing, Demolition, Grading (with blade)
Dump Truck	No equivalent	Diesel	Road Construction, Demolition
Mobile Crane(s)	No equivalent	Diesel	Building Construction, Electrical System Installation
Grader	120, 140	Diesel	Road Construction
Roller Compactor	CB2.5	Diesel	Road Construction, Foundations
Front-end Loader	910, 926M, 950	Diesel	Road Construction
Man-lift	Genie® S-45	Flexible	Building Construction, Deconstruction, Electrical System Installation
Telehandler	TL642	Diesel	Building Construction, Deconstruction, Electrical System Installation
Cement Truck	No Equivalent	Diesel	Foundations, Walkways, and Sidewalks
Skid Steer	D32D3	Diesel	Clearing, Grading, Backfilling
Asphalt Paver/Screed	AP600/SE47 FM	Diesel	Road Construction
Backhoe	450, 434	Diesel	Road Construction, Excavation, Trenching, Grading

An excavator could be used to remove some of the smaller shrubs growing at the immediate road surface edge. Soil disturbance and removal would be minimized as much as possible during vegetation removal (see Table 3 for mitigation measures). The use of an excavator is preferred over removing vegetation because large mowers or brush cutters (e.g., brush hogs) are generally too large and less precise. Any larger limbs growing into the roadway would be cut manually with a chainsaw.

The SMP proposes concrete sidewalks at the University of Hawaii building and staff residence comprising approximately 370 linear feet of concrete (Appendix 5). If the caretaker family residence option is built, about 70 linear feet of concrete would also be installed for a sidewalk (Appendix 5). Work associated with sidewalk installation would include the use of a small excavator or backhoe to remove vegetation, compaction of the subgrade with a portable vibratory compactor, installation of aggregate subbase layer, and pouring of concrete into forms. Depending on project phasing, concrete could be delivered pre-mixed by a cement truck or be mixed onsite, either by hand or using a portable concrete mixer.

Utility Upgrades and Installation

Installation of New Septic System

All new facilities that are constructed with bathrooms would be serviced by an appropriate septic tank and leach field, including the volunteer bunkhouse, horticulture building, and the caretaker's residence. New septic systems would be installed for buildings currently serviced by outhouses or cesspools. Depending on the selected location of the caretaker's residence, the building may be able to share the septic system with the staff residence or may require an individual septic system. A non-flush toilet system may remain on-site as a backup in case of failure.

The volunteer bunkhouse septic system would include an approximately 2,000-square-foot leach field, a septic tank, and approximately 50 linear feet of pipe connecting the leach field, tank, and building sewer. The horticulture building septic system would include an approximately 1,260-square-foot leach field, a septic tank, and approximately 50 linear feet of connecting pipe. The non-family caretaker residence option would require approximately 200 linear feet of pipe to connect with the volunteer bunkhouse system. The caretaker family residence option would include an approximately 1,000-square-foot leach field, a septic tank, and approximately 50 linear feet of connecting pipe.

Crews would excavate the sites of the septic systems using hand tools and a hydraulic excavator, backhoe, or other machinery. The septic tanks, connecting pipes, and subsurface soil absorption systems would then be installed to design specifications and covered with appropriate fill and topsoil. Following construction, the sites would be seeded and allowed to revegetate. Vegetation management and maintenance would be necessary to prevent damage to the systems by root infiltration.

Replacement and/or Upgrade of Existing Water System

Water storage tanks would be located at higher elevations and a new network of distribution piping would be installed in underground conduits to reduce the need for pumping. Buildings with larger roof areas would be located at higher elevations and used to collect runoff for these new centralized water storage tanks. Water storage tanks could be installed in phases as new buildings are constructed. Conduit sleeves should be placed below ground at select locations for future water system expansion and modification.

The centralized water storage tanks would be chlorinated, and individual treatment systems and pressure tanks would be located at each of the buildings requiring potable water. These individual treatment utilities may be installed inside each building or built into the auxiliary pump houses that serve them. Potable water treatment would require an ultraviolet light (UV) treatment system, sediment filter, and carbon filter. Buildings needing new potable water service include the staff residence, the volunteer bunkhouse, the caretaker's residence, the horticulture building, and the maintenance building.

The proposed water system upgrades would include the removal of five 7,000-to-8,000-gallon tanks; the removal of approximately 1,130 linear feet of existing pipe; the relocation of five 16,000-to-21,000-gallon tanks; seven new 21,000-gallon tanks; and the installation of approximately 1,040 linear feet of new pipe and conduit. The new or relocated tanks would be placed on concrete pads approximately 24 feet in diameter. The process of pad construction, tank installation, and demolition and removal of existing tanks would be similar to the processes described above for building construction and demolition.

Existing pipes to be replaced would be excavated using hand tools and small machinery such as a backhoe or excavator; some pipes could be abandoned in place to reduce cost. Crews using machinery and hand tools would excavate new trenches to design depths and slopes for the placement of new pipe and conduit. Once installed, the trenches would be backfilled and revegetated.

Installation of New Electrical Systems

Individual photo-voltaic (P-V) solar panel systems would be installed at buildings requiring electricity and one centralized system would be installed at the operations yard. Each system would be equipped with a solar panel array and battery system sized to accommodate anticipated electricity needs.

The Operations Zone P-V system would consist of 120 solar panels and a 60-kilowatt hour (kWh) battery bank. Electricity would be distributed through a series of trenches. Trenches would be dug with hand tools or small machinery and backfilled following wiring installation. This system would support primarily daytime use.

The decentralized P-V systems are designed to serve individual building needs using a total of 210 solar panels with batteries sized according to need. Those serving residence buildings are designed to accommodate heavy morning and evening usage with corresponding increased battery capacity. P-V panels would be installed on individual building rooftops with solar inverters and batteries installed in electrical closets. The number of P-V panels and battery capacity for decentralized P-V system are shown in Table 2.

TABLE 2 - DECENTRALIZED P-V SYSTEM QUANTITIES

Building Name	Number of P-V Panels	Battery Size (kWh)
Staff Residence	100	80
Volunteer Bunkhouse	40	36
Caretaker's Residence (Non-Family)	16	15
Caretaker's Residence (Family)	22	18
Horticulture Building	20	10
Fire Cache	12	9

Installation of new P-V panels could require the use of machinery such as man-lifts, telehandlers, or a mobile crane to install the panels on building roofs. Table 1 identifies vehicles and equipment that could be used for installation of utilities. Actual equipment used for construction would be determined by the selected contractor.

Vegetation Management

Removal of Vegetation

Approximately 30 koa trees would be removed from the action area as a result of implementing projects identified in the SMP. Trees would be felled with a chainsaw, and branches would generally be lopped and either scattered or chipped. If chipped, the chips would be broadcast in a location determined by

refuge staff. How trees are felled and disposed of would depend on the location of the trees, existing site conditions, and the professional judgment of refuge staff.

Vegetation would need to be cleared in areas identified for new roads, parking lots, buildings, outbuildings, utilities, and associated infrastructure. Wheeled and tracked construction vehicles would be used for vegetation clearance and removal, grading, and other site preparation where soil stability, slope, and saturation levels permit. During construction, low-growing plant communities would be protected as much as practicable and promoted as the basis for ongoing vegetation management following project completion. Clearing would consider vegetation species height and growth rates, ground slope, structure and utility locations, solar panel location, and clearance distance required for future operation and maintenance access.

Restoration of Areas Disturbed by Construction

All areas disturbed by construction activities, except permanent road and walkway surfaces, would be reseeded with a predominantly native seed mix suitable for the location and conditions. The original grade and drainage patterns in sensitive areas would be restored to the extent practicable. A full list of mitigation measures is described in Table 3.

The SMP considered phasing and sequencing of various improvements to maintain function of the Station during construction, and to provide more flexibility for funding of individual projects. The plan may be implemented in stages, in part or in whole, and elements of the plan may be slightly modified in a manner that would not substantially change the impacts identified in this EA or result in significant impacts.

Implementation of the Proposed Action Alternative would ensure that the Station and the staff that use it can maintain and improve their ability to serve the mission of the Refuge and meet the goals of the CCP. Station repairs and improvements would follow a cohesive and consistent plan to develop fully integrated systems.

Mitigation Measures and Conditions

Mitigation measures include:

1. avoidance of an impact through not taking an action or parts of an action;
2. minimizing impacts through limiting the degree or magnitude of an action; or
3. rectifying impacts by repairing, rehabilitating, or restoring the affected environment.

In addition to the General Project Design Guidelines for Protected Species listed in the SMP, the Refuge would implement mitigation measures outlined in Table 3. Measures generally include pre-construction surveys for protected species, delineation of construction areas, transplant and monitoring of endangered plants, compliance with Refuge biosecurity protocols, timing of vegetation removal around sensitive periods, and incorporation of building design features that minimize impacts to wildlife.

TABLE 3 - MITIGATION MEASURES

Resource Category	Mitigation Measures
Terrestrial Wildlife	• Trees to be removed between January 15 and September 1 would be surveyed for active nests. Trees with active nests would be avoided by 500 ft. to the degree possible. Alternatively, trees could be removed during the non-breeding season of September to January 15. • Refuge staff will use maps, flagging, or signs to identify and monitor "sensitive areas" (e.g., near tree stands, water lines, cultural features, and fences). This will minimize unintentional impacts to natural resources and Refuge infrastructure. • Crews will adhere to the Refuge's Biosecurity Protocols (Appendix 4-2) and any additional protocols provided. • To avoid the introduction of nonnative and invasive species (including little fire ants, *Wasmannia auropunctata*), all construction equipment, materials, and vehicles will be cleaned and inspected prior to construction and deconstruction activities. • The potential presence of fire ants will be monitored following demolition and construction activities. If any little fire ants are detected, a determination of the full extent of infestation would occur and the infestation would be treated with an approved pesticide. • Gravel used in construction will be sourced at the Refuge or if locally sourced, inspected prior to entry into the Refuge to prevent introduction of nonnative species. • Retain existing low-growing vegetation where possible, and minimize the use of clearing/grubbing to preserve the roots of low-lying vegetation.
Threatened and Endangered Species and Other Special Status Species	• Refuge staff will use maps, flagging, or signs to identify and monitor "sensitive areas" (e.g., near tree stands, water lines, cultural features, and fences). This will minimize unintentional impacts to natural resources and Refuge infrastructure. • Crews will adhere to the Refuge's Biosecurity Protocols (Appendix 4-2) and any additional protocols provided.

	• To avoid the introduction of nonnative and invasive species (including little fire ants, *Wasmannia auropunctata*), all construction equipment, materials, and vehicles will be cleaned and inspected prior to construction and deconstruction activities. • The potential presence of fire ants will be monitored following demolition and construction activities. If any little fire ants are detected, a determination of the full extent of infestation would occur and the infestation would be treated with an approved pesticide. • Gravel used in construction will be sourced at the Refuge or if locally sourced, inspected prior to entry into the Refuge to prevent introduction of nonnative species. • A formal Section 7 consultation will be prepared and reviewed prior to initiating the proposed alternative. • The Refuge biologist will survey areas proposed for construction to ensure there will be no impacts to endangered wildlife species that may utilize the area for foraging, nesting, or roosting. Species-specific protocols are listed below. • Heavy machinery activities will occur outside the endangered species breeding and birthing seasons or as described below. • Avoid construction and deconstruction activities during nēnē breeding season (September 1 to March 31) to prevent displacing nēnē. However, if breeding season cannot be avoided, construction and deconstruction would be restricted within 150 feet of breeding or nesting nēnē, to ensure they are not disturbed. • All work will cease immediately if a nēnē nest is discovered within a radius of 150 feet of proposed work. Work will not commence or continue in that area until the nest is no longer active and the birds have left the area. • A Refuge biologist will monitor the project component areas for any nēnē activity prior to work starting and regularly during the project. • If nēnē are observed loafing or foraging near construction activities during the breeding season, work will halt and a biologist familiar with the nesting behavior of nēnē would survey for nests in and around the project area prior to the resumption of work. Surveys would continue for 3 or more days following the observation of nēnē presence (during which the birds may attempt to nest). • In areas where nēnē are known to be present, the Refuge will inform project personnel and contractors about the presence of threatened species on-site.

	• Construction staff will be educated to not approach, feed, or disturb nēnē. • Project specifications will include specific measures to ensure project work does not impact nēnē, such as requiring all food-related waste to be in fully sealed refuse containers and removed from the site daily to ensure birds and predators do not have access to the food waste. • No tree removal will occur during the peak forest bird (ʻakiapōlāʻau, ʻalawī, and ʻiʻiwi) breeding season (January 1 to June 30). • Prevent the spread or survival of nonnative or invasive species (see 'Vegetation' discussion below). • Avoid construction activities that result in the creation of standing water. • Avoid construction activities that may result in fire ignition in grassland habitat. • Nighttime construction will be prohibited to prevent impacts to the ʻuaʻu, ʻaʻo, and ʻakēʻakē between September 15 to December 15. • Building design shall include fully shielded outdoor lights so the bulb can only be seen from below and automatic motion sensor switches and controls on all outdoor lights or turn off lights when human activity is not occurring in the lighted area. • Any new permanent lighting on buildings will be compliant to reduce impacts to endangered seabirds (minimum necessary, full cutoff, downward directed, amber [560-nanometer or greater] lamping). • The action area will be surveyed during the ʻio breeding season (March 1 to September 30) and if ʻio nests are found, no trees will be removed in that area until after the nesting is complete. • For each SMP project, if work must be conducted during the breeding season, a biologist familiar with the species will conduct a nest search of the project footprint and surrounding areas immediately prior to the start of construction activities. • Clearing of vegetation or construction activities shall not occur within 1,600 feet of any active ʻio nest during the breeding season until the young have fledged. • Pre-disturbance surveys for ʻio are only valid for 14 days. If disturbance of the specific location does not occur within 14 days of the survey, conduct another survey.

	• Regardless of the time of year, avoid trimming or cutting trees containing a hawk nest, as nests may be reused during consecutive breeding seasons. • As part of Leadership in Energy and Environmental Design Certification requirements for the new facilities, this project will include compliance with Pilot Credit 55: Bird Collision Deterrence to minimize impacts to migratory birds. This measure is intended to reduce the chances of bird injury and mortality from in-flight collisions with buildings. This rule requires designers and builders to comply with building façade and site structures that include a lighting and a monitoring plan designed to minimize bird collisions. • Disturbance, removal, or trimming woody plants and trees greater than 15 feet tall during the ʻōpeʻapeʻa birthing and pup rearing season (June 1 to September 15) will be avoided. • Prior to deconstruction and construction, a survey for endangered plants (*Cyanea lindseyana, Cyanea shipmanii,* and *Phyllostegia brevidens*) will be completed and where possible, individual plants will be avoided. Surveys will be completed during the peak time for flowering when identifiable features of the plants are more likely to be visible. • If avoidance is not possible, the Refuge will work with the U.S. Fish and Wildlife Service Pacific Islands Office (PIFWO) and the Plant Extinction Prevention Program (PEPP) to transplant the plants to suitable undisturbed habitat. • The Refuge will monitor endangered plants periodically during construction to monitor health and any impacts. • Retain existing low-growing vegetation where possible, and minimize the use of clearing/grubbing to preserve the roots of low-lying vegetation.
Vegetation (including vegetation of special management concern)	• Specimens of threatened and endangered plant species populations would be protected during construction. • Refuge staff will use maps, flagging, or signs to identify and monitor “sensitive areas” (e.g., near tree stands, water lines, cultural features, and fences). This will minimize unintentional impacts to natural resources and Refuge infrastructure. • Staging and refueling areas would be established at least 150 ft. away from wetlands and other waterbodies to the extent possible, and they would include containment measures. • To control spread of non-native species, construction equipment (including vehicles) would be washed before it was mobilized to the Refuge. • Replanting with native seed mix would occur as rapidly as possible following the completion of construction.

	• Bird nest surveys for common native and endangered species will be completed prior to tree cutting. No trees will be cut if there are active nests found in them. • Crews will adhere to the Refuge's Biosecurity Protocols (Appendix 4-2) and any additional protocols provided. • To avoid the introduction of nonnative and invasive species (including little fire ants, *Wasmannia auropunctata*), all construction equipment, materials, and vehicles will be cleaned and inspected prior to construction and deconstruction activities. • Gravel used in construction will be sourced at the Refuge or if locally sourced, inspected prior to entry into the Refuge to prevent introduction of nonnative species. • Work would include developing a plan to monitor and maintain native plant communities and control non-native and invasive plants. It would include mechanical and chemical treatment methods for non-native species.* • Equipment used for clearing vegetation (including vehicles) will be cleaned prior to entering the Refuge to decrease the likelihood of transporting nonnative species and the pathogens that cause Rapid ʻŌhiʻa Death (ROD). • Native plants will be salvaged as much as possible prior to ground disturbance. Appropriate native species will be propagated and replanted using local sources of materials (e.g., air layering, seeds, and salvaged seedlings). • Tree removal will be minimized as much as possible. • Retain existing low-growing vegetation where possible, and minimize the use of clearing/grubbing to preserve the roots of low-lying vegetation. • Invasive plants colonizing the area post construction will be removed and the area revegetated with appropriate native species. • Use weed-free straw, hydromulch, or similar ground cover for erosion control during construction and restoration activities in areas that cannot be revegetated immediately. • Leave erosion and sediment control devices in place until all disturbed sites are revegetated and erosion potential has returned to pre-project conditions.
Geology and Soils	• Prepare and implement a Stormwater Pollution Prevention Plan (SWPPP) and an erosion control plan, consistent with National Pollutant Discharge Elimination System (NPDES) requirements and Section 401 consultation, as appropriate.

	• Use sediment barriers, such as silt fences, straw matting, and straw wattles. • Leave erosion and sediment control devices in place until all disturbed sites are revegetated and erosion potential has returned to pre-project conditions. • Cut and fill slopes, dips, water bars, and cross drainages will be designed and constructed to minimize soil erosion. • Minimize the area of disturbance, use minimum areas for staging, clearing, and grubbing. • Avoid and minimize construction on steep or unstable slopes, if possible. • Gravel used in construction will be sourced at the Refuge or if locally sourced, inspected prior to entry into the Refuge to prevent introduction of nonnative species. • Apply water from water trucks to excavation areas, access and haul roads, and staging areas as needed to control fugitive dust. • Conduct construction activities during the dry season as much as possible, to minimize erosion, sedimentation, and soil compaction. • Erosion control measures such as sediment barriers and other suitable erosion and runoff control devices, would be applied to construction, staging, and access areas. • Leave erosion and sediment control devices in place until all disturbed sites are revegetated and erosion potential has returned to pre-project conditions • Apply mulch or straw, or reseed exposed soil areas to reduce erosion and dust after completing work within a given area. • Sequence construction to minimize soil exposure and erosion potential. • Limit the amount of time soils are exposed. Stockpiled soils would be covered if they would be inactive for more than a few days. • Retain existing low-growing vegetation where possible, and minimize the use of clearing/grubbing to preserve the roots of low-lying vegetation. • Break up compacted soils in staging areas and decommissioned access roads by disking, tilling, ripping, or scarifying prior to reseeding and replanting.

	• Use adaptive management measures to respond to unexpected erosion or accretion.*
Air Quality & Greenhouse Gas Emissions	• Apply water from water trucks to excavation areas, access and haul roads, and staging areas as needed to control fugitive dust. • Set a low speed limit on access roads to reduce dust generation. • Restrict idling of construction vehicles and machinery to a maximum of 5 minutes. • Encourage contractor to maintain all vehicle engines in good operating condition to minimize exhaust emissions. • Recycle or salvage non-hazardous construction and demolition debris, if possible. • Limit the time soils are left exposed. Stockpiled soils would be covered if they would be inactive for more than a few days. • Replanting with native seed mix would occur as rapidly as possible following the completion of construction. • Use weed-free straw, hydromulch, or similar ground cover for erosion control during construction and restoration activities in areas that cannot be revegetated immediately.
Water Resources	• Water and sediment quality would be sampled during project planning to establish the environmental baseline and identify any pollutants that could be released during construction or operations. • Sediments for restoration activities would be obtained on-site to the degree possible. • Cut and fill slopes, dips, water bars, and cross drainages will be designed and constructed to minimize soil erosion. • Prepare and implement a SWPPP and an erosion control plan, consistent with NPDES requirements and Section 401 consultation, as appropriate. • Staging areas, storage sites (fuel, chemical, equipment, and materials), and potentially polluting activities would be identified and secured using methods identified in the SWPPP, and would be located 150 ft. or more from any natural water body or wetland, or on an adjacent, established road area in a location and manner that would preclude erosion into or contamination of the stream or floodplain. • Delineate construction limits within 100 feet of streams, other water bodies, wetlands, and floodplains, as specified in the SWPPP, with a sediment fence, straw wattles, or a similarly approved method to eliminate

	sediment discharge into waterways; minimize the size of construction disturbance areas; and minimize the removal of vegetation, to the greatest extent possible. • Store, fuel, and maintain vehicles and equipment in designated vehicle staging areas located a minimum of 100 feet away from any stream or water body. • Refuge staff will use maps, flagging, or signs to identify and monitor "sensitive areas" (e.g., near tree stands, water lines, cultural features, and fences). This will minimize unintentional impacts to natural resources and Refuge infrastructure. • Crews will adhere to the Refuge's Biosecurity Protocols (Appendix 4-2) and any additional protocols provided. • A Spill Prevention Control and Countermeasures (SPCC) Plan would be developed. • Restrict refueling and servicing operations to locations where any spilled material cannot enter natural or human-made drainage conveyances (e.g., ditches, catch basins, ponds, wetlands, streams, and pipes) and use pumps, funnels, absorbent pads, and drip pans when fueling or servicing vehicles. • Power wash all vehicles and equipment at an approved cleaning facility prior to entering construction work areas to remove any residual sediment, petroleum, or other contaminants; inspect equipment and tanks on a weekly basis for drips or leaks and promptly make necessary repairs. • Pollution and control measures identified in the SWPPP would be implemented. • All non-emergency maintenance of equipment would be performed off-site. • All waste (solid waste, hazardous materials, etc.) would be disposed off-site as regulated by the state. • All equipment, materials, supplies, and waste would be removed from project site when complete. • Conduct construction activities during the dry season as much as possible, to minimize erosion, sedimentation, and soil compaction. • Erosion control measures such as sediment barriers and other suitable erosion and runoff control devices, would be applied to construction, staging, and access areas. • Leave erosion and sediment control devices in place until all disturbed sites are revegetated and erosion potential has returned to pre-project conditions. • Best Management Practices (BMPs) for erosion and sediment control would be applied during operations.

	• Limit the amount of time soils are exposed. Stockpiled soils would be covered if they would be inactive for more than a few days. • Provide spill prevention kits at designated locations on the project site.
Visitor Use and Experience	• Maintain access to as much of the Refuge as possible during construction. • Install signs to inform the public of the lengths of closures and alternate locations of birdwatching, hiking, or other uses.
Cultural Resources	• Protect any unanticipated cultural resources discovered during construction as follows: o Stop all work; cover and protect the 'find' in place. o Notify Project Leader and Zone Archaeologist immediately. o Coordinate with Zone Archaeologist to determine whether additional NHPA or other cultural resources law needs to be followed. o If necessary, complete research to determine eligibility for listing in the National Register of Historic Places (NRHP).
Refuge Land Use and Administration	• Maintain access to as much of the Refuge as possible during construction. • Install signs to inform the public of the lengths of closures and alternate locations of birdwatching, hiking, or other uses. • Use traffic controls such as flagging, reduced speed limits, signage, and barriers to route traffic through affected areas and at truck entry/exit points. • Prepare a traffic control plan to detail items such as traffic control measures to be used and how they would be implemented. • Provide a schedule of construction activities to all staff, volunteers, and landowners who could be affected by construction.
Local and Regional Economies; Social and Community Resources	• Use local rock sources for road construction, if possible.

	• Ensure that local businesses (including small and minority-owned) and workforce are informed of, and may competitively apply for employment or contracting opportunities associated with implementation of the Proposed Action, in accordance with applicable Federal Acquisition Regulations. • Maintain access to as much of the Refuge as possible during construction. • Install signs to inform the public of the lengths of closures and alternate locations of birdwatching, hiking, or other uses.
Aesthetic and Visual	• Reseed and plant disturbed areas with appropriate native species and control weeds immediately following construction. Periodically inspect reseeded sites to verify adequate growth. If necessary, implement contingency measures to ensure adequate growth and vegetation cover. • Use water trucks to apply water, as needed, to the construction area for dust control. • Protect and retain native riparian/wetland vegetation, to the extent practicable, by avoiding construction activities in these areas. • Minimize the size of the disturbance area, to the extent practicable. • Clean-up site and remove equipment, as practical, during non-construction periods.
Health and Safety	• Provide a schedule of construction activities to all staff, volunteers, and landowners who could be affected by construction. • Construction near residences would be limited to the hours between 7:00 a.m. and 10:00 p.m. • Equipment would be fitted with best available sound muffling devices to the extent practicable, and mufflers would be regularly checked to ensure they are functioning properly. • Additional methods of sound dampening or shielding such as noise barriers would be evaluated during construction planning and implemented to the extent practicable. • Construction phasing would be reviewed to minimize the duration of particularly noisy activities and the overall duration of construction near residences.

	• Refuge staff will use maps, flagging, or signs to identify and monitor "sensitive areas" (e.g., near tree stands, water lines, cultural features, and fences). This will minimize unintentional impacts to natural resources and Refuge infrastructure. • Hold crew safety meetings at the start of each workday to review hazards associated with the job, work procedures, special precautions, and other potential safety issues. • Maintain fuel break buffers around Refuge facilities and roads to reduce the risk of human caused ignitions. • Comply with all fire safety laws, rules, and regulations of the State of Hawaii and prepare a fire prevention and suppression plan to meet Service, local authority, and Refuge manager requirements. • The potential presence of fire ants will be monitored following demolition and construction activities. If any little fire ants are detected, a determination of the full extent of infestation would occur and the infestation would be treated with an approved pesticide. • A description of hazardous materials to be used, and handling procedures would be available on-site.* • Written procedures for notifying environmental response agencies would be posted at the work site.* • Spill containment kits with written instructions for cleanup and disposal adequate for the types and quantities of materials used at the site would be available at the work site. * • Workers would be trained in spill containment procedures and would be informed of the location of spill containment kits.* • Workers would wear protective clothing when working with potentially hazardous materials.* • Inspect equipment daily for potential leaks. • Any waste liquids generated at the staging areas would be temporarily stored under an impervious cover until they could be properly transported to and disposed of at a facility that is approved for receipt of hazardous materials. • Secure the site at the end of each workday, as much as possible, to protect equipment and the general public.

* Measures that are intended to address potential long-term impacts, and which would be implemented during both construction and operations.

Alternative B — USFWS does not adopt the SMP – [No Action Alternative]

Under Alternative B (No Action), the USFWS would take no action, which means the SMP would not be adopted to improve the Station's ability to service the Refuge and meet the goals stated in the CCP, and projects described in the SMP would not be implemented. Evaluation of future improvements and repairs to facilities and infrastructure would continue to be made incrementally, on a project-specific basis, and with no cohesive plan to guide long-range planning and implementation. The Station would continue to rely on existing facilities and infrastructure at or near the end of their serviceable life with varying degrees of suitability for their current use. Station housing availability would continue to be insufficient for current and future levels of staff and volunteer utilization. Facilities would not operate collectively within fully integrated systems. Implementation of the No Action Alternative would limit the Station's ability to service the Refuge and meet the goals stated in the CCP and would not meet the purpose and need for this project. Plans and proposals would continue to be reviewed and implemented on an inefficient, case-by-case basis without existing NEPA coverage.

Affected Environment and Environmental Consequences of the Action

This section describes the existing environmental setting in the action area along with the environmental consequences of the action on each Affected Resource. For this analysis, the action area is defined as a contiguous area that includes the footprints of all planned SMP features and at least 10 meters of buffer around those features. In total, the action area comprises approximately 9 acres of previously disturbed, developed, or revegetated land.

This EA includes the written analyses of the environmental consequences on a resource only when the impacts on that resource could be more than negligible and it is therefore considered an "Affected Resource," or when a resource is otherwise considered important as related to the proposed action. Resources that would not be more than negligibly impacted by the proposed action, or have been identified as not otherwise important as related to the proposed action have been dismissed from further analyses in Table 4.

A detailed description of the Refuge and the affected environment is included in the Refuge's CCP (USFWS 2010), which is incorporated here by reference.

Due to the nature of the Proposed Action Alternative (the adoption of a plan to be implemented in phases), environmental consequences of the action have been analyzed assuming full build out. However, since the exact sequencing of individual projects is yet to be determined, the environmental consequences of implementing the SMP are analyzed quantitatively to the extent practicable, and qualitatively when necessary. Environmental consequences of an action include direct, indirect, and cumulative effects, which are defined by the federal government in 40 CFR 1508.1(g):

(g) Effects or impacts means changes to the human environment from the proposed action or alternatives that are reasonably foreseeable and include the following:

(1) Direct effects, which are caused by the action and occur at the same time and place.

(2) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

(3) Cumulative effects, which are effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

(4) Effects include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effects would be beneficial.

The analysis considers short and long-term effects. "Short-term" is used for impacts lasting only for the project duration or during the construction period for an action. Since the Proposed Action would consist of a series of phased construction projects implemented over the life of the SMP, the short-term impacts to resources described below would also occur with each successive phased construction project (e.g., more than once), and may recur in portions of the action area previously subjected to short-term impacts and mitigation measures. "Long-term" impacts occur beyond the date the project is considered fully implemented and are not readily mitigatable. To evaluate the impacts associated with implementation of the Proposed Action, the impact levels were characterized as high, moderate, low, negligible, or no impact. In addition, beneficial impacts are noted where applicable. "Beneficial" is a positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition. Table 4 identifies resources considered and their potential to be affected by the action. Resources not considered further are briefly described in Table 5. Resources with greater than negligible impacts are described, along with the effects from project alternatives, in Table 6 through Table 10.

TABLE 4 - POTENTIAL FOR IMPACTS

Resources	**Not applicable:** Resource does not exist in action area	**No/negligible impacts:** Resource exists but no or negligible impacts	**Greater than negligible impacts:** Impacts analyzed in this EA
Terrestrial Wildlife	☐	☐	☒
Aquatic Species	☒	☐	☐
Threatened and Endangered Species and Other Special Status Species	☐	☐	☒
Vegetation (including vegetation of special management concern)	☐	☐	☒
Geology & Soils	☐	☐	☒
Air Quality	☐	☐	☒
Greenhouse Gas Emissions	☐	☐	☒
Water Resources	☐	☐	☒
Wetlands	☒	☐	☐
Floodplains	☒	☐	☐

Resources	**Not applicable:** Resource does not exist in action area	**No/negligible impacts:** Resource exists but no or negligible impacts	**Greater than negligible impacts:** Impacts analyzed in this EA
Error! Reference source not found.	☐	☒	☐
Visitor Use and Experiences	☐	☐	☒
Cultural Resources	☐	☐	☒
Refuge Land Use	☐	☐	☒
Refuge Administration	☐	☐	☒
Local and Regional Economies	☐	☐	☒
Environmental Justice	☒	☐	☐
Social & Community Resources	☐	☐	☒
Aesthetic & Visual	☐	☐	☒
Health & Safety	☐	☐	☒

Table 5 provides a short description of resources that either do not exist within the action area, or would be unaffected to negligibly affected by the proposed action and no action alternative. These will not be further analyzed in this EA.

TABLE 5 - UNAFFECTED NATURAL RESOURCES NOT ANALYZED FURTHER

Aquatic Species
Unaffected Resource Streams in the upper elevations of the HFU are typically intermittent, becoming perennial at lower elevations. Fauna within the streams are unknown and unstudied, but are presumed to be primarily invertebrates (USFWS 2010). Seasonal manmade ponds on the Refuge are not maintained and have transitioned to beneficial sedges and rushes over time. There are no aquatic habitats in the action area, and the proposed alternative would have no or negligible impacts on aquatic species.
Wetlands
Unaffected Resource *Carex* bogs in the HFU primarily occur below 4,500 feet elevation (USFWS 2010). There are no *Carex* bogs at the Station, and the action area lacks hydric soils (USDA 2022). The selected alternative would have no impact on wetlands.
Floodplains
Unaffected Resource HFU is mapped as an area of unknown flood risk (FEMA 2022). There are no indications that the area is subject to routine regional flooding. The Proposed Action would have no impacts on floodplains.
Wilderness

A review of wilderness criteria for the HFU determined that inventory unit B2 (all HFU lands below 5,000 feet elevation) meets the minimum criteria for wilderness and will be considered a wilderness study area (WSA). Unit B2 is 23,000 acres of roadless land with limited relict impact from fences and gates. Nonnative species including cows, pigs, and mosquitos have caused some negative impacts, but integrated pest management strategies are being used to counteract these effects.

Inventory unit B1 (all HFU lands above 5,000 feet elevation) does not currently meet requirements for naturalness and opportunities for solitude. This unit contains all HFU access roads, the Station, and a high percentage of highly modified former ranchland containing stock ponds, corrals, fences, and non-native ground cover. The wilderness review, including a map of the HFU inventory units, is included in Appendix D of the Refuge's CCP, which is incorporated here by reference (USFWS 2010). The Proposed Action would have no impact on the inventory unit B2 WSA or its wilderness character.

Environmental Justice

Unaffected Resource

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires all Federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high or adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities.

Human health and environmental effects from implementing the SMP may result from increased traffic of construction vehicles, materials, and equipment to and from the Refuge, likely originating in Hilo or Kailua-Kona. SMP projects would be phased and carried out over several years, so increases in traffic in these communities would be negligible compared to baseline. Potential community and economic benefits to low-income and minority populations in Hawaii County from the proposed action are described in Table 10.

The Service has not identified any potential high and adverse environmental or human health impacts from this proposed action or any of the alternatives. Minority or low-income communities would not be disproportionately affected by any impacts from this proposed action or any of the alternatives.

Table 6 through Table 10 provide:

1. A brief description of the Affected Resources in the proposed action area.
2. Direct and indirect impacts of the proposed action and any alternatives on those resources.

TABLE 6 - AFFECTED NATURAL RESOURCES AND ANTICIPATED IMPACTS

Terrestrial Wildlife

Affected Resource

The Refuge supports a diversity of wildlife species including common and endangered passerines, a native goose, an endemic hawk, a listed bat, the pueo (Hawaiian short-eared owl, *Asio flammeus sandwichensis*), and a diversity of native plants and invertebrates. Threatened and endangered species and other special status species are discussed further in the next section.

Common native forest birds occur in medium to high numbers in restored koa stands at the Station throughout the year (Kendall et al 2022). The Hawai'i 'elepaio (*Chasiempsis sandwichensis*), 'apapane (*Himatione sanguinea*), 'amakihi (*Chlorodrepanis virens*), and 'ōma'o (*Myadestes obscurus*) are

common throughout the area. The pueo is also known to use open grasslands, shrublands, and montane parklands on Maunakea and may nest and hunt in habitat surrounding the Station.

Habitat restoration projects at HFU include a reforestation program and control of invasive pests, plants, and predators. An in-depth discussion of affected terrestrial wildlife is included in Appendix 4.

Anticipated Impacts

Alternative A: Approximately 0.9 acres of non-native grassland plant assemblages, outplantings of native grasses, native shrubs, and native trees within the action area would be cleared in order to implement actions proposed in the SMP. Tree and vegetation clearing would include the removal of approximately 30 koa (*Acacia koa*) trees between 6 to 12" diameter at breast height (dbh), which could impact some tree-nesting bird species (including Pueo and other native Hawaiian birds) by removing potential nesting, foraging, and roosting sites. Noise and dust generated by construction vehicles and equipment have the potential to impact terrestrial wildlife within, or in the vicinity of the action area. Direct mortality of less mobile wildlife could occur from clearing, demolition, and construction activities. Direct impacts, however, would be mostly restricted to the displacement of individuals from the active work zone, and in most instances would only cause low, short-term impacts. Displaced wildlife could move to undisturbed sites within the Refuge or potentially out of the action area if suitable conditions were not available. Loss of fitness (i.e. from reduced foraging) to displaced wildlife could result from the construction disturbance. These short-term direct impacts would be temporary and low because sufficient dispersal habitat exists on three sides of the Station, effects would be mitigated by removing trees during non-breeding periods, and the site would be replanted with native trees and shrub species in accordance with the Proposed Station Layout (Appendix 3, Figure 2). Forested areas would be avoided between January 1 and June 30 during the forest bird breeding season (Table 3).

Construction equipment, materials, vehicles, and personnel have the potential to introduce invasive plants, invertebrates, or disease agents to the action area and surrounding Refuge. If established, invasive species and disease agents could outcompete, displace, or eliminate native flora and fauna, which would reduce available habitat for native species, and contribute to overall loss of biodiversity at the Refuge.

Mitigation measures included in building design and biosecurity protocols as well as measures used during construction, such as vehicle wash stations (see Table 3 and Appendix 4-2) would be implemented to reduce the impacts of invasive species on terrestrial wildlife species.

The implementation of the Proposed Action would result in several beneficial changes for terrestrial wildlife. At full build out, the Station would have increased housing capacity for Refuge staff and volunteers, improved operations and maintenance capability, and a new horticulture building, all of which would increase Refuge ability to conduct plant propagation and habitat restoration activities. Wildlife habitat enhancement efforts would therefore increase relative to current conditions, and it is anticipated that the Refuge would see increases in invertebrate and plant populations, and overall species diversity, which would enhance conditions for native wildlife. The impact to terrestrial wildlife associated with the increase in extent, diversity, and condition of native habitat would be long-term, moderate, and beneficial.

With the inclusion of mitigation measures and considering the anticipated benefits to Refuge operations, including habitat restoration and invasive species management, it is expected that the Proposed Action would have a long-term, moderate, beneficial impact on terrestrial wildlife. Reduced quality habitat for wildlife would occur after construction until maturation of restored vegetation, relative to existing conditions. However, because the affected portions of the Refuge would be

expected to fully recover after several years and the surrounding Refuge would ultimately be enhanced above existing conditions, the impacts would be considered temporary and low.

Alternative B: No impact to wildlife beyond daily Station operation and ongoing maintenance of existing facilities. Individual projects to improve Station facilities would continue to be proposed and evaluated on a case-by-case basis. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. The ability of the Service to meet the Refuge purpose and CCP goals for protection of species and their habitat would continue to be constrained by the dilapidated condition of equipment and structures required for Refuge operation and maintenance, and the insufficient quantity and quality of housing for Service staff and volunteers.

Threatened and Endangered Species and Other Special Status Species

Affected Resource

Threatened and endangered species whose ranges overlap with the proposed action area include the threatened nēnē (Hawaiian goose, *Branta sandvicensis*); four species of forest birds: the endangered ʻakiapōlāʻau (*Hemignathus munroi*), the endangered ʻalawī (*Oreomystis mana*), the endangered Hawaiʻi ʻākepa (*Loxops coccineus*), and the threatened ʻiʻiwi (*Vestiaria coccinea*); three Hawaiian seabirds: the endangered ʻakēʻakē (band-rumped storm-petrel, *Oceanodroma castro*), the endangered ʻuaʻu (Hawaiian petrel, *Pterodroma sandwichensis*), and the threatened ʻaʻo (Newell's shearwater, *Puffinus auricularis newelli*); and the endangered ʻōpeʻapeʻa (Hawaiian hoary bat, *Lasiurus cinereus semotus*).

Six endangered plant species are present at the Station: two species of ʻōha wai (*Clermontia pyrularia* and *C. Lindseyana*), hāhā (*Cyanea shipmanii*), *Phyllostegia brevidens* (no common name), kīponapona (*Phyllostegia racemosa*), and makou (*Ranunculus hawaiensis).*

All these species, apart from the Hawaiian seabirds, *C. Pyrularia*, kīponapona, and makou, occupy a recently restored koa forest within the action area that is less than 30 years old. Endangered plants have been propagated from wild founder lines. *C. Lindseyana*, hāhā, and *P. Brevidens* have been outplanted by Refuge staff at the Station. *C. Pyrularia,* kīponapona, and makou propogules are kept in the Refuge greenhouse and have not been outplanted at the Station. Additional information on species descriptions and historical presence in the action area is included in Appendix 4.

There is no currently designated critical habitat within the action area. Proposed critical habitat for iʻiwi includes the reforested areas within the action area but does not include manmade structures or disturbed areas. Designated critical habitat for the endangered plants *Clermontia pyrularia*, kīponapona, and hāhā is within 200 meters south and east of the action area. *Clermontia lindseyana* critical habitat is greater than 400 meters from the action area and *Clermontia paleana* critical habitat is more than 3.8 kilometers away.

A Species of Special Concern whose range overlaps the action area is the ʻio (Hawaiian hawk, *Buteo solitarius*). Additional information on this species' historical presence in the action area is included in Appendix 4. Additionally, the ʻapapane, ʻamakihi and ʻōmaʻo (described in *Terrestrial Wildlife*, above) are all considered by the USFWS to be Birds of Conservation Concern (BCC) throughout their range in Hawaiʻi and the Pacific Islands and are protected under the Migratory Bird Treaty Act (MBTA).

Visitor access to HFU is prohibited due to the presence of endangered species and their habitat, and due to the danger posed by Rapid ʻŌhiʻa Death (USFWS 2022). An in-depth discussion of affected threatened and endangered species and other special status species, and Rapid ʻŌhiʻa Death is included in Appendix 4.

Anticipated Impacts

Alternative A: Endangered and threatened forest birds occupy the koa stands near the Station for foraging year-round, as well as for nesting between the months of January through August. Removal of koa trees (approximately 30) from the Station may impact the endangered forest bird species (ʻakiapōlāʻau, ʻalawī, and ʻiʻiwi) by removing potential foraging, roosting, and nesting sites. However, direct impacts would be mitigated by removing trees during non-breeding periods, and replanting the action area with appropriate native plant species in accordance with the SMP. Dispersal habitat is present on three sides of the action area which would be sufficient to accommodate listed forest birds that may be affected by the Proposed Action. Impacts to listed species that cannot be avoided with these and other mitigation measures (Table 3) would be covered in a formal Biological Consultation with USFWS Pacific Islands Office.

Demolition, construction, and restoration activities may result in temporary minor disturbance to nēnē feeding or nesting near the Station. Indirect disturbance or displacement of nēnē individuals foraging or flying to or from nests is also possible due to localized noise and human or vehicle activity associated with deconstruction and construction activities. Project activity would be intermittent but result in short-term impacts by increasing the existing baseline levels of human activity and traffic for the duration of each project. Prior to commencing construction activities, personnel and contractors would be educated to not approach, feed, or disturb nēnē, and a Refuge biologist would monitor the project component areas for any nēnē activity prior to work starting and regularly during the project. With the inclusion of these and other mitigation measures (Table 3), impacts to nēnē from the Proposed Action are anticipated to be short-term, and moderate.

Noises and visual stimuli from construction equipment, vehicles, and workers may cause short-term disturbance to ʻakiapōlāʻau, ʻalawī, and ʻiʻiwi, causing individuals to move away from the source of the disturbance temporarily. These impacts would be temporary, as sufficient dispersal habitat exists on three sides of the action area to accommodate wildlife that may be affected. Tree removal would be restricted during the peak forest bird breeding season (January 1 to June 30). With the inclusion of these and other mitigation measures (Table 3), we anticipate that implementing the plan would result in short-term, low impacts to ʻakiapōlāʻau, ʻalawī, and ʻiʻiwi.

The action area is within proposed critical habitat for the ʻiʻiwi. Manmade structures, such as roads and buildings are not included in the proposed critical habitat; however, the removal of koa trees within proposed critical habitat may be considered likely to adversely modify the critical habitat. Specific mitigation measures, which may include compensatory action such as habitat restoration (a key mission of the Refuge), will be determined during a formal ESA Section 7 consultation. Critical habitat for C*. Pyrularea, C. Lindseyana, C. Paleana,* kīponapona, and hāhā is not present within, or adjacent to the action area and would therefore not be impacted by the Proposed Action.

Outdoor lighting could result in listed seabird (ʻuaʻu, ʻaʻo, and ʻakēʻakē) disorientation, fallout, and injury or mortality. Seabirds are attracted to lights and after circling the lights they may become exhausted and collide with nearby wires, buildings, or other structures or they may land on the ground. Downed seabirds are subject to increased mortality due to starvation, and predation by introduced predators. Young birds (fledglings) traversing the Refuge between September 15 and December 15, in their first flights from their mountain nests to the sea, are particularly vulnerable to light attraction. Nighttime construction would therefore be prohibited between September 15 to December 15 in order to minimize potential impacts to seabirds. With the inclusion of this and other mitigation measures (Table 3), the Proposed Action is anticipated to cause no impacts to ʻuaʻu, ʻaʻo, and ʻakēʻakē.

Construction activities have the potential to temporarily disturb ʻio using the area, and nest failure could result from the repeated loud, irregular, and unpredictable noises associated with construction, such as heavy equipment use or assembling a structure. In order to minimize impacts to ʻio during the breeding season (March 1 – September 30), pre-disturbance surveys would be conducted by a qualified biologist immediately prior to the onset of construction activities to assess the action area and vicinity for presence of nesting ʻio. If present, no construction activities would be permitted within 1,600 feet of the nest. With the implementation of these and other mitigation measures (Table 3), impacts to ʻio from the Proposed Action are expected to be short-term and low.

Noises and visual stimulus from trucks, equipment, and workers may disturb endangered ʻōpeʻapeʻa, causing individuals to move away from the action area temporarily. Removal of koa trees from the action area may impact the ʻōpeʻapeʻa by reducing the number of potential birthing sites. If trees or shrubs 15 feet or taller are cleared during the ʻōpeʻapeʻa pupping season (June 1–September 15), there is a risk that young ʻōpeʻapeʻa could inadvertently be harmed or killed since they are too young to fly or may not move away. These impacts would be temporary, since sufficient habitat is available to provide security to displaced wildlife, would be near-negligible to overall species populations, and would be mitigated by removing trees during non-pupping periods and replanting the site with appropriate native plant species in accordance with the site plan (Appendix 3, Figure 2). With the implementation of these and other mitigation measures (Table 3), we anticipate the Proposed Action would result in short-term, low impacts to ʻōpeʻapeʻa.

Clearing portions of the action area during construction is necessary to permit long-term maintenance and management with heavy equipment (mower, tractor, skid steer). During this process, removal of some native vegetation is unavoidable. Vegetation clearing during implementation of the SMP may affect outplanted ESA-listed plant species by causing physical damage to plant parts (roots, stems, flowers, fruits, seeds, etc.) as well as impacts to other life-requisite features of their habitat which may result in reduction of germination, growth and/or reproduction. Cutting and removal of vegetation surrounding listed plants has the potential to alter microsite conditions (e.g., light, moisture, temperature), damaging or destroying the listed plants and increasing the risk of invasion by nonnative plants.

Soil disturbance or removal has the potential to impact the soil seed bank of listed plant species if such species are present or historically occurred in the action area. Depending on the species, seeds brought to the surface could be impacted by predation, rot, desiccation, or harmful exposure to UV radiation. Removal of soil could result in seed deposition in unfavorable habitat. Construction vehicles, personnel, and construction materials could also be agents for the unintentional introduction and/or spread of non-native or invasive plants and arthropods within the action area and surrounding Refuge. If established, invasive species and disease agents could outcompete, displace, or eliminate native flora and fauna, which would reduce available habitat for native species, and contribute to overall loss of biodiversity at the Refuge. Mitigation measures included in building design and biosecurity protocols as well as measures used during construction, such as vehicle wash stations (see Table 3, and Appendix 4, Table B) would be implemented to reduce the impacts of soil disturbance species on listed plant species.

The Refuge does not anticipate that the short-term impacts of construction at the Station would reduce the baseline condition of the listed plant species' populations. As all founder plants would be protected, any potential impacts to listed plants would be limited to outplants and propagules. Mitigation measures would be implemented to protect outplants and propagules within the action area, including flagging and avoiding known locations during construction, and translocating individuals located within proposed building footprints or disturbance areas. In spite of these and

other mitigation measures (Table 3) unavoidable impacts to three species of endangered plants (*C. lindseyana*, *C. shipmanii*, and *P. brevidens*) in the form of individual mortality and localized population decrease could still occur from handling, translocation, and replanting. Impacts to *C. lindseyana*, *C. shipmanii*, and *P. brevidens* are therefore anticipated to be temporary and moderate. Because these individual plants cannot be avoided, the Refuge will initiate a formal consultation with USFWS Ecological Services division.

C. pyrularia, makou, and kīponapona propagules are only found in the Refuge greenhouse ex situ collection or in small populations outside of the action area. Therefore the Proposed Action would result in no impacts to *C. Pyrularia*, makou, and kīponapona.

Once construction is complete, operation of the Station would resume at a level of activity and daily use comparable to or slightly increased from current conditions. Impacts to listed species within and in the vicinity of the Station may include disturbance to foraging and nesting from noise associated with short-term, intermittent vehicle use, equipment operation, or gatherings of staff or volunteers. Some listed wildlife, such as nēnē, may quickly become accustomed to the noise and activity associated with daily Station operation and appear undisturbed or indifferent. Other listed wildlife may move away from daily sources of noise and activity, but impacts from such interruptions would be short-term and negligible. Listed plant populations that may be present at the Station would be marked with appropriate signage and avoided, resulting in no impacts from daily operation.

The implementation of the Proposed Action would result in several beneficial changes for listed species and designated and proposed critical habitat at full build out. Listed species occupancy, movement, and activity in and around the action area would resume to current conditions. The increased housing capacity for staff and volunteers, improved operations and maintenance capability, and new horticulture building, would enhance the scale, scope, quality, and efficiency of plant propagation, habitat restoration activities, and invasive species management throughout the Refuge. As a result, the Refuge is anticipated to see increases in invertebrate and plant populations, and overall species diversity, which would in turn enhance conditions for listed species. The impacts to listed species associated with the increase in extent, diversity, and condition of native and critical habitat would be long-term, moderate, and beneficial.

The Proposed Action is not anticipated to jeopardize the continued existence of any ESA-listed species or adversely modify designated or proposed critical habitats. With the inclusion of mitigation measures (Table 3) and considering the anticipated benefits to Refuge operations, including habitat restoration and invasive species management, it is expected that implementing the Proposed Action would have a long-term, moderate, beneficial impact on threatened and endangered species and their critical habitat.

Reduced quality habitat for listed species would persist within the action area after construction until maturation of restored vegetation, relative to existing conditions. However, because the affected portions of the action area would be expected to fully recover after several years and the surrounding Refuge would ultimately be enhanced above existing conditions, the impacts would be considered temporary and low.

Alternative B: No impact to listed species beyond daily Station operation and ongoing maintenance of existing facilities. Individual projects to improve Station facilities would continue to be proposed and evaluated on a case-by-case basis. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. The ability of the Service to meet the Refuge purpose and CCP goals for protection of species and their habitat would continue to be constrained by the dilapidated condition of equipment and structures

required for Refuge operation and maintenance, and the insufficient quantity and quality of housing for Service staff and volunteers.

Vegetation (including vegetation of special management concern)

Affected Resource

HFU supports an abundance and diversity of subtropical mesic to wet rainforest vegetation. Historically, the area near the Station was dominated by mesic koa forest, but 150 years of intensive cattle grazing eliminated the forest and created open grasslands. Since the Refuge's establishment in 1985, over 600,000 native trees, primarily koa, have been planted to reforest these open grasslands.

The action area is located on a previously disturbed landscape containing two habitat types: 1) open nonnative grasslands (*Cenchrus clandestinus*, *Ehrharta stipoides*, *Anthoxanthum odoratum*, and *Poa pratensis*) that are mowed and maintained around Refuge facilities; and 2) open nonnative grasslands that have been re-planted with koa trees with understory of exotic grasses and outplanted native trees and shrubs (*Coprosma rhynchocarpa*, *Myoporum sandwicense*, *Chenopodium oahuense*, *Cheirodendron trigynum*, *Leptecophylla tameiameiae*, *Rubus hawaiensis*). Three endangered plant species (C. *lindseyana*, *C. shipmanii*, and P. *brevidens*) have been outplanted at the Station and are described above.

The Refuge is currently closed to the public due to concerns about a disease called Rapid ʻŌhiʻa Death, which has killed thousands of acres of mature ʻōhiʻa trees in forests and residential areas in Puna and Hilo Districts of Hawaiʻi Island. The disease can be transported on contaminated soil found on vehicles, tools, shoes and clothing. An in-depth discussion of affected vegetation is included in Appendix 4.

Anticipated Impacts

Alternative A: During construction, vegetation within the action area would be cleared prior to the onset of construction activities for individual phased construction projects, such as in areas where roadway or walkway work would occur and at structure removal, utility replacement, or building construction sites. These actions would result in the removal of approximately 30 native koa trees and the temporary disruption and loss of approximately 0.9 acres of non-native grassland plant assemblages and outplantings of native grasses, native shrubs, and native trees. Soil disturbance or removal has the potential to impact the soil seed bank of native plant communities present or known to historically occur in the action area. Depending on the species, seeds brought to the surface could be impacted by predation, rot, desiccation, or harmful exposure to UV radiation. Removal of soil could result in seed deposition in unfavorable habitat. Construction vehicles, personnel, and construction materials could also be agents for the unintentional introduction and/or spread of non-native or invasive plants and arthropods, which thrive in disturbed areas. If established, invasive species and disease agents could outcompete, displace, or eliminate native flora and fauna, which would reduce available habitat for native species, and contribute to overall loss of biodiversity at the Refuge. Mitigation measures included in building design and biosecurity protocols as well as measures used during construction, such as vehicle wash stations (see Table 3, and Appendix 4-2) would be implemented to reduce the impacts of clearing activities and soil disturbance species vegetation in the action area.

Following the completion of each individual phased project, all disturbed areas would be restored to native vegetation communities through seeding or by planting with plugs. In general, revegetation efforts would occur wherever plants have been removed, as quickly as possible once grubbing, grading, excavation or other ground-disturbing work has been completed. Immediate reseeding with

native species would occur on temporarily disturbed ground, including locations of staging, clearing, grading, demolition, excavation, trenching, backfilling, compaction, road and walkway construction, and disturbance from construction vehicle ingress and egress. Construction impacts including disruption of plant communities and direct removal of vegetation would be temporary, and low. Impacts would be reduced with implementation of mitigation measures identified in Table 3 and additional measures described in Appendix 4-2.

Once construction is complete, operation of the Station would resume at a level of activity and daily use comparable to or slightly increased from current conditions. Long-term maintenance and management of vegetation within the action area with heavy equipment (mower, tractor, skid steer) would resume. During this process, removal of some native vegetation is unavoidable. Impacts to native vegetation from ongoing vegetation maintenance would include physical damage to plant parts (roots, stems, flowers, fruits, seeds, etc.) as well as impacts to other life-requisite features of their habitat which may result in reduction of germination, growth and/or reproduction. Impacts to vegetation within the Station from ongoing operation and maintenance activities would be short-term, intermittent, and low.

The implementation of the Proposed Action would result in several beneficial changes for native plant communities at full build out. The increased housing capacity for staff and volunteers, improved operations and maintenance capability, and new horticulture building would enhance the scale, scope, quality, and efficiency of plant propagation, habitat restoration activities, and invasive species management throughout the Refuge. As a result, the Refuge is expected to see increases in invertebrate and plant populations, and overall species diversity. Post-construction revegetation efforts would ultimately result in a net gain of native forest habitat on the Refuge. The impacts to vegetation species associated with the increase in extent, diversity, and condition of native plant communities would therefore be long-term, moderate, and beneficial.

Alternative B: Vegetation clearing and koa tree removal associated with the Proposed Action would not occur. No impact to vegetation beyond daily Station operation and ongoing maintenance of existing facilities. Individual projects to improve Station facilities would continue to be proposed and evaluated on a case-by-case basis. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. The ability of the Service to meet the Refuge purpose and CCP goals for protection of species and their habitat would continue to be constrained by the dilapidated condition of equipment and structures required for Refuge operation and maintenance, and the insufficient quantity and quality of housing for Service staff and volunteers.

Geology & Soils

Affected Resource

HFU is on the slopes of the dormant Maunakea within the Laupāhoehoe Volcanics unit ranging between 11,000 – 64,000 years old (Trusdell, Wolfe, and Morris 2006). The entire HFU is within United States Geographical Survey (USGS) lava hazard zone 8, as “only a few percent of this area has been covered by lava in the past 10,000 years” (Wright et al. 1992). There is no evidence of faults or landslides within the area of impact.

The volcanic layer is overlain by Pu‘u ‘O‘o silt loam, a strongly acidic layer formed from volcanic ash on the windward slope. The layer is moderately permeable with a slight erosion hazard (USFWS 2010). Roadways within the Station have experienced erosion, including the road in front of the P-V power

building. The access road to the volunteer bunkhouse and garage area is steep and funnels water from above. With enough precipitation, water backs up against and into the garage.

Anticipated Impacts

Alternative A: The clearing and removal of approximately 0.9 acres of vegetation and trees to accommodate full build out of the Proposed Action would temporarily expose soils throughout the action area. These disturbed and exposed areas would be highly erodible and potential sources of sedimentation during windy conditions, rain events, and the movement of personnel and equipment. Heavy equipment use would also compact exposed soils, thereby decreasing soil permeability. Since the action area contains soils with moderate permeability and a slight erosion risk, mitigation measures such as working during dry weather for construction would be implemented to minimize actual erosion risk (see Table 3). Since soils within the action area are previously disturbed, ground disturbance associated with the Proposed Action would likely result in minimal soil compaction from equipment operation and negligible loss of soil productivity compared to existing conditions. Any excavated soils which are not used for grading or backfilling would be spread evenly around new buildings and structures and stabilized to minimize future erosion. Because the Proposed Action would occur on previously disturbed soils, and the soils would be stabilized to minimize future erosion following construction, impacts on soil erosion are expected to be temporary and low.

The use of heavy equipment during structure demolition, construction of new or replacement structures, and replacement of utility systems would result in increased soil compaction in the immediate vicinity where equipment is used. Compaction of soils by heavy equipment degrades soil structure by reducing the pore space within soils. Pore spaces contribute to the retention of moisture and gas exchange, which are important for respiration and other metabolic functions of soil organisms. Compaction would be localized and is not expected to significantly increase or permanently alter the soils' ability to infiltrate water or increase stormwater runoff. Peak construction activities would be conducted during the dry season as much as possible to minimize soil compaction. Prior to the completion of individual phased projects, all portions of the action area affected by construction activities would be inspected to determine if any areas of excessive compaction are present. Compacted areas would be scarified or tilled to promote infiltration and gas exchange before final site stabilization measures. Direct impacts on soil permeability and productivity from compaction associated with the Proposed Action are therefore expected to be short-term, temporary, and low.

Under the Proposed Action, approximately 2,000 linear feet of the existing Station entrance road would be improved, realigned, and reconstructed. The existing entrance road is located over soils with moderate permeability and slight erosion risk. Portions of the entrance road with a steep grade would have an increased risk of soil erosion when disturbed by construction activities. Mitigation measures such as working during dry weather for construction would be implemented to minimize actual erosion risk (see Table 3). Improving road access may require the use of a road grader to smooth surfaces, lower grades, or importing rock to provide a drivable surface. There would be low impacts on soils as a result of road improvements because these areas have been previously disturbed by road construction. Short-term impacts from temporary increases in erosion may occur during grading activities when the ground is disturbed. Additionally, entrance road work would include installation, replacement, and reshaping of drainage structures such as culverts, drain dips, roadway ditches, and culvert inlets and outlets; all of which would result in temporary increases in construction-related erosion. Incorporating the mitigation measures identified in Table 3 is expected to reduce erosion associated with road improvements. Therefore, impacts on soils from existing entrance road work are expected to be short-term and low.

The Station's existing 3,200 linear feet of internal access road network would be improved, realigned, and reconstructed under the Proposed Action with construction activities, soils impacts, and mitigation measures similar to those described above for the Station entrance road. In addition to these construction activities, the internal access road network may also have portions of the roadway removed and decommissioned, and new roadway sections constructed. Proposed new access road construction would require clearing and grading on soils rated as slight erosion potential. New access road construction would remove the uppermost portion of the soil within a 20-foot width to establish a drivable surface. Within the 20-foot wide corridor, direct disturbance to soils would increase the potential for erosion until final stabilization of the road bed is completed. Mitigation measures such as working during dry weather, and using sediment barriers to minimize off-site sediment movement during construction would be implemented to minimize actual erosion risk (see Table 3). Removal and decommissioning of portions of the existing internal access roads would reestablish the natural contour and profile to the greatest extent practicable. Construction machinery would be used to scarify and dislodge the upper 12 inches of the existing roadbed, and redistribute the loosened material to fill and duplicate natural contours, or reuse the material for other road work associated with the Proposed Action. Revegetation would occur as quickly as possible once ground-disturbing work has been completed for internal access road work, and immediate reseeding with native species would occur on temporarily disturbed ground. Due to the relatively small amount of new construction, and the incorporation of mitigation measures into the Proposed Action's design, impacts to soils from the proposed access road construction and removal are expected to be short-term and low.

At full build out, the Proposed Action would result in a net increase of impervious surface area at the Station. The Station entrance road would be reconstructed and paved, some internal access roads would be relocated and may be paved in the future, and overall building footprint would increase. Impervious surfaces can increase the volume and velocity of stormwater runoff, which can negatively impact soils by increasing the potential for erosion and off-site sediment transport. The construction of drainage structures such as culverts, drain dips, and roadway ditches, and the revegetation of disturbed areas as quickly as possible following the conclusion of construction activities would minimize any potential increase in surface runoff from the Proposed Action. Incorporating these and other mitigation measures identified in Table 3 would result in low, short- and long-term impacts to soils from impervious surfaces.

Once construction is complete, operation of the Station would resume at a level of activity and daily use comparable to current conditions. Operation and maintenance activities would include incidental repairs to buildings, outbuildings, utilities, and access roads, which could cause localized soil disturbance. Ongoing vegetation management activities in the action area would be non-ground disturbing and would not impact underlying soils. In general, operation and maintenance activities would have long-term, intermittent, low impacts on soils because they would be confined to small, localized, previously-disturbed areas dispersed throughout the action area.

The implementation of the Proposed Action would result in several beneficial changes for soils at full build out. Newly installed, replaced, and reshaped drainage structures (culverts, drain dips, roadway ditches, and culvert inlets and outlets) would improve stormwater management capacity and performance of roadways and building sites over existing conditions. Grade reduction along steep portions of the Station entrance road would contribute to reduced velocity and volume of stormwater runoff, which is expected to reduce the frequency of road repairs required in those locations after storm events. Post-construction revegetation efforts would ultimately result in a net gain of native

forest habitat on the Refuge. Therefore, the Proposed Action is expected to have long-term, low, and beneficial impacts on soil erosion and productivity.

Alternative B: Under the No Action Alternative, the Proposed Action would not be implemented; therefore, the impacts related to the construction of the individual phased construction projects in the SMP would not occur. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. Operation and maintenance activities at the Station and Refuge would continue and would be similar to existing conditions. Maintenance activities would likely increase as existing structures deteriorate, and more structure repair and replacement could be required. Maintenance of access roads would continue to be needed, particularly along steep portions of the entrance road which would continue to require repair from damage and washout following most rain events. The road work under the Proposed Action would likely need to take place, but would continue to be proposed, evaluated, funded, and implemented as individual projects on a case-by-case basis. Therefore, the maintenance activities would result in long-term, moderate impacts on soils, including erosion, compaction, and productivity.

Air Quality

Affected Resource

Air quality at the Station is generally very good due to Hawai‘i Island’s location in the middle of the Pacific Ocean and the remoteness of the Station. Existing sources of air pollution from human activity at the Station are low impact and relatively infrequent, including occasional use of a diesel-powered generator, exhaust from gasoline powered hand tools and vehicles, and fugitive dust from roadway use and in other disturbed areas.

Anticipated Impacts

Alternative A: The Proposed Action could impact air quality within and in the vicinity of the action area as a result of tailpipe emissions and fugitive dust generated by the movement of vehicles, personnel, and equipment during construction activities (including any ground-disturbing activities, on-site travel on unpaved surfaces, and emissions from employee vehicles. Construction activities during hot summer months would have a greater potential to increase ozone in the project area as a result of vehicle emissions. Demolishing existing structures also has the potential to release building material particulates into the air, which could temporarily affect air quality in the vicinity. However, construction activities and vehicle emissions would only increase dust and particulate levels on a short-term, temporary basis in a localized area within the Station. Construction crews would be required to shut down all idling equipment, and water trucks or other erosion control measures would be used to control dust during construction when soil is disturbed or exposed. With these and other mitigation measures outlined in Table 3, direct impacts on air quality are expected to be temporary, short-term, and low.

Following the completion of construction activities, air quality could also be affected as a result of the operation and maintenance of facilities associated with the Proposed Action. Although there would continue to be occasional vehicle emissions during Station maintenance activities, the number of vehicle trips is anticipated to be low and would also be similar to existing conditions. For these reasons, impacts on air quality from operation and maintenance activities would be short-term and low.

At full build out, the Proposed Action would result in several beneficial changes for air quality. Improved quality and quantity of housing options would increase Station capacity for staff and

volunteers to permanently reside or temporarily lodge on site, thereby reducing overall number of daily commutes between the Refuge and distant communities. The addition of paved asphalt surfaces to the Station entrance road and portions of the internal access road network would decrease the amount of vehicle travel on exposed soil and unpaved surfaces over existing levels, which would reduce the generation of dust and other particulates from these activities. The replacement of existing diesel generators with a decentralized P-V powered backup system would minimize or eliminate existing impacts to air quality during backup power system operation. Post-construction revegetation efforts would ultimately result in a net gain of native forest habitat on the Refuge, which would reduce erosion potential and increase sequestration of particulates over current conditions. Therefore, the Proposed Action is expected to have indirect, long-term, low, and beneficial impacts on air quality.

Alternative B: The Proposed Action would not be implemented; therefore, the impacts related to the construction of the individual phased construction projects in the SMP would not occur. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. Operation and maintenance activities at the Station and Refuge would continue and would be similar to existing conditions. Housing capacity issues would persist, with staff and volunteers continuing to make daily commutes by vehicle to and from the Refuge. Road reconstruction of steep portions of the Station entrance road would still be required following most rain events, which would continue to impact air quality in the vicinity of the repairs. Maintenance activities would likely increase as existing structures deteriorate, and more structure repair and replacement could be required. The demolition and new construction of structures under the Proposed Action would likely need to take place, but would continue to be proposed, evaluated, funded, and implemented as individual projects on a case-by-case basis. Therefore, the maintenance activities would result in long-term, moderate impacts on air quality.

Water Resources

Affected Resource

The area near the Station was historically used for livestock grazing. Manmade modifications in the vicinity include fences, stock ponds, corrals, fences, nonnative tree plantings, introduced grasses, roads, and buildings. Ranching activities degraded water quality by introducing animal waste, sediment, and diseases to streams and ponds, and by compacting soils, which reduces groundwater retention and can encourage flash flooding. Feral pigs and rats also pose significant threats to water quality throughout the Refuge.

The reach of Hakalau stream adjacent to the Station is classified as intermittent, with flowing water only when there is sufficient precipitation. Restored koa forest along the riparian corridor of the stream acts as a vegetation buffer that captures and filters surface runoff from the Station.

Potable and non-potable water at the Station is obtained through rooftop rainwater harvesting. Collected rainwater is stored in cisterns that are located near the buildings they serve. Some water supply lines are not buried sufficiently and are vulnerable to damage.

Some areas of the Station are prone to erosion and flooding with substantial rainfall. Of particular concern is flooding at the vehicle garage, which could lead to chemical contamination of runoff. Erosion along roadways introduces sediment into stormwater. Vegetated areas around the Station act as a buffer preventing the introduction of sediment-laden runoff from roadways into surface waters.

No public drinking water sources, well heads, or surface water intakes are known to occur within the action area.

Anticipated Impacts

Alternative A: Ground disturbance associated with building demolition and construction, roadway and walkway construction, and utility work, including clearing of vegetation, grading, and compaction from heavy equipment, could indirectly cause erosion and sedimentation that could reach streams and increase turbidity, degrading water quality. The risk of erosion would be highest where unconsolidated sediments are susceptible to water and wind erosion, on steep slopes with erodible soils, and after rain events. Construction BMPs, including erosion and sediment control mitigation measures (Table 3), would be implemented during construction to prevent adverse impacts on water quality in streams. Short-term impacts from temporary increases in erosion may occur during ground-disturbing activities, and prior to the maturation and establishment of plants from the post-construction revegetation efforts. Incorporating the mitigation measures identified in Table 3 is expected to reduce erosion associated with road improvements. Therefore, impacts on water quality from construction activities associated with the Proposed Action are expected to be short-term and low.

At full build out, the Proposed Action would result in a net increase of impervious surface area at the Station. The Station entrance road would be reconstructed and paved, some internal access roads would be relocated and may be paved in the future, and overall building footprint would increase. New access roads would increase impervious surfaces in the action area, which could adversely affect stream hydrology and water quality over the long term. Road work would include construction, replacement, and reshaping drainage ditches, culverts, or water bars, as necessary, to prevent potential surface erosion or other road failure to minimize these effects. Additionally, new and improved access roads would be composed of a compacted gravel surface to minimize erosion. In general, water quality impacts from impervious surfaces are expected to be localized and temporary and are not expected to affect stream function or habitat, or result in water quality parameters being exceeded. Therefore, indirect impacts to water quality associated with the Proposed Action would be short-term and low.

During construction, petroleum products and hazardous materials such as fuels, oils, and lubricants would be present onsite, primarily in vehicles and construction equipment. Use of these materials as well as uncured concrete increases the risk of accidental discharge into riparian areas or directly into water bodies, resulting in impaired water quality as well as injury or mortality of aquatic species. Leakage of hydraulic fluids, fuels, and solvents could occur during construction in the vicinity of Hakalau stream. These impacts would be reduced to low by implementation of a SPCC plan in accordance with state law, as well as use of standard construction BMPs designed to best contain hazardous materials and reduce the chances of spills or leaks.

Impervious surfaces from new paved access roads, walkways, parking lots, and building footprints have the potential to reduce surface to groundwater infiltration rates in localized areas within the Station, but are not expected to reduce infiltration rates to a degree that it would affect groundwater recharge. There would be no impact on groundwater.

Once construction is complete, operation of the Station would resume at a level of activity and daily use comparable to current conditions. Operation and maintenance activities would include incidental repairs to buildings, outbuildings, utilities, access roads, walkways, and parking lots, which could cause localized soil disturbance. Ongoing vegetation management activities in the action area would generally be non-ground disturbing, but could result in soil erosion and compaction. In general, operation and maintenance activities would have short-term, intermittent, low impacts on water quality because they would be confined to small, localized areas dispersed throughout the action area.

The implementation of the Proposed Action would result in several beneficial changes for soils at full build out. Newly installed, replaced, and reshaped drainage structures (culverts, drain dips, roadway ditches, and culvert inlets and outlets) would improve stormwater management capacity and performance of roadways and building sites over existing conditions. These improvements would decrease the risk of utility exposure from erosion during rain events, and reduce the potential for building flooding and subsequent off-site transfer of contaminants. Grade reduction along steep portions of the Station entrance road would contribute to reduced velocity and volume of stormwater runoff, which is expected to reduce the frequency off-site sediment transport during storm events. Post-construction revegetation efforts would ultimately result in a net gain of native forest habitat on the Refuge. Therefore, the Proposed Action is expected to have long-term, low, and beneficial impacts on water quality.

Alternative B: Under the No Action Alternative, the Proposed Action would not be implemented; therefore, the impacts related to the construction of the individual phased construction projects in the SMP would not occur. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. Operation and maintenance activities at the Station and Refuge would continue and would be similar to existing conditions. Maintenance activities would likely increase as existing structures deteriorate, and more structure repair and replacement could be required. Maintenance of access roads would continue to be needed, particularly along steep portions of the entrance road which would continue to require repair from damage and washout following most rain events. Utilities would remain at risk of exposure from erosion, and Station buildings would continue to flood during storm events. The road work under the Proposed Action would likely need to take place, but would continue to be proposed, evaluated, funded, and implemented as individual projects on a case-by-case basis. Therefore, operation and maintenance activities would result in long-term, low impacts on water quality.

Greenhouse Gas Emissions

Affected Resource

Transportation is the most significant source of greenhouse gas emissions in Hawai‘i County, of which aviation fuel makes up half and on-road transportation approximately one third. Off-road vehicles, including construction equipment, make up 1.24% of the county’s transportation emissions (County of Hawai'i 2021).

Due to the insufficient staff housing capacity at the Station, some Refuge staff must travel to the Station and back to their homes each work day.

Electricity at the Station is generated by a centralized P-V system backed up by battery storage and a diesel-powered generator. Inadequate redundancy in the Station electrical system presents the risk of emissions from use of the Station’s diesel generator.

Anticipated Impacts

Alternative A: The Proposed Action could impact greenhouse gas emissions within and in the vicinity of the action area as a result of tailpipe emissions generated by the movement and operation of vehicles and equipment during construction activities, and employee vehicles. However, construction activities and vehicle emissions would only increase greenhouse gas emission levels on a short-term, temporary basis in a localized area within the Station. Construction crews would be required to shut down all idling equipment, and contractors would be instructed to maintain vehicle engines in good operating condition to minimize exhaust emissions. With these and other mitigation measures

outlined in Table 3, impacts on greenhouse gas emission levels are expected to be temporary, short-term, and low.

Following the completion of construction activities, operation and maintenance of Station facilities would resume at a level similar to existing conditions. Although there would continue to be occasional greenhouse gas emissions during operation and maintenance activities, the number of vehicle trips is anticipated to be low. Therefore, impacts on greenhouse gas emissions levels from operation and maintenance activities would be short-term and low.

At full build out, the Proposed Action would result in several beneficial changes for greenhouse gas emission levels. Improved quality and quantity of housing options would increase Station capacity for staff and volunteers to permanently reside or temporarily lodge on site, thereby reducing overall number of daily commutes between the Refuge and distant communities. The replacement of existing diesel generators with a decentralized P-V powered backup system would minimize or eliminate the emission of greenhouse gases during backup power system operation. Post-construction revegetation efforts would ultimately result in a net gain of native forest habitat on the Refuge, which would provide reduced erosion potential and increased carbon sequestration over current conditions. Therefore, the Proposed Action is expected to have indirect, long-term, low, and beneficial impacts on greenhouse gas emission levels.

Alternative B: Proposed Action would not be implemented; therefore, the impacts related to the construction of the individual phased construction projects in the SMP would not occur. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. Operation and maintenance activities at the Station and Refuge would continue and would be similar to existing conditions. Housing capacity issues would persist, with staff and volunteers continuing to make daily commutes by vehicle to and from the Refuge. Maintenance activities would likely increase as existing structures deteriorate, and more structure repair and replacement could be required. The demolition and new construction of structures under the Proposed Action would likely need to take place, but would continue to be proposed, evaluated, funded, and implemented as individual projects on a case-by-case basis. Therefore, the maintenance activities would result in long-term, moderate impacts on greenhouse gas emission levels.

TABLE 7 - AFFECTED VISITOR USE AND EXPERIENCE AND ANTICIPATED IMPACTS

Visitor Use and Experiences
Affected Resource Visitor access to HFU is prohibited due to the presence of endangered species and their habitat, and due to the danger posed by Rapid ʻŌhiʻa Death (USFWS 2022). The Station is closed to the general public, with limited access to portions of the Refuge available by Special Use Permit (SUP). The Refuge relies on volunteers to support key functions, including invasive species management and outplanting, tasks aimed at restoration of native plants, and to support projects in and around the Station and Refuge. Promoting and enhancing the volunteer program is CCP objective 7.2 (USFWS 2010). Current volunteer quarters include a single bunkhouse, a portable platform tent for overflow housing, and an outhouse. Volunteer work activities largely occur within the current greenhouse facilities and adjacent storage.
Anticipated Impacts

Visitor Use and Experiences
Alternative A: Since the Refuge and Station are closed to the general public, the proposed adoption of the SMP would have no impact on visitor use and experience. At full build out, the Proposed Action would result in several beneficial changes for volunteer use and experience at the Station. Improved quality and quantity of housing options would increase Station capacity for staff and volunteers to permanently reside or temporarily lodge on site, which would improve recruitment and retention prospects due the reduced need for long commutes between the Refuge and distant communities. The Proposed Action would ensure that spaces designed for volunteers are supportive of their role and efforts at the Refuge. The SMP would enhance a "volunteer zone" to focus and streamline volunteer facilities and their proximity to volunteer activities. Upgrades to and expansion of volunteer housing would have a long-term, low, beneficial impact on volunteer use and experience at the Station. **Alternative B:** No impact to visitor use and experience beyond daily Station operation and ongoing maintenance of existing facilities, which would be comparable to current conditions. Improvements to Station facilities would continue to be proposed, evaluated, funded, and implemented as individual projects on a case-by-case basis. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. The ability of the Service to meet the Refuge purpose and CCP goals for protection of species and their habitat would continue to be constrained by the dilapidated condition of equipment and structures required for Refuge operation and maintenance, and the insufficient quantity and quality of housing for Service staff and volunteers. Impacts to visitor use from ongoing Station operation and maintenance activities would be long-term, and low to moderate.

TABLE 8 - AFFECTED CULTURAL RESOURCES AND ANTICIPATED IMPACTS

Cultural Resources
Affected Resource Cultural resources include prehistoric and historic archaeological sites; historic buildings, structures, and districts; and physical entities and manmade or natural features important to a culture, a subculture, or a community for traditional, religious, or other reasons. Cultural resources are designated in three major categories: Archaeological resources (prehistoric and historic) are locations where human activity has measurably altered the earth or left deposits of physical remains. Architectural resources include standing buildings, structures, landscapes, and other built-environment resources of historic or aesthetic significance. Traditional cultural properties may include archaeological resources, structures, districts, prominent topographic features, habitat, plants, animals, and minerals that Native Americans, Native Hawaiian Organizations, or other groups consider essential for the preservation of traditional culture. According to the Section 106 NHPA (36 CFR § 800), an Area of Potential Effects (APE) is defined as the geographic area or areas in which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if such properties exist. For the Proposed Action, the APE for cultural resources is defined as a contiguous area that includes the footprints of all planned Station

Cultural Resources

Master Plan features and at least 10 meters of buffer around those features. In total, the action area comprises approximately 9 acres of previously disturbed, developed, or revegetated land. All proposed upgrades and renovations would be kept within this APE.

Historical accounts, archaeological and cultural studies (Bingham 1969; Bird 1974; Ellis 1963; Handy and Handy 1972; Kelly et al. 1981; McEldowney 1979) provide information on traditional residence patterns, land-use, and subsistence horticulture of the areas that encompass the Refuge that suggest traditional practices had developed prior to European contact.

Traditionally, the Refuge was utilized primarily by two Native Hawaiian user groups, canoe builders and bird catchers (Tomonari-Tuggle 1996). Canoe builders accessed the area to harvest Koa trees, while bird catchers harvested feathers for the creation of traditional cloaks, capes, and necklaces. Utilization of the area by bird catchers would have increased and continued well into the 19th century.

The Mahele of 1848 brought largescale changes to land ownership, which in turn paved the way for foreign property owners to purchase unclaimed lands and turn it over to sugar production and cattle grazing. By the 1890s there were two large ranches operating in or near the Refuge, which continued into the late 1900s. The creation of the Refuge in 1985 permanently protected the land for the benefit of endangered forest birds and their habitat. Further details of historic land use can be found in the report produced for the Service titled “Bird Catchers and Bullock Hunters in the Upland Maunakea Forest: A Cultural Resource Overview of the Hakalau Forest National Wildlife Refuge, Island of Hawai‘i” (Tomonari-Tuggle 1996).

Currently the Refuge is serviced from the centrally located Station. The facilities and infrastructure have been constructed and modified over time since the conception of the Refuge. All the buildings at the Station post-date 1985. None of the buildings are more than 50 years old and thus do not meet the age criterion for consideration as a historic property.

Since being established, numerous archaeological projects have occurred on the Refuge. Primarily, the work focused on identifying cultural resources in areas where new fence-lines, outplanting areas, quarries, and other infrastructure improvements were proposed. Most of the investigations took place in the upper (western) portions of the Refuge. Studies have documented feature types that included stone walls, a platform, enclosures, fence posts, earthen reservoirs, rock cairns, and cabins. One site (Site 50-10-24-15074) appears to be a pre-Contact or early post-Contact era habitation complex (Raymond 1993), though the majority of identified sites are the remains of post-Contact ranching. The most noteworthy are the Pua‘ākala and Maulua cabins, and the ranch infrastructure associated with them as well as the Nāuhi cabin, one of the few remaining buildings associated with the early development and management of the Hilo Forest Reserve (Raymond 1993, Speulda 1996, Schuster 2002).

Three archeological pedestrian surveys were conducted in and around the APE. In 1986, archeological surveys were conducted by Haun, in support of proposed boundary fences and a cabin site. The survey for the cabin site was approximately 1 acre. The cabin site became the Service’s administration site, now known as the volunteer bunkhouse. The second survey within the APE was completed in 1993 (Raymond), which covered the location of the proposed University of Hawai‘i Research Facility. An approximately 5-acre area was surveyed. The surveyed was described as a pasture located above

Cultural Resources
the Hakalau Cabin, the field headquarters for the Refuge (administration site) at the time. The third survey again examined the areas around the administrative buildings (cabins and greenhouse) along existing roads in 2002 (Schuster). No cultural resources were identified within these surveyed areas.
Anticipated Impacts **Alternative A:** The Service is required under the NHPA to consider the effects of the Proposed Action on sites eligible for listing on the NRHP. No sites were identified within the APE of the Proposed Action. Therefore, no historic properties would be affected by the proposed undertaking. Construction activities, including the removal of existing buildings, the installation of new buildings, and construction or improvement of roadways, are the types of activities with the potential to affect cultural resources, including human remains, which are not known to exist in the APE. Protocols described in Table 3 would ensure that previously undiscovered resources were managed properly as required by NHPA, and would minimize both direct and indirect impacts from the Proposed Action. Since there are no historic properties or known cultural resources in the APE, nor are any finds anticipated, potential impacts to cultural resources would therefore be low. **Alternative B:** No impact to cultural resources and historic properties beyond daily Station operation and ongoing maintenance of existing facilities, which would be comparable to current conditions. Improvements to Station facilities would continue to be proposed, evaluated, funded, and implemented as individual projects on a case-by-case basis, including NHPA consultation. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. The ability of the Service to meet the Refuge purpose and CCP goals for protection of species and their habitat would continue to be constrained by the dilapidated condition of equipment and structures required for Refuge operation and maintenance, and the insufficient quantity and quality of housing for Service staff and volunteers.

TABLE 9 - AFFECTED REFUGE MANAGEMENT AND OPERATIONS AND ANTICIPATED IMPACTS

Refuge Land Use
Affected Resource The Station's primary role is to support Refuge habitat restoration and management, and infrastructure maintenance. The site has four typical uses: volunteer housing and activities, staff housing, horticulture, operations and maintenance, and University of Hawai'i Field Station activities. These uses are intermixed and connected on the site, without any clear differentiation or zoning. The primary land use at the Refuge is maintenance to restore and benefit native species. Biological research and monitoring is also an important activity conducted at the Refuge. In addition, limited public use is permitted. The Administration Act identifies six wildlife-dependent visitor uses on refuges: hunting and fishing, wildlife observation and photography, and environmental education and interpretation. All recreational activities must be compatible with the primary purpose of the refuge. The HFU, located on the windward side of Mauna Kea, is situated 13 mi northwest of Hilo. It spans portions of both the North Hilo District and the South Hilo Districts. The HFU is accessed by taking Mauna Kea Summit Road to Keanakolu Road, which is an unpaved road that follows the upper elevation boundary of the Refuge. The 32,733 ac HFU is comprised of four tracts, including Maulua,

Honohina, Hakalau, and Pua ʻĀkala. These tracts are further divided into subunits. The HFU is surrounded by various sections of the Hilo Forest Reserve to the north, east, and south. Along the northern boundary of the Refuge, north of the Maulua tract, the Refuge is bordered by the Laupāhoehoe Section of the Hilo Forest Reserve and the Laupāhoehoe Natural Area Reserve. The Hilo Watershed Forest Reserve abuts the property to the south, while the Pīhā (Game Management Area) Section of the Hilo Forest Reserve splits the Honohina and Maulua tracts. Currently, the Department of Hawai'i Home Lands (DHHL) and the Hawai'i Division of Forestry and Wildlife (DOFAW) are two land owners that own and maintain a majority of the land adjacent to the Refuge. Two private landowners own 3 parcels located at the northwestern corner of the Upper Maulua tract. Additional detail of land use and ownership within and in the vicinity of the Refuge may be referenced in the CCP, incorporated here by reference (USFWS 2010).

Anticipated Impacts

Alternative A: People living, working, and traveling in or near the Station would be temporarily exposed to and experience construction-related impacts from noise, dust, and traffic delays. Building and utility work may require staff or specific equipment to temporarily relocate to a different area of the Station for the duration of that phase of construction. However, construction activities would be choreographed in an efficient manner that would minimize these potential impacts and any disruption to ongoing Station management. In total, approximately 0.9 acres of the Station would be temporarily impacted by construction activities. These impacts would be temporary and intermittent, resulting in a low impact.

At full build out, the Proposed Action would result in several beneficial changes for land use. Improved quality and quantity of housing options would increase Station capacity for staff and volunteers to permanently reside or temporarily lodge on site, thereby reducing overall number of daily commutes between the Refuge and distant communities. Newly installed, replaced, and reshaped drainage structures would improve stormwater management capacity and performance of roadways and building sites over existing conditions. Grade reduction along steep portions of the Station entrance road would contribute to reduced velocity and volume of stormwater runoff, which is expected to reduce the frequency of road repairs required in those locations after storm events. This would reduce the time, money, and effort currently expended to repeatedly repair infrastructure at the Station, and allow these resources to be devoted to supporting the Refuge's purpose and CCP goals. Building design, use zones and user group organization and activity would be consistent with the Station layout proposed in the SMP (Appendix 5), which would contribute to a more organized, efficient, and functional Station compared to current conditions. This would improve the ability of the Service to meet the Refuge purpose and CCP goals for protection of species and their habitat. The removal of approximately 30 koa trees would decrease canopy coverage in the action area in the short term, but post-construction revegetation efforts would ultimately result in a net gain of native forest habitat on the Refuge. Therefore, the Proposed Action is expected to have indirect, long-term, low, and beneficial impacts on land use.

Alternative B: The Proposed Action would not be implemented; therefore, the impacts related to the construction of the individual phased construction projects in the SMP would not occur. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. Operation and maintenance activities at the Station and Refuge would continue and would be similar to existing conditions. Maintenance activities would likely increase as existing structures deteriorate, and more structure repair and replacement could be required. The roadway, building, and utility work under the Proposed Action would likely need to take place, but would continue to be proposed, evaluated, funded, and implemented as

individual projects on a case-by-case basis without a cohesive layout to improve function and efficiency. Therefore, operation and maintenance activities would result in long-term, low impacts to land use.

Refuge Administration

Affected Resource

The Refuge staff currently includes 10 personnel plus support from 6 additional permanent Service positions. The remoteness of the Station and the necessity of overnight stays or long daily commutes present recruitment and retention challenges for the Refuge Manager. The annual Refuge budget is approximately $1.45 million.

Anticipated Impacts

Alternative A: The Refuge manager, deputy manager, and maintenance staff would be involved to some extent with components of the Proposed Action, either directly through implementation, or indirectly through funding, acquisition, and contractor oversight. Contractors would likely implement most large SMP components.

Refuge administration and daily Station management activities may be temporarily reduced or disrupted during construction of individual phased projects. People living, working, and traveling in or near the Station would be temporarily exposed to and experience construction-related impacts from noise, dust, and traffic delays. Building and utility work may require staff or specific equipment to temporarily relocate to a different area of the Station for the duration of that phase of construction, which could disrupt daily work activities and timelines for deliverables. However, construction activities would be choreographed in an efficient manner that would minimize these potential impacts and any disruption to ongoing Station management. In total, approximately 0.9 acres of the Station would be temporarily impacted by construction activities. These impacts would be temporary and intermittent, resulting in a low impact.

Full implementation of the projects in the SMP would cost an estimated $16 million. If completed in phases, full implementation could cost in excess of $20 million over approximately 10 years due to the added cost of repeated mobilization and de-mobilization. Funding to implement project components would come from a variety of sources including, but not limited to: USFWS national and regional deferred maintenance programs, which are intended to fund such infrastructure projects; partners; and grants.

At full build out, the Proposed Action would result in several beneficial changes for refuge administration. Improved quality and quantity of housing options would increase Station capacity for staff and volunteers to permanently reside or temporarily lodge on site, which would improve recruitment and retention prospects due to the reduced need for long commutes between the Refuge and distant communities. Newly installed, replaced, and reshaped drainage structures would improve stormwater management capacity and performance of roadways and building sites over existing conditions. In addition to these drainage improvements, grade reduction along steep portions of the Station entrance road would contribute to reduced velocity and volume of stormwater runoff, all of which is expected to reduce the overall frequency of road repairs required in those locations after storm events. This would reduce the time, money, and effort currently expended to repeatedly repair infrastructure at the Station, and allow these resources to be devoted to support the Refuge's purpose and CCP goals. Building design, use zones and user group organization and activity would be consistent with the Station layout proposed in the SMP (Appendix 5), which would contribute to a more organized, efficient, and functional Station compared to current conditions. Despite high

projected costs, the Proposed Action would greatly benefit Refuge administration in the future by upgrading or constructing facilities, roads, and utilities to improve safety, durability, and operational efficiency. Therefore, the Proposed Action is expected to have indirect, long-term, low, and beneficial impacts on refuge administration.

Alternative B: The Proposed Action would not be implemented; therefore, the impacts related to the construction of the individual phased construction projects in the SMP would not occur. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. Operation and maintenance activities at the Station and Refuge would continue and would be similar to existing conditions. Maintenance activities would likely increase as Station buildings and infrastructure deteriorate, and more structure repair and replacement could be required. Improvement of Station facilities under the Proposed Action would likely need to take place, but would continue to be proposed, evaluated, funded, and implemented as individual projects on a case-by-case basis. The ability of the Service to meet the Refuge purpose and CCP goals for protection of species and their habitat would continue to be constrained by the dilapidated condition of buildings and infrastructure required for Refuge operation and maintenance, and the insufficient quantity and quality of housing for Service staff and volunteers. Therefore, impacts to refuge administration from ongoing Station operation and maintenance activities would be long-term, intermittent, and low.

TABLE 10 - AFFECTED SOCIOECONOMIC RESOURCES AND ANTICIPATED IMPACTS

Local and Regional Economies
Affected Resource The Refuge is located approximately 40 road miles from the community of Hilo, Hawai‘i, with a population of 44,186 (according to the 2020 census). Tourism, agriculture, and research (at the University of Hawai‘i) are the primary economic sectors in Hawai‘i County. The Refuge is closed to the public due to the danger of Rapid ‘Ōhi‘a Death (USFWS 2022). Limited guided access is currently only available via operators licensed under Special Use Permits (USFWS 2022), but those users do not utilize the Station. Hunting is not permitted on the Refuge (USFWS 2010). Although the units of the Hakalau Forest NWR are not open to the public, the Refuge does contribute to the local economy through recreational expenditures. In 2007, Carver and Caudill found that the Refuge generated total annual recreational expenditure of $56,400 from 1,323 visitors engaging in birding and other wildlife observation at HFU. Roughly 90 percent of these total expenditures were from nonresidents. In addition to recreational expenditures, the Refuge contributes money to the local economy through the Refuge Revenue Sharing Act of 1978 (16 U.S.C. 715s). This Act authorizes the transfer of Federal payments to the County of Hawai‘i annually in lieu of discontinued taxation of private property (USFWS 2010). In 2021, $83,534 was paid to Hawai‘i County for Hakalau Forest NWR.
Anticipated Impacts **Alternative A:** Since construction activities associated with the Proposed Action would occur in phases, no permanent changes in population are anticipated in Hawai‘i County. The origin of the work force is likely to be local, requiring minimal temporary lodging in the local area during construction.

Because an increase in population is expected to be minimal, the Proposed Action would have low to no effects related to temporary or permanent increases in population.

No new employment is anticipated from operation and maintenance activities following construction completion. The Proposed Action would have a small, positive impact on the regional economy during construction. Local purchases would likely include fuel for vehicles and equipment, and other incidental materials and supplies. Because construction workers would likely be hired from the local labor force, there likely would not be a large increase in spending. Overall spending from the phased construction of the individual projects in the Proposed Action would be short-term, intermittent, and is likely to have low socioeconomic impacts on employment and income. Low, beneficial impacts may result from increased spending in the local community during construction.

The Proposed Action may drive a temporary increase in Refuge spending with local contractors. Contractors would likely implement most larger components of the SMP and receive a direct economic benefit from being awarded the work. Funding to implement project components would come from a variety of sources including, but not limited to: USFWS Refuges National and Regional deferred maintenance programs, which are intended to fund such infrastructure projects; partners; and grants.

Commercial guiding is not practiced within or in the vicinity of the section of the Refuge near the Station. Therefore the Proposed Action would have no impact on income generated or employment supported by commercial guiding opportunities within the Refuge.

As described above, estimated local project-related expenditures, employment, and construction-related earnings are likely to be small relative to the total amount of economic activity, employment, and income in the county, and are short-term in nature. As a result, the overall impact of Proposed Action on local and regional economies, while beneficial, is expected to be temporary and low.

Implementing the SMP would aid the Refuge in meeting the goals outlined in the CCP. If conservation efforts are successful enough to allow for future reopening of some areas of the Refuge to unguided visitors, then tourism at the Refuge could increase beyond current levels and local economies would benefit.

For these reasons, the Proposed Action would have a low, beneficial impact to local and regional economies.

Alternative B: The Proposed Action would not be implemented; therefore, the impacts to local and regional economies (e.g., temporary employment, purchases or goods and services) related to the construction of the individual phased construction projects in the SMP would not occur. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. Operation and maintenance activities at the Station and Refuge would continue and would be similar to existing conditions. Maintenance activities would likely increase as existing structures deteriorate, and more structure repair and replacement could be required. Improvements to Station facilities would continue to be proposed, evaluated, funded, and implemented as individual projects on a case-by-case basis. The ability of the Service to meet the Refuge purpose and CCP goals for protection of species and their habitat would continue to be constrained by the dilapidated condition of equipment and structures required for Refuge operation and maintenance, and the insufficient quantity and quality of housing for Service staff and volunteers. Therefore, impacts to local and regional economies from ongoing Station operation and maintenance activities would be short-term, intermittent, and low.

Social & Community Resources

Affected Resource

The Refuge provides social and community services through volunteer opportunities, housing researchers at the University of Hawai‘i Field Station, working to conserve and restore culturally significant native wildlife and habitat, and environmental education opportunities.

The Refuge partners with Friends of Hakalau Forest NWR, a 501 (c)(3) non-profit organization that registers volunteers, raises funds, and organizes volunteer/community events at the Refuge. Among the many other volunteer groups that visit the Refuge, several are focused on environmental education, including ‘Imi Pono no ka ‘Āina, a program for 12- to 16-year-olds, and Teaching Change, which organizes monthly field ecology classes for middle and high-school students. Environmental education field trips are generally two- or three-day events, and students are housed at the Station.

The existing volunteer bunkhouse at the Station is at the end of its useful life and additional temporary housing (portable platform tent) is necessary to meet capacity needs. The University of Hawai‘i Field Station provides valuable lodging, office, and meeting space for researchers collecting data or conducting experiments in the HFU. The current Station layout results in pedestrian-vehicle conflicts for staff, volunteers, and researchers.

Many of the native plants on the Refuge have ethnobiological uses ranging from food and medicine to construction material, and several of the animal species there are culturally important to Hawaiians: pueo are associated with ancestral spirits; ‘io is the historical symbol of Hawaiian royalty; forest birds were harvested for their feathers and for food; nēnē is the state bird; and ‘ōpe‘ape‘a is the state land mammal.

Anticipated Impacts

Alternative A: Volunteer and educational opportunities may be temporarily reduced or disrupted during construction of individual phased projects. People living, working, and traveling in or near the Station would be temporarily exposed to and experience construction-related impacts from noise, dust, and traffic delays. Building and utility work may require volunteers or specific equipment to temporarily relocate to a different area of the Station for the duration of that phase of construction. However, construction activities would be choreographed in an efficient manner that would minimize these potential impacts and any disruption to ongoing Station management. In total, approximately 0.9 acres of the Station would be temporarily impacted by construction activities. These impacts would be temporary and intermittent, resulting in a low impact to social and community resources.

Improvements to volunteer housing, infrastructure, safety, health, and aesthetics would benefit volunteers and environmental education groups as individual projects are implemented. A reduction in pedestrian-vehicle conflicts at the Station would improve safety for volunteers, staff, and researchers. Impacts to vegetation and wildlife are discussed in Table 6. At full build out, the Proposed Action would result in several beneficial changes for social and community resources (see Table 7, Visitor Use and Experience). These impacts would be long-term, beneficial, and low.

Alternative B: No impact to social and community resources beyond daily Station operation and ongoing maintenance of existing facilities, which would be comparable to current conditions. Improvements to Station facilities would continue to be proposed, evaluated, funded, and implemented as individual projects on a case-by-case basis. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. The ability of the Service to meet the Refuge purpose and CCP goals for protection of species and their habitat would continue to be constrained by the dilapidated condition

of equipment and structures required for Refuge operation and maintenance, and the insufficient quantity and quality of housing for Service staff and volunteers. Impacts to social and community resources from ongoing Station operation and maintenance activities would be long-term, and low to moderate.

Aesthetic & Visual Resources

Affected Resource

The current Station is a functional environment. While some facilities have included aesthetic considerations, such as the views from the existing volunteer bunkhouse, the site does not have a cohesive aesthetic and is a product of un-organized use and incremental development. Vegetation buffers and sight lines throughout most areas of the Station do not follow a cohesive plan.

Vehicle traffic is currently mixed between the user groups and is generally undifferentiated between gravel driving surfaces and adjacent vegetated surfaces that also are driven or parked on. This undifferentiated use is results in no distinct functional aesthetic.

Anticipated Impacts

Alternative A: Impacts to visual resources would occur for viewers near construction activities for individual phased construction projects, such as in areas where roadway or walkway work would occur and at structure removal, utility replacement, or building construction sites. Construction activities would be visible from the Station entrance road, internal access roads and walkways, buildings, and portions of the action area during the construction seasons. Within and adjacent to the action area, the view would include construction vehicles, construction materials and fencing, and disturbed areas where project elements were being installed. Since the construction of individual phased projects would occur over time during multiple construction seasons, the impacts on visual resources during construction would be temporary and moderate.

Once construction is complete, operation of the Station would resume at a level of activity and daily use comparable to current conditions. Operation and maintenance activities would include incidental repairs to buildings, outbuildings, utilities, access roads and walkways, and vegetation maintenance. Viewers in the vicinity of these activities would experience short-term, low impacts to visual resources. In general, operation and maintenance activities would have long-term, intermittent, low impacts on visual resources because they would be confined to small, localized areas dispersed throughout the action area.

At full build out, the Proposed Action would result in several changes to visual resources within and in the vicinity of the Station. Disturbed ground in the vicinity of the most recently completed construction activities would be temporarily visible. Although the approximately 30 koa trees removed during construction would not be replaced, native revegetation would occur throughout the Station. Over time, as vegetation establishes and matures, the changes would resemble more natural features that occur along the margins of the action area and would be consistent with the existing surrounding landscape. Although new buildings, walkways, and paved roadways would initially cause a substantial change to the viewshed, project contrast would reduce over time until the action area achieves a more natural state. Building design, use zones and user group organization and activity would be consistent with the Station layout proposed in the SMP (Appendix 5), which would contribute to a more organized, cohesive, functional visual aesthetic compared to current conditions. A more efficient waste and debris removal process would decrease the amount of time such items are

left unattended, and provide improved screening of, and capacity for sorting and removal. Consequently, the long-term impacts on visual resources would be low.

Alternative B: The Proposed Action would not be implemented; therefore, the impacts related to the construction of the individual phased construction projects in the SMP would not occur. No koa trees would be removed from the action area. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. Operation and maintenance activities at the Station and Refuge would continue and would be similar to existing conditions. Maintenance activities would likely increase as existing structures deteriorate, and more structure repair and replacement could be required. The demolition and new construction of structures under the Proposed Action would likely need to take place, but would continue to be proposed, evaluated, funded, and implemented as individual projects on a case-by-case basis without a cohesive vision for layout, function, and aesthetics. Therefore, operation and maintenance activities would result in long-term, low impacts to visual resources.

Health & Safety

Affected Resource

The Volunteer Bunkhouse's sewer system is currently connected to a cesspool. Cesspools are a potential source of pollution and are required by State law to be upgraded, converted, or connected to a sewerage system (State of Hawai'i Act 125, HB 1244).

The various uses at the Station are intermixed and connected, without any clear differentiation or zoning. Vehicle and pedestrian traffic from different user groups is also mixed, creating a safety concern. The existing entry road that connects the Station to the road system is a narrow gravel road with a steep grade and small-radius curves that present a hazard to vehicle traffic.

The existing fuel storage shed houses a portable 75 gallon gasoline tank, and a bulk 250 gallon diesel tank is stored near the existing P-V power building.

Structure and wildland fires are also health & safety concerns at this remote station. While the Refuge does keep and maintain firefighting equipment, there is currently no designated firefighting facility at the Station.

No contaminated sites have been identified on the Refuge units (USFWS 2010). However, Hawai'i Island is exposed to high sulfur dioxide (SO2) levels from Kīlauea volcano emissions (vog), as well as traces of metals such as mercury. Sulfur dioxide is an irritant gas that may cause acute and chronic changes in human health, such as eye and respiratory system irritation (USFWS 2010).

Anticipated Impacts

Alternative A: During construction, construction site safety BMPs would be employed (Table 3). Construction sites would be fenced and signed to prevent unauthorized access. A health and safety plan would be developed and implemented. The potential for injury to workers would increase for the duration of the construction period, but workers would practice construction safety measures, such as holding daily safety briefings and wearing appropriate protective footwear, gloves, clothing, and hearing and eye protection. In the unlikely event that contaminated soil or water was encountered, work would stop in that area, a designated manager would be contacted, and work would not resume in the area until appropriate actions were taken to minimize any risks to health and safety. Impacts to worker health and safety would be short-term, and low.

Potential public health and safety impacts would be associated with the use of construction and heavy equipment; potential exposure to hazardous materials used during construction, such as fuels,

lubricants, solvents, and herbicides; construction traffic entering and traveling throughout the Station; building demolition and removal; fire risk from hot equipment or an errant spark; and cesspool removal and remediation. Equipment would be inspected daily for leaks, and a SPCC would be prepared and implemented to avoid and contain accidental spills, including notification assessment, security, clean-up, and reporting requirements. These and other mitigation measures described in Table 3 would reduce potential public health and safety impacts during construction to short-term, and low.

Following the completion of construction activities, operation of the Station would resume at a level of activity and daily use comparable to current conditions. Operation and maintenance activities would include incidental repairs to buildings, outbuildings, utilities, access roads, walkways, and parking lots, which could pose a risk to health and safety of those in the vicinity of the activity. With the implementation of a SPCC and other mitigation measures listed in Table 3, operation and maintenance activities would have short-term, intermittent, low impacts on health and safety.

At full build out, the Proposed Action would result in several beneficial changes for health and safety. The Station layout would be consistent with the layout in the SMP (Appendix 5), would provide a clear plan for zoning and separation of vehicle and pedestrian traffic that would increase long-term health and safety benefits for staff and volunteers at the Station. Improvements to Station roadways would include grade reduction, drainage structure upgrades, and resurfacing that would bring the roadways up to current engineering and design standards, improving long-term vehicular safety. Newly installed, replaced, and reshaped drainage structures would improve stormwater management capacity and performance at building sites and previously disturbed areas of the Station over existing conditions. Buried utilities would have a reduced risk of exposure from erosion during rain events, and the risk of flooding to buildings and subsequent off-site transfer of contaminants would be reduced over current conditions. Removal of the existing outhouses and cesspool, and replacement with upgraded septic tank and sewer lines would remove an existing source of contamination, enhance sanitary sewer utility function and waste management over current conditions, and ensure compliance with Hawai‘i State law. Installation of a new Fire Cache to consolidate firefighting equipment would improve emergency planning and response times long-term, a beneficial impact for Refuge staff and visitors. The installation of two 500 gallon fuel tanks would increase the amount of fuel housed at the Station over current conditions. In the event of an accidental fuel leak or spill, the potential risk to health and safety would be increased over existing conditions. Implementation of a SPCC and other mitigation measures in Table 3 would reduce this risk to long-term, and low. With the inclusion of mitigation measures (Table 3), the Proposed Action is expected to have an overall long-term, beneficial, low to moderate impact on health and safety.

Alternative B: The Proposed Action would not be implemented; therefore, the impacts related to the construction of the individual phased construction projects in the SMP would not occur. Use conflicts within the Station would persist, and daily use would continue to degrade equipment and buildings which are already at the end of their serviceable life. Operation and maintenance activities at the Station and Refuge would continue and would be similar to existing conditions. Maintenance activities would likely increase as Station buildings and infrastructure deteriorate, and more structure repair and replacement could be required. Improvement of Station facilities under the Proposed Action would likely need to take place, but would continue to be proposed, evaluated, funded, and implemented as individual projects on a case-by-case basis. The ability of the Service to meet the Refuge purpose and CCP goals for protection of species and their habitat would continue to be constrained by the dilapidated condition of buildings and infrastructure required for Refuge operation and maintenance, and the insufficient quantity and quality of housing for Service staff and volunteers.

Therefore, impacts to health and safety from ongoing Station operation and maintenance activities would be long-term and low.

Cumulative Impacts

Cumulative effects are the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR § 1508.7). The vision of the SMP is to create a safe, organized, and efficient Station that is attractive to visitors and volunteers. Adopting and implementing the SMP would aid the Refuge in achieving the goals of the CCP, offsetting many of the impacts of past, present, and future actions.

SMP projects would be implemented in phases over several years. The past, present, and reasonably foreseeable actions at the Station have and will continue to increase the noise and visual disturbance to endangered birds and bats. Actions such as road construction and development increase human access and result in the possibility of increased wildfire and invasive species threats. Maintenance of vegetation buffers around buildings and roads within the area of the SMP would mitigate the possibility of human caused ignitions occurring at the Station, and consolidation of firefighting equipment at a designated fire cache would improve firefighting response times. This has a long-term beneficial impact to wildlife, vegetation, and endangered species on Refuge lands throughout the HFU.

Because hundreds of thousands of koa trees have been planted on the Refuge over the past 30 years, and due to the species' natural ability to re-colonize habitat, it is anticipated that existing vegetation will increase over the next 30 years. Additionally, the Refuge continues an active reforestation program planting several thousand trees each year. Several acres at the Station would be restored with suitable native trees and shrubs upon complete implementation of the SMP, which would result in an overall increase in native vegetation in the area.

In combination with other past, present, and reasonably foreseeable future actions, implementing the SMP is expected to have an overall beneficial impact on the environment.

List of Sources, Agencies and Persons Consulted:

U.S. Department of Agriculture

- U.S. Forest Service, Pacific Southwest Research Station, Institute of Pacific Islands Forestry, Honolulu

U.S. Department of the Interior

- U.S. Fish and Wildlife Service, Field Supervisor, Pacific Islands Ecoregion, Honolulu
- U.S. Fish and Wildlife Service, Project Leader, Hawaiian and Pacific Islands NWRC
- U.S. Fish and Wildlife Service, Region 1 Fire Management Officer, Portland, Oregon
- U.S. Fish and Wildlife Service, Wildland Urban Interface Coordinator, Portland, Oregon
- U.S. Fish and Wildlife Service, Branch Chief Regional Archaeologist, Sherwood, Oregon
- U.S. Geological Survey, Biological Resources Division, Pacific Island Ecosystem Research Center
- National Park Service, Fire Management Officer, Hawai'i Volcanoes National Park
- National Park Service, Resources Management Division, Hawai'i Volcanoes National Park
- National Park Service, Cultural Resources Division, Hawai'i Volcanoes National Park

Congressional Delegation

- Senator Mazie Hirono
- Senator Brian Schatz
- Representative Jill Tokuda

State Agencies

- Hawai‘i Department of Land and Natural Resources (Chairman)
- Division of Forestry and Wildlife (Administrator)
- Division of Forestry and Wildlife, Hawai‘i District (Manager)
- State Historic Preservation Division, Honolulu (Director)
- Department of Hawaiian Home Lands (Chairman)
- Office of Hawaiian Affairs, Hawaiian Rights Division
- Maunakea Watershed Alliance

County Agencies

- County of Hawai‘i, Planning Department
- County of Hawai‘i, Fire Department
- County of Hawai‘i, Department of Public Works

Hawaiian Community

- Hawaiian-Environmental Alliance (President)
- Edith Kanakaole Foundation (Chair)
- Hawaiian Civic Clubs of Laupāhoehoe, Hāmākua, and Waimea (Chair)
- Kahu Kū Mauna (President)
- Kepa Maly, Kumu Pono Associates
- Liliuokalani Trust
- ‘Oiwi Lokahi O Ka Mokupuni O Keawe
- Waimea Homesteaders Association (President)

Private Conservation Organizations

- Earth Justice Legal Defense Fund Sierra Club, Hawai‘i Chapter
- The Nature Conservancy, Hawai‘i
- Friends of Hakalau Forest National Wildlife Refuge

Private Landowners and Other Interested Parties

- George Robertson
- Parker Ranch (Chief of Operations)
- Big Island Wildfire Coordinating Group
- Dr. Patrick Hart, University of Hawai‘i, Manoa Campus
- College of Tropical Agriculture and Human Resources (J.B. Friday)
- Hawai‘i Bird Guide, LLC
- Hawai‘i Birds, LLC
- Hawai‘i Forest and Trail
- Hawai‘i Nature Explorers

- Kona Adventure Tours
- Victor Emanuel Nature Tours

Public Outreach

The Refuge maintains a mailing list, for news release purposes, to local newspapers, radio, and websites. In addition, information about the proposed facility enhancements will be available at the Big Island NWR Complex office, and on the Hakalau Forest NWR website https://www.fws.gov/refuge/hakalau-forest. The Draft EA will be made available for a 14-day comment period. The Draft EA will be posted on the Refuge's website. Comments or requests for additional information can be submitted via email (hakalauforest@fws.gov) or U.S. mail:

Hakalau Forest NWR
60 Nowelo Street
Suite 100
Hilo, Hawaii 96720

All comments received from individuals become part of the official public record. All requests for such comments are handled in accordance with the Freedom of Information Act and the CEQ's NEPA regulations in 40 CFR 1506.6(f). The Service's practice is to make comments, including names and home addresses of respondents, available for public review during regular business hours. Individual respondents can request that we withhold their home address from the record, which we will honor to the extent allowable by law. If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comments.

APPENDIX 1 — OTHER APPLICABLE STATUTES, EXECUTIVE ORDERS & REGULATIONS

Cultural Resources American Indian Religious Freedom Act, as amended, 42 U.S.C. 1996 – 1996a; 43 CFR Part 7 Antiquities Act of 1906, 16 U.S.C. 431-433; 43 CFR Part 3 Archaeological Resources Protection Act of 1979, 16 U.S.C. 470aa – 470mm; 18 CFR Part 1312; 32 CFR Part 229; 36 CFR Part 296; 43 CFR Part 7 National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470-470x-6; 36 CFR Parts 60, 63, 78, 79, 800, 801, and 810 Native American Graves Protection and Repatriation Act, 25 U.S.C. 3001-3013; 43 CFR Part 10 Executive Order 11593 – Protection and Enhancement of the Cultural Environment, 36 Fed. Reg. 8921 (1971) Executive Order 13007 – Indian Sacred Sites, 61 Fed. Reg. 26771 (1996)	Federal agencies' responsibility for protecting historic properties is defined primarily by Sections 106 and 110 of the NHPA. Section 106 requires federal agencies to consider the effects of their undertakings on historic properties. Section 110 of the NHPA requires federal agencies to establish—in conjunction with the Secretary of the Interior—historic preservation programs for the identification, evaluation, and protection of historic properties. Cultural resources also may be covered by state, local, and territorial laws. To this end, the Service initiated Section 106 consultation with the State Historic Preservation Officer and consulting parties, including Native Hawaiian Organizations, on May 17, 2023. The Service made a determination that no historic properties would be affected by the Proposed Action in letters dated July 16, 2023, and August 28, 2023.
Fish & Wildlife Bald and Golden Eagle Protection Act, as amended, 16 U.S.C. 668-668c, 50 CFR 22 Endangered Species Act of 1973, as amended, 16 U.S.C. 1531-1544; 36 CFR Part 13; 50 CFR Parts 10, 17, 23, 81, 217, 222, 225, 402, and 450 Fish and Wildlife Act of 1956, 16 U.S.C. 742 a-m Lacey Act, as amended, 16 U.S.C. 3371 et seq.; 15 CFR Parts 10, 11, 12, 14, 300, and 904 Migratory Bird Treaty Act, as amended, 16 U.S.C. 703-712; 50 CFR Parts 10, 12, 20, and 21	The ESA directs all federal agencies to work to conserve endangered and threatened species and to use their authorities to further the purposes of the ESA. Section 7 of the ESA requires federal agencies to consult with the U.S. Fish and Wildlife Service (USFWS) on any action that may affect endangered or threatened species or candidate species, or that may result in adverse modification of critical habitat. Section 7 of the ESA is the mechanism by which federal agencies ensure their actions do not jeopardize the existence of any listed species. Under Section 7, federal agencies consult with the Service or the National Marine Fisheries Service when any action they carry out, fund, or authorize may affect a listed species. As noted in the preceding sections, ESA Section 7 consultation would be conducted prior to finalization of this EA. Because there are endangered species that occur within the action area of the SMP, it is

Executive Order 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds, 66 Fed. Reg. 3853 (2001)	anticipated that the Service would initiate a formal Biological Assessment addressing the potential impacts to endangered species and that implementation of the plan would result in a "Not Likely to Adversely Affect" finding. Migratory bird conventions and the Migratory Bird Treaty Act (Act) impose substantive obligations on the United States for the conservation of migratory birds and their habitats. EO 13186 directs executive departments and agencies to take certain actions to further implement the Act, including supporting the conservation intent of the migratory bird conventions, restoring, and enhancing the habitat of migratory birds, as practicable, and preventing or abating detrimental alteration of the environment for the benefit of migratory birds, as practicable. The proposed action is consistent with EO 13186 and would protect migratory birds by not lighting the viewpoint at night, which can disorient seabirds and cause them to fly into wires and poles. As migratory seabirds may fly over the site at night, this effect is avoided.
Natural Resources Clean Air Act, as amended, 42 U.S.C. 7401-7671q; 40 CFR Parts 23, 50, 51, 52, 58, 60, 61, 82, and 93; 48 CFR Part 23 Wilderness Act, 16 U.S.C. 1131 et seq. Executive Order 13112 – Invasive Species, 64 Fed. Reg. 6183 (1999)	EO 13112 requires federal agencies to prevent the introduction of invasive species and provide for their control and minimize the economic, ecological, and human health impacts that invasive species cause. The proposed action would be consistent with this EO because biosecurity protocols are incorporated into the mitigation measures listed in Table 3.
Water Resources Coastal Zone Management Act of 1972, 16 U.S.C. 1451 et seq.; 15 CFR Parts 923, 930, 933 Federal Water Pollution Control Act of 1972 (commonly referred to as Clean Water Act), 33 U.S.C. 1251 et seq.; 33 CFR Parts 320-330; 40 CFR Parts 110, 112, 116, 117, 230-232, 323, and 328	Best management practices for Stormwater Pollution Prevention would be implemented for construction and deconstruction projects in accordance with Clean Water Action (CWA) Section 402.

Rivers and Harbors Act of 1899, as amended, 33 U.S.C. 401 et seq.; 33 CFR Parts 114, 115, 116, 321, 322, and 333	

APPENDIX 2 — ACRONYMS & ABBREVIATIONS, REFERENCES, AND LIST OF PREPARERS

Acronyms & Abbreviations

APE	area of potential effects
BMP	Best management practice
BCC	Birds of Conservation Concern
CCP	Comprehensive Conservation Plan
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CWA	Clean Water Act
dbh	Diameter at Breast Height
DM	United States Department of the Interior Manual
DHHL	Department of Hawai'I Home Lands
DOFAW	Hawai'i Division of Forestry and Wildlife
EA	Environmental Assessment
ESA	Endangered Species Act
EO	Executive Order
FR	Federal Register
FW	United States Fish and Wildlife Service Manual
HFNWR	Hakalau Forest National Wildlife Refuge (or Refuge)
HFU	Hakalau Forest Unit
KFU	Kona Forest Unit
kWh	kilowatt hour
MBTA	Migratory Bird Treaty Act
NEPA	National Environmental Policy Act
NHO	Native Hawaiian Organization
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System
NWRSAA	National Wildlife Refuge System Administration Act
OSHA	Occupational Safety and Health Administration
PEPP	Plant Extinction Prevention Program
PIFWO	Pacific Islands Fish and Wildlife Office
P-V	photo-voltaic
Refuge	Hakalau Forest National Wildlife Refuge (or HFNWR)
ROD	Rapid ʻŌhiʻa Death
Service	United States Fish and Wildlife Service (or USFWS)

Station	Hakalau Forest Unit Field Station
SDMP	Step-Down Management Plan
SHPD	State Historic Preservation Division
SMP	Station Master Plan
SO2	Sulfur Dioxide
SPCC	Spill Prevention Control and Countermeasures
SUP	Special Use Permit
SWPPP	Stormwater Pollution Prevention Plan
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service (or Service)
USGS	United States Geographical Survey
UV	ultraviolet
vog	volcanic emissions
WSA	Wilderness Study Area

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List of Preparers

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- Zachary Gustafson, Conservation Planner, Pacific Region 1, USFWS
- Brenna Hughes, PND Engineers, Inc.
- Schuyler Roskam, PND Engineers, Inc.

APPENDIX 3 — FIGURES

Figure 1 – Project Overview

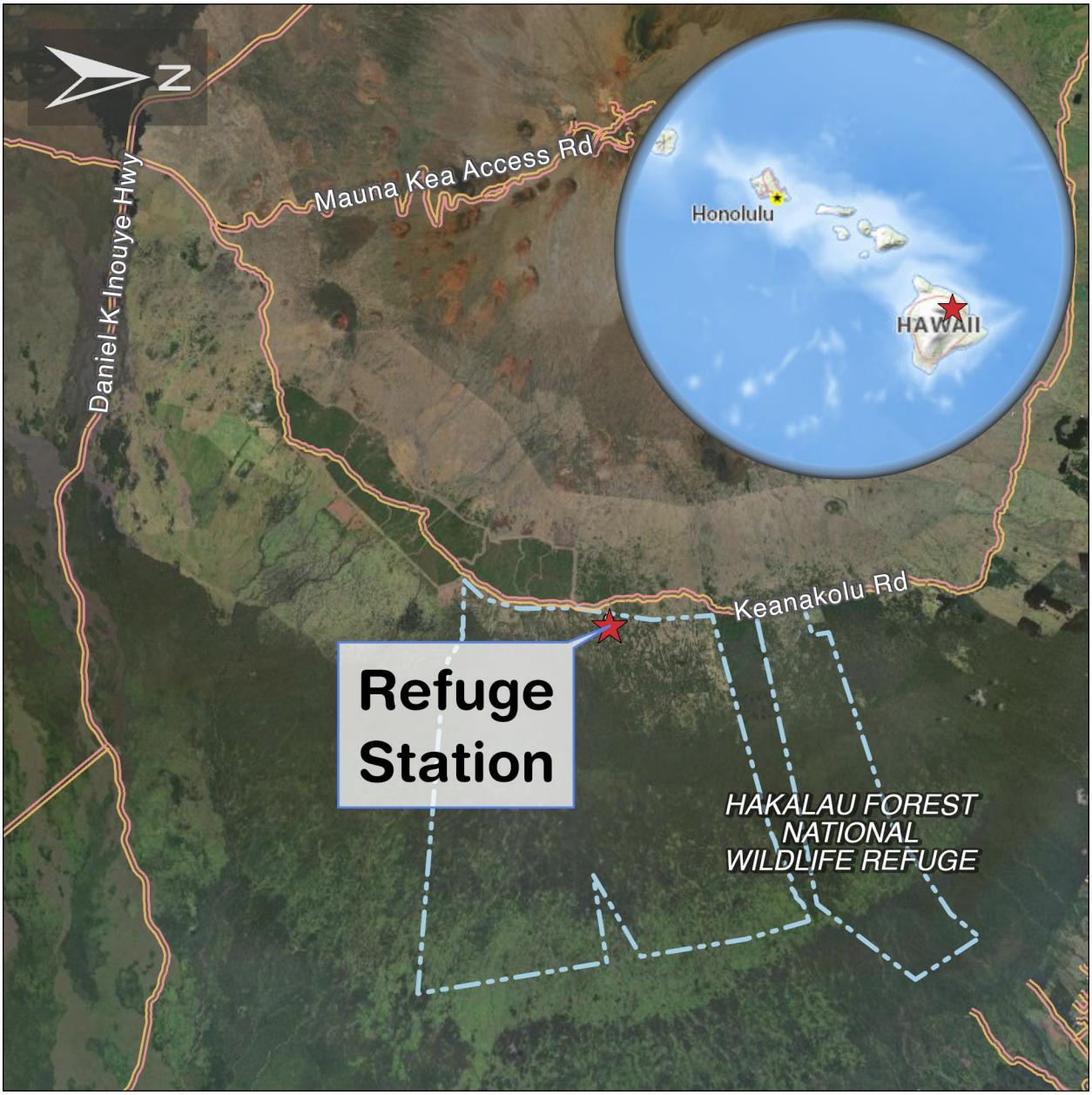
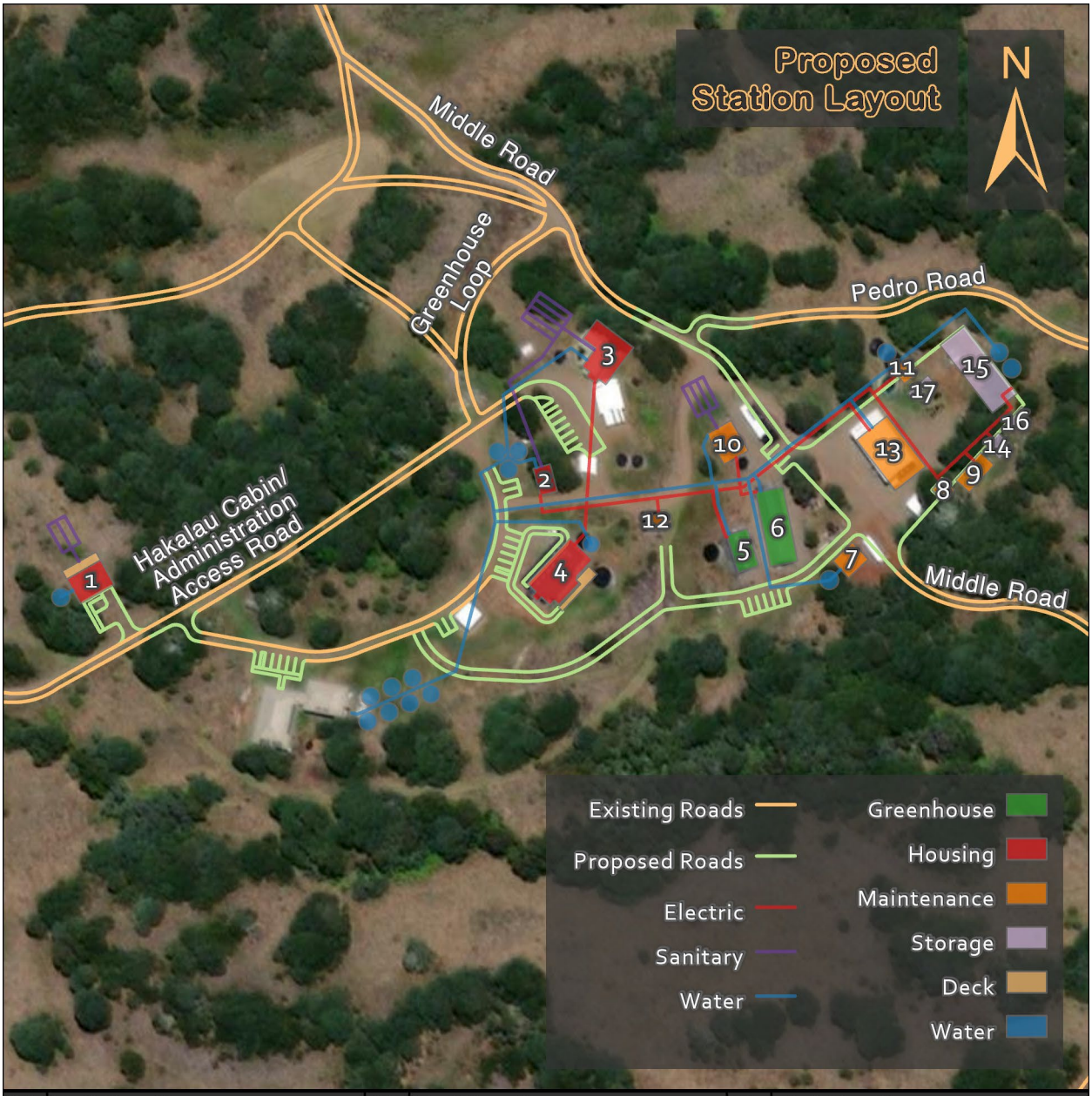


Figure 2 – Proposed Station Layout



ID	Building Name	ID	Building Name	ID	Building Name
1	Caretaker's Residence	7	Fire Cache	13	Building Maintenance Shop
2	Caretaker's Residence	8	Fuel Station	14	Storage Building
3	Volunteer Bunk House	9	ORV Building	15	Pole Barn
4	Staff Residence Bunkhouse	10	Horticulture Building	16	Modular Chemical Unit
5	Greenhouse	11	Washdown Station	17	Modular Chemical Unit
6	Rare Plant Greenhouse	12	Photo-Voltaic Power Building		

APPENDIX 4 — BIOLOGICAL RESOURCES ASSESSMENT

This narrative presents a general discussion of the affected biological resources associated with adoption of the Hakalau Forest National Wildlife Refuge (Refuge) Station Master Plan (SMP). It evaluates the impacts of SMP implementation at a programmatic level and the no-action alternative of continuing Refuge management without adoption of the SMP.

Table A provides an expanded discussion of biological resources that would be affected by the Proposed Action. Table B lists mitigation measures and conservation design features that would be implemented to minimize the degree or severity of impacts from SMP plan elements.

For this discussion, the action area is defined as a contiguous area that includes the footprints of all planned SMP features and at least 10 meters of buffer around those features. In total, the action area comprises approximately 9 acres of previously disturbed, developed, or revegetated land

We anticipate a "no effect" or "not likely to adversely affect" finding for all endangered wildlife species and a "likely to adversely affect" finding for endangered plant species that cannot be avoided during the proposed implementation of the plan. Table C identifies ESA-listed species within the action area and a summary of anticipated effects determinations.

TABLE A – AFFECTED BIOLOGICAL RESOURCES AND ANTICIPATED IMPACTS OF THE PROPOSED ACTION AND ANY ALTERNATIVES

Terrestrial Wildlife
Affected Resource (Detailed Descriptions) The Refuge supports a diversity of wildlife species including common and endangered passerines, a native goose, endemic hawk, a listed bat, pueo (the Hawaiian short-eared owl, *Asio flammeus sandwichensis*), and a diversity of native plants and invertebrates. Threatened and endangered species and other special status species are discussed further in the next section. Common native forest birds occur in medium to high numbers in restored koa stands at the Refuge Station throughout the year (Kendall et al 2022). The Hawai‘i ‘elepaio (*Chasiempsis sandwichensis*), ‘apapane (*Himatione sanguinea*), ‘amakihi (*Chlorodrepanis virens*), and ‘ōma‘o (*Myadestes obscurus*) are common throughout the area. The pueo is also known to use open grasslands, shrublands, and montane parklands on Maunakea and may nest and hunt in habitat surrounding the Station.
Threatened and Endangered Species and Other Special Status Species
Affected Resource (Detailed Descriptions) Habitat at the Station is currently composed of previously disturbed nonnative grassland habitat that has been reforested with koa and native understory species over the past 30 years. The area includes a developed dirt road with grassland edge that is mowed and maintained around facilities. Portions of the area have already been heavily disturbed (lacking native trees and animals). Protection of natural resources on the Refuge is maximized by placement the action area within the existing footprint of the Station. Threatened and endangered species whose ranges overlap with the Station include the threatened nēnē (Hawaiian goose, *Branta sandvicensis*); four species of forest birds: the endangered ‘akiapōlā‘au (*Hemignathus munroi*), the endangered ‘alawī (*Oreomystis mana*), the threatened ‘i‘iwi (*Vestiaria*

coccinea), and the endangered Hawai‘i ‘ākepa (*Loxops coccineus*); three Hawaiian seabirds: the endangered ‘akē‘akē (band-rumped storm petrel, *Oceanodroma castro*), the endangered ‘ua‘u (Hawaiian petrel, *Pterodroma sandwichensis*), and the threatened ‘a‘o (Newell’s shearwater, *Puffinus auricularis newelli*); and the endangered ‘ōpe‘ape‘a (Hawaiian hoary bat, *Lasiurus cinereus semotus*).

Nēnē utilize the Station area throughout the year for foraging and nesting. Approximately 8 to 12 Nēnē pairs are known to nest near the Station each year between September and March. Nēnē using this portion of the Refuge appear to be somewhat “acclimated” to the relatively high level of human activity at the Station near Refuge buildings and the access road.

Endangered and threatened forest birds (‘akiapōlā‘au, ‘alawī, and ‘i‘iwi) utilize the restored koa habitat at the Station. Hawaiian forest birds’ current ranges are predominately restricted to montane forests above 3,500 feet in elevation. They are known to attain some of their highest population densities at the Refuge with stable or increasing population trends, particularly in reforestation areas (Scott et al. 1986; Kendall et al. 2022). ‘Ākepa do not utilize the habitat in this portion of the Refuge.

Endangered and threatened seabirds (‘ua‘u, ‘a‘o, and ‘akē‘akē) nest at high elevations above the Refuge and do not use the proposed action area but may traverse the action area at night during the breeding, nesting, and fledging seasons (March 1 to December 15).

The ‘io, (Hawaiian hawk, *Buteo solitarius*) is a Hawaiian Species of Greatest Conservation Need (Hawai‘i 2015), and the Station is within their range. ‘Io are not known to nest on or near the Station but may occasionally perch in trees and forage in the area. Additionally, the ‘apapane, ‘amakihi and ‘ōma‘o are all considered by the USFWS to be Birds of Conservation Concern (BCC) throughout their range in Hawai‘i and the Pacific Islands and are protected under the Migratory Bird Treaty Act (MBTA).

‘Ōpe‘ape‘a (*Lasiurus cinereus semotus*) are endangered bats found on the Refuge throughout the year. They roost in both exotic and native woody vegetation across the Hawaiian Islands and will leave young unattended in trees and shrubs when they forage.

Six endangered plant species are present at the Station: two species of ‘ōhā wai (*Clermontia lindseyana* and *C. pyrularia*), hāhā, Phyllostegia brevidens (no common name), kīponapona, and makou (Ranunculus hawaiensis). Endangered plants have been propagated from wild founder lines. *C. lindseyana, P. brevidens,* and *C. shipmanii* have been outplanted by the Refuge at the Station, while *C. pyrularia*, makou, and kīponapona propagules exist only in the Station greenhouse. Outplants at the Station occupy a recently restored koa forest less than 30 years old within the action area. A total of 15 *C. lindseyana*, 6 *C. shipmanii*, and 4 *P. brevidens* occur within a 0.9-acre section of the 9 acres included in the SMP. Listed plants that have been outplanted are now reproductively mature. No wild endangered founder plants occur at the Station.

There is no designated Critical Habitat at the Station; however, proposed critical habitat for ‘i‘iwi includes the reforested areas within the action area, and designated critical habitat for *C. pyrularia*, kīponapona, and hāhā is within 200 meters south and east of the action area. *C. lindseyana* critical habitat is greater than 400 meters from the action area and *C. paleana* critical habitat is more than 3.8 kilometers away.

Potential impacts to threatened, endangered, and special status species due to climate change are not fully understood and are challenging to predict. Increasing drought at high elevations on Maunakea elevates risk of wildfire in grassland habitat, spread of invasive species, an elevational expansion of nonnative mosquitoes that carry avian malaria. The Refuge will continue to participate in studies and climate monitoring to help better understand and evaluate impacts.

There has been increasing interest in reforestation and invasive species management on state lands adjacent to Hakalau Forest NWR. This has led to several beneficial partnerships between the

Department of Hawaiian Homes Lands, the Maunakea Watershed Alliance, and the Refuge. The Refuge continues to serve as an important repository for native species biodiversity and protection of the forested watershed within the broader Maunakea landscape, which is essential to the conservation of the species discussed above.

Additional information on species descriptions and historical presence in the action area is included in Appendix 4-1 and can be found on the Service's Pacific Islands webpages (https://www.fws.gov/pacificislands).

Vegetation (including vegetation of special management concern)

Affected Resource (Detailed Descriptions)

The Refuge is known for supporting an abundance and diversity of subtropical mesic to wet rainforest vegetation. Historically, most of the area near the Station was covered by a diverse mesic koa forest, but 150 years of cattle grazing eliminated the forest and created open nonnative grasslands in the upper elevations of the Refuge. Since the Refuge's establishment in 1985, these grasslands have been reforested with over 600,000 native trees, primarily koa (*Acacia koa*).

The action area is located on a previously disturbed landscape containing two habitat types: 1) open nonnative grasslands (*Cenchrus clandestinus*, *Ehrharta stipoides*, *Anthoxanthum odoratum*, and *Poa pratensis*) that are mowed and maintained around Refuge facilities; and 2) open nonnative grasslands that have been replanted with koa trees with understory of exotic grasses and outplanted native trees and shrubs (*Coprosma rhynchocarpa*, *Myoporum sandwicense*, *Chenopodium oahuense*, *Cheirodendron trigynum*, *Leptecophylla tameiameiae*, *Rubus hawaiensis*). Three endangered plant species (C. *lindseyana*, *C. shipmanii*, and P. *brevidens*) have been outplanted at the Station and are described further above.

Potential impacts to habitat and vegetation due to climate change are not fully understood and are challenging to predict. The potential for fire in the introduced grassland habitat is a concern with the possibility of increasing drought and changes in annual rainfall. Maintaining fuel break buffers around Refuge facilities and roads will continue to be a Refuge priority to reduce the risk of human caused ignitions. The Refuge will continue to restore native forest and participate in studies and climate monitoring to help understand and adapt management to the address changing climate.

Management actions taking place on adjacent lands in the Hakalau Forest NWR region include invasive gorse removal and tree planting projects by the Department of Hawaiian Home Lands and conservation fencing and invasive species control projects by the state Natural Area Reserve program (DLNR) and the Maunakea Watershed Alliance. The Refuge is currently involved in a partnership with the Watershed Alliance to promote native tree restoration on adjacent lands to increase native forest and species biodiversity on Maunakea.

Biological Resources Mitigation Measures and Conditions

Mitigation measures include:

1. avoidance of an impact through not taking an action or parts of an action;
2. minimizing impacts through limiting the degree or magnitude of an action; or
3. rectifying impacts by repairing, rehabilitating, or restoring the affected environment.

In accordance with the Endangered Species Act, Migratory Bird Treaty Act (MBTA), Clean Water Act, and Clean Air Act, the following mitigation measures and conservation design features would be

implemented to minimize the degree or severity of impacts during deconstruction and construction activities. The mitigation measures in Table B are considered part of the project description and would be implemented as part of the SMP. These conservation measures will be addressed in a formal consultation with the USFWS Pacific Islands Ecological Services Office.

TABLE B. CONSERVATION DESIGN AND MITIGATION MEASURES

Impact Topic	Avoidance Measures
General Mitigation and Design Measures	• Prior to construction, all areas proposed for construction, replacement, or modification will be flagged by Refuge staff to avoid confusion by the contractor doing work as part of the project. • All construction personnel will be briefed on mitigation measures prior to the initiation of construction activity. • Refuge staff will identify and monitor "sensitive areas" (e.g., near tree stands, water lines, cultural features, and fences). This will minimize unwanted negative impacts to natural resources and Refuge infrastructure. • Project footprints were selected to minimize erosion and damage to native trees. The disturbed areas will be no wider than necessary to accommodate required footprint of building and road rehabilitation projects proposed in the SMP. • Bird nest surveys for common native and endangered species will be completed prior to tree cutting. No trees will be cut if there are active nests found in them. • Cut and fill slopes, dips, water bars, and cross drainages will be designed and constructed to minimize soil erosion.
Nonnative Species	• Crews will adhere to the Refuge's Biosecurity Protocols (Appendix 4-2) and any additional protocols provided. • To avoid the introduction of nonnative and invasive species (including little fire ants, *Wasmannia auropunctata*), all construction equipment, materials, and vehicles will be cleaned and inspected prior to construction and deconstruction activities. • The potential presence of fire ants will be monitored following demolition and construction activities. If any little fire ants are detected, a determination of the full extent of infestation would occur and the infestation would be treated with an approved pesticide. • Gravel used in construction will be sourced at the Refuge or inspected prior to entry into the Refuge to prevent introduction of nonnative species.
	Threatened and Endangered Species and Other Special Status Species
General Measures	• A formal Section 7 consultation will be prepared and reviewed prior to initiating the proposed alternative. • The Refuge biologist will survey areas proposed for construction to ensure there will be no impacts to endangered wildlife species that may utilize the area for foraging, nesting, or roosting. Species-specific protocols are listed below.

	• Heavy machinery activities will occur outside the endangered species breeding and birthing seasons or as described below.
Nēnē	• Avoid construction and deconstruction activities during nēnē breeding season (September 1 to March 31) to prevent displacing nēnē. However, if breeding season cannot be avoided, construction and deconstruction would be restricted within 150 feet of breeding or nesting nēnē, to ensure they are not disturbed. • All work will cease immediately if a nēnē nest is discovered within a radius of 150 feet of proposed work. Work will not commence or continue in that area until the nest is no longer active and the birds have left the area. • A Refuge biologist will monitor the project component areas for any nēnē activity prior to work starting and regularly during the project. • If nēnē are observed loafing or foraging near construction activities during the breeding season, work will halt and a biologist familiar with the nesting behavior of nēnē would survey for nests in and around the project area prior to the resumption of work. Surveys would continue for 3 or more days following the observation of nēnē presence (during which the birds may attempt to nest). • In areas where nēnē are known to be present, the Refuge will inform project personnel and contractors about the presence of threatened species on-site. • Construction staff will be educated to not approach, feed, or disturb nēnē. • Project specifications will include specific measures to ensure project work does not impact nēnē, such as requiring all food-related waste to be in fully sealed refuse containers and removed from the site daily to ensure birds and predators do not have access to the food waste.
Forest Birds	• No tree removal will occur during the peak forest bird (ʻakiapōlāʻau, ʻalawī, and ʻiʻiwi) breeding season (January 1 to June 30). • Prevent the spread or survival of nonnative or invasive species. • Avoid construction activities that result in the creation of standing water. • Avoid construction activities that may result in fire ignition in grassland habitat.
Hawaiian Seabirds	• Nighttime construction will be prohibited to prevent impacts to the ʻuaʻu, ʻaʻo, and ʻakēʻakē between September 15 to December 15. • Building design shall include fully shielded outdoor lights so the bulb can only be seen from below and automatic motion sensor switches and controls on all outdoor lights or turn off lights when human activity is not occurring in the lighted area. • Any new permanent lighting on buildings will be compliant to reduce impacts to endangered seabirds (minimum necessary, full cutoff, downward directed, amber [560-nanometer or greater] lamping).
ʻIo	• The action area will be surveyed during the ʻio breeding season (March 1 to September 30) and if ʻio nests are found, no trees will be removed in that area until after the nesting is complete.

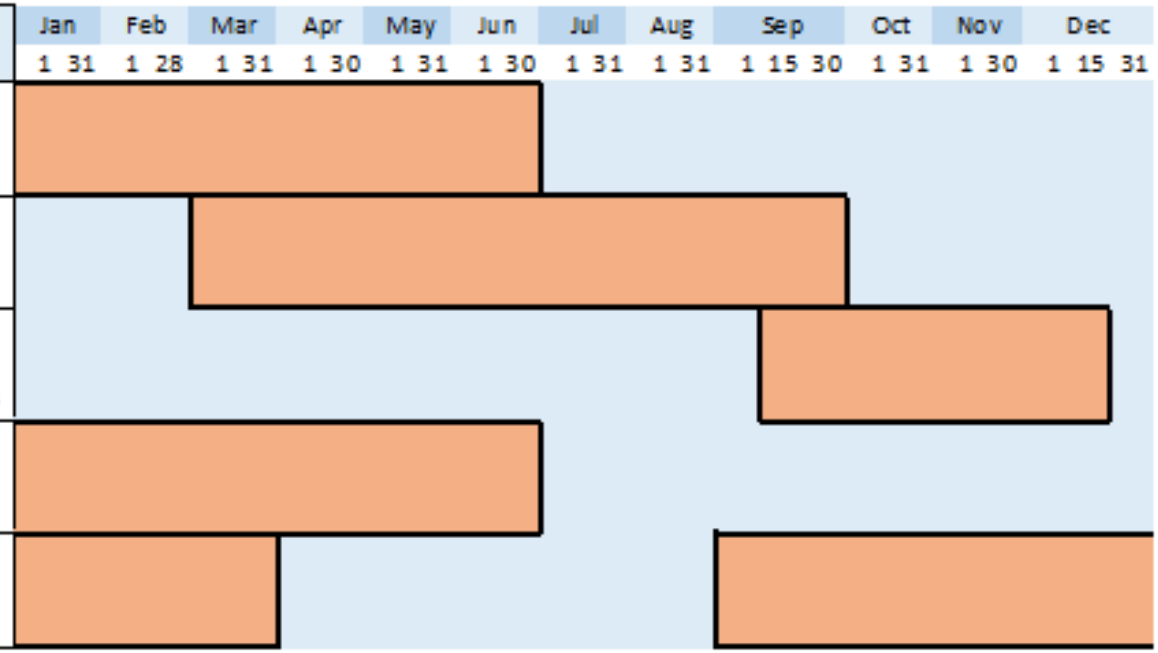
	• For each SMP project, if work must be conducted during the breeding season, a biologist familiar with the species will conduct a nest search of the project footprint and surrounding areas immediately prior to the start of construction activities. • Clearing of vegetation or construction activities shall not occur within 1,600 feet of any active ʻio nest during the breeding season until the young have fledged. • Pre-disturbance surveys for ʻio are only valid for 14 days. If disturbance of the specific location does not occur within 14 days of the survey, conduct another survey. • Regardless of the time of year, avoid trimming or cutting trees containing a hawk nest, as nests may be reused during consecutive breeding seasons.
Migratory Birds	• As part of Leadership in Energy and Environmental Design Certification requirements for the new facilities, this project will include compliance with Pilot Credit 55: Bird Collision Deterrence to minimize impacts to migratory birds. This measure is intended to reduce the chances of bird injury and mortality from in-flight collisions with buildings. This rule requires designers and builders to comply with building façade and site structures that include a lighting and a monitoring plan designed to minimize bird collisions.
ʻŌpeʻapeʻa	• Disturbance, removal, or trimming woody plants and trees greater than 15 feet tall during the ʻōpeʻapeʻa birthing and pup rearing season (June 1 to September 15) will be avoided.
Endangered Plants	• Prior to deconstruction and construction, a survey for endangered plants (*Cyanea lindseyana, Cyanea shipmanii,* and *Phyllostegia brevidens*) will be completed and where possible, individual plants will be avoided. Surveys will be completed during the peak time for flowering when identifiable features of the plants are more likely to be visible. • If avoidance is not possible, the Refuge will work with the U.S. Fish and Wildlife Service Pacific Islands Office (PIFWO) and the Plant Extinction Prevention Program (PEPP) to transplant the plants to suitable undisturbed habitat. • The Refuge will monitor endangered plants periodically during construction to monitor health and any impacts.
	Vegetation
	• Equipment used for clearing vegetation (including vehicles) will be cleaned prior to entering the Refuge to decrease the likelihood of transporting nonnative species and the pathogens that cause Rapid ʻŌhiʻa Death (ROD). • Native plants will be salvaged as much as possible prior to ground disturbance. Appropriate native species will be propagated and replanted using local sources of materials (e.g., air layering, seeds, and salvaged seedlings). • Tree removal will be minimized as much as possible. • Invasive plants colonizing the area post construction will be removed and the area revegetated with appropriate native species.

TABLE C. ESA-LISTED SPECIES WITHIN THE ACTION AREA AND SUMMARY OF EFFECTS DETERMINATION.

Scientific Name	Common Name	Native Common Name	ESA Status	Expected ESA Determination
Birds				
Branta sandvicensis	Hawaiian goose	Nēnē	Threatened	Not Likely to Adversely Affect
Hemignathus munroi	ʻAkiapōlāʻau	ʻAkiapōlāʻau	Endangered	Not Likely to Adversely Affect
Oreomystis mana	Hawaiʻi creeper	ʻAlawī	Endangered	Not Likely to Adversely Affect
Vestiaria coccinea	ʻIʻiwi	ʻIʻiwi	Threatened	Not Likely to Adversely Affect
Loxops coccinea	Hawaiʻi ʻākepa	ʻĀkepa, ʻakakane	Endangered	No effect
Oceanodroma castro	Band-rumped storm petrel	ʻAkēʻakē	Endangered	Not Likely to Adversely Affect
Pterodroma sandwichensis	Hawaiian petrel	ʻUaʻu	Endangered	Not Likely to Adversely Affect
Puffinus auricularis newelli	Newell's shearwater	ʻAʻo	Threatened	Not Likely to Adversely Affect
Mammals				
Lasiurus cinereus semotus	Hawaiian hoary bat	ʻŌpeʻapeʻa	Endangered	Not Likely to Adversely Affect
Plants				
Clermontia pyrularia	ʻŌhā wai	ʻŌhā wai	Endangered	No effect
Clermontia lindseyana	ʻŌhā wai	ʻŌhā wai	Endangered	Likely to Affect
Cyanea shipmanii	Hāhā	Hāhā	Endangered	Likely to Affect
Phyllostegia brevidens	(no common name)	(no common name)	Endangered	Likely to Affect
Phyllostegia racemosa	Kīponapona	Kīponapona	Endangered	No effect
Ranunculus hawaiensis	Hawaiian buttercup	Makou	Endangered	No effect

TABLE D. PROJECT TIMING CONSIDERATIONS FOR AVOIDANCE AND MINIMIZATION OF EFFECTS TO ESA-LISTED SPECIES

Mitigation Measure	Dates
Disturbance, removal, or trimming of woody plants and trees >15' tall prohibited.	1/1 - 6/30
'Io nesting season. Nest surveys must be completed; no removal of trees near nests.	3/1 - 9/30
Nigthtime construction prohibited.	9/15 - 12/15
Peak forest bird breeding season. No tree removal.	1-1 - 6/30
Nēnē breeding season; avoid construction/ deconstruction. No work within 150 feet of nests.	9/1 - 3/31



Appendix 4-1: Summary Descriptions of Threatened and Endangered Species and Other Special Status Species Occurring within the Action Area

A brief description of the listed species that may occur in the action area is provided below. Descriptions of all species are derived from the CCP, Endangered Species Reports, and from the Service's Pacific Islands webpages (https://www.fws.gov/pacificislands).

Threatened and Endangered Animals

Hawaiian goose, Nēnē (Branta sandvicensis)

Threatened; A species likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Critical habitat has not been designated.

The nēnē is similar in appearance to a Canada goose except only the face, cap, and hindneck are black; and Hawaiian geese have buff-colored cheeks. The front and sides of the neck appear to have black and white stripes. This is caused by diagonal rows of white feathers with black skin showing through. Males and females have identical plumage. It is also interesting to note that the dusty black feet of this goose are not completely webbed as in all other geese. Usually smaller than the Canada goose (25" to 43"), the Hawaiian goose ranges in size from approximately 21" to 26" in length.

Nēnē are commonly found in shrublands and grasslands and human-altered habitats ranging from coastal to alpine environments (Banko 1988, pp. 30-31, Banko et al. 1999, p.1). On Hawai'i and Maui, nēnē nest, raise their young, forage, and molt in grassy shrublands and sparsely vegetated lava flows. Nēnē are browser-grazers and the composition of their diet depends largely on the vegetative composition of their surrounding habitats.

The current distribution of wild nēnē has been highly influenced by the location of release sites for captive-bred birds. At the Refuge, the State Division of Forestry and Wildlife introduced a total of 10 adults and 25 goslings near the Station in 1996, 1997, 2002, and 2003. The Refuge-wide population of nēnē has increased from 10 in 1996-1997 to approximately 60 pairs in 2021. Currently, approximately 30 pairs are known to use the Station area alone, which is roughly half the nēnē population at the Refuge. Approximately 8-12 nēnē nests are found near the Station annually, with another 18-20 nests at the Refuge's Pua'ākala barn site each breeding season. During the non-breeding season, approximately 30 birds are regularly seen on the Refuge. Approximately 8-12 individuals are seen during this time near the Station, where they are observed loafing and foraging. Most adult nēnē typically disperse from the Refuge by the end of May.

Nēnē nest between September and March (USFWS 2004, p. 19). Nēnē nest on the ground in a shallow scrape in the dense shade of a shrub or other vegetation. A clutch typically contains three to five eggs and incubation lasts for 29 to 31 days. Once hatched, young remain in the nest for one to two days (Banko et al. 1999, pp. 16-17). Fledging of captive birds occurs at 10 to 12 weeks but may be later in the wild. Adults are flightless while molting for a period of four to six weeks and generally attain their flight feathers around the same time as their offspring. Flightless goslings and adults are extremely vulnerable to predators, such as cats, dogs, and mongoose. From June to September, family groups join others in post-breeding flocks often far from nesting areas.

The increase in the nēnē population is due to efforts by state and federal agencies, nonprofits, and private landowners. In addition, there was a captive breeding program that started in 1949 and ended in 2011, that introduced approximately 2,800 captive-bred nēnē to the Hawaiian Islands. This reintroduction succeeded because a diverse network of conservation organizations and individuals also took steps to manage the nēnē's habitat and keep predators at bay, providing the conditions the newly introduced birds needed to survive.

ʻAkiapōlāʻau (Hemignathus munroi)

Endangered; A species in danger of extinction throughout all or a significant portion of its range. Critical habitat has not been designated.

The ʻakiapōlāʻau is medium-sized, stocky, short-tailed Hawaiian honeycreeper endemic to Hawaiʻi Island. Its most remarkable feature is the extraordinary bill, which has a long, sickle-shaped upper mandible and a short, straight lower mandible that is only half as long as the upper. Males are larger and heavier than females and have a slightly longer bill. Adult males have a bright yellow head and underparts, a greenish back and wings, and black lores. Adult females differ in color, with a yellowish-white chin, throat, and an upper breast that contrasts with a pale yellowish-gray lower breast and belly (USFWS 2006). The ʻakiapōlāʻau is mainly insectivorous. Tree species preferred for foraging include koa (*Acacia koa*), kōlea (*Myrsine* spp.), māmane (*Sophora chrysophylla*), and naio (*Myoporum sandwicense*). The foraging behavior of ʻakiapōlāʻau is very specialized compared with that of other forest birds, and foraging sites and food may be limiting (USFWS 2006, p. 2-98). ʻAkiapōlāʻau are regularly seen foraging in planted koa tree groves at upper elevations of the Refuge several kilometers above old growth forest areas, and the highest ʻakiapōlāʻau densities reported are in upper elevation koa forest plantations on the Refuge (Pejchar 2005). Highest densities of ʻakiapōlāʻau in central windward Hawaiʻi were detected in altered forest stratum, which included koa silviculture areas (Camp et al. 2010).

At Hakalau Forest NWR, ʻakiapōlāʻau occur between 4,200' to 6,200' elevation where they use montane wet ʻōhiʻa and mesic koa/ʻōhiʻa forest. They attain their highest densities on the Refuge in the upper elevation areas with a koa component and heterogeneous habitats along the forest margins (Camp et al. 2003). Analysis of population trends suggest the species is benefiting from over two decades of habitat restoration in the Hakalau Forest NWR (Camp et al. 2010). The current population of ʻakiapōlāʻau at the Refuge is 1,163 birds (Kendall et al. 2022).

Males and females remain together in pairs most of the time. Breeding occurs between Feb and July, but has been observed as late as August at the Refuge (Kendall pers. comm. 2020, Pratt et al. 2001). The home range size of both sexes varies from approximately 12-100 acres. Territories are defended, and there is little evidence of daily or seasonal movements.

Hawaiʻi creeper, ʻAlawī, (Oreomystis mana)

Endangered; A species in danger of extinction throughout all or a significant portion of its range. Critical habitat has not been designated.

The ʻalawī is a small Hawaiian honeycreeper endemic to Hawaiʻi Island. It is predominantly olive green on the back and dull greenish-buff below, with a white chin and throat and dark gray loral-mask extending around the eyes (USFWS 2006).

At the Refuge, ʻalawī are found between 4,200' and 6,200' elevation where they occur most commonly in mesic and wet forests dominated by ʻōhiʻa and koa with a subcanopy of ʻōlapa, pūkiawe, ʻōhelo,

ʻākala, kōlea, kāwaʻu, and hāpuʻu (USFWS 2006). Outside the breeding season (January-June), the species frequently joins mixed-species foraging flocks (Hart and Freed 2003) and forages over home ranges that average 17.3 acres (Vanderwerf 1998, Ralph and Fancy 1994). ʻAlawī most frequently glean insects, spiders, and other invertebrates from the branches, trunks, and foliage of live ʻōhiʻa and koa trees. Recent surveys and population estimates indicate the ʻalawī population is stable overall and increasing in the Refuge (Gorresen et al. 2009), suggesting the species has benefitted from over two decades of habitat restoration (Camp et al. 2010). The current population of ʻalawī at the Refuge is estimated to be 9,888 birds (Kendall et al. 2022).

ʻIʻiwi (Vestiaria coccinea)

Threatened; A species likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Critical habitat is proposed for this species and the proposed critical habitat would encompass much of the Hakalau Forest Unit, including the action area. Manmade structures, such as buildings and roads, would not be included in the critical habitat.

The ʻiʻiwi is a Hawaiian forest bird in the endemic honeycreeper subfamily of the *Fringillidae* (finch family). Male and female ʻiʻiwi are primarily vermillion red, with a black tail and wings, and a long, decurved pink bill. The juvenile is green with black spots and a shorter dusky bill, which becomes yellow then pink with age. It is found primarily in closed canopy, montane wet or montane mesic forests of tall stature, dominated by native ʻōhiʻa trees (*Metrosideros polymorpha*) or both ʻōhiʻa and koa trees. ʻIʻiwi distribution range is restricted mostly to elevations greater than 4,100' because of loss and destruction of native forests, and presence of cold-intolerant *Culex* mosquitoes that transmit avian diseases at lower elevations (Scott et al. 1986, van Riper et al. 1986, Atkinson et al. 1995). Paxton (2013) estimates that 90 percent of remaining ʻiʻiwi are restricted to a narrow band of habitat between elevations of roughly 4,265' and 6,234'. ʻIʻiwi are very susceptible to avian malaria and avian pox. Movement studies by Kuntz (2008) showed ʻiʻiwi from the Refuge will migrate to lower elevations outside the Refuge after the breeding season. These results suggest that upper elevation forest reserves in Hawaiʻi may not adequately protect mobile nectarivores such as ʻiʻiwi, since individuals traveling to lower elevations during the summer months face a higher probability of exposure to introduced mosquito-borne diseases.

ʻIʻiwi are nectarivorous; their diet consists predominantly of nectar from the flowers of ʻōhiʻa, but they may also feed on *Sophora chrysophylla* (māmane), and plants in the lobelia family (*Campanulaceae*) (Pratt *et al*. 2009, p. 193), as well as opportunistic feeding upon insects and spiders (Pratt *et al*. 2009, p. 193). ʻIʻiwi breeding season occurs from January to June, coinciding with peak flowering of ʻōhiʻa (Fancy and Ralph 1998, p. 2). The average clutch size is 2 eggs, and only one brood is normally reared per season.

At the Refuge, densities of ʻiʻiwi are highest in upper elevation (greater than 4,900') mesic and wet koa/ʻōhiʻa and ʻōhiʻa forests with high stature and closed canopy. ʻIʻiwi abundances are positively associated with koa, presence of banana poka (*Passiflora tarminiana*) and elevation, and negatively associated with grass, nonnative vegetation, and presence of tree ferns. The positive association with banana poka may be due to the use of its copious nectar by ʻiʻiwi (Fancy and Ralph 1998). ʻIʻiwi occur at low densities in heterogeneous habitats along the grass-forest interface and in mid-elevation forest.

Analysis of population trends suggest the species is benefiting from over two decades of habitat restoration in the Hakalau Forest NWR (Camp et al. 2010). The current population of ʻiʻiwi at the Refuge is estimated to be 110,028 birds (Kendall et al. 2022).

Hawaiʻi ʻākepa (Loxops coccineus coccineus)

Endangered; A species in danger of extinction throughout all or a significant portion of its range. Critical habitat has not been designated.

The Hawaiʻi ʻākepa is a small, sexually dichromatic Hawaiian honeycreeper endemic to Hawaiʻi Island. The male is bright red-orange while the female ʻākepa has a greenish top & yellow belly. This species has a short conical bill which is generally pale yellow in color (USFWS 2006). The species feeds mainly on ʻōhiʻa leaf clusters, but also on koa leaves and seed pods. It uses its bill to pry open leaf and flower buds in search of small arthropods.

At the Refuge, Hawaiʻi ʻākepa are locally common, and found in the montane wet ʻōhiʻa forest and mesic koa/ʻōhiʻa forest. Densities of Hawaiʻi ʻākepa are highest in upper elevation koa/ʻōhiʻa and ʻōhiʻa forests of high stature and closed canopy (Camp et al. 2003). They occur in a gradient of population density, with a small core area of highest density in the Puaʻākala area at the Refuge and rapid decreases in density away from the core (Scott et al. 1986, Hart 2001). The species was absent or occurred at low densities in heterogeneous habitats along the grass-forest interface and in mid-elevation forest (Camp et al. 2003).

Hawaiʻi ʻākepa breed from March to September. This species is an obligate cavity nester, with most nests placed in natural cavities found in old growth ʻōhiʻa and koa trees. Consequently, their density depends in part on the density of large trees, because only large trees provide the cavities required for nesting (Hart 2000, 2001; Freed 2001). The average size of trees used for nesting is 3.3 ft in diameter at breast height (Freed 2001). ʻŌhiʻa appear to be more important to ʻākepa than koa. Large ʻōhiʻa trees provide both cavities for nest-sites and the preferred foraging substrate, whereas large koa trees provide mainly cavities (Freed 2001).

Breeding densities at the Refuge appear to be limited by the availability of nest sites (Hart 2000), and the population may be at or near carrying capacity with respect to food availability (Fretz 2002). The current population of Hawaiʻi ʻākepa population at the Refuge is estimated to be 7,221 (Kendall et al. 2022).

Band-rumped storm-petrel, ʻAkēʻakē, (Oceanodroma castro)

Endangered; A species in danger of extinction throughout all or a significant portion of its range. Critical habitat has not been designated for this species.

The Hawaiʻi Distinct Population Segment (DPS) of the ʻakēʻakē is an endangered seabird that is found throughout the Pacific Ocean basin, and nests in the Hawaiian Islands. ʻAkēʻakē are a small seabird measuring approximately 8 inches (20 centimeters) long with a wingspan of 19 inches (47 cm), and weighing about 2 ounces (50 grams). The tail is only slightly notched and is almost square in appearance. Plumage is an overall blackish-brown with a white band across the rump, just above the tail. This species typically flies with a relatively shallow wingbeat and glides on slightly bowed wings as a regular part of flight (Slotterback 2002, p. 2). Both sexes are alike in size and appearance. Vocalizations at breeding colonies can be used to further distinguish this species from other Procellariiformes seabirds (albatrosses and petrels) found throughout Hawaiʻi (Allan 1962, p. 279; James and Robertson 1985, pp.

391-392). ʻAkēʻakē are long-lived, with lifespans of 15 to 20 years. ʻAkēʻakē do not occur within the Refuge but may traverse the area during the breeding, nesting, and fledging seasons (March 1–December 15) where they breed and congregate at high elevation sites on the island of Hawai'i. When not at nesting sites, adults spend their time foraging on the open ocean for small fish, squid, and crustaceans.

Hawaiian petrel, ʻUaʻu (Pterodroma sandwichensis).

Endangered; A species in danger of extinction throughout all or a significant portion of its range. Critical habitat has not been designated for this species.

The ʻuaʻu, also known as the Hawaiian petrel or dark-rumped petrel, has a dark gray head, wings, and tail, and a white forehead and belly. It has a stout grayish-black bill that is hooked at the tip, and pink and black feet. This bird measures 16 inches in length and has a wingspan of three feet. It has a distinctive call during breeding season that sounds like "oo ah oo". They also have calls that sound like the yapping of a small dog. The ʻuaʻu does not occur within the Refuge but may traverse the area at night during the breeding, nesting, and fledging seasons (March 1–December 15) when they breed and congregate at high elevations on the island of Hawai'i. When not at nesting sites, adults spend their time foraging on the open ocean for small fish, squid, and crustaceans.

Newell's shearwater, ʻAʻo (Puffinus auricularis newelli)

Threatened; A species likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Critical habitat has not been designated for this species.

The ʻaʻo is a medium-sized shearwater measuring 12 to 14 inches with a wingspan of 30 to 35 inches. It has a dark black back, contrastingly white underside and underwing, and a black bill that is sharply hooked at the tip. Its claws are well adapted for burrow excavation and climbing. ʻAʻo can be identified by its very quick, almost frantic flapping style with the wings held straight. The ʻaʻo has a very distinctive call that sounds like a braying donkey, which can be heard in many places on Kauai just after sunset. No critical habitat has been designated for this species. The ʻaʻo does not occur within the Refuge but may traverse the area at night during the breeding, nesting, and fledging seasons (March 1–December 15) when they breed and congregate at high elevations on the island of Hawai'i. When not at nesting sites, adults spend their time foraging on the open ocean for small fish, squid, and crustaceans.

ʻŌpeʻapeʻa (Hawaiian hoary bat, Lasiurus cinereus semotus)

Endangered; A species in danger of extinction throughout all or a significant portion of its range. No critical habitat has been designated for this species.

ʻŌpeʻapeʻa is an endangered endemic mammal found in the Hawaiian archipelago. Listed as a subspecies of the hoary bat (*L. cinereus*), ʻōpeʻapeʻa is distributed across all the major islands of the Hawaiian archipelago. Changes in seasonal abundance of ʻōpeʻapeʻa at locations of different elevations indicate that altitudinal migrations occur on the Island of Hawaiʻi. The ʻōpeʻapeʻa is a distinctively marked bat with long narrow wings. Its fur is long and soft, dark brown to black at the base, followed by a broad band of cream color, then a slightly narrower band of mahogany brown, tipped with white. The outer three colors are visible from the surface, giving the fur a hoary appearance. The bat has a distinctive yellowish-brown collar under its chin and yellowish ears edged in black. Dense fur extends to

the tip of its tail and just beyond the wrists along the undersides of its wings, with distinctive white patches on the shoulders and wrists.

The ʻopeʻapeʻa is found at the Refuge year-round where it uses the restored koa forest, alien grassland with scattered native shrubs and trees, and intact native koa/ʻōhiʻa forest for foraging, roosting, and birthing. The ʻōpeʻapeʻa pupping season occurs between June 1 and September 15. They roost alone or with dependent young in native and nonnative trees, typically more than 4.6 meters (15 feet) tall (Amlin and Siddiqi 2015).

Endangered Plants

ʻŌhā wai (Clermontia pyrularia)

Endangered; A species in danger of extinction throughout all or a significant portion of its range. A total of 5,379 acres of Critical habitat for this species has been designated at the Refuge. The designated critical habitat does not include the action area. The nearest *C. pyrularia* critical habitat to the action area is approximately 180 meters to the south.

Clermontia pyrularia is a member of the *Campanulaceae* (bellflower) family. In 1990, fruits were collected from the only known existing *C. pyrularia* within the Pīhā Game Management Area, adjacent to the Refuge. The seeds were germinated and the seedlings propagated at the Refuge greenhouse. The original wild plant subsequently died, but since that time, 14 others have been found nearby. These plants are considered to be the last known population. Thirty-one seedlings, from seeds taken from the original wild plant, were outplanted at 12 different sites on the Refuge in 1992. Twelve of these plants (7 sites) were still living in 1996. During the 1998 fruiting season in August-September, fruits were collected from eight plants, all within the only known population. *C. pyrularia* founder lines are still maintained for propagation in the Refuge greenhouse collection. From 1999 through 2021, a total of 6,028 *C. pyrularia* have been grown and outplanted at the Refuge.

ʻŌhā wai (Clermontia lindseyana)

Endangered; A species in danger of extinction throughout all or a significant portion of its range. A total of 4,868 acres of Critical habitat for this species has been designated at the Refuge. The designated critical habitat does not include the action area. The nearest *C. pyrularia* critical habitat to the action area is approximately 450 meters to the southeast.

Clermontia lindseyana, a short-lived perennial of the bellflower family (*Campanulaceae*), is a shrub or tree that grows from two to six meters tall (Lammers 1990, p. 431). On the island of Hawaiʻi, *C. lindseyana* grows in habitat including koa/ʻōʻhia mesic forest with *Cheirodendron* sp. (ʻōlapa), *Cibotium* sp. (hāpuʻu), *Coprosma* spp., *Cyanea shipmanii* (hāhā), *Dryopteris wallichiana* (ʻiʻo nui), *Ilex anomala* (kāwaʻu), *Myrsine lessertiana* (kolea lau nui), *Rubus hawaiensis* (akala), and *Vaccinium* sp. (ʻōhelo) (USFWS 2010, p. 4).

Three populations of *C. lindseyana* are known on the Refuge. In August/September 1998, fruits were collected from four wild *C. lindseyana,* one in the Middle Honohina Unit and three areas in the HFU. Successful propagation and genetic storage for *C. lindseyana* has been done at the Refuge, and starting in 1999, plants were outplanted in the Puaʻākala and Maulua tracts. Many of these plants are now mature and producing fruit and the Refuge has been collecting seeds from them for propagation.

Research on pollination ecology discovered that two honeycreeper species, ʻiʻiwi and Hawaiʻi ʻamakihi, were infrequent or occasional floral visitors to *C. lindseyana* at the Refuge (Pender 2013, p. 109).

During the most recent survey, the Refuge contained 13 wild founders of *C. lindseyana* (USFWS 2015, p. 2). Between 1999 and 2021, a total of 10,294 *C. lindseyana*, have been propagated and outplanted at the Refuge.

Hāhā (Cyanea shipmanii)

Endangered; A species in danger of extinction throughout all or a significant portion of its range. A total of 3,897 acres of Critical habitat has been designated at the Refuge. The designated critical habitat does not include the action area. The nearest hāhā critical habitat to the action area is approximately 120 meters to the east.

Cyanea shipmanii, is a member of the bellflower family (*Campanulaceae*) and a short-lived perennial. The habitat of *C. shipmanii* is montane mesic forest dominated by *Metrosideros polymorpha* (ʻōhiʻa) on the windward slopes of the island, at elevations between 5,400 and 6,200 ft. The four individuals at the Refuge are growing with *Clermontia lindseyana* (USFWS 1996a, p. 41).

Historically, *C. shipmanii* was known only from the eastern slopes of Maunakea on Hawai'i Island. Five *C. shipmanii,* (over half of the world population) were found on the Refuge in 1993. One plant died in 1994 and a second in 1997, both from rat herbivory. A third plant, one of two last remaining fruit-bearing plants, died in September of 2000. Fruit and seed have been collected for propagation and genetic storage at the Refuge (Kendall et al. 2022, p. 7). This was done to improve the genetic variability in plants at the Refuge. New genetic stock is vital to the restoration of this extremely endangered species. The two wild plants on the Refuge were visited in 2014. One was still alive. Between 1999 and 2021, a total of 5,389 *C. shipmanii* have been grown and outplanted at the Refuge.

Phyllostegia brevidens (No common name)

Endangered; A species in danger of extinction throughout all or a significant portion of its range. There is no critical habitat proposed or designated for this species.

Phyllostegia brevidens, a member of the *Lamiaceae* (mint) family, is a sprawling subshrub with stems covered in hairs. The species occurs in lowland and montane wet forest characterized by the dominant overstory tree, *Metrosideros polymorpha* (ʻōhiʻa), with *Cibotium* spp. (hāpuʻu) tree fern, *Cheirodendron trigynum* (ʻōlapa) and *Ilex anomala* (kāwaʻu) subcanopy, and understory composed of diverse fern species, *Peperomia* spp., *Vaccinium* spp., and other understory plants.

A single wild individual of *P. brevidens* was discovered near the Maulua section of the Refuge in 1991 at 5,450' elevation (PTGB 1991, p. 1; HFNWR 2020, p. 8; Jeffrey pers. comm. 2020). The specimen was first identified as *P. macrophylla*, then *P. ambigua* prior to identification as *P. brevidens* (PTGB 1991), though there is still some taxonomic uncertainty among botanists. No additional individuals of *P. brevidens* are reported in the wild at the Refuge. Seeds and cuttings were collected from this plant and have been propagated at the Refuge greenhouse (HFNWR 2020, p. 8; Kendall pers. comm. 2020). From this one founder, 5,883 individuals of *P. brevidens* were planted beginning in the 2000's at 9 sites in Maulua Nui and Hakalau Nui (PEPP 2016, pp. 12–13; Kendall pers. comm. 2020; HFNWR 2020, p. 9). Survival of outplants monitored over a period of approximately 20 years since the first planting has been approximately 36 percent (HFNWR 2020, p. 9; USFWS 2020, pp. 1–2). Translocated plants have grown

vigorously but natural recruitment has not been documented (Kendall pers. comm. 2020). At the end of 2019, there were 249 individuals of *P. brevidens* growing in the Refuge greenhouses (USFWS 2020, p. 9).

Kīponapona (Phyllostegia racemosa)

Endangered; A species in danger of extinction throughout all or a significant portion of its range. A total of 5,335 acres of Critical Habitat has been designated for this species at the Refuge. The designated critical habitat does not include the action area. The nearest kīponapona critical habitat to the action area is approximately 130 meters to the east.

Phyllostegia racemosa, or kīponapona, is an endangered climbing vine with square stems. This plant is also characterized by the spicy odor of its foliage. Located from 4,650' to 6,070' elevation, kīponapona primarily occurs in montane wet or mesic forest dominated by ʻōhiʻa and koa, as well as hāpuʻu. Other associated taxa include ʻōhelo, ʻākala, and laukahi (USFWS 1998a).

Seven individuals were present on the Refuge in 2001 within the Upper Maulua and Hakalau units (Jeffrey et al. 2001). To date, roughly 1,043 kīponapona have been outplanted at the HFU.

Currently, no kīponapona individuals are known at the Refuge except for founder lines in the Refuge greenhouse ex situ collection used for propagation. Prudent measures must be taken to prevent the loss of genetic diversity for this species. In August 1998, fruits were collected from four plants, with cuttings taken from the most vigorous plants. Many of the seeds proved viable and all cuttings rooted under the care of the Refuge horticulturist. Seedlings and cuttings of kīponapona have responded well to planting in areas where grass is controlled. From 1999 through 2021, 1,769 seedlings and cuttings have been planted at the Refuge.

Makou (Ranunculus hawaiensis)

Endangered; A species in danger of extinction throughout all or a significant portion of its range. No critical habitat has been designated for this species.

Ranunculus hawaiensis is an erect or ascending perennial herb in the *Ranunculaceae* (buttercup) family. The Refuge had been propagating and outplanting *R. hawaiensis* prior to its listing as endangered in 2016. The founders for the outplants are from Hakalau and Kanakaleonui (Maunakea) (Wiesenberger pers. comm. 2020). The Refuge continues maintaining an ex-situ collection of *R. hawaiensis* in the Refuge nursery and conducting reintroductions. The Refuge has reintroduced 562 individuals to date, and plants and seeds remain in their ex-situ facilities for propagation (HFNWR 2020, pp. 8–9).

Special Status Species (Currently Not Federally Listed Under the ESA)

ʻIo (Hawaiian hawk, Buteo solitarius)

Federally Delisted. Protected under Hawaiʻi State law as a Species of Greatest Conservation Need (Hawaiʻi 2015). Critical habitat has not been designated.

The ʻio is a raptor in the genus *Buteo* and is endemic to the Hawaiian Islands. They occur only on the Island of Hawaiʻi from sea level to 8,000' elevation where they use lowland nonnative forests, urban areas, agricultural lands, pasturelands, and high-elevation native forests with both intact and degraded understory (Mitchell et al. 2005, Klavitter et al. 2003). During the winter, ʻio have been reported in subalpine māmane-naio forest, suggesting some seasonal movements (Mitchell et al. 2005).

‘Io have been observed in high elevation portions of the Refuge year-round between 3,300‘ and 6,600‘ using the montane wet ‘ōhi‘a forest, mesic and dry koa/‘ōhi‘a forest, and montane wet ‘ōhi‘a/*Dicranopteris* sp. forest and grasslands. As of 2007, densities of ‘io were 0.34 birds/sq. mile in mature forests with grasslands and 0.3 birds/sq. mile in mature native forest. The average density for the Island of Hawai‘i is 0.21 + 0.02 birds/sq. mile (Gorresen et al. 2008). ‘Io have been recorded nesting in the Refuge between March-September (Klavitter et al. 2003).

The ‘io is adaptable and versatile in its feeding habits and preys on a variety of rodents, birds, and large insects (Munro 1944, p. 48; Griffin 1998, pp. 142-145). Breeding season occurs between March-September. Klavitter et al. (2003, p. 172) stated the ‘io appears limited in its range by habitat availability because the species occurs in relatively high densities only in vegetated habitats that have large trees it needs for nesting, perching, and hunting. Highest densities are found in areas of mature ‘ōhi‘a forest and old growth ‘ōhi‘a forest with grass understory, and lower densities in pioneer ‘ōhi‘a forest, mixed native/exotic forest, exotic forest, suburbs, and shrubland habitat (Gorresen et al. 2008, pp. 15 and 47). The most recent population estimate indicates the species is “stable” with a total population of approximately 3,000 birds on the island (USFWS 2020).

Appendix 4-2: Biosecurity Protocols for Hawai'i Island

1. All work vehicles, machinery, and equipment are to be cleaned, inspected by its user, and found free of mud, dirt, debris, and organisms prior to entry into the Refuge.
   - Vehicles, machinery, and equipment must be thoroughly pressure washed in a designated cleaning area (designated by the responsible land manager) and visibly free of mud, dirt, plant debris, insects, frogs (including frog eggs) and other vertebrate species such as rats, mice, and non-vegetative debris. A hot water wash is preferred. Areas of particular concern include bumbers, grills, hood compartments, areas under the battery, wheel wells, undercarriage, cabs, and truck beds (truck beds with accumulated material (intentionally placed or fallen from trees) are prime sites for accidental transport of invasive species).
   - The interior and exterior of vehicles, machinery, and equipment must be free of rubbish and food. The interiors of vehicles and the cabs of machinery must be vacuumed clean. Floor mats shall be sanitized with a solution of >70% isopropyl alcohol or a freshly mixed 10% bleach solution.
   - Any machinery, vehicles, equipment, or other supplies found to be infested with ants (or other invasive species) must not enter the Refuge. Treatment is the responsibility of the equipment or vehicle owner and operator.
2. Little fire ants — All work vehicles, machinery, and equipment are to be inspected for invasive ants prior to entering the Refuge.

a. A visual inspection for little fire ants is to be conducted prior to entry into the Refuge.
b. Hygiene is paramount, but even the cleanest vehicle may transport little fire ants. Place MaxForce Complete Brand Granular Insect Bait (1.0% Hydramethylnon; http://littlefireants.com/MaxForce%20Complete.pdf) into refillable tamper resistant bait stations. An example of a commercially available refillable tamper resistant bait station is the Ant Cafe Pro (https://www.antcafe.com/) Place a bait station (or stations) in each vehicle. Note that larger vehicles, such as trucks, may require multiple stations. Monitor bait stations frequently (every week at a minimum) and replace bait as needed. If the station does not have a sticker to identify the contents, apply a sticker listing contents of the station.
c. Any machinery, vehicles, equipment, or other supplies found to be infested with ants (or other invasive species) must not enter the Refuge until it is sanitized and re-tested following a resting period of at least 24 hours. Infested vehicles must be sanitized following recommendations by the Hawai'i Ant Lab (http://www.littlefireants.com/) or other ant control expert in accordance with all State and Federal Laws. Treatment is the responsibility of the equipment or vehicle owner and operator.
d. Gravel, building materials, or other equipment such as portable buildings are to be baited using MaxForce Complete Brand Granular Insect Bait (1.0% Hydramethylnon; http://littlefireants.com/MaxForce%20Complete.pdf) or AmdroPro (0.72% Hydramethylnon; http://littlefireants.com/Amdro%20Pro.pdf) following label guidance.
e. Storage areas that hold field tools, especially tents, tarps, and clothing are to be baited using MaxForce Complete Brand Granular Insect Bait (1.0% Hydramethylnon; http://littlefireants.com/MaxForce%20Complete.pdf) or AmdroPro (0.72% Hydramethylnon; http://littlefireants.com/Amdro%20Pro.pdf) following label guidance.

3. Base yards and staging areas inside and outside the Refuge must be kept free of invasive species.

a. Base yards and staging areas are to be inspected at least weekly for invasive species and any invasive found is to be removed immediately. The local land manager(s) will determine what species are to be targeted in these inspections and removal procedures (please refer to contacts listed at the end of this appendix for current disposal/removal recommendations). The local land manager will also ensure regulatory compliance with all activities. Land managers are to pay particular attention to where vehicles are parked overnight, keeping areas within 10 meters of vehicles free of debris. Parking on pavement and not under trees, while not always practical, is best.
b. Project vehicles or equipment stored outside of a base yard or staging area, such as a private residence, are to be kept in a pest free area as defined by the onsite land or project manager.
4. All cutting tools used in the Refuge must be sanitized to prevent the spread of Rapid ʻŌhiʻa Death (ROD) fungus.
a. Avoid wounding ʻōhiʻa trees and roots with mowers, chainsaws, weed eaters, and other tools. Cut only the minimum number of trees and branches as approved for the project.
b. All cutting tools, including machetes, chainsaws, and loppers must be sanitized to remove visible dirt and other contaminants prior to entry into the Refuge, and when moving to a new project area within the Refuge. Tools may be sanitized using a solution of >70% isopropyl alcohol or a freshly mixed 10% bleach solution. One minute after sanitizing, you may apply an oil based lubricant to chainsaw chains or other metallic parts to prevent corrosion.
c. Only dedicated tools and chainsaws are to be used to sample known or suspected ROD infected trees.
d. Vehicles, machinery, and equipment must be cleaned as described in (1) above.
5. Imported ʻōhiʻa firewood, logs, and ʻōhiʻa parts:
a. ʻŌhiʻa firewood, logs, and parts are not to be transported. For State guidance see: http://www.hdoa.hawaii.gov/.
6. For individuals working in the field on Hawaiʻi Island:
a. **Before going into the field,** visually inspect and clean your clothes, boots, pack, radio, harness, tools, and other personal gear and equipment for seeds, soil, plant parts, insects, and other debris. A small brush is handy for cleaning boots, equipment, and gear. Soles of shoes are to be sanmitized using a solution of >70% isopropyl aldohol or a freshly mixed 10% bleach solution.
b. **Immediately before leaving the field,** visually inspect and clean you clothes, boots, pack, radio harness, tools, and other personal gear and equipment for seeds, soil, plant parts, insects, and other debris. Soles of shoes are to be sanmitized using a solution of >70% isopropyl aldohol or a freshly mixed 10% bleach solution.
c. **Little fire ants in trees.** If you are under a tree and that tree is bumped or somehow stressed, the threat response of ants is to fall from the leaves and sting the person under the tree. If you are subject to an ant attack, do not panic. The ants are extrememly small, but their stings are painful, so make sure you remove all ants from your body and clothing. The stings cause inch long welts that are itchy and painful, and can last for weeks. Treat stings as you would other insect stings. In some persons, stings can produce life threatening reactions. Stocking antihistimine in the first aid kit is a reasonable precaution.
d. **Rat Lungworm disease** is caused by a parasite that can infect humans who consume raw or undercooked infected snails or slugs or consume raw produce that contains a small infected snail or slug. Infection is rare but can be serious. Symptoms can include severe headache, neck stiffness, low grade fever, nausea, and vomiting anywher from 1-6 weeks after exposure. The

disease is not spread person to person. Anyone who handles snails or slugs is to wear gloves and/or wash hands. Eating unwashed produce is discouraged.

For current disposal/removal recommendations please contact the following:

1. Little fire ants — http://www.littlefireants.com/
2. Rapid ʻŌhiʻa Death — https://cms.ctahr.hawaii.edu/rod/
3. Coqui — http://www.biisc.org/
4. All taxa — http://www.biisc.org/

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APPENDIX 5 — STATION MASTER PLAN

(Attached)

HAKALAU FOREST NATIONAL WILDLIFE REFUGE

STATION MASTER PLAN | FINAL PLANNING DOCUMENT

AUGUST 2021

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

PND ENGINEERS, INC.

Corvus Design
Landscape Architecture • Planning • Industrial Design

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INTRODUCTION

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BACKGROUND

Hakalau Forest National Wildlife Refuge (the Refuge) was established in 1985 to protect and manage endangered Hawaiian forest birds and their forest habitat. Located on the windward slope of Mauna Kea, Island of Hawai'i, the approximately 33,000-acre Hakalau Forest Unit supports a diversity of native birds and plants unequaled by other areas in the State of Hawai'i.

The Refuge is located approximately 40 road miles northwest of Hilo, Hawai'i, and situated at an elevation between 2,500 and 6,500 feet. The climate across this elevation span ranges from very wet and tropical at the lower elevations to semi-arid montane at the upper elevations. The terrain is rolling with gentle to steep slopes and contains numerous steep and deeply incised gulches and streams. Deep, productive soils overlaying ancient lava flows typify the complex geology of the area and are accented by numerous bedrock outcrops and boulder fields. Koa and 'ohi'a forest dominate much of the refuge landscape with about 5,000 acres of grasslands at upper elevations. The Refuge has been actively restoring these former pasturelands to native forest since Refuge establishment.

PROJECT PURPOSE

The Refuge is serviced from the centrally located Field Station (the Station). The Station's facilities and infrastructure (i.e., transportation routes and utilities) have been constructed and modified over time and have varying levels of condition and appropriateness to their current uses. The Master Planning process involved assessment of existing facilities and infrastructure and recommendation for facilities and infrastructure improvements, replacements, and additions. This is to ensure that the Station and the staff that use it are able to maintain and improve their ability to serve the mission of the Refuge into the future.

SUMMARY

This report outlines the existing conditions of all Station facilities and infrastructure, shown opposite on Page 3. It assesses utility needs (current and future) with recommendations and alternatives for expansion, upgrade, or any combination thereof (utility systems include photo-voltaic power, catchment water supply, and septic). The Master Plan also assesses all Station buildings to address current and future building needs and provide recommendations and alternatives for expansion, upgrade, or any combination thereof.

This plan includes, but is not limited to:

- Updates to the existing site plan to identify buildings and utilities;
- Creation of a new site plan identifying recommended utility locations, future buildings, and other infrastructure improvements;
- Design of an Operations Yard that depicts facilities, including a fueling station, washdown station, off-road vehicle (ORV) building, storage building, and an equipment pole barn;
- Provision of a master plan-level cost estimation; and
- Provision of a consistent facility naming convention.

Phasing and sequencing of the various improvements was considered to maintain function of the Station during construction, and to provide more flexibility for funding of individual projects. Many of the identified improvements can be constructed incrementally; however, some buildings, such as the Volunteer Bunkhouse, will require demolition of the existing structure and alternate housing during construction of the new building. Other improvements, such as construction of the new Fire Cache, can be completed without significant interruption to Station operations. Construction of each facility may require use of an alternate facility to maintain function (e.g., volunteer housing must be covered elsewhere while the new building is being constructed), and will need to consider future improvements, such as utility corridors or location of future structures or roads.

A conceptual cost estimate is provided for Station improvements, and separated into distinct phases (i.e., roads, Operations Yard, utilities, and each main building) to inform future funding requests.

EXISTING STATION INFRASTRUCTURE


Turn-off to Station from Mana Road


University of Hawaii Research Station


BRD Cabin


Garage


Volunteer Bunkhouse


Photo-Voltaic (P-V) Power Building


Maintenance Building


Staff Residence Bunkhouse


Greenhouses, Storage, and Dog Kennel Buildings

2

EXISTING CONDITIONS

EXISTING CONDITIONS

SUMMARIES

GENERAL CONDITIONS

Please reference the Site Visit 1 - Field Report (December 2020) for detailed information about the Station's existing conditions.

Current conditions illustrate that the Station has grown incrementally over time. While the buildings and systems have differing levels of function and condition, they share a weakness in that they do not operate collectively within fully integrated systems.

The Station is a functional environment. While some facilities have included aesthetic considerations (the original views from the Volunteer Bunkhouse), the site does not have a cohesive aesthetic and is a product of non-organized vehicle use and incremental decisions.

BUILDINGS

Permanent buildings on the site include:

- Staff Residence Bunkhouse (Sleeps 10)
- Volunteer Bunkhouse (Sleeps 12)
- USGS Biological Resources Division (BRD) Cabin (Sleeps 4)
- Maintenance Building
- Garage
- Storage Shed
- Dog Kennel (storage / tool shed)
- Photo-Voltaic (P-V) Power Building
- Two greenhouses

In addition to these buildings, there are also two weatherports used for maintenance and operations, one weatherport used for volunteer housing, an outbuilding used for fuel storage, a conex outfitted as a modular chemical unit, and several sheds adjacent to the greenhouses.

Throughout the document, the existing buildings will be referred to by their name and/or a building code. These are summarized in the following table:

BUILDING DESCRIPTION	BUILDING CODE
Fuel Storage Shelter	AUX1
Modular Chemical Unit	AUX2, M
Outhouses	AUX3, 4
UofH Residence & Research Building	UH1
UofH Generator	UH2
Weatherport	WP
Staff Residence Bunkhouse	B1
Maintenance Building	B2
P-V Power Building	B3
Volunteer Bunkhouse	B4, V
Garage	B5
Storage Shed	B6
Dog Kennel	B7
BRD Cabin	B8
Hakalau Rare Plan Greenhouse	GH1
Hakalau Forest Greenhouse	GH2

UTILITIES

Utilities have been developed over time, appear to be sufficient, and should be further evaluated for their suitability in servicing the Station and proposed improvements into the future. As buildings are renovated or new ones constructed, their associated utilities and share of the overall utility network should be reviewed and upgraded. When possible, consideration should be given to future upgrades or expansion ("future-proofing").

Water

Rainwater is the only source for stored water on the site: storage tanks are fed with water primarily collected from adjacent buildings. Exposed and buried piping connects buildings to these tanks, and provides connections between tanks.

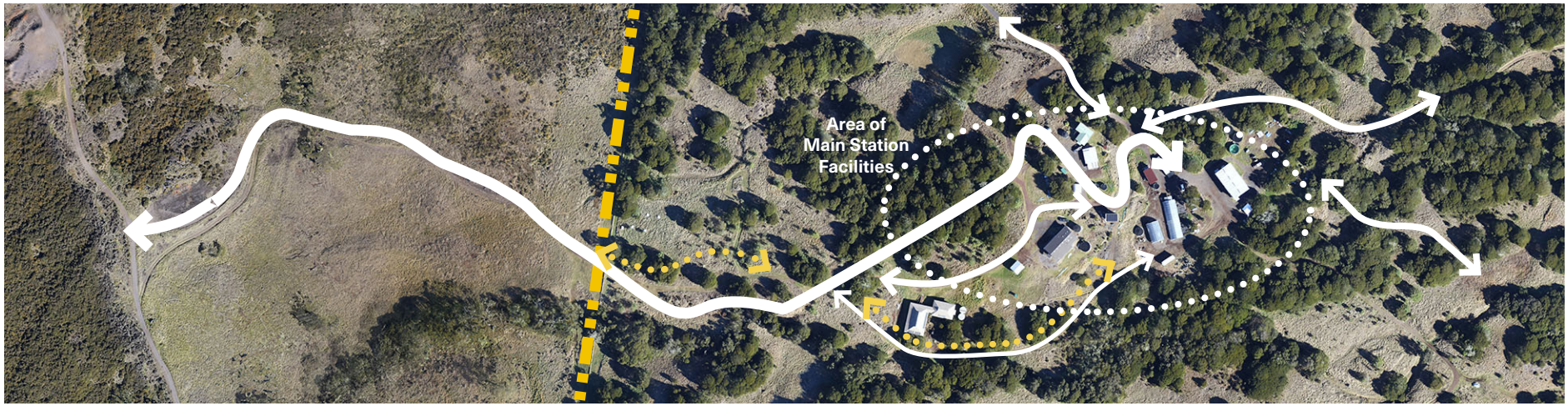
The Station is currently serviced by 13 water catchment tanks, with individual capacities between 6,700 gallons to 21,000 gallons. The total storage capacity of the site is estimated to be 179,600 gallons.

Piping and related components for the water system (exposed and buried) are assumed to be PVC. These exposed pipes are degrading.

Assessment: The storage system is efficient in that it optimizes storage next to roof collection. Water transfer between tanks is less efficient due to routing and excess capacity at lower elevation on the site. Piping should be replaced either in part or in full to avoid system down-time from breakage of aging materials.

Future: For a remote station, the use of passive systems should be prioritized. For a water system, the goal is to avoid mechanical pumping and rely on gravity feed. The current system of providing storage capacity at each building to meet that building's needs is logical. With sufficient roof water generation, there are advantages to having excess capacity at higher elevation on the site. This allows gravity feed to lower tanks, and could provide system pressure. If there is enough extra roof water generation higher on the site, tank sizes could be reduced in lower areas if aesthetics or other factors would benefit from smaller tank sizes. Minimum building-specific tank sizes should be based on the provision of emergency capacity should that building be disconnected from the larger system. Overall system design should allow gravity feed of all tanks from above, and the ability to pump water up from lower tanks if needed.

HAKALAU FIELD STATION



Not to Scale

Electric

Electric needs are provided by a photo-voltaic array with a battery bank. A stand-by generator is available as needed to supplement the system. Exposed shallow-bury electric lines were observed, and should be investigated to determine if they should be replaced or reinstalled.

Assessment: The existing generation system is designed with two-layer redundancy (batteries and generator), but should likely have additional redundancy. A failure in the battery bank in November 2020 has caused significant impact to Station operations.

Future: For a remote station, durability and redundancy within power systems should be prioritized. Electric lines should be routed and/or installed at depths that eliminate the possibility of accidental damage. Conduit size, spare conduit, and/or conductor sizing should anticipate future needs.

Propane

Multiple propane tanks are provided at each building based on the needs of the building. This allows off-site propane refill without service interruption.

Assessment: This approach for the use of propane is efficient and meets needs.

Future: For a remote station, energy source redundancy is beneficial. The inclusion of propane (or another non-electric energy source) allows for operation when electricity might not be available. There may be an advantage if tanks were refueled on-site, but that is dependent on economics and feasibility of a refueling truck coming to the Station.

Sewer Systems

Sewer systems include septic fields, cesspools and outhouses.

Assessment: Cesspools are no longer standard practice and should be removed.

Future: Any new facilities that are constructed with bathrooms should be serviced by an appropriate septic tank and leach field. For a remote station, interconnected systems can create issues when one fails. A non-flush toilet system should be considered to have on-site as a back-up.

LEGEND

- Vehicle Circulation
- Interpretive Trail
- Refuge Boundary

OPERATIONS YARD

The Station has a recently constructed Maintenance Building that has significantly enhanced operations and maintenance activities. There are still a number of portable structures for storage and equipment protection throughout the Station. The Maintenance Building has a yard area to the east of it, but it is not yet optimized to consolidate all operations and maintenance needs within it. A fully developed and consolidated Operations Yard is critical for efficient Station operations.

Assessment: Efforts to consolidate and streamline operations and maintenance facilities are ongoing.

Future: Fully develop an efficient Operations Yard.

EXISTING CONDITIONS

USES AND CIRCULATION

USERS

The site has four typical uses: volunteer housing and activities, staff housing, operations and maintenance, and University of Hawaii Field Station activities. These uses are intermixed and connected on the site, without any clear differentiation or zoning.

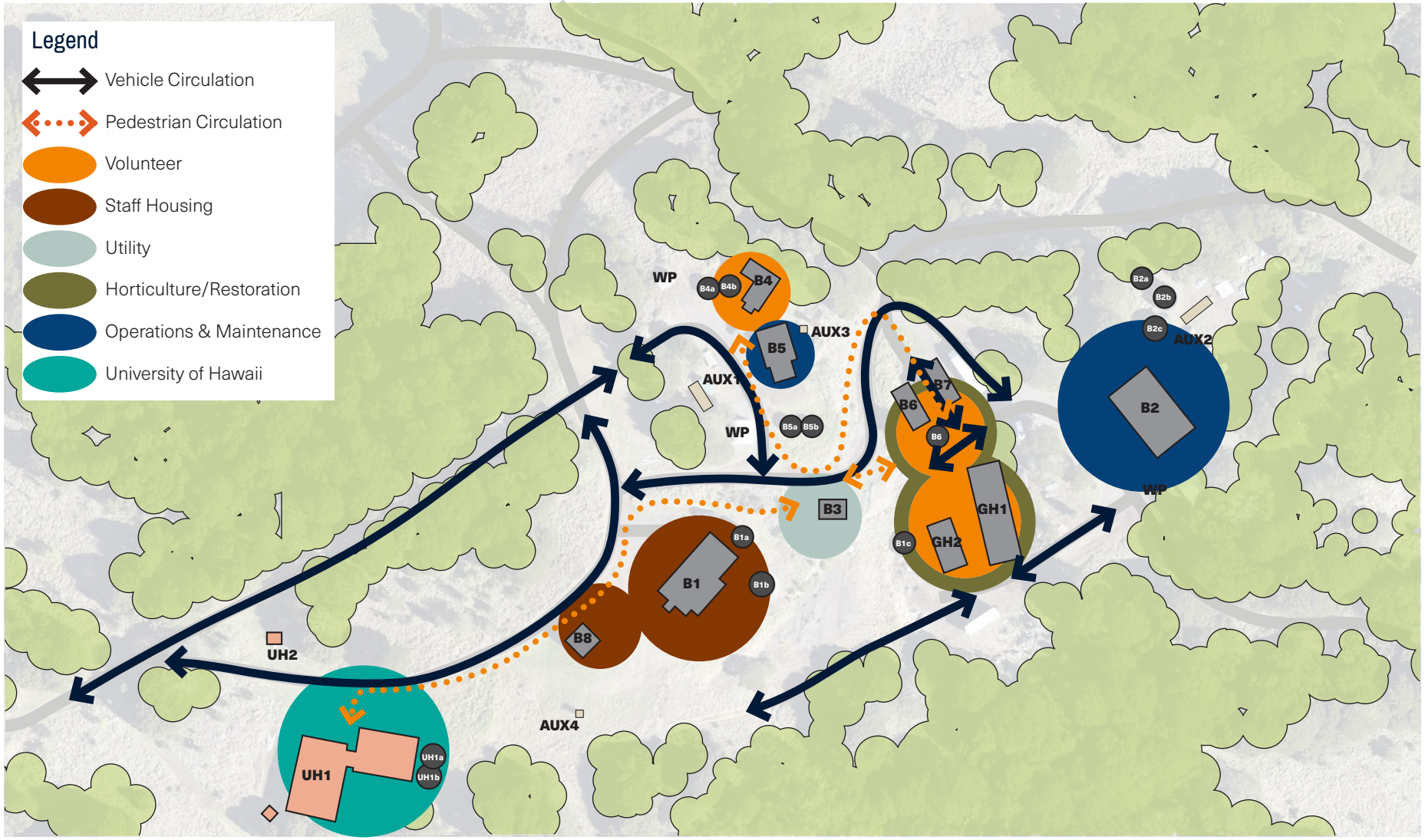
VEHICLES

Vehicle traffic is currently mixed between the user groups, and is generally undifferentiated between gravel driving surfaces and adjacent vegetated surfaces that also are driven or parked on. This undifferentiated use is vehicle-centric and results in a site that has a distinct functional aesthetic.

PEDESTRIAN

With undifferentiated vehicle use, pedestrian routes generally follow vehicle routes, with the exception of short cuts across vegetated areas and eroded 'goat paths' where a route is consistently used, such as the steep path that connects the P-V area to the greenhouses below.

SITE USES AND CIRCULATION



Existing Buildings

AUX1 -Fuel Storage Shelter
AUX2 - Modular Chemical Unit
AUX3,4 - Outhouses
B1 - Staff Residence Bunkhouse
B2 - Maintenance Building
B3 - P-V Power Building
B4 - Volunteer Bunkhouse
B5 - Garage
B6 - Storage Shed
B7 - Dog Kennel
B8 - BRD Cabin
GH1 - Hakalau Rare Plant Greenhouse
GH2 - Hakalau Forest Greenhouse
UH1 - University of Hawaii
UH2 - UofH Generator
WP - Weatherport

EXISTING CONDITIONS

CONDITION ASSESSMENTS

GENERAL

The exhibit to the right provides a conceptual classification of existing structures and their condition. Some facilities are in serviceable condition and can remain in place, but could be relocated or replaced if that would benefit the master plan. Initial master planning indicates that their current locations are appropriate.

Please reference the Site Visit 1 – Field Report for more information on existing structures.

BUILDINGS

Below are narratives for those structures that are at their end of life.

Volunteer Bunkhouse:

The volunteer bunkhouse is at its expected end of life due to condition. A new facility is needed that safely and comfortably provides capacity.

Garage:

The garage is at its expected end of life due to condition, replacement of some of its function with the new maintenance building, and planned new structures rendering its use redundant. It is currently used to support ORV use and house volunteer gear. Its location and use as an operations and maintenance building is also expected to be in conflict with new zoning for the area as volunteer housing: Refuge staff desire separation from other uses in the housing design.

Storage Shed & Dog Kennel:

These structures are at their expected end of life due to condition, obsolescence, replacement of some of their function with the new maintenance building, and that planned new structures would further replace their use.

BRD Cabin

The BRD Cabin is close to its expected end of life due to condition, and redundancy of some of its function with improvements to staff housing. In 2021 the facility was renovated to accommodate four people, providing an extension of life.

UTILITIES

All utilities shown in the exhibits are diagrammatic and based on limited site information.

Electric:

The existing system's 48-volt battery bank failed in November 2020. The lead-acid batteries will be replaced with lithium-ion batteries. The inverters from an older 24-volt system are still on hand, along with an old backup generator, which may be used for an additional system "boost" if needed in the future.

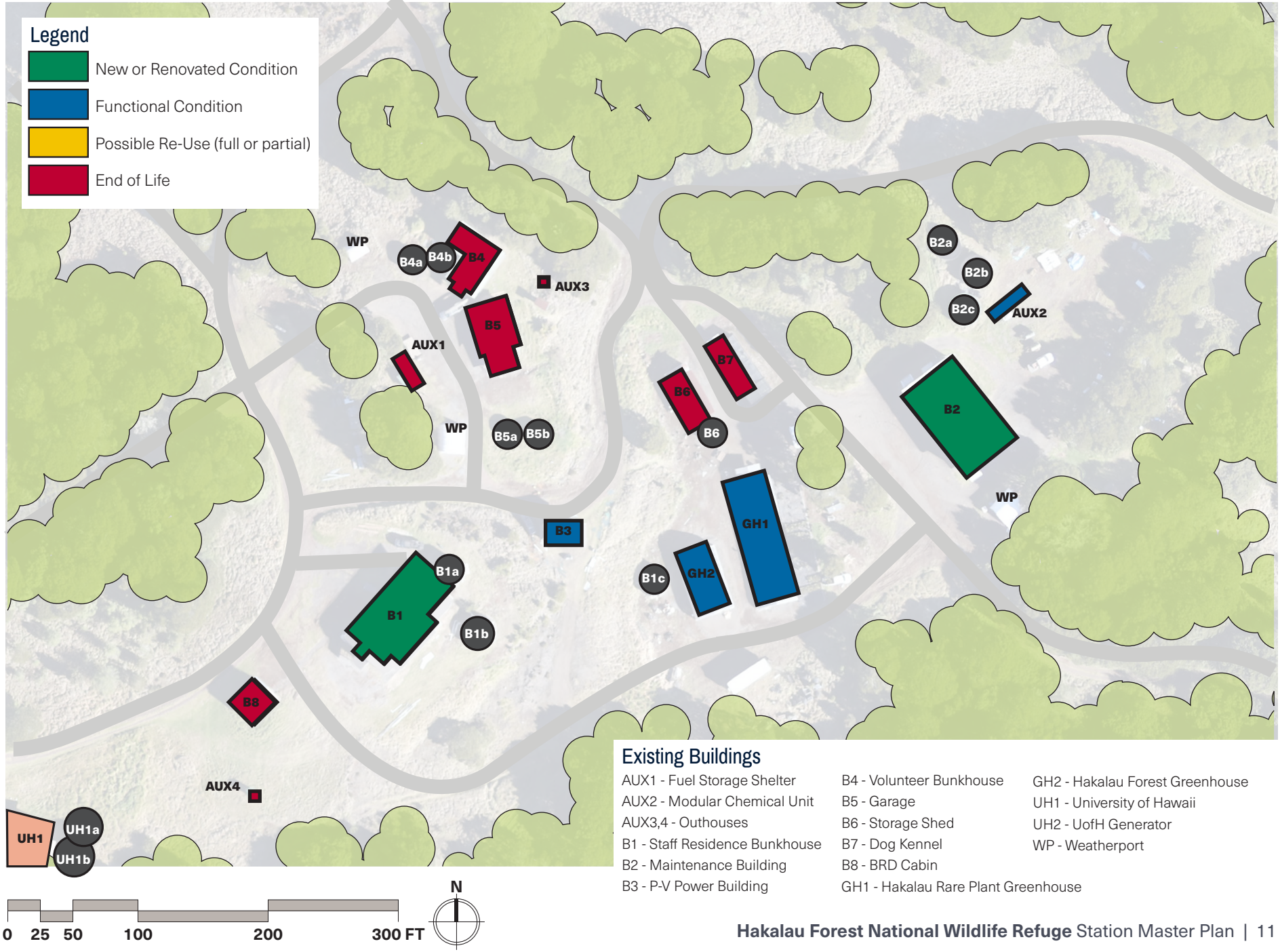
Water:

Refer to the field report for detail on the existing tanks and distribution lines.

Sewer:

The Station's buildings are served by on-site septic tanks and leach fields at the Staff Residence Bunkhouse and BRD Cabin, by a cesspool at the Volunteer Bunkhouse, and by three outhouses at the Volunteer Bunkhouse, BRD Cabin, and University of Hawaii facilities. The EPA requires that cesspools be properly abandoned and replaced with a more appropriate system.

FACILITY CONDITION



Existing Buildings

AUX1 - Fuel Storage Shelter
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AUX3,4 - Outhouses
B1 - Staff Residence Bunkhouse
B2 - Maintenance Building
B3 - P-V Power Building
B4 - Volunteer Bunkhouse
B5 - Garage
B6 - Storage Shed
B7 - Dog Kennel
B8 - BRD Cabin
GH1 - Hakalau Rare Plant Greenhouse
GH2 - Hakalau Forest Greenhouse
UH1 - University of Hawaii
UH2 - UofH Generator
WP - Weatherport

EXISTING CONDITIONS

NOTABLE ISSUES

1 - University of Hawai'i Generator (UH2)

The UofH generator shed is highly visible along the gateway route. As possible in the future, this functional structure should be relocated out of this aesthetic corridor.

2 - University of Hawai'i Outhouse

This outhouse should be removed and decommissioned.

3 - BRD Cabin (B8)

The BRD Cabin is at its expected end of life.

4 - BRD Cabin Outhouse (AUX4)

This outhouse should be removed and decommissioned.

5 - Volunteer Bunkhouse (B4) and Garage Area (B5) Erosion and Flooding

The access road to this area is steeper and prone to erosion. Grading in and above channels significant amounts of water into it. The area does not have positive drainage, and with enough precipitation, water backs up against and into the garage.

6 - Volunteer Bunkhouse (B4)

The Volunteer Bunkhouse is at its expected end of life. The adjacent cesspool would be included for demolition.

7 - Volunteer Bunkhouse Outhouse (AUX3) & Cesspool

This outhouse, and the cesspool adjacent to it in the northwest, should be removed and decommissioned.

8 - Volunteer Bunkhouse Weatherport (WP)

This weatherport is used for extra volunteer housing capacity, and should be removed when a new volunteer facility is built.

9 - Garage (B5)

The Garage is at its expected end of life.

10 - Fuel Storage Shelter (AUX1)

This structure should be removed when its use is integrated into the Operations Yard.

11 - Garage Area Weather-port (WP)

This structure should be removed when its use is integrated into the Operations Yard.

12 - P-V Power Building Road Erosion

The road in front of the P-V Building experiences recurring erosion. This access should be eliminated, or the area should be regraded and the road should hardened to eliminate erosion.

13 - Storage Shed (B6) & Dog Kennel (B7)

These structures should be removed and their desired uses integrated into a replacement horticulture and restoration-focused building.

14 - Maintenance Building Water Supply

The supply lines that connect to the three water storage tanks are not buried sufficiently below the adjacent access road. These expose them to possible damage. This issue should be eliminated through water line modifications or traffic rerouting to avoid this corner.

15 - Operations Yard

To protect and maintain equipment in a marine environment with high rainfall, equipment should be stored under cover. The Operations Yard should be provided with covered vehicle storage sufficient to meet needs, or to the extent that the area can spatially accommodate necessary structures. Facilities for fuels and chemicals are not centrally located, and should be integrated with the yard. The yard should also better accommodate vehicle access, turnaround, and maintenance and operation activities.

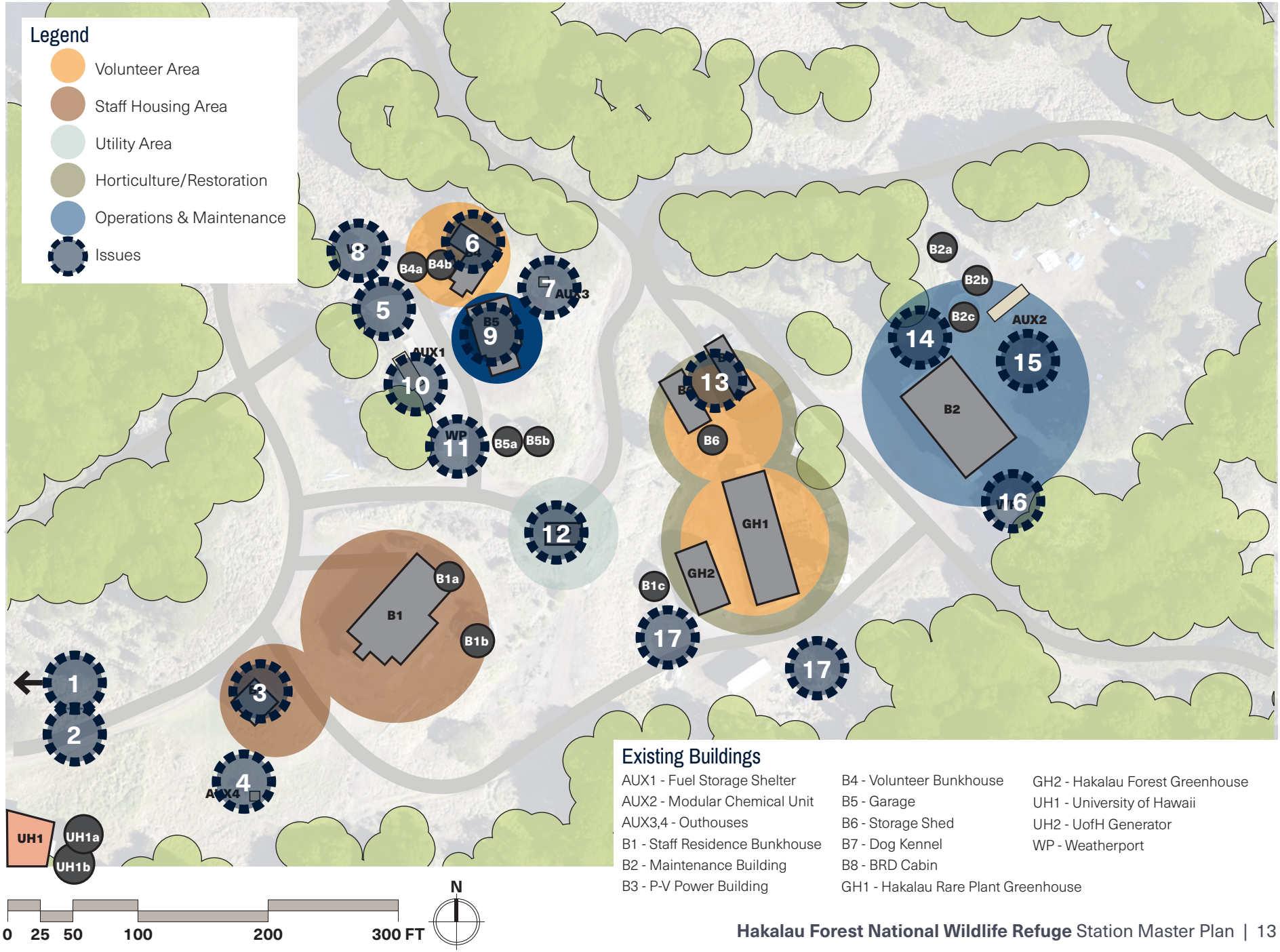
16 - Operations Yard Weatherport (WP)

This structure should be removed when its use is integrated into the Operations Yard.

17 - Debris Areas

There are several easily visible areas of debris within the Station. These are currently being cleaned up and removed. Waste should be appropriately removed from the Refuge with a process in place to address waste and debris in a timely fashion. If needed, this should include a temporary storage and sorting area that is out of view or appropriately screened.

NOTABLE ISSUES



Existing Buildings

AUX1 - Fuel Storage Shelter
AUX2 - Modular Chemical Unit
AUX3,4 - Outhouses
B1 - Staff Residence Bunkhouse
B2 - Maintenance Building
B3 - P-V Power Building
B4 - Volunteer Bunkhouse
B5 - Garage
B6 - Storage Shed
B7 - Dog Kennel
B8 - BRD Cabin
GH1 - Hakalau Rare Plant Greenhouse
GH2 - Hakalau Forest Greenhouse
UH1 - University of Hawaii
UH2 - UofH Generator
WP - Weatherport

3

MASTER PLANNING

MASTER PLANNING

PROGRAMMING

MISSION

Operations and Maintenance

The Station's key role is to support Refuge restoration and maintenance. Facilities should be well-planned, well-designed, and well-constructed to support such operations and maintenance.

Volunteers

The mission of the US Fish and Wildlife Service is to "conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people." Hakalau volunteers are integral to fulfilling this mission.

The volunteer experience at Hakalau must be enhanced to better recognize and show appreciation towards Refuge volunteers. This can be done by improving walking trail systems throughout the forest for volunteer enjoyment, and by implementing changes to the Station. These changes should include thoughtful design of the Volunteer Bunkhouse, as well as development of a revegetation demonstration area at the greenhouses to feature native species planted at the Refuge for habitat restoration.

PROGRAMMING

Square Footage Balancing

The USFWS requires their facilities have net-zero square footage: phasing must recognize and accommodate this need. The removal of existing facilities may repurpose their square footage for new facilities.

Programming

The programming and facility specifics used to develop this Master Plan are conceptual only and will need to be refined for each facility. This will ensure that buildings are properly sized for their expected needs, and include planning for potential future needs and uses.

USERS AND STATION ZONING

Station Gateway and Entry road:

Site access is shared for all users. The entry experience should be upgraded to become an intentional entry to a nationally significant site. This should include a paved road with a new sign or gateway that makes the entry clear. Whether at Mana Road or at the gateway to the Station, there should be a location for visitor photo opportunities.

Volunteer Zone:

This area should improve aesthetics and special experience. Conceptual guidance is provided within the Design Guideline chapter. Beyond architectural and spatial planning, revegetation in these areas will improve aesthetics, contribute to visitor experience, act as restoration strategy examples, and provide teaching benefit.

Staff Housing Zone:

While this area is for staff, it should be similar in development to the volunteer zone to provide staff with a quality residential experience when staying on-site.

University of Hawaii Zone:

This area is used by the University of Hawaii and outside of the scope of this project.

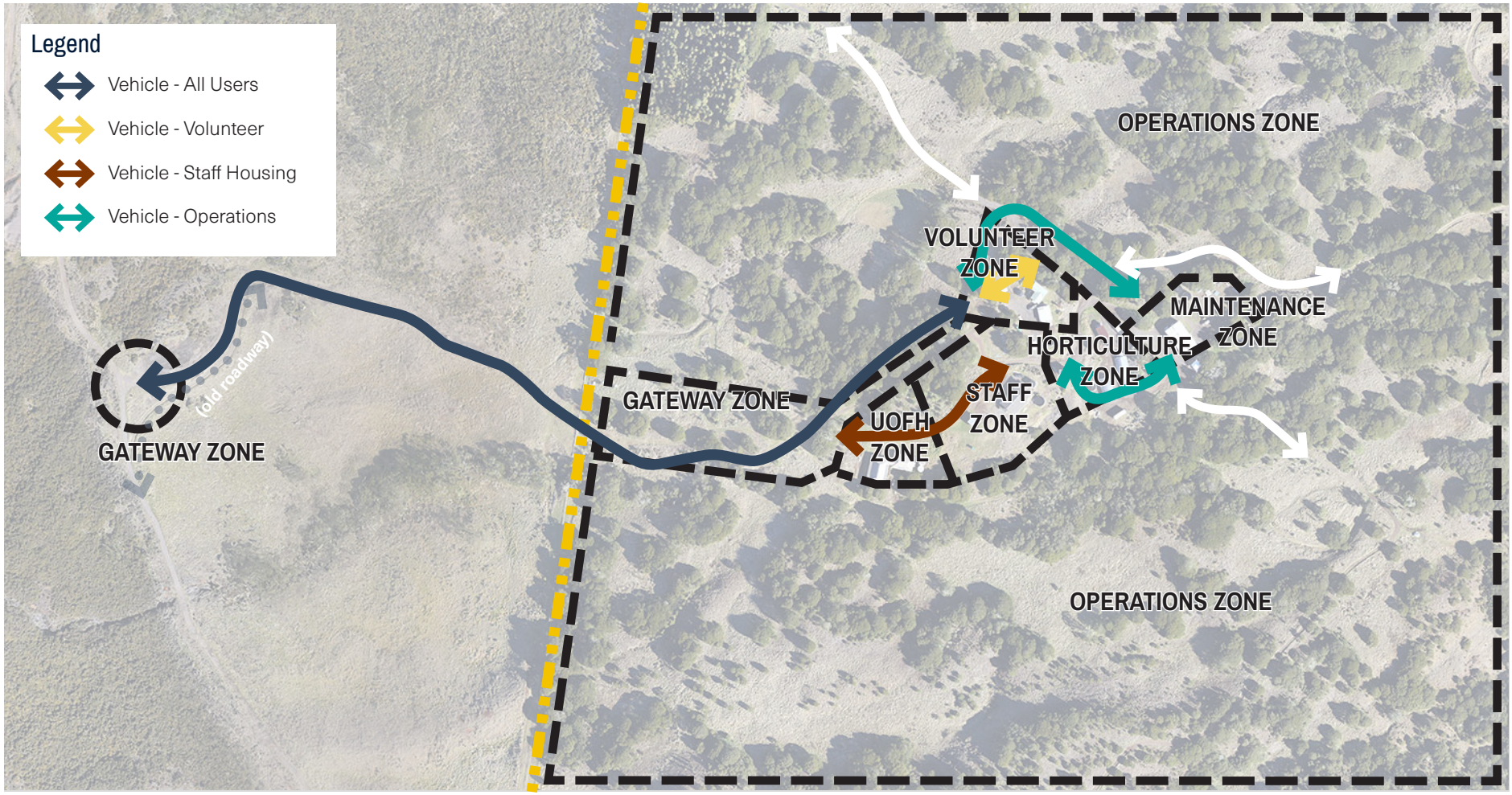
Operations and Maintenance Zone:

These are the functional areas of the Station, and are set beyond any desired screening or restoration focus areas.

Horticulture Zone:

These are the areas that have a direct horticultural use in the propagation of plants, storage of tools and equipment, and preparation for field activities.

SITE ZONING AND CIRCULATION



Volunteer Zone: Housing area separated from other uses, integrated with and connected to Volunteer functions

Staff Housing Zone: Housing area separated from other uses, with varying levels of privacy for staff

Gateway Zone: Focus on aesthetics and ease of access into, and wayfinding within, Station area

University of Hawaii (UofH) Zone: Outside of the scope of this project

Operations/Maintenance/Horticulture Zone: Functional areas optimized for operations and maintenance activities

FACILITIES – GENERAL

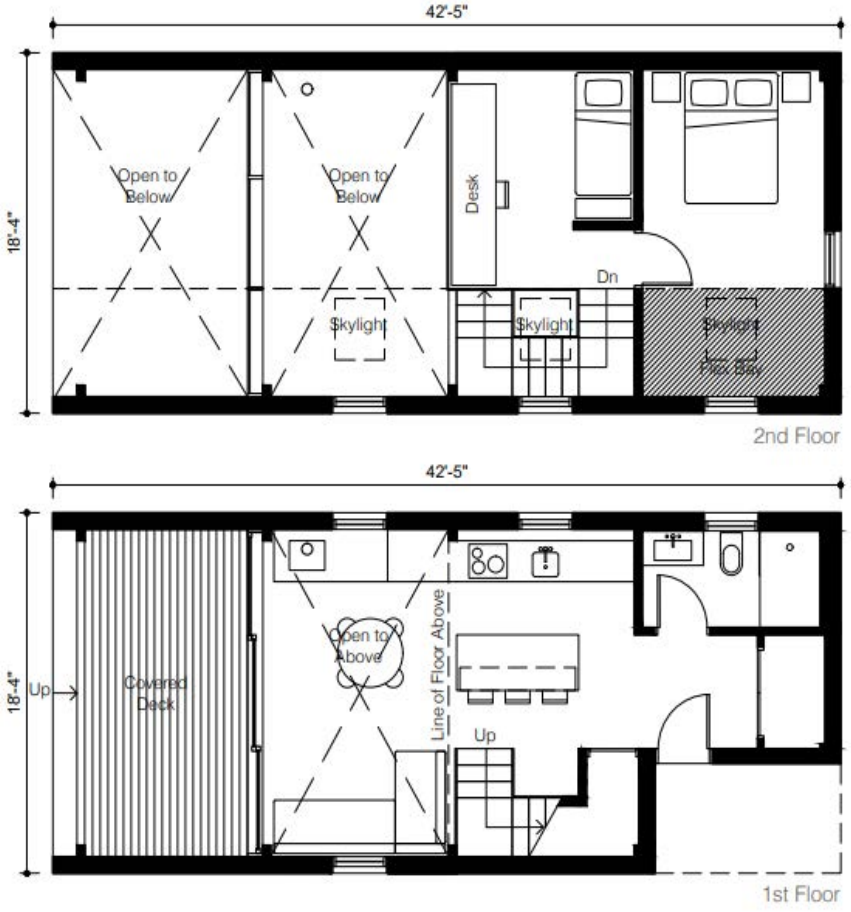
Construction efforts at the Station will be impacted due to its remote location and poor access road conditions. A combination of modular, or pre-manufactured buildings, could benefit the project by reducing the amount of time needed for on-site construction.

Modular construction involves building portions of the buildings (modules) in a shop or construction yard and then transporting the modules to the project site for placement and assembly on a foundation, which could include pier blocks, jacks, or concrete pads. Buildings with simple architectural requirements, such as limited structural returns, or short open spans, are ideal for modular construction. Examples of such buildings at the Station could include the Volunteer Bunkhouse and Caretaker's Residence.

While no modular fabricators currently exist in Hawaii, several contractors on Hawaii do coordinate with fabricators in the contiguous United States and will ship modules for specific projects. The cost of modular building construction and erection would be on the order of 15% less than conventional construction on site. The size of modules that can be brought to the Station will be limited by existing road conditions and alignment. There are many types and styles of modular housing to choose from. An example of a two-story modular layout is shown at right (Backcountry Hut Company).

Another alternative to conventional construction would be pre-fabricated structures that are designed for a purpose and transported to the site for erection and finishes. Such a building type would be suitable for the proposed storage buildings. Pre-fabricated structures can be constructed of timber or steel framework that is designed and fabricated remotely and then erected on a prepared foundation. Exterior siding and interior finishes would also be completed on site. Pre-fabricated concrete panels can also be used to form the outer shell of a structure with the concrete serving as the exterior finish.

Pre-fabricated structures would pose less of a challenge for mobilizing materials to the remote Station site as it is transported in smaller pieces. A prefabricated structure could present savings of approximately 10% over conventional on-site construction.



Sample Modular Housing Unit Floorplan

FACILITIES - NAMING CONVENTION

The names of each building assessed in the Master Plan and their building codes, as noted on figures, are displayed in the following table. The table also summarizes the Master Plan for each structure:

BUILDING DESCRIPTION	BUILDING CODE	MASTER PLAN STATUS
Fuel Storage Shelter	AUX1	Remove
Modular Chemical Unit	AUX2, M	Relocate to Operations Yard
Outhouses	AUX 3,4	Remove
U of H Residence & Research Building	UH1	Retain
U of H Generator	UH2	Retain
Weatherport	WP	Remove
Staff Residence Bunkhouse	B1	Retain
Maintenance Building	B2	Retain
P-V Power Building	B3	Retain
Volunteer Bunkhouse	B4, V	Remove B4, Replace with V
Garage	B5	Remove
Storage Shed	B6	Remove
Dog Kennel	B7	Remove
BRD Cabin	B8	Remove
Hakalau Rare Plan Greenhouse	GH1	Retain
Hakalau Forest Greenhouse	GH2	Retain
Caretaker's Residence (Family Alternative)	C	Proposed
Caretaker's Residence (Non-family Alternative)	C	Proposed
Horticulture Building	H	Proposed
ORV Building	S1	Proposed
Storage Building	S2	Proposed
Fuel Station	F	Proposed
Pole Barn	P	Proposed
Washdown Station	W	Proposed
Fire Cache	FC	Proposed

FACILITIES - HOUSING

Refuge access is strenuous for staff, who might be driving in and out on a regular basis, due to exceptionally poor access road conditions that make for lengthy and unpleasant drives. If access roads are not improved to decrease transit time and to improve safety, it is critical that the Station provides staff housing. If road access is not improved in the future, then the Station should provide additional quarters for some or all staff to permanently reside on-site. This is beyond the specific housing facilities mentioned in this section.

Staff Residence Bunkhouse (existing)

The existing staff housing building is currently undergoing renovation (2020). The structure has six single bedrooms and two double rooms for a total occupancy of ten individuals. The facility includes restrooms, cooking facilities, and a small staff common area. Parking is currently undifferentiated, with a projected typical parking need for six parking spaces, including one ADA-compliant space.

The current facility improvements will include ramp access installation on the southern face of the building, accessible route installation from parking, and expansion of the southern deck for more staff common area.

Master Plan improvements for this facility should include better parking definition. This will consolidate parking and reduce impact to non-parking areas that should be vegetated.

Phasing: There are no significant phasing options for this facility. Parking improvements are not time-critical, nor resource-intensive.

BRD Cabin (existing)

The BRD Cabin is outdated and is expected to be phased out in the long-term Station Master Plan. For the near future it can fill a housing need for Refuge staff or a permanent caretaker.

Phasing: This facility is expected to be demolished.

Caretaker's Residence (proposed)

The Refuge would benefit greatly from an on-site caretaker. The specific requirements for this building would depend on caretaker duties and the facilities and amenities needed to attract the desired person. At a minimum, this should be a separate structure sized and equipped to provide a permanent residence for a single person or couple. There may be benefit in providing full housing for a family (three bedroom).

The type of housing will stem from management decisions. The non-family caretaker alternative may be preferred if the planned management approach includes multi-day shifts of rotating employees. However, a larger, family-style residence should be constructed if the Refuge requires permanent on-site caretaker residence.

If a smaller (non-family) residence is constructed, it could be consolidated within the Staff area as a separate structure. It should give the caretaker privacy and not rely on shared amenities with other buildings. A combination of separation by distance and separation by screening, through a combination of vegetation and possible fencing, should be considered for privacy. Two parking spaces should be provided.

The location of the existing BRD structure could be a potential site, given its proximity to existing utilities. Another option is north of the Staff Residence Bunkhouse and west of the existing Volunteer Bunkhouse, in an area currently used for storage. This area is separated from other site uses, and therefore more private.

If a larger (family) residence is constructed, it should be located farther away in order to provide more privacy for the caretaker and family. A possible location is closer to the gated entry to the site, set back from the road. This will remove it from the main site, and give the caretaker some ability to monitor Refuge access.

Phasing: Phasing for this facility could involve construction of the smaller residence now and construction of the larger residence in the future. The smaller residence could be repurposed for other housing uses. If the BRD site is selected, the BRD cabin would need to be demolished. If the non-BRD site is selected, the BRD cabin could still be used until demolition was desired.

Volunteer Bunkhouse (replacement)

The new volunteer housing would provide safe and comfortable housing and amenities for volunteers. This facility should be attractive to volunteers and create additional incentive for volunteering at the Refuge. It would accommodate 12 to 16 people, with two bunk rooms (four beds each) and two double occupancy rooms. Kitchen and dining facilities should be provided in addition to a common area with seating and good views. Exterior deck space should also be provided. Two restrooms should be provided, with fixtures appropriate to the occupancy (possibly double-stall bathrooms). The structure should include an area for storing and changing into and out of field gear provided to volunteers (a mud room function). Parking for six vehicles should be provided, including one ADA-compliant space.

The surrounding site should also provide room for the addition of a weatherport for temporary volunteer housing as needed.

Phasing: There are no significant phasing options for this facility as it cannot be incrementally constructed. If a site other than the existing location is selected, the existing facility could be used until demolition was desired (after new housing is complete).

MASTER PLANNING

CONCEPTUAL STATION PLAN RENDERING

Existing Buildings to Remain

UH1 - University of Hawaii
UH2 - U of H generator
B1 - Staff Residence Bunkhouse
GH1 - Hakalau Rare Plant Greenhouse
GH2 - Hakalau Forest Greenhouse
B2 - Maintenance Building
B3 - P-V Power Building
B8 - BRD Cabin

Proposed Buildings

C - Caretaker's Residence
F - Fuel Station
FC - Fire Cache
H - Horticulture Building
M - Modular Chemical Unit
P - Pole Barn
S1 - ORV Building
S2 - Storage
V - Volunteer Bunkhouse
W - Washdown Station

FACILITIES - HORTICULTURE

Greenhouses (existing)

The existing greenhouses are functional and are expected to remain in place. They are centrally located, well-positioned to receive proper light for growing operations, accessible from north and south, and conveniently lower in elevation relative to the majority of Refuge water storage tanks. The larger greenhouse should be renovated with a new gravel floor, water distribution system, and new tables.

Phasing: The greenhouses are expected to remain in place. Should their replacement be needed, this zone should be reassessed for greenhouse placement and future growth. The areas around and to the south of the greenhouses should be left undeveloped for possible future use.

Demonstration Forest (proposed)

There is a small vegetated area at the northeast corner of the greenhouses used as a demonstration forest. Expansion is desired to provide educational and training use.

Phasing: This improvement can occur at any time. Better definition of vehicle use areas may provide additional space or better protection.

Storage Shed and Dog Kennel (Existing)

These buildings are at the ends of their lives and will be demolished.

Phasing: These buildings will be removed. Temporary space is needed to replace their function while a new facility is constructed.

Horticulture Building (proposed)

A new horticulture building is proposed to replace the existing storage building and old dog kennels. This building will support the horticulture and restoration activities in the Refuge. This building would include storage for materials and supplies, tools and equipment, and personal protective equipment; secure storage for found plant stock material; and an ATV bay. It will also include a bathroom for staff and volunteer use.

Phasing: This facility is planned to occupy an area of existing buildings. Phasing depends upon temporary relocation of building uses and demolition of the existing structures.

FACILITIES - OPERATIONS & MAINTENANCE

Garage (existing)

The garage has been partially replaced in function by the new Maintenance Building. The building may temporarily serve as a staging area for volunteer workers (current use), ORV support, a fire building to house the Refuge's fire truck (one–ton pickup with utility boxes and water tank) and fire-fighting tools, or be removed to accommodate the new Volunteer Bunkhouse. The building's concrete pad floor has warrant for inclusion in the Master Plan. One concern if this structure remains a functioning part of the Refuge is addressing localized flooding that occurs in front of the structure. Undesirable grades route water toward the garage doors.

Phasing: The future of this facility depends upon whether it provides any benefit for the development of Volunteer Bunkhouse. It is likely that it should be removed to construct a new volunteer-focused zone.

P-V Power Building (existing)

The P-V Power Building is the core facility to the Station's centralized electric system. It is in relatively good condition and could remain in place and service the Station moving forward with some minor upgrades and improvements, such as re-siding with metal siding, replacing the gangway, and including an adequate handrail. Refuge staff were also open to relocating the P-V Power Building if an evaluation determined a better location to service the Station. Vehicle access to the south of the building is necessary for maintenance. However, as power generation options improve, future facilities may be designed to generate some or all of their own power. While a centralized system will likely remain in place, if only for redundancy, decentralized systems may make the current centralized system obsolete.

Phasing: This building is expected to remain in place.

Maintenance Building (existing)

The existing Maintenance Building is a new facility and meets the needs of the Refuge. Vehicles may damage its water lines; they may need replacement. Its adjacent yard is discussed below.

Phasing: This building is expected to remain in place.

Operations Yard (proposed)

The area surrounding the Maintenance Building should be improved for operations and maintenance functions to include:

- Storage Building
- ORV Building
- Fuel Station
- Pole barn (3-sided vehicle and equipment storage)
- Modular Chemical Unit
- Washdown station

Phasing: Phasing depends upon construction for multi-use facilities in this area, but is otherwise flexible since it is open and non-programmed.

Fire Cache (proposed)

Fire response on the Refuge will benefit from a Fire Cache building. This building would contain supplies and tools for fire response, including a response vehicle (1-ton pickup with tool boxes and a large water tank). This building is expected to be approximately 1000 SF, including one vehicle bay and adjacent equipment storage and preparation area.

Phasing: Phasing is flexible because this is a new facility planned for integration within the Maintenance Building area.

UTILITIES - WATER

Water system improvements to the Station will optimize and centralize water storage, maximize storage at higher elevations on the site to reduce the need for pumping, and develop a new network of distribution piping. Storage tanks will be placed adjacent to buildings to collect rainfall runoff from the roof area. A combination of centralized storage, making use of higher topography and larger roof areas, and smaller building-specific storage should be considered for redundancy. Storage volumes must be considered for each facility, as well as water treatment for buildings requiring potable water. Buildings needing new potable water service include the Staff Residence Bunkhouse, the Volunteer Bunkhouse, the Caretaker's Residence, the Horticulture Building, and the Maintenance Building. Water in the centralized tanks should be chlorinated. Individual treatment systems and pressure tanks should be located at each of the buildings requiring potable water.

Staff Residence Bunkhouse

The Staff Residence Bunkhouse will house a maximum of ten people. Potable water storage should be constructed adjacent to the building. Potable water treatment would require a UV treatment system, sediment filter, and carbon filter.

BRD Cabin

Though it will eventually be phased out, the BRD Cabin can house up to four residents. Potable water treatment would require a UV treatment system, sediment filter, and a carbon filter.

Volunteer Bunkhouse

The Volunteer Bunkhouse will have a maximum occupancy of sixteen residents or visitors. A more centralized water storage system, and placement of the storage at a higher elevation, could allow the Volunteer Bunkhouse and the Caretaker's Residence to share use. Potable water treatment for this facility would consist of two UV treatment devices, two sediment filters, and two carbon filters.

Caretaker's Residence

The Caretaker's Residence will have a maximum occupancy of four residents. Potable water treatment would require a UV treatment system, sediment filter, and a carbon filter.

Horticulture Building

Potable water is desired in the Horticulture Building's bathroom. Treatment could consist of a UV treatment system, sediment filter, and carbon filter, or an under-sink reverse osmosis system specific to the bathroom sink.

Maintenance Building

The existing Maintenance Building currently has a water treatment system of chlorination, sediment filter, UV, and activated charcoal. However, the UV system has not worked reliably. The treatment system should be assessed and replaced if necessary.

Water Storage Tanks

Roof-captured rainfall will be collected and stored in tanks adjacent to buildings. Some existing tanks may be reused or relocated for use elsewhere at the Station. A summary of the Master Plan for the existing and new storage tanks is provided in the table at left.

Phasing: While a full renovation or replacement of the water system would be ideal, incremental development is possible. Water line installation may interfere with other projects, so coordination is needed. At a minimum, conduit sleeves should be placed below ground at select locations for future water system expansion and modification.

Water storage tanks can be installed in phases as new buildings are constructed. Constructing the storage tanks and distribution piping at the U of H building could maximize the available roof-captured rain volume, the higher topography to reduce need for pumping, and the distribution potential to various buildings.

Water treatment systems may be located in the new buildings or built into auxiliary pump houses that serve each building. In addition to outdoor storage tanks and individual treatment systems at each facility, pressure tanks must also be installed in conjunction with treatment systems.

TANK NUMBER	TANK CAPACITY	PROPOSED BUILDING ROOF SOURCE	MASTER PLAN STATUS
B1a	18,600 gal	Staff Residence Bunkhouse	Retain
B1b	21,000 gal	Caretaker's Residence (non-family)	Relocate from Staff Residence Bunkhouse
New	21,000 gal	Caretaker's Residence (non-family)	Proposed
New	21,000 gal	Caretaker's Residence (non-family)	Proposed
B1c	18,500 gal	Fire Cache	Relocate from Staff Residence Bunkhouse
B2a	15,600 gal	Washdown Station	Relocate within Operations Yard
B2b	21,000 gal	Pole Barn	Relocate within Operations Yard
B2c	20,400 gal	Pole Barn	Relocate within Operations Yard
B4a	8,200 gal	-	Remove
B4b	8,200 gal	-	Remove
B5a	8,200 gal	-	Remove
B5b	8,200 gal	-	Remove
B6	6,700 gal	-	Remove
UH1a	12,800 gal	U of H	Retain
UH1b	12,800 gal	U of H	Retain
New	21,000 gal	U of H	Proposed
New	21,000 gal	U of H	Proposed
New	21,000 gal	U of H	Proposed
New	21,000 gal	U of H	Proposed
New	21,000 gal	U of H	Proposed
New	21,000 gal	Caretaker's Residence (family)	Proposed
Fuel Station		F	Proposed
Pole Barn		P	Proposed
Washdown Station		W	Proposed
Fire Cache		FC	Proposed

UTILITIES – ELECTRICAL

The goal of electrical system improvements is to optimize the photo-voltaic system for power storage, stability, and output while providing adequate redundancy. The P-V system will generate electricity during the day to power the various building loads, with surplus energy exported to the battery bank for storage. The existing standby generator can provide additional power and provide power when the P-V system is offline in overcast conditions, or in the chance the system fails. Minor improvements to the P-V Power Building and existing distribution system would maintain the current centralized system.

Building or area-specific systems should also be considered with any facility improvements. A decentralized system with multiple P-V arrays, battery banks, and generators provides greater resiliency if one system fails. Each standalone system would consist of roof-mounted solar panels, a solar inverter, and a battery located on the exterior of the building or in an electrical closet. Housing should be designed with more battery storage than non-housing buildings for greater morning and evening electrical demand, because the solar supply at these times requires more battery storage.

Standalone P-V systems would be installed on each building within the Station except for the Operations Yard and greenhouses. This is an ideal layout for a decentralized system. A centralized system could be installed in the Operations Yard, with the Pole Barn or Maintenance Building acting as the central hub with roof-mounted solar panels. Likewise, a system could be mounted on the Horticulture Building for the Horticulture Zone, feeding the Horticulture Building and the two greenhouses.

Phasing: Incremental development of the electrical system is possible, and the existing centralized system can remain in place until standalone systems are developed at each building. It may also remain as a backup indefinitely. Panel arrays will be primarily installed on rooftops. Phasing and planning for the decentralized systems on new buildings can be completed during building construction. Non-rooftop arrays may be installed in open areas throughout the Station as well as off-site on the greater Refuge. Installation of buried electrical lines and conduit should be coordinated with projects, such as road construction, to minimize disturbance.

UTILITIES – SEWER

Sewer system improvements will consist of septic tanks with leach fields. Existing septic systems, such as at the Staff Residence Building and UofH facility, will be assessed to determine if additional improvements or expansion is required. The State of Hawaii, under Act 125, has mandated that all cesspools be replaced by septic or sewer by 2050. New septic systems will be installed for buildings currently serviced by outhouses or cesspools. New septic systems should be installed at the Volunteer Bunkhouse, Horticulture Building, and the Caretaker's Residence. Depending on the selected location of the Caretaker's Residence, an individual septic system may be required to serve the building or the building may share the septic system with the Staff Residence Bunkhouse.

Phasing: Construction of new septic systems should coincide with construction of the new buildings. Leach field locations should be kept in mind for phasing of other infrastructure and for revegetation planning.

ROADWAY - INTERIOR

A revised roadway system is proposed to minimize vehicle-pedestrian conflicts, limit vehicular travel along roadways to similar uses, reduce maintenance costs, reduce the potential for erosion, and provide access to proposed facilities.

Phasing: Road system re-routing should be completed following or concurrent with utility installations. Work could be independent of construction of proposed facilities.

ROADWAY - GATEWAY

A new entry road and gateway would primarily improve the Station's and make it readily recognizable as a nationally significant facility. At a minimum this would include the development of higher quality signage at Mana Road, road paving, and potential road realignment to address steep grades and provide a better driving experience.

Phasing: A new entry road and gateway would need to be coordinated to allow Station access during construction.

HABITAT

While the Station has a focus on function, it also provides housing and volunteer experience. With better differentiation of volunteer and housing zones, some focus should be given to improving the area's aesthetics. Beyond better definition of vehicular and pedestrian spaces and providing user amenities, a focus on habitat restoration in the area would improve aesthetics. Revegetation will also assist in the separating and buffering different areas from one another.

Areas designated for revegetation should be carefully planned to avoid potential conflict with utilities. Utility alignments will require maintenance and replacement, so they should be kept free of vegetation other than that which is easily disturbed for excavation or other activities.

Areas for revegetation should also be planned to allow for future new buildings, expansions, or outdoor use areas.

The Refuge's mission is centered on habitat restoration and revegetation, it is best to avoid or minimize impact to restored areas. Replanting is a special activity for volunteers, and there will be emotional connection to the plants and areas that they have worked on. Non-protected trees and vegetation could be removed in the future.

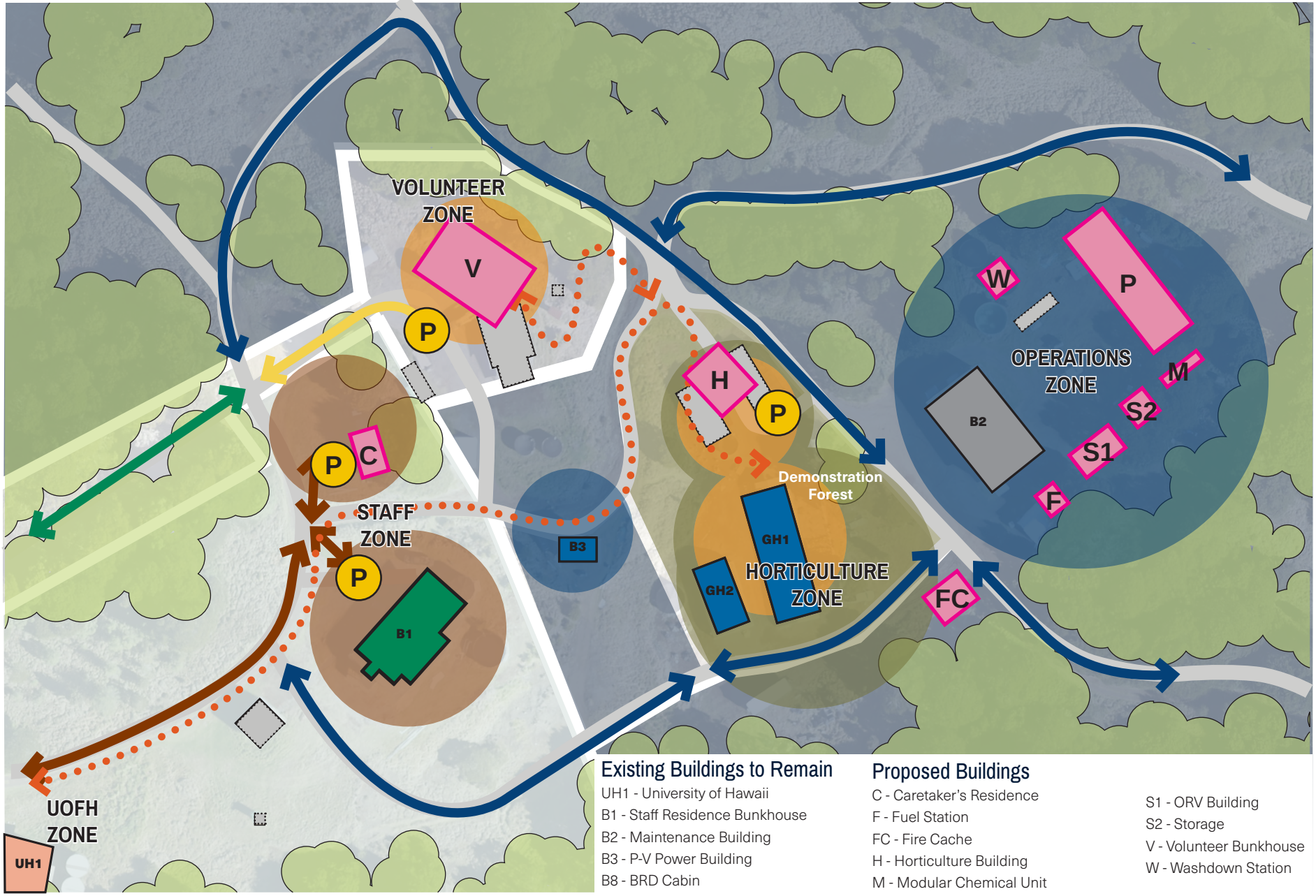
Protected species should be used within the Station only in areas that will never be disturbed.

Phasing: Vegetation for current needs can be planted any time. Planting for future needs is also recommended, but only with certainty of future conditions to eliminate or, if acceptable, reduce the possibility of improper placement for future development.

NON-STATION FACILITIES

This Master Plan focuses on the main Station area. Off-site facility improvements within the Refuge will include greater development for visitor services and experiences in the Pua Akala Barn and Pua Akala Cabin areas.

CONCEPTUAL MASTER PLAN - SITE PLAN OVERLAY



Existing Buildings to Remain

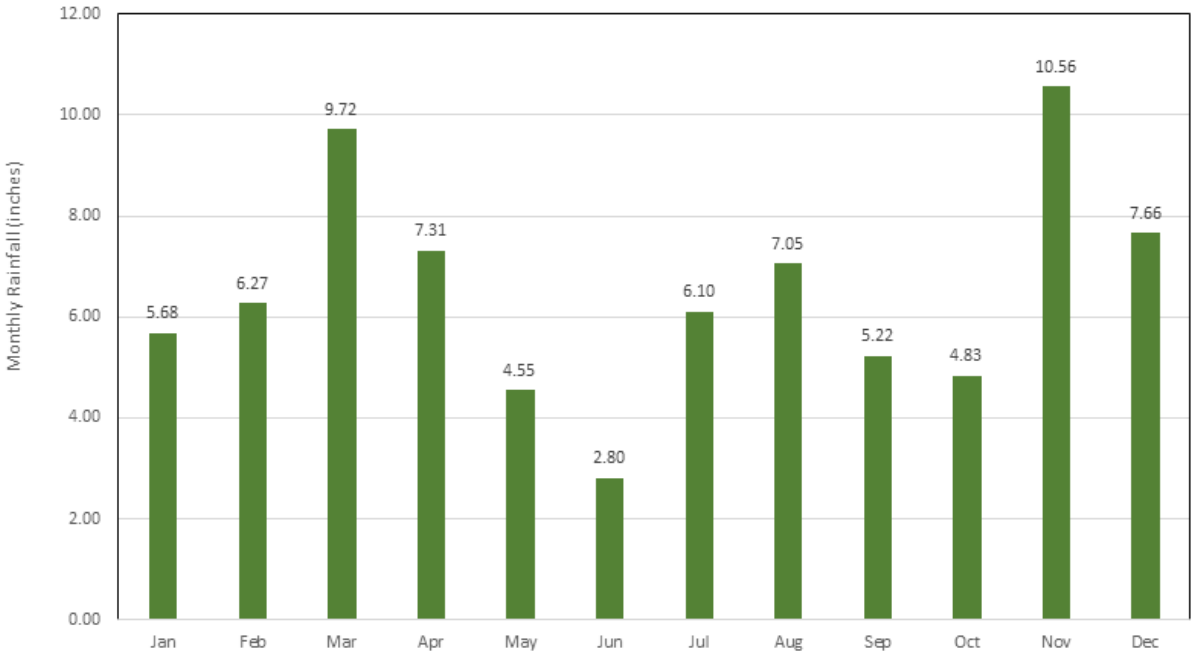
UH1 - University of Hawaii
B1 - Staff Residence Bunkhouse
B2 - Maintenance Building
B3 - P-V Power Building
B8 - BRD Cabin
GH1 - Hakalau Rare Plant Greenhouse
GH2 - Hakalau Forest Greenhouse

Proposed Buildings

C - Caretaker's Residence
F - Fuel Station
FC - Fire Cache
H - Horticulture Building
M - Modular Chemical Unit
P - Pole Barn
S1 - ORV Building
S2 - Storage
V - Volunteer Bunkhouse
W - Washdown Station

WATER SYSTEM ASSESSMENT

Annual Precipitation - Hakalau Station (129)



ANNUAL RAINFALL

- Min: 37.16 in
- Average: 73.74 in
- Maximum: 95.98 in

NOTES:

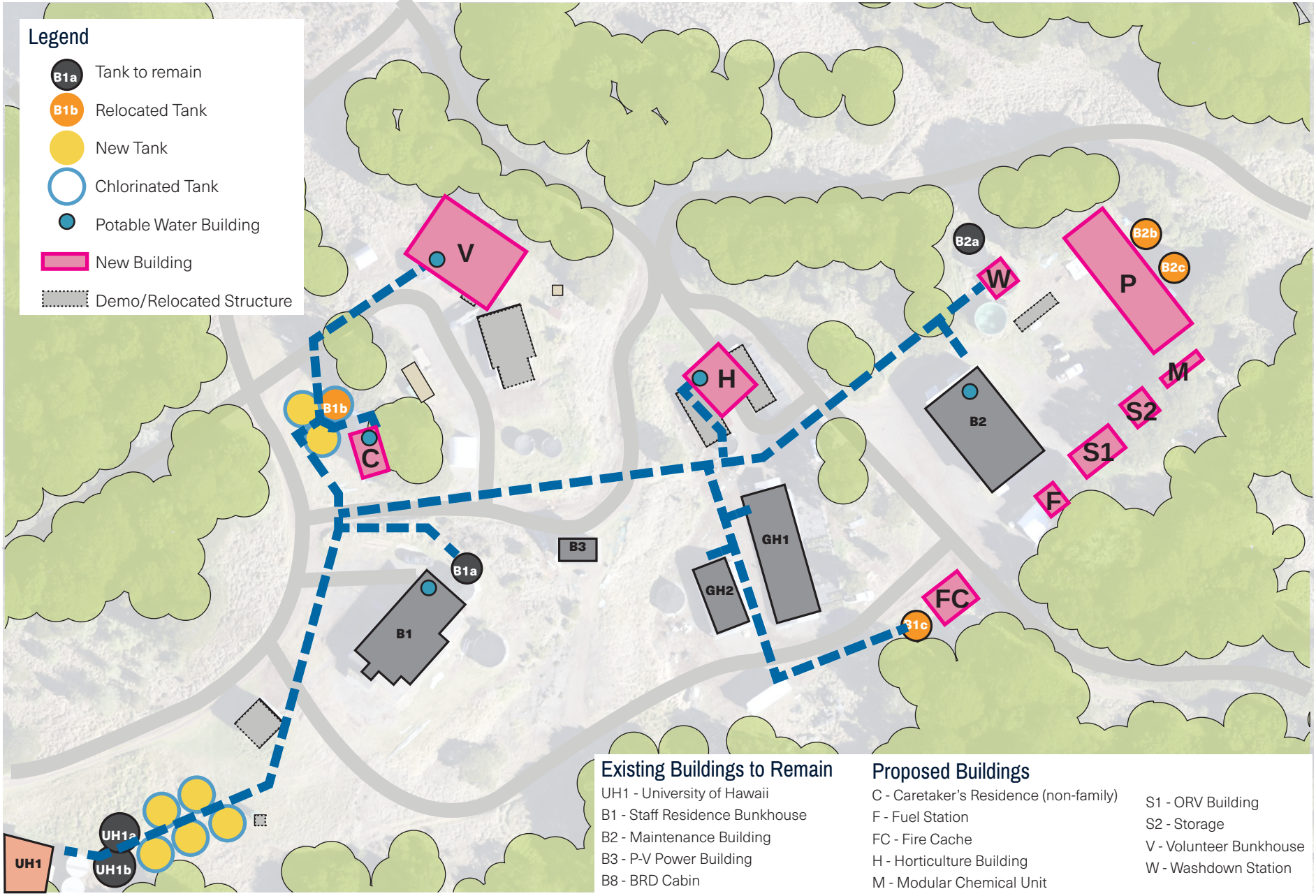
1. Rainfall data from Hakalau Weather Station (SKN 129); data record: 18 years (min/max 9 years) 2003-present, from Online Rainfall Atlas of Hawai'i: http://rainfall.geography.hawaii.edu/interactivemap.html

2. Roof-captured rain volume is calculated based on rainfall data, roof area, and a 75% scale factor to account for evaporation, routing losses, and uncaptured roof lines.

3. Proposed tanks increase existing capacity by over 40%.

BUILDING NAME	ROOF-CAPTURED RAIN VOLUME (GAL)			PROPOSED TANK CAPACITY (GAL)	NOTES
	Minimum	Average	Maximum		
UNIVERSITY OF HAWAII	110,000	230,000	280,000	130,600	Use existing 2 tanks + 5 (21k gal) new
STAFF RESIDENCE BUNKHOUSE	60,000	130,000	160,000	18,500	Salvage T-B1a; remains in place
VOLUNTEER BUNKHOUSE	20,000	40,000	50,000	-	Shared storage from Caretaker Facility (Non-Family)
CARETAKER'S RESIDENCE (NON-FAMILY)	20,000	50,000	70,000	63,000	Relocate T-B1b + 2 (21k gal) new tanks
CARETAKER'S RESIDENCE (FAMILY)	30,000	60,000	80,000	21,000	New tank (local storage only)
POLE BARN	70,000	150,000	190,000	40,800	Relocate T-B2b and T-B2c for use
WASHDOWN STATION	0	10,000	20,000	15,600	Relocate T-B2a for use
FIRE CACHE	10,000	30,000	40,000	18,500	Relocate T-B1c for use

CONCEPTUAL MASTER PLAN - WATER SYSTEM OVERLAY



Existing Buildings to Remain

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B3 - P-V Power Building
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GH2 - Hakalau Forest Greenhouse

Proposed Buildings

C - Caretaker's Residence (non-family)
F - Fuel Station
FC - Fire Cache
H - Horticulture Building
M - Modular Chemical Unit
P - Pole Barn
S1 - ORV Building
S2 - Storage
V - Volunteer Bunkhouse
W - Washdown Station

ELECTRIC SYSTEM ASSESSMENT

BUILDING NAME	USAGE ASSUMPTIONS	RECOMMENDED SOLAR P-V SYSTEMS BASED ON USAGE & SIZE			
		Qty of Solar Panels	System Size (KW)	Estimated (KWh) Of Energy Produced Per Month	Battery Size (KWh)
STAFF RESIDENCE BUNKHOUSE	Housing: 10; heavy morning and evening usage requiring larger battery	100	38.0	3750	80
VOLUNTEER BUNKHOUSE	Housing: 16	40	15.2	1500	36
CARETAKER'S RESIDENCE (NON-FAMILY)	Housing: 2	16	6.1	600	15
CARETAKER'S RESIDENCE (FAMILY)	Housing: 4	22	8.4	825	18
HORTICULTURE	Non-housing; primarily daytime use	20	7.6	750	10
FIRE CACHE	Non-housing	12	4.6	450	9
OPERATIONS ZONE	Non-housing; primarily daytime use	120	45.6	4500	60

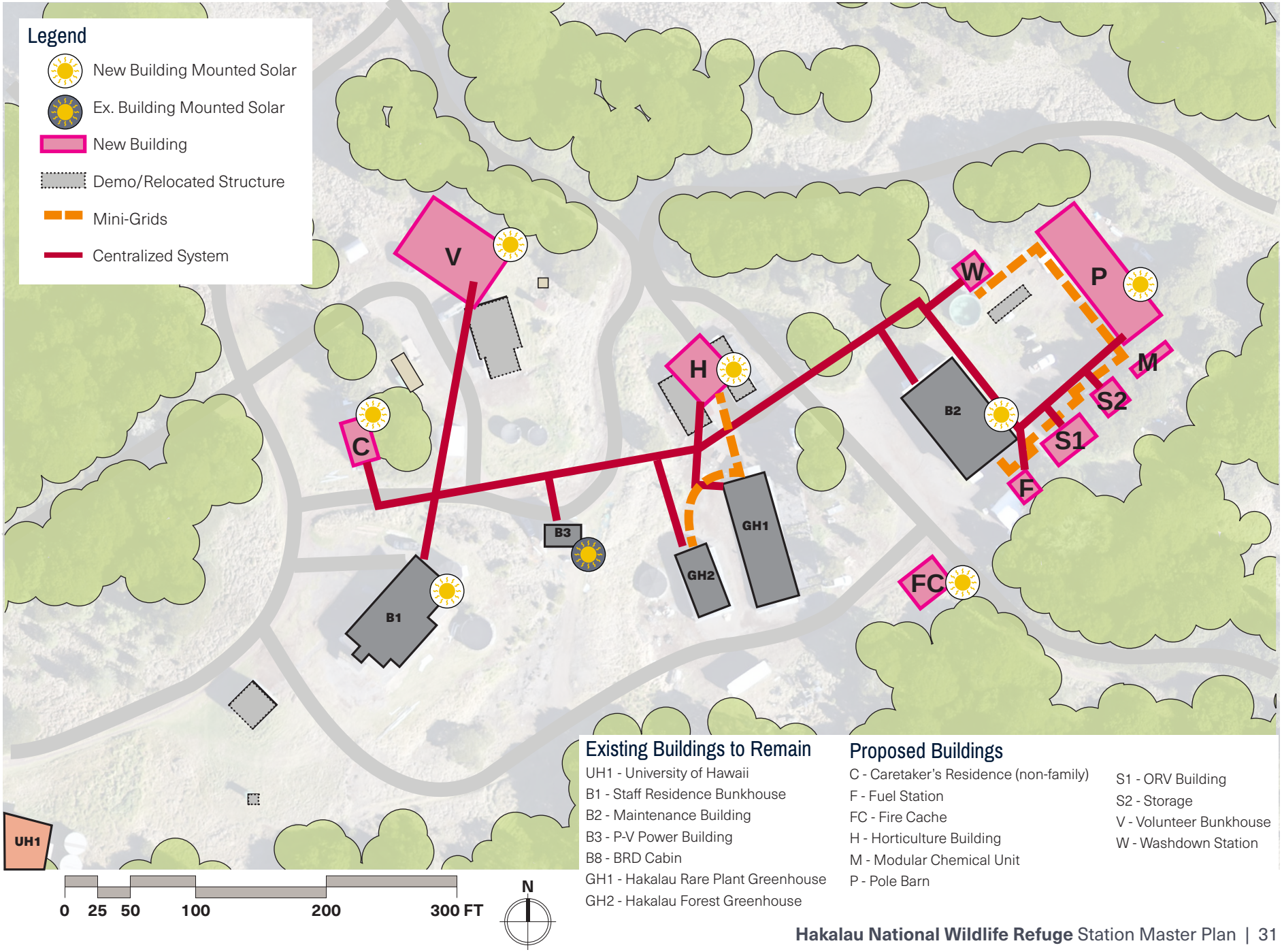
NOTES:

1. All buildings installed as a decentralized P-V system, other than those in the Operations Zone.

2. Decentralized P-V systems will consist of P-V panels on roof with solar inverter and batteries in an electrical closet.

3. Centralized P-V system in the Operations Zone will consist of the system located on the Pole Barn. The system feeds entire zone through series of trenches.

CONCEPTUAL MASTER PLAN - ELECTRIC SYSTEM OVERLAY



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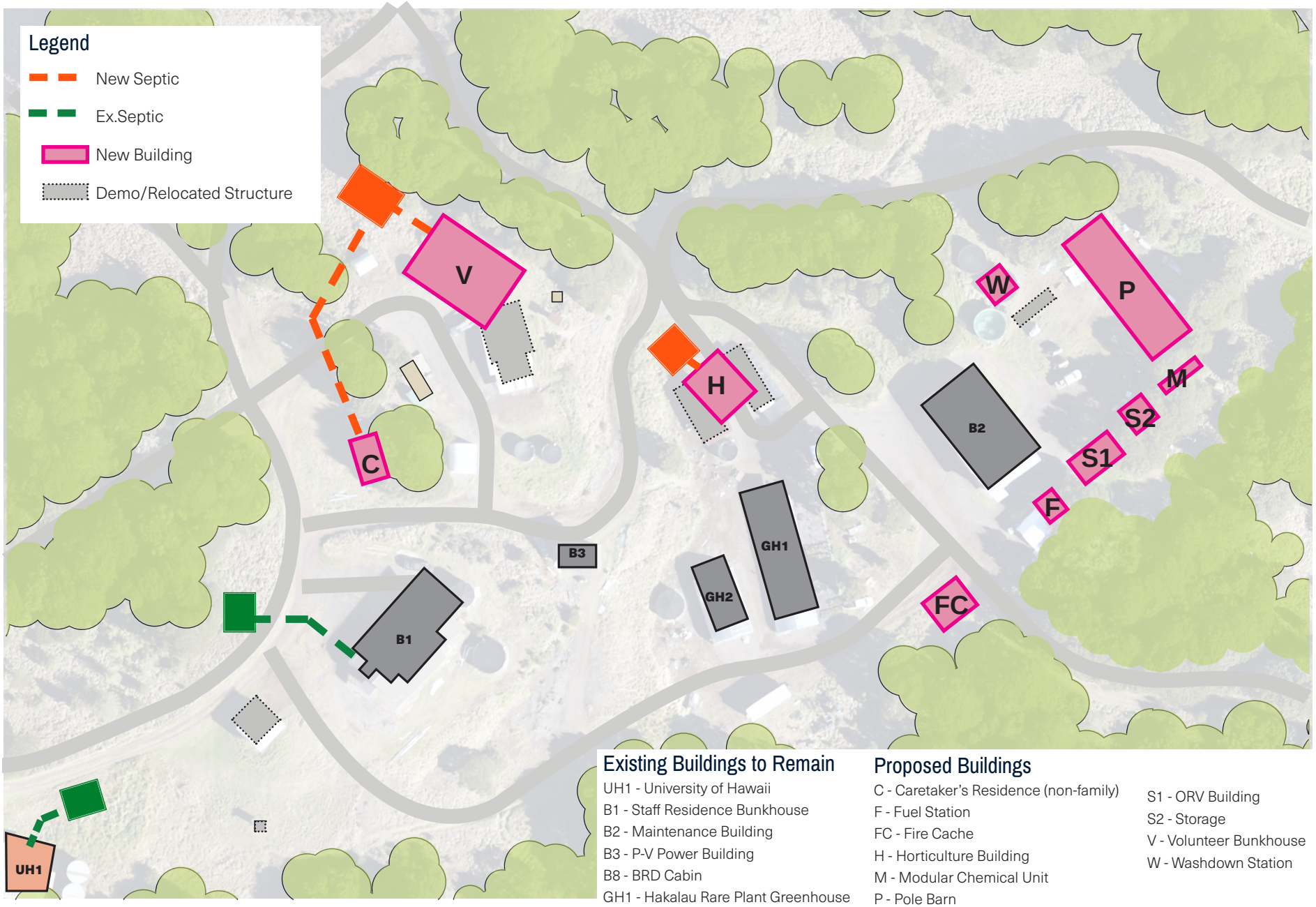
Proposed Buildings

C - Caretaker's Residence (non-family)
F - Fuel Station
FC - Fire Cache
H - Horticulture Building
M - Modular Chemical Unit
P - Pole Barn
S1 - ORV Building
S2 - Storage
V - Volunteer Bunkhouse
W - Washdown Station

CONCEPTUAL MASTER PLAN - SEWER SYSTEM OVERLAY



Existing Buildings to Remain

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B3 - P-V Power Building
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GH2 - Hakalau Forest Greenhouse

Proposed Buildings

C - Caretaker's Residence (non-family)
F - Fuel Station
FC - Fire Cache
H - Horticulture Building
M - Modular Chemical Unit
P - Pole Barn
S1 - ORV Building
S2 - Storage
V - Volunteer Bunkhouse
W - Washdown Station

MASTER PLANNING

SQUARE FOOTAGE BALANCING

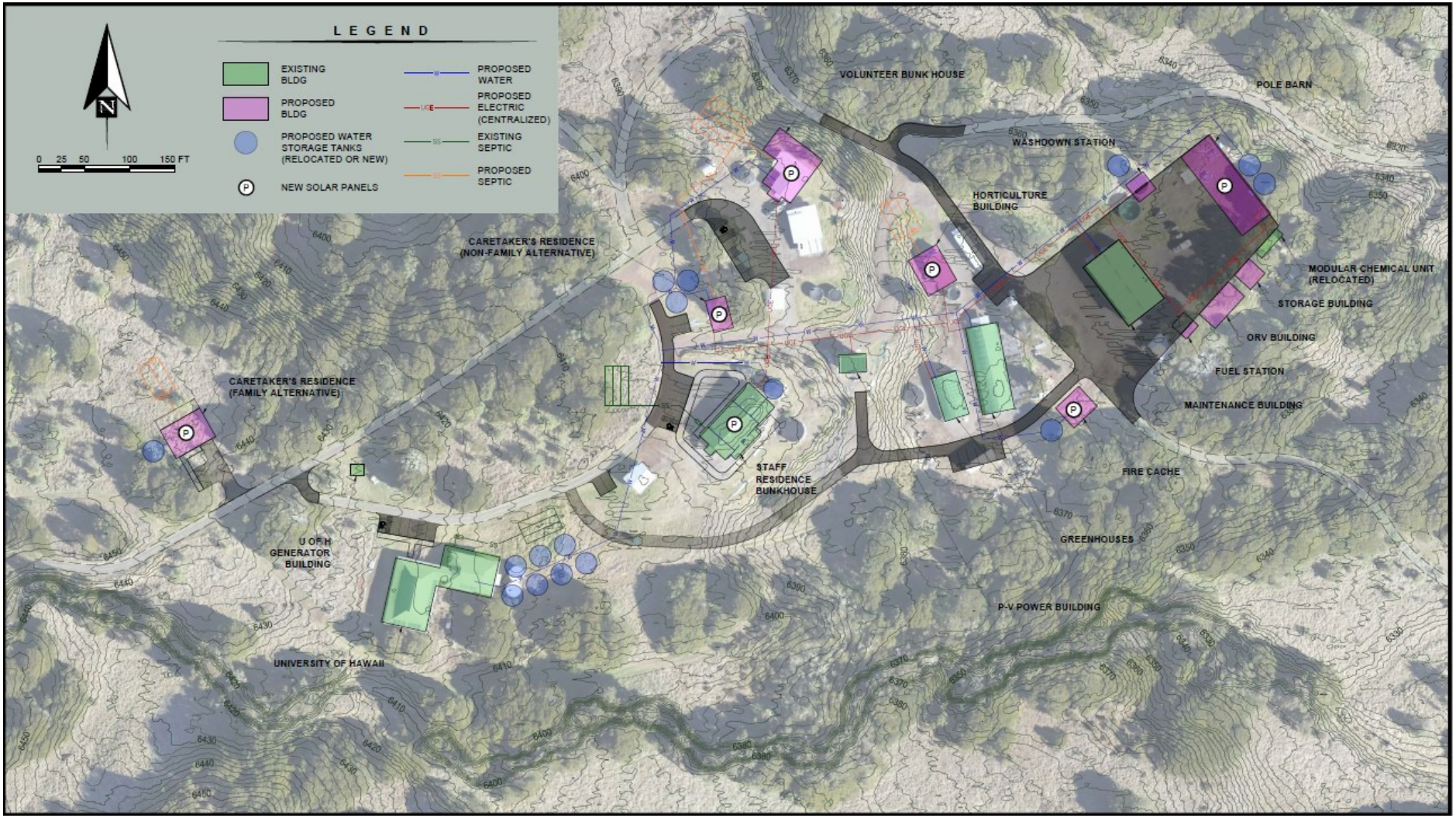
The table below includes buildings (existing, to be removed, and proposed) that have square footages that need to be balanced.

BLDG. CODE	MP STATUS	EX. SF	REMOVED SF	NEW SF	RPI DESCRIPTION	NOTES
B1	Retain	3744			Hakalau Staff Residence Bunkhouse	
B2	Retain	3200			Maintenance Building	
B3	Retain	420 (est)			Photo-Voltaic Power Bldg (P-V)	
B4	Remove	832	832		Hakalau Volunteer Bunkhouse	
B5	Remove	896	896		Hakalau Garage	
B6	Remove	640	640		Hakalau Storage Shed	
B7	Remove	800	800		Dog Kennel	
B8	Remove	425 (est)	425 (est)		BRD Cabin	
GH2	Retain	2880			Hakalau Forest Greenhouse	
GH1	Retain	1440			Hakalau Rare Plant Greenhouse	
V	NEW			3000	Volunteer Bunkhouse	
C	NEW			800	Caretaker's Residence (non-family)	
H	NEW			2000	Horticulture Building	
FC	NEW			1050	Fire Cache	
S2	NEW			576	Storage Building	
S1	NEW			1200	ORV Building	
			3593	8626		

The table below includes structures (existing, to be removed, and proposed) whose square footages do not need to be balanced.

BLDG. CODE	MP STATUS	SF	SIZE	NOTES
AUX1	Remove			Fuel Storage Shelter
AUX2	Relocate			Modular Chemical Unit
AUX3	Remove			Volunteer Bunkhouse Outhouse
AUX4	Remove			BRD Cabin Outhouse
UH1	N/A			UH Residence & Research Bldg
UH2	N/A			UH Generator Bldg
WP	Remove			Weatherport
P	NEW	4400	106x40	Pole Barn
W	NEW	576	24x24	Washdown Station
F	NEW	160	8x20	Fuel Storage

CONCEPTUAL STATION PLAN - UTILITY OVERLAY



MASTER PLANNING

ENVIRONMENTAL

The Hakalau Forest National Wildlife Refuge was established to protect and manage endangered Hawaiian forest birds and their forest habitat. Consideration of these birds, their habitat, and other wildlife is integral to the master planning for the Station.

Species with General Project Design Guidelines

General project design guidelines for three species present within the Station's project area were downloaded from the USFWS Information for Planning and Consultation website. These species include: the band-rumped storm-petrel, the Newell's Townsend's Shearwater, and the Hawaiian Hoary Bat.

Hawaiian seabirds may traverse the project area at night between March 1 and December 15 during breeding, nesting, and fledging seasons. Young birds may traverse the project area between September 15 and December 15 as they leave their mountain nests to fly to the sea. Seabirds are attracted to light, which can result in disorientation, fallout, and injury. Lighting at the Station should be shielded from above. automatic motion sensor switches should be considered for outdoor lights, and nighttime construction should be avoided during the seabird fledging period.

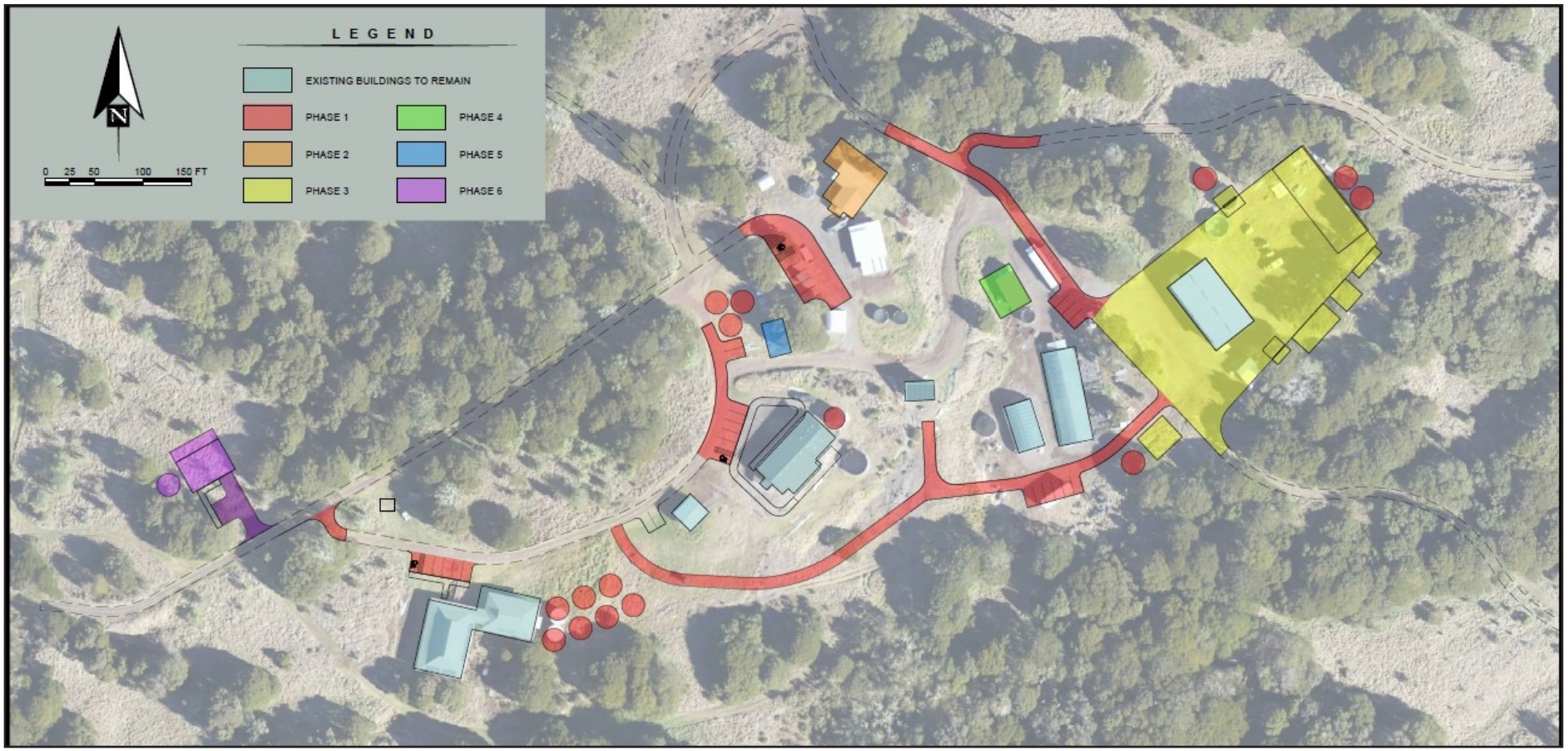
Hawaiian hoary bats roost in forested areas and will leave their young unattended while foraging. If trees or shrubs 15 feet or taller are cleared during the pup rearing season, there is risk for young bats to be harmed or killed. Clearing at the Station should avoid disturbing or removal of plants greater than 15 feet tall during the bat birthing and pup rearing season, which lasts from June 1 through September 15.

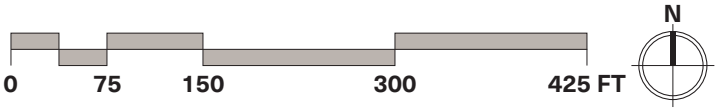
In addition to lighting and vegetation clearing, fencing, powerlines, guywires, and other cables can present a hazard. The vertical profiles of powerlines, guywires, and cables should be minimized and remain below vegetation height, if possible, to avoid and minimize collision by seabirds. Where fences extend above vegetation, three strands of polytape should be integrated into the fence to increase visibility. Barbed wire fence should be avoided to prevent injury to bats.

National Environmental Policy Act Requirements

The work described in this Master Plan will require compliance with the National Environmental Policy Act (NEPA). An Environmental Assessment (EA) will be prepared assessing the proposed action (adoption of the recommendations in this document) along with a "no action" alternative. If no significant potential impacts from the Master Plan adoption are identified during EA preparation, a Finding of No Significant Impact (FONSI) will be prepared and an Environmental Impact Statement (EIS) would not be required.

CONCEPTUAL STATION PLAN - PHASING OVERLAY





NOTES

1. This figure presents a schematic of possible phasing for improvements at the Station.
2. Phase 1 includes installation of water and electrical lines in conjunction with road work. Solar panels to be mounted during associated building construction.
3. Construction duration and estimate assumes construction of all components simultaneously during that phase.
4. Reference the Cost Estimation and Facility Summary Sheets for a cost and duration breakdown by facility.

PHASE	DESCRIPTION	CONSTRUCTION DURATION	COST ESTIMATE
1	Roads & Utilities	6 months	$5,166,890
2	Volunteer Bunkhouse	4 months	$3,763,643
3	Operations Yard	6 months	$4,291,034
4	Horticulture Building	4 months	$1,654,623
5	Caretaker's Residence (Non-family)	4 months	$1,401,206
6	Caretaker's Residence (Family)	4 months	$2,515,108

4

COST ESTIMATION

COST ESTIMATION

ESTIMATION

Item	Quantity	Unit	Unit Price	Ext. Price	Notes
OPERATIONS YARD					
Fuel Station					
Demo Existing Structure (Fuel Structure)	100	SF	$ 75	$ 7,500	
Concrete (14' x 20')	280	SF	$ -	$ -	Cost incorporated with structure line item
Tanks	1	EA	$ 17,500	$ 17,500	500 gallon tank
Building Structure (8' x 20')	1	EA	$ 16,500	$ 16,500	From Hanalei, includes roof, concrete, bollards, ground rod, etc.
Fuel Station Subtotal		LS		$ 41,500	
Pole Barn					
Concrete (110' x 40')	4,400	SF	$ 20	$ 88,000	
Building Structure (110' x 40')	4,400	SF	$ 195	$ 858,000	
Pole Barn Subtotal		LS		$ 946,000	
Wash Down Station					
Concrete (24' x 24')	544	SF	$ -	$ -	Cost incorporated with structure line item
Building Structure (24' x 24')	1	EA	$ 127,000	$ 127,000	From Hanalei, includes process equipment, install, etc.
Wash Down Subtotal		LS		$ 127,000	
Storage Building					
Building Structure (24' x 24')	576	SF	$ 220	$ 126,720	
Storage Building Subtotal		LS		$ 126,720	
Off-Road Vehicle Building					
Building Structure (24' x 48')	1,152	SF	$ 220	$ 253,440	
Off-Road Vehicle Building Subtotal		LS		$ 253,440	
Fire Cache					
Concrete (35' x 30')	1,050	SF	$ 20	$ 21,000	
Building Structure (35' x 30')	1,050	SF	$ 220	$ 231,000	
Electrical System	1	EA	$ 32,500	$ 32,500	Standalone photo voltaic system for the Fire Cache
Fire Cache Subtotal		LS		$ 284,500	
Earthwork					
Grading	1,000	CY	$ 30	$ 30,000	Assumes average 1' fill over entirety of pad (N, E of Structure)
Gravel Surfacing	3,000	SY	$ 27	$ 81,000	
Earthwork Subtotal		LS		$ 111,000	
TOTAL CONSTRUCTION COST				$ 1,890,160	
USFWS Project Administration				$ 189,016	10% per USFWS
Mob/demob				$ 283,524	15%
Design				$ 113,410	6%
Field Work				$ 75,606	4%
Permitting				$ 37,803	2%
Construction Administration				$ 94,508	5%
Worker Per Diem	1,200	DAY/PERS	$ 374	$ 448,800	crew of 6 + 2 camp crew (8 total) over 6 months

Item	Quantity	Unit	Unit Price	Ext. Price	Notes
Camp Cost	1,200	DAY/PERS	$ 250	$ 300,000	camp for 8
Contingency				$ 858,207	25%
TOTAL (including mob/demob, non-const. costs, and contingency)				$ 4,291,034	

Item	Quantity	Unit	Unit Price	Ext. Price	Notes
Caretaker Residence (Non-Family)					
Demo Existing Structure (Existing BRD)	650	SF	$ 75	$ 48,750	Demo only required if conflicting with proposed building location
Demo Existing Outhouse	1	EA	$ 5,000	$ 5,000	
Building Structure	800	SF	$ 500	$ 400,000	
Water - Treatment System	1	EA	$ 3,000	$ 3,000	Not Included in Water System (standalone)
Electrical System	1	EA	$ 49,000	$ 49,000	Standalone photo voltaic system for the Caretaker Residence
Septic Pipe	200	LF	$ 100	$ 20,000	Connects to new Volunteer Residence Septic Tank / Field
TOTAL CONSTRUCTION COST				$ 525,750	
USFWS Project Administration				$ 52,575	10% per USFWS
Mob/demob				$ 78,863	15%
Design				$ 31,545	6%
Field Work				$ 21,030	4%
Permitting				$ 10,515	2%
Construction Administration				$ 26,288	5%
Worker Per Diem	600	DAY/PERS	$ 374	$ 224,400	crew of 4 + 2 camp crew (6 total) over 4 months
Camp Cost	600	DAY/PERS	$ 250	$ 150,000	camp for 6
Contingency				$ 280,241	25%
TOTAL (including mob/demob, non-const. costs, and contingency)				$ 1,401,206	

Item	Quantity	Unit	Unit Price	Ext. Price	Notes
Caretaker Residence (Family)					
Building Structure	1,800	SF	$ 500	$ 900,000	
Deck	600	SF	$ 60	$ 36,000	
Concrete Walk	380	SF	$ 20	$ 8,000	
Drive	1,640	SF	$ 40	$ 66,000	
Septic Tank	1	EA	$ 6,000	$ 6,000	
Septic Field	1,000	SF	$ 22	$ 22,000	
Septic Pipe	50	LF	$ 100	$ 5,000	
Water - Tank (Procure & Install New)	1	EA	$ 15,000	$ 15,000	Not Included in Water System (standalone)
Water - Concrete Tank Pad (8-in)	1	EA	$ 20,000	$ 20,000	Not Included in Water System (standalone)
Water - Treatment System	1	EA	$ 3,000	$ 3,000	Not Included in Water System (standalone)
Electrical System	1	EA	$ 62,300	$ 62,300	Standalone photo voltaic system for the Caretaker Residence

Item	Quantity	Unit	Unit Price	Ext. Price	Notes
Generator	1	EA	$ 10,000	$ 10,000	
TOTAL CONSTRUCTION COST				$ 1,153,300	
USFWS Project Administration				$ 115,330	10% per USFWS
Mob/demob				$ 172,995	15%
Design				$ 69,198	6%
Field Work				$ 46,132	4%
Permitting				$ 23,066	2%
Construction Administration				$ 57,665	5%
Worker Per Diem	600	DAY/PERS	$ 374	$ 224,400	crew of 4 + 2 camp crew (6 total) over 4 months
Camp Cost	600	DAY/PERS	$ 250	$ 150,000	camp for 6
Contingency				$ 503,022	25%
TOTAL (including mob/demob, non-const. costs, and contingency)				$ 2,515,108	

Item	Quantity	Unit	Unit Price	Ext. Price	Notes
Volunteer Bunkhouse					
Demo Existing Structure	1,320	SF	$ 75	$ 99,000	
Demo Existing Garage	896	SF	$ 75	$ 67,200	
Demo Existing Cesspool and Outhouse	2	EA	$ 5,000	$ 10,000	
Septic Tank	1	EA	$ 6,000	$ 6,000	
Septic Field	2,000	SF	$ 22	$ 44,000	Assume 50' x 40'
Septic Pipe	50	LF	$ 100	$ 5,000	
Water - Treatment System	2	EA	$ 3,000	$ 6,000	Not Included in Water System (standalone)
Electrical System	1	EA	$ 119,500	$ 119,500	Standalone photo voltaic system for the Volunteer Bunkhouse
Building Structure	3,000	SF	$ 500	$ 1,500,000	
TOTAL CONSTRUCTION COST				$ 1,856,700	
USFWS Project Administration				$ 185,670	10% per USFWS
Mob/demob				$ 278,505	15%
Design				$ 111,402	6%
Field Work				$ 74,268	4%
Permitting				$ 37,134	2%
Construction Administration				$ 92,835	5%
Worker Per Diem	600	DAY/PERS	$ 374	$ 224,400	crew of 4 + 2 camp crew (6 total) over 4 months
Camp Cost	600	DAY/PERS	$ 250	$ 150,000	camp for 6
Contingency				$ 752,729	25%
TOTAL (including mob/demob, non-const. costs, and contingency)				$ 3,763,643	

Item	Quantity	Unit	Unit Price	Ext. Price	Notes
Horticulture Building					
Demo Existing Storage Shed	920	SF	$ 75	$ 69,000	
Demo Existing Dog Kennel	976	SF	$ 75	$ 73,200	Includes brood-stock greenhouse square footage
Septic Tank	1	EA	$ 6,000	$ 6,000	
Septic Field	1,260	SF	$ 22	$ 27,720	Assume 42' x 30'
Septic Pipe	50	LF	$ 100	$ 5,000	
Water - Treatment System	1	EA	$ 3,000	$ 3,000	Not Included in Water System (standalone)
Electrical System	1	EA	$ 44,600	$ 44,600	Standalone photovoltaic system for the Horticulture Building
Building Structure	2,000	SF	$ 220	$ 440,000	
TOTAL CONSTRUCTION COST				$ 668,520	
USFWS Project Administration				$ 66,852	10% per USFWS
Mob/demob				$ 100,278	15%
Design				$ 40,111	6%
Field Work				$ 26,741	4%
Permitting				$ 13,370	2%
Construction Administration				$ 33,426	5%
Worker Per Diem	600	DAY/PERS	$ 374	$ 224,400	crew of 4 + 2 camp crew (6 total) over 4 months
Camp Cost	600	DAY/PERS	$ 250	$ 150,000	camp for 6
Contingency				$ 330,925	25%
TOTAL (including mob/demob, non-const. costs, and contingency)				$ 1,654,623	

Item	Quantity	Unit	Unit Price	Ext. Price	Notes
UTILITY SYSTEMS					
Water System					
Water - Tank (Demo and Remove Existing)	5	EA	$ 10,000	$ 50,000	T-B4a, T-B4b, T-B5a, T-B5b, T-B6 (7k -8k gallon capacity each)
Water - Tank (Relocate Existing)	5	EA	$ 5,000	$ 25,000	T-B1b, T-B1c, T-B2a, T-B2b, T-B2c (16k - 21k gallon capacity each)
Water - Tank (Procure and Install New)	7	EA	$ 15,000	$ 105,000	21k gallon capacity each
Water - Concrete Tank Pad (8-in)	13	EA	$ 20,000	$ 260,000	Assume 21k gallon capacity = 12' radius;
Water - Pipe Demo & Remove Existing	1,130	LF	$ 50	$ 56,500	Measured = 899 LF, 25% increase applied to account for uncert. Could instead abandon in place to reduce cost
Water - Distribution System	2,040	LF	$ 100	$ 204,000	Measured = 1854 LF, 10% increase applied to account for uncert.
Water System Subtotal		LS		$ 700,500	
USFWS Project Administration				$ 70,050	10% per USFWS
Mob/demob				$ 105,075	15%
Design				$ 42,030	6%
Field Work				$ 28,020	4%
Permitting				$ 14,010	2%

Item	Quantity	Unit	Unit Price	Ext. Price	Notes
Construction Administration				$ 35,025	5%
Worker Per Diem	1,200	DAY/PERS	$ 374	$ 448,800	crew of 6 + 2 camp crew (8 total) over 6 months
Camp Cost	1,200	DAY/PERS	$ 250	$ 300,000	camp for 8
Contingency				$ 435,878	25%
Water System Subtotal (with non-construction costs & contingency)				$ 2,179,388	
Electrical System					
Electrical - Demo & Remove Existing	1,020	LF	$ 50	$ 51,000	if desired; 812 LF, 25% increase applied to account for uncert.
Electrical System	1	EA	$ 339,100	$ 339,100	Centralized system in Operations Yard
Staff Bunkhouse Electrical System	1	EA	$ 279,600	$ 279,600	standalone
Greenhouse Electrical System	1	EA	$ 345,800	$ 345,800	standalone
Generator	1	EA	$ 10,000	$ 10,000	additional backup generator for PV building or elsewhere onsite
Electrical System Subtotal		LS		$ 1,025,500	
USFWS Project Administration				$ 102,550	10% per USFWS
Mob/demob				$ 153,825	15%
Design				$ 61,530	6%
Field Work				$ 41,020	4%
Permitting				$ 20,510	2%
Construction Administration				$ 51,275	5%
Worker Per Diem	600	DAY/PERS	$ 374	$ 224,400	crew of 4 + 2 camp crew (6 total) over 4 months
Camp Cost	600	DAY/PERS	$ 250	$ 150,000	camp for 6
Contingency				$ 457,653	25%
Electrical System Subtotal (with non-construction costs & contingency)				$ 2,288,263	
TOTAL CONSTRUCTION COST				$ 1,726,000	
TOTAL (including mob/demob, non-const. costs, and contingency)				$ 4,467,650	

Item	Quantity	Unit	Unit Price	Ext. Price	Notes
Roadways & Walks					
Roadways (Demo Existing)	2,200	LF	$ 40	$ 88,000	Measured = 47,445 SF, 10% decrease applied
Roadways (Station Campus)	5,600	LF	$ 40	$ 224,000	Measured = 51,122 SF, 10% increase applied
Roadways (Station Entrance)	2,000	LF	$ 145	$ 290,000	Measured = 36,000 SF (assumed 2000' long, 20' wide)
Sidewalks (UH & Staff Residence)	2,780	SF	$ 20	$ 55,600	Staff Residence (2300 SF) + UH (470 SF)
TOTAL CONSTRUCTION COST				$ 657,600	
USFWS Project Administration				$ 65,760	10% per USFWS
Mob/demob				$ 98,640	15%
Design				$ 39,456	6%
Field Work				$ 26,304	4%
Permitting				$ 13,152	2%

Item	Quantity	Unit	Unit Price	Ext. Price	Notes
Construction Administration				$ 32,880	5%
Worker Per Diem	1,200	DAY/PERS	$ 374	$ 448,800	crew of 6 + 2 camp crew (8 total) over 6 months
Camp Cost	1,200	DAY/PERS	$ 250	$ 300,000	camp for 8
Contingency				$ 345,648	25%
TOTAL (including mob/demob, non-const. costs, and contingency)				$ 2,028,240	
STATION MASTER PLAN GRAND TOTAL CONSTRUCTION COST				**$ 8,478,030**	Does not account for design costs, contingencies, etc.
STATION MASTER PLAN GRAND TOTAL CONSTRUCTION COST (W/ CONTINGENCY)				**$ 15,984,503**	Includes mob/demob, non-construction costs, and contingency; constructed at once with crew of 6 + 2 camp staff over 6 months
PHASED STATION MASTER PLAN GRAND TOTAL CONSTRUCTION COST (W/ CONTINGENCY)				**$ 20,121,503**	Includes mob/demob, non-construction costs, and contingency; phased construction (*one facility at a time)*

Notes:

1. The Station Master Plan Grand Total Construction Cost (w/ Contingency) assumes all phases are constructed simultaneously over a 6-month period with a 6-person crew.
2. The Phased Station Master Plan Grand Total Construction Cost (w/ Contingency) includes the costs associated with separate construction phases (additional mob/demob costs, worker and camp costs, etc.) rather than simultaneous construction.

HAKALAU MASTER PLAN COST ESTIMATE - UNIT COSTS			
Unit Costs	**$/Unit**	**Unit**	**Source**
Buildings (fuel station)	$ 16,500	EA	Hanalei Station Fuel Tank Roof / Structure / Concrete: $12k (Kauai, 2017). Pro-rate at 2.5% per year. Apply 25% factor for Hakalau Remoteness.... Use $16.5k
Buildings (wash down station)	$ 127,000	EA	Hanalei Station Washdown Station (USFWS): $96k (Kauai, 2017). Pro-rate at 2.5% per year. Apply 20% factor for Hakalau Remoteness.... Use $127k
Buildings (concrete floor, non-finished)	$ 220	SF	Hakalau Station Maintenance Shop (USFWS); $190/sf (2015) pro-rated at 2.5% per year
Buildings (living quarters, finished)	$ 500	SF	$290 - $780/SF for single family home, Honolulu, 2020 (Rider Levett Bucknall 1st Qrtr Construction Cost Report)
Deck	$ 60	SF	Average price = $25, Range = $15 - $35, Use $40 for Hakalau (homeguide.com); bumping up to $60 for lumber prices
Concrete Flatwork - Light Duty (4-inch)	$ 20	SF	$500/cy @ 4-inch thickness = $6.20/sf use $20/SF due to remoteness, sourcing, and logistics
Concrete Flatwork - Heavy Duty (8-inch)	$ 40	SF	$500/cy @ 8-inch thickness = $12.40/sf; use $40/sf due to remoteness, sourcing, and logistics
Concrete Tank Pad - Heavy Duty (8-inch)	$ 20,000	EA	Assume 21k gallon capacity = 12' radius; Assume 8-inch thickness; 452sf * 40/sf = $18,080; use $20,000 each
Grading / Fill	$ 30	CY	Excavate: $5/cy, Process: $10/cy, Haul: $3/cy/mile, Place & Compact: $5/cy; 5 + 10 + (3*.8) + 5 = $22.4/cy; use $30/cy
Gravel Surfacing	$ 27	SY	2020 roadway contract: $150k/mile (USFWS) = $2.84 / sf (10-ft roadway width); 2.84*9 = $25.56/sy; use $27/sy
Utilities - Water	$ 100	LF	
Utilities - Sewer	$ 100	LF	
Utilities - Electrical	$ 75	LF	No piping assembly required, smaller trench compared to water / sewer
Water Tank - Demo	$ 10,000	EA	Assume $2500 for disassembly, removal, & demo (1-day, 2-man crew, plus equipment); Assume $5/cy/mile haul; ~45 miles to Hilo Transfer Station; Assume average demo'd tank = 10k gal tank (1500 ft3); Assume 50% volume for removal (corrugated walls, liner, concrete pad) ~ 30cy; ($5/cy/mi)*(45-mi)*(30-cy) = $6750/each; $2,500 + $6,750 = $9,250 / each; use $10,000 /each
Water Tank - Relocate	$ 5,000	EA	Assume $2500 for disassembly, $2500 for re-assembly (Assume 1 day for disassembly; 1 day for re-assembly 1-day, 2-man crew)
Water Tank - New	$ 15,000	EA	From Island Catchment: material price for 21k gal tank = $6,300
Water Treatment System	$ 3,000	EA	Material costs ~$1,000; assume $3,000 total including installation
Septic - Tank	$ 6,000	EA	SR Contracting - Guide to Septic Tanks for Hawaii: 2017, 5-6 bedroom house, 1200 gallon tank, $2500 tank cost. Use $6000 for 2020 tank and installation.
Septic - Field	$ 22	SF	Sizing of field based on 16-30 min/inch perc rate (250 sf / bedroom)
Electrical - Building Solar	$ 120,000	EA	varies depending on panel and battery needs per building
Electrical - Building Generator	$ 10,000	EA	For caretaker residence (small 10kW cabinet-type generator for residence = $3000, assume $10k for installation and hookup to structure / propane)
Fuel Tank	$ 17,500	EA	Double walled steel tank with epoxy, 500 gallons
Demo - Existing Structure	$ 75	SF	Assume $5/cy/mile haul; ~45 miles to Hilo Transfer Station; Assume 6-ft tall structure for volume; ($5/cy/mi)*(45-mi)*(6-ft)*(1/27-cy) = $50/sf; $75/SF for road conditions
Demo - Existing Utilities	$ 50	LF	Assume demo is 50% of install cost
Demo - Outhouse / Cesspool	$ 5,000	EA	
Roadway - Demo & Reclamation	$ 40	LF	Assume reclamation is half of cost for new roadway
Roadway - New (Campus)	$ 40	LF	2020 roadway contract: $150k/mile (USFWS) = $2.84 / sf (10-foot roadway)... Use $4/sf for new campus roadways (some new, some improvement...); ~$40/LF
Roadway - New (Entrance)	$ 145	LF	Assume 18-foot roadway with asphalt pavement (AASHTO design guidelines for low-volume roads). Unit cost ~ 3x 2020 roadway contract.
Worker Per Diem	$ 374	DAY/PERS	Max: $374 for Hawaii, effective 1/1/21
Man Camp	$ 250	DAY/PERS	~$150k for 5-tent camp; $100k for set up/take down; ~$150-$250/person/day

5

FACILITY SUMMARY SHEETS

HOUSING

VOLUNTEER BUNKHOUSE

EXISTING CONDITIONS

Existing Volunteer Bunkhouse

The volunteer bunkhouse is at its expected end of life due to condition, safety concerns, and capacity expansion to meet needs.

Demolition will include full removal of the building and an outhouse, and decommissioning of an active cesspool. Two water tanks shall be assessed for removal or use, either in place or relocated.

- Footprint: 832 SF
- Water: Potable water provided (chlorination, filter, UV, activated charcoal), runoff routed to two 8,200-gal tanks (16,400-gal total)
- Sewer: Toilet connected to cesspool, outhouse
- Electricity: 60-amp service
- Propane: Three 100-pound tanks

It is assumed that the existing garage will also be removed.

- Footprint: 896 SF
- Water: no water service, roof runoff routed to one of two tanks (16,400 gallons total)
- Sewer: none
- Electricity: 60-amp service
- Propane: none

PROPOSED CONDITIONS

New volunteer housing shall be comfortable and provide amenities for volunteers beyond sleeping and eating. It will be attractive, consistent with Station architecture, an additional incentive for volunteering, and ADA accessible.

- Footprint: 3000 SF (estimated)
- Two bunk rooms (six beds each)
- Two double-occupancy rooms
- Kitchen and dining for sixteen people
- Interior common area with good views
- Exterior common area with good views
- Two bathrooms (double-stall or as required by code)
- Storage and change area for field gear
- Parking for six vehicles (including one ADA)
- Electricity (assumes 100A service or more)
- Septic (new septic field)
- Water (per Station water master plan, potable)
- Propane (hot water and heat)

The site should provide room for a weatherport when temporary volunteer housing is needed.

Location on Site and Conceptual Site Plan

SUMMARIES

Phasing

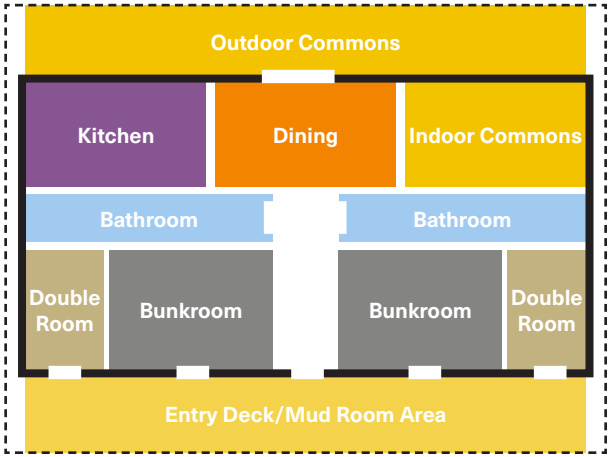
- Requires demolition of existing bunkhouse and garage
- Potentially requires provision of alternate volunteer housing during construction period

Project Schedule

- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 4 months

Cost Estimation (2021 dollars, assumes constructed separately from other facilities)

- Construction Budget: $1,856,700
- Design & Other Construction Costs: $1,154,214
- Contingency: 25%
- Total Funding Need: $3,763,643



Conceptual Building Organization (diagrammatic - not to scale)

HOUSING

CARETAKER (NON-FAMILY) ALTERNATIVE

EXISTING CONDITIONS

Existing BRD Cabin

The existing BRD cabin is one option for a caretaker housing location. This structure would be demolished prior to construction if this location was used. Note that this is not the recommended location.

- Footprint: 425 SF (estimated)
- Water: potable water provided via Staff Residence Building
- Sewer: sewer connected to Staff Residence Drain Field, outhouse
- Electricity: 20-amp service
- Propane: One 100-pound propane tank

The other location is on the terrace above the volunteer bunkhouse area. This area is used for temporary storage, and has no demolition requirements prior to use as a building.

PROPOSED CONDITIONS

This is one of two options for caretaker housing that focuses on an individual or couple without children.

New caretaker housing shall be comfortable and provide amenities for caretakers beyond sleeping and eating. It will be attractive and consistent to Station architecture, and ADA accessible.

- Footprint: 800 SF (estimated)
- One bedroom
- Kitchen and dining for two people
- Interior living room area
- Storage and other spaces as validated
- Exterior deck area
- Bathroom
- Parking for two vehicles (including one ADA)
- Electricity (assumes 60A service or more)
- Septic (depends on location for new septic field or connecting to staff housing field)
- Water (per Station water master plan, potable)
- Propane (hot water and heat)

SUMMARIES

Phasing

- The existing BRD cabin could provide caretaker housing, allowing focus on other more critical items.
- If that location is chosen, the BRD Cabin must be demolished.

Project Schedule

- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 4 months

Cost Estimation (2021 dollars, assumes constructed separately from other facilities)

- Construction Budget: $525,750
- Design & Other Construction Costs: $595,215
- Contingency: 25%
- Total Funding Need: $1,401,206

Location on Site and Conceptual Site Plan

Conceptual Building Organization (diagrammatic - not to scale)

HOUSING

CARETAKER (FAMILY) ALTERNATIVE

EXISTING CONDITIONS

The location for this facility would be in a currently undeveloped area.

PROPOSED CONDITIONS

This is one of two options for caretaker housing that focuses on an individual or couple with children.

New caretaker family housing shall be comfortable for a family, attractive, consistent with Station architecture, and ADA accessible.

- Footprint: 1800 SF (estimated)
- Three bedrooms
- Kitchen, dining, living room
- Storage and other spaces as validated
- Exterior deck area and yard
- Two bathrooms (min. one full, one half)
- Parking for two vehicles (including one ADA)
- Electricity (assumes 100A service or more)
- Septic (septic field)
- Water (stand-alone system, potable)
- Propane (hot water and heat)

The project location will provide privacy for family housing, in a location off the main entry road toward the site's entry gate. The road may be monitored to some extent from this location.

SUMMARIES

Phasing

- No constraints

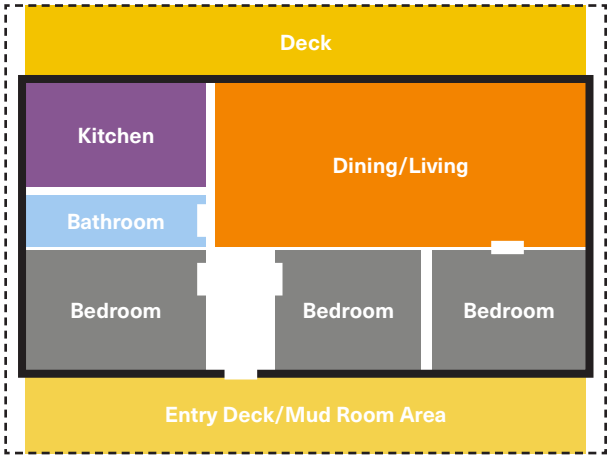
Project Schedule

- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 4 months

Cost Estimation (2021 dollars, assumes constructed separately from other facilities)

- Construction Budget: $1,153,300
- Design & Other Construction Costs: $858,786
- Contingency: 25%
- Total Funding Need: $2,515,108

Location on Site and Conceptual Site Plan



Conceptual Building Organization (diagrammatic - not to scale)

FACILITIES

HORTICULTURE BUILDING

EXISTING CONDITIONS

Existing Storage Shed and Dog Kennel

The storage shed and the dog kennel are at their expected end of life due to condition, safety concerns, and need for more horticultural operations support.

Storage Shed

- Footprint: 640 SF
- Water: eyewash, runoff routed to 6,700-gal tank
- Sewer: none
- Electricity: 15-amp

Dog Kennel

- Footprint: 800 SF
- Water: eyewash, hose bibs
- Sewer: none
- Electricity: 15-amp

PROPOSED CONDITIONS

A new horticulture building shall be optimized for its desired functions, and as possible include flexibility for future growth or changes to operational demands. It will be attractive, consistent with Station architecture, and ADA accessible.

- Footprint: 2000 SF (estimated)
- One bathroom
- Horticulture storage
- Staging/storage for volunteer functions
- Brood house/greenhouse
- Parking for four vehicles (including one ADA)
- Electricity (assumes 60A service or more)
- Septic (septic field)
- Water (per Station water master plan, potable))
- Propane (hot water and heat)

SUMMARIES

Phasing

- Requires demolition of existing Storage Shed and Dog Kennel
- Potentially requires provision of alternate facilities during construction period

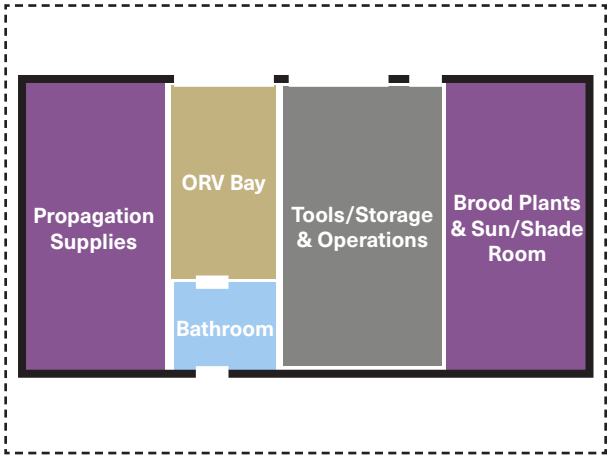
Project Schedule

- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 4 months

Cost Estimation (2021 dollars, assumes constructed separately from other facilities)

- Construction Budget: $668,520
- Design & Other Construction Costs: $655,178
- Contingency: 25%
- Total Funding Need: $1,654,623

Location on Site and Conceptual Site Plan



Conceptual Building Organization (diagrammatic - not to scale)

FACILITIES

FIRE CACHE

EXISTING CONDITIONS

Existing Yard Toward South Side

The development of this structure assumes the completion of operations yard site work. Existing conditions would be ready for construction.

PROPOSED CONDITIONS

The fire cache building will contain supplies and tools for fire response, including a truck mounted tank (1-ton pickup with tool boxes and a large water tank). This building will be approximately 1000 SF with garage door access so it could operate as a two-bay garage. While only a single-bay will likely be needed for truck/water tank use, storage and operations for the remainder of the garage would benefit from similar access and flexibility for future uses. The garage door for the equipment bay should include a man-door.

The structure is expected to be a metal building similar to the existing maintenance building, and the floor of the structure will be a concrete pad of sufficient thickness and reinforcement to allow for heavy equipment.

The facility will be serviced with electric for lighting and general use.

SUMMARIES

Phasing

- Requires construction of operations yard gravel pad, installation of utility infrastructure (water and electric).
- Water supply by mainline system or dedicated water storage tank.

Project Schedule

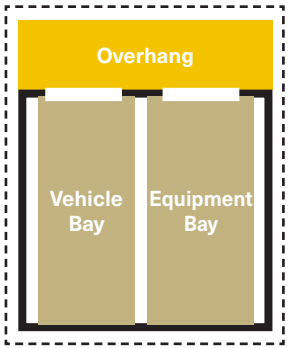
- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 4 months

Cost Estimation (2021 dollars)

- Construction Budget: $284,500*

*Assumes construction simultaneously with development of the Operations Yard. Design, CA, and contingency, etc. are applied to the full development of the Operations Zone and Fire Cache. See Cost Estimate for more information.

Location on Site and Conceptual Site Plan



Conceptual Building Organization (diagrammatic - not to scale)

OPERATIONS YARD

SITE WORK

EXISTING CONDITIONS

Existing Yard Toward North Side

There is an existing operations yard that would be expanded. Renovation or replacement of existing gravel surfacing may be required to bring this existing area fully consistent with a new design. An existing chemical unit would be relocated.

PROPOSED CONDITIONS

This work is for the development of the complete operations yard footprint. This will include clearing and grubbing, and excavation, fill and compaction as needed to provide a durable surface for the operation of heavy equipment.

This work would include the relocation of the existing chemical unit.

It is expected that the final design section for the gravel lot would be approximately 110'x130' for open driving areas.

SUMMARIES

Phasing

- Relocation of equipment stored in existing yard

Project Schedule (includes development of the entire Operations Zone)

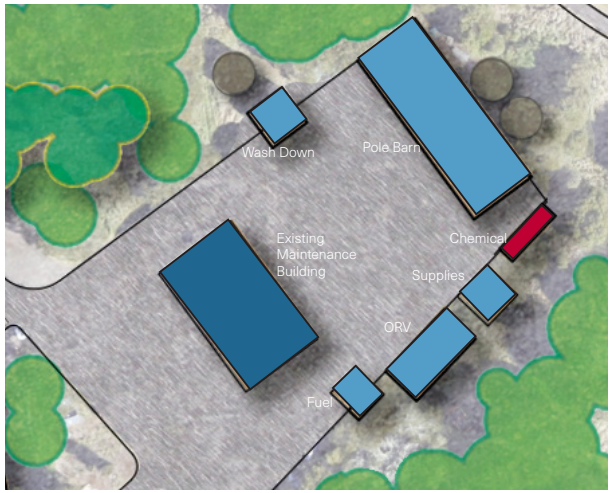
- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 6 months

Cost Estimation (2021 dollars)

- Construction Budget: $111,000*

*Assumes construction simultaneously with development of the Operations Yard. Design, CA, and contingency, etc. are applied to the full development of the Operations Zone and Fire Cache. See Cost Estimate for more information.

BLDG. CODE	MP STATUS	SF	SIZE	NOTES	CONSTRUCTION COST
AUX2	RELOCATE			MODULAR CHEMICAL UNIT	
P	NEW	4240	106X40	POLE BARN	$946,000
W	NEW	576	24X24	WASHDOWN STATION	$127,000
S1	NEW	1152	48X24	ORV BUILDING	$253,440
S2	NEW	576	24X24	STORAGE BUILDING	$126,720
F	NEW	160	8X20	FUEL STORAGE	$41,500
FC	NEW	1000	40X25	FIRE CACHE	$284,500
				SITE WORK	$111,000
				TOTAL:	$1,890,160
				TOTAL (WITH OTHER COSTS & CONTINGENCY):	$4,291,034



Location on Site and Conceptual Site Plan

OPERATIONS YARD

POLE BARN

EXISTING CONDITIONS

Existing Yard Toward North Side

The development of this structure assumes the completion of operations yard site work. Existing conditions would be ready for construction.

PROPOSED CONDITIONS

The structure will be a 110' by 40' three-sided building. this will provide six 15' wide bays. The overhang may be extended on the front, the back, or both to provide additional shelter for operations (front) or for storage (behind).

The structure will be a metal building similar to the existing Maintenance Building, and the floor of the structure will be a concrete pad of sufficient thickness and reinforcement to allow for heavy equipment.

The facility will be serviced with electric for lighting, general use, and specialty uses such as welding.

SUMMARIES

Phasing

- Requires construction of operations yard gravel pad, installation of utility infrastructure (electric).

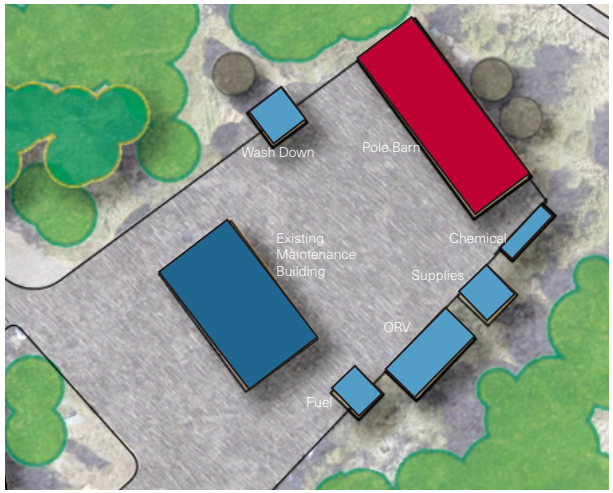
Project Schedule (includes development of the entire Operations Zone)

- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 6 months

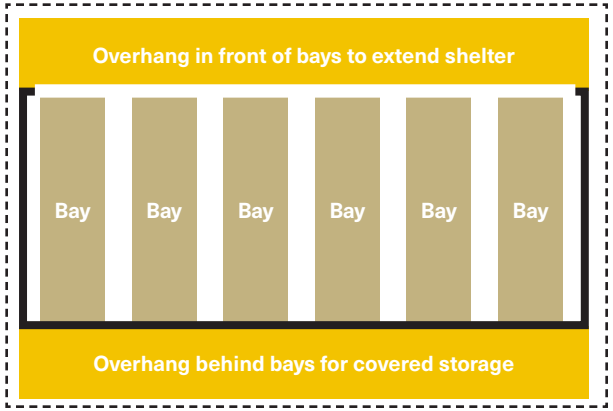
Cost Estimation (2021 dollars)

- Construction Budget: $946,000*

*Assumes construction simultaneously with development of the Operations Yard. Design, CA, and contingency, etc. are applied to the full development of the Operations Zone and Fire Cache. See Cost Estimate for more information.



Location on Site and Conceptual Site Plan



Conceptual Building Organization (diagrammatic - not to scale)

OPERATIONS YARD

STORAGE BUILDING

EXISTING CONDITIONS

Existing Yard Toward South Side

The development of these structures assume the completion of operations yard site work. Existing conditions would be ready for construction.

PROPOSED CONDITIONS

The structure will be a multi-use storage building accessed by garage door. The structure will be a metal building similar to the existing maintenance building, and the floor of the structure will be a concrete pad of sufficient thickness and reinforcement to allow for heavy equipment.

The facility will be serviced with electric for lighting and general use.

The storage shed will be 24'x24' (576 SF)

SUMMARIES

Phasing

- Requires construction of operations yard gravel pad, installation of utility infrastructure (electric).

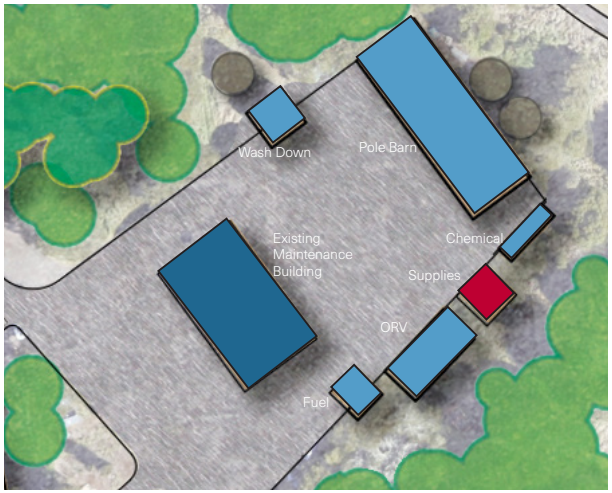
Project Schedule (includes development of the entire Operations Zone)

- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 6 months

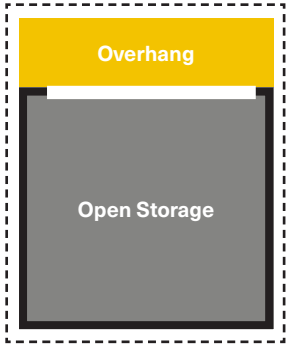
Cost Estimation (2021 dollars)

- Construction Budget: $126,720*

*Assumes construction simultaneously with development of the Operations Yard. Design, CA, and contingency, etc. are applied to the full development of the Operations Zone and Fire Cache. See Cost Estimate for more information.



Location on Site and Conceptual Site Plan



Conceptual Building Organization (diagrammatic - not to scale)

OPERATIONS YARD

OFF-ROAD VEHICLE BUILDING

EXISTING CONDITIONS

Existing Yard Toward South Side

The development of these structures assume the completion of operations yard site work. Existing conditions would be ready for construction.

PROPOSED CONDITIONS

The structure will be a multi-use storage building accessed by garage door. The structure will be a metal building similar to the existing Maintenance Building, and the floor of the structure will be concrete pad of sufficient thickness and reinforcement to allow for heavy equipment.

The facility will be serviced with electric for lighting and general use.

This structure will be an ORV shed and should be designed to accommodate 2-4 UTVs and 4-6 ATVs. plus a work area (bench, tools, flame cabinet, e

The ORV building will be 24'x48' (1152 SF).

SUMMARIES

Phasing

- Requires construction of operations yard gravel pad, installation of utility infrastructure (electric).

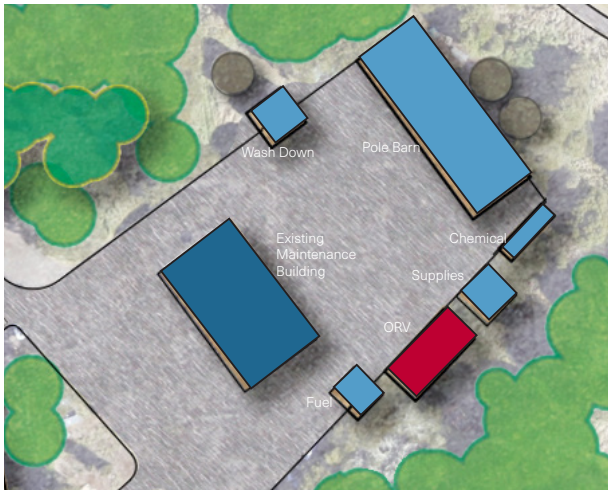
Project Schedule (includes development of the entire Operations Zone)

- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 6 months

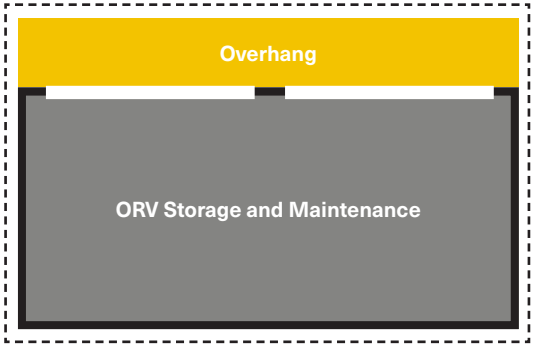
Cost Estimation (2021 dollars)

- Construction Budget: $253,440*

*Assumes construction simultaneously with development of the Operations Yard. Design, CA, and contingency, etc. are applied to the full development of the Operations Zone and Fire Cache. See Cost Estimate for more information.



Location on Site and Conceptual Site Plan



Conceptual Building Organization (diagrammatic - not to scale)

OPERATIONS YARD

FUEL STATION

EXISTING CONDITIONS

Existing Yard Toward North Side

The development of this structure assumes the completion of operations yard site work. Existing conditions would be ready for construction.

PROPOSED CONDITIONS

The fuel station includes a tank shelter, a 14' x 20' concrete apron, and a new 500 gallon fuel tank each for gas and diesel storage. The proposed tank will be steel, double-contained and dual-chambered with a mechanical pumping system.

Note: Recent work at Hanalei provides a good design precedent for this site.

SUMMARIES

Phasing

- Requires construction of operations yard gravel pad, installation of utility infrastructure (electric).

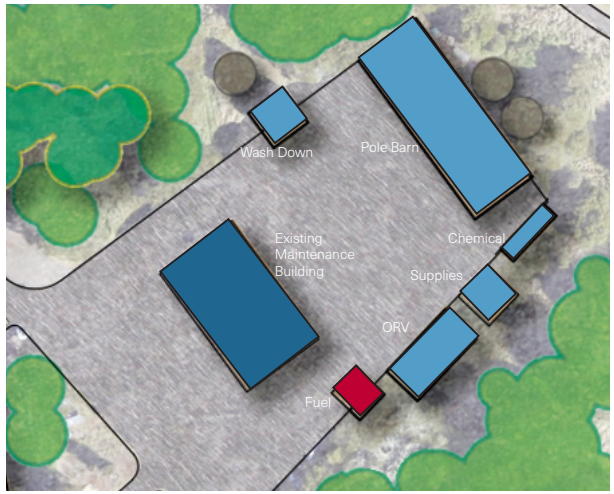
Project Schedule (includes development of the entire Operations Zone)

- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 6 months

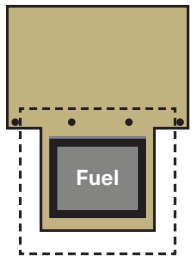
Cost Estimation (2021 dollars)

- Construction Budget: $41,500*

*Assumes construction simultaneously with development of the Operations Yard. Design, CA, and contingency, etc. are applied to the full development of the Operations Zone and Fire Cache. See Cost Estimate for more information.



Location on Site and Conceptual Site Plan



Conceptual Building Organization (diagrammatic - not to scale)

OPERATIONS YARD

WASHDOWN STATION

EXISTING CONDITIONS

Existing Yard Toward Southeast Corner

The development of this structure assumes the completion of operations yard site work. Existing conditions would be ready for construction.

PROPOSED CONDITIONS

The shelter will be 24' wide x 24' long with a height sized to accommodate Refuge vehicles and heavy equipment. The facility should include water service for vehicle washing and a process system for water treatment and decontamination from washdown activities. The treatment system should be similar to the USFWS Hanalei Facility, which has a pretreatment pit, chemical mixing module, clarifier, separator, and skimmer.

Note: Recent work at Hanalei provides a good design precedent for this site.

SUMMARIES

Phasing

- Requires construction of operations yard gravel pad, installation of utility infrastructure (water and electric).
- Water supply by mainline system or dedicated water storage tank.

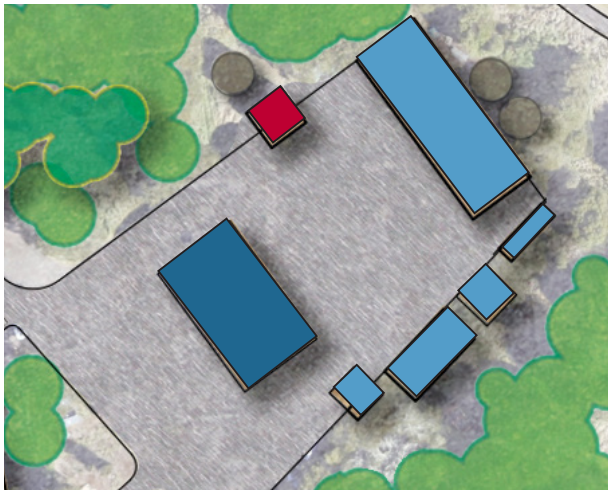
Project Schedule (includes development of the entire Operations Zone)

- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 6 months

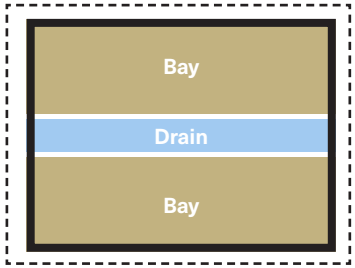
Cost Estimation (2021 dollars)

- Construction Budget: $127,000*

*Assumes construction simultaneously with development of the Operations Yard. Design, CA, and contingency, etc. are applied to the full development of the Operations Zone and Fire Cache. See Cost Estimate for more information.



Location on Site and Conceptual Site Plan



Conceptual Building Organization (diagrammatic - not to scale)

ROAD SYSTEM

RE-ROUTE OF INTERNAL ACCESS

EXISTING CONDITIONS

Existing Station Aerial

Vehicular travel is conducted throughout the Station via several gravel roadways totaling over 3,200 linear feet. They provide access to living quarters, volunteer facilities, and maintenance buildings. These roadways also double as walking paths, which can present undesirable vehicle-pedestrian conflicts and potential safety concerns.

PROPOSED CONDITIONS

A revised roadway system is proposed to minimize vehicle-pedestrian conflicts, limit vehicular travel along roadways to similar uses (i.e. volunteer, staff, etc.), and provide access to proposed facilities.

The proposed roadway system includes approximately 1,200 linear feet of re-constructed roadway and 600 linear feet of roadway removal and restoration. Re-constructed roadway could range from re-surfacing well-established existing routes to new roadway construction in select areas.

SUMMARIES

Phasing

- Re-route of road system should be completed following (or concurrent with) utility installations.
- Work could be independent of construction of proposed facilities.

Project Schedule

- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 6 months

Cost Estimation (2021 dollars, assumes constructed separately from other facilities)

- Construction Budget: $657,600 (combined with entry road gateway)
- Design & Other Construction Costs: $1,024,992
- Contingency: 25%
- Total Funding Need: $2,028,240

Vehicle access areas to be removed or modified

Proposed vehicle access areas

ROAD SYSTEM

ENTRY ROAD AND GATEWAY

EXISTING CONDITIONS

Existing Entry Road Aerial

The entry roadway is a 2,000-foot drive connecting Mana Road to the refuge Station. The drive is a gravel roadway that descends down a steep grade at the upper end. This section is subject to frequent maintenance and repair.

An upgrade to the entry roadway is needed to:

- Provide a safe, traversable, and efficient route to the Station for user access, including but not limited to staff, visitors, and contractors;
- Provide a roadway sufficiently designed to accommodate heavy equipment, large trucks and trailers, and other vehicles accessing the site (e.g., semi-trucks delivering materials);
- Eliminate or reduce steep grades at the upper end of the drive and eliminate small-radius curves to minimize roadway maintenance and improve vehicular safety; and
- Create an entrance that signifies entrance to a United States Fish and Wildlife Refuge and appropriately welcomes its users.

PROPOSED CONDITIONS

The new entry roadway should be designed to the horizontal and vertical geometry standards provided in AASHTO's Guidelines for Geometric Design of Very Low-Volume Local Roads.

The new roadway should include a gravel structural section with a paved surface course. Roadway width, including shoulders, should be no less than 18 feet.

SUMMARIES

Phasing

- Re-route of road system should be completed following (or concurrent with) utility installations.
- Work could be independent of construction of proposed facilities.

Project Schedule

- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 6 months

Cost Estimation (2021 dollars, assumes constructed separately from other facilities)

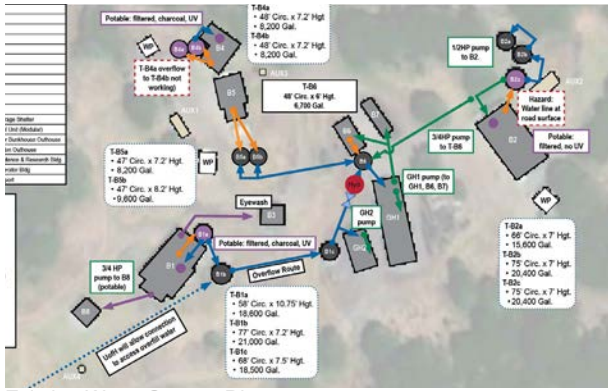
- Construction Budget: $657,600 (combined with internal)
- Design & Other Construction Costs: $1,024,992
- Contingency: 25%
- Total Funding Need: $2,028,240

Conceptual vehicle Circulation

UTILITIES

WATER SYSTEM

EXISTING CONDITIONS



Existing Water System Diagram

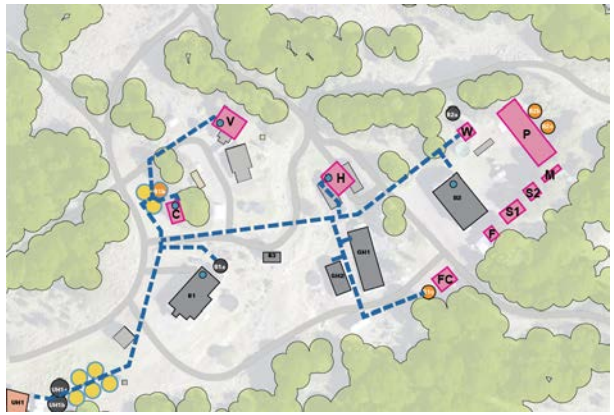
The existing water system is composed of 13 water catchment tanks located adjacent to buildings where water is needed or can be generated. Some tanks are interconnected through a PVC pipe network system, moving water around the site.

The water system should be overhauled to consolidate tanks where possible and replace the degrading PVC pipe network. Additionally, tanks should be located at higher elevations to reduce the need for pumping.

PROPOSED CONDITIONS

The proposed water system includes a consolidated tank farm located near the top of the Station, a singular pump house to pressurize the system, and a new water distribution pipe network. Standalone tanks may still be warranted at isolated locations or facilities that are expected to draw large amounts of water (e.g., the Fire Cache). Each building will also need a pressure tank and water filtration system if potable water is desired inside the building. A second, smaller tank farm is shown at the upper Station, providing system redundancy and Station resiliency during dry years.

Treatment would be achieved at the tank farms via chlorination and at the buildings requiring potable water by incorporating UV treatment device(s), sediment filter(s), and carbon filter(s).



Conceptual System Diagram

SUMMARIES

Phasing

- Water system revisions should be completed prior to (or concurrent with) road construction.
- Where road improvements might occur, sleeves should be included to allow water system expansion/ modification.
- Construction of the tank farm and associated distribution piping at the U of H building could be prioritized in order to maximize on available roof-captured rainfall volume and the higher topography to reduce pumping need.

Project Schedule

- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 6 months

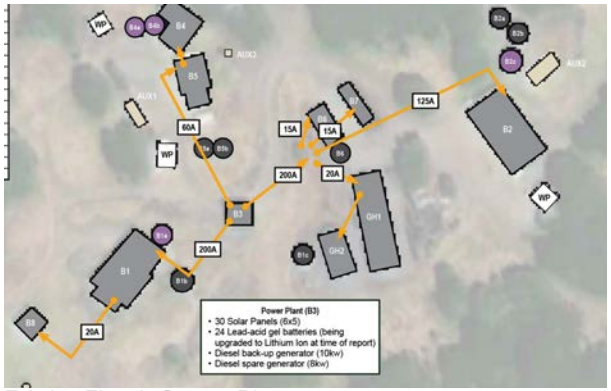
Cost Estimation (2021 dollars, assumes constructed separately from other facilities)

- Construction Budget: $700,500
- Design & Other Construction Costs: $1,043,010
- Contingency: 25%
- Total Funding Need: $2,179,388

UTILITIES

ELECTRIC SYSTEM

EXISTING CONDITIONS



Existing Electric System Diagram

The Station is powered by a battery bank and solar panels that sit atop a centralized photo-voltaic building. The system's lead-acid battery bank will be replaced with lithium ion batteries after a failure in Fall of 2020.

The centralized electrical system struggled to provide consistent power to the Station via the backup generator during the battery failure and caused delays to important work at the Refuge.

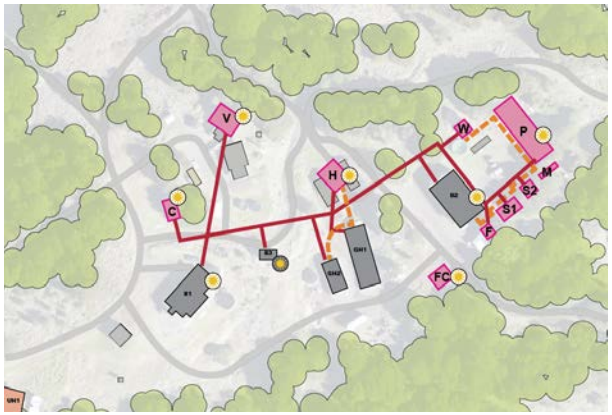
The shallow-bury electrical distribution system is prone to exposure during rain events and an overhaul is warranted.

PROPOSED CONDITIONS

The recent battery failure highlighted the need to potentially transition from centralization to a more localized approach, where buildings are powered by their own solar panels and battery systems.

For a localized approach, P-V systems would be installed at each building, other than within the Operations and Horticulture Zones. A centralized system could be installed in the Operations Zone: the Pole Barn or Maintenance Building could house the main system and distribute power to the remaining buildings within the Operations Yard. Likewise, a P-V system installed on the Horticulture Building could power the Horticulture Building and both greenhouses. This localized approach would give the Station more resiliency, and a battery failure would not cripple the rest of the Station. This approach could also include smaller back-up generator systems in the event of failure.

With small upgrades, the existing P-V Power Building, distribution system, and generator could remain in use during construction of the different facilities, and could continue to remain in place as a backup system, if desired.



Conceptual System Diagram

SUMMARIES

Phasing

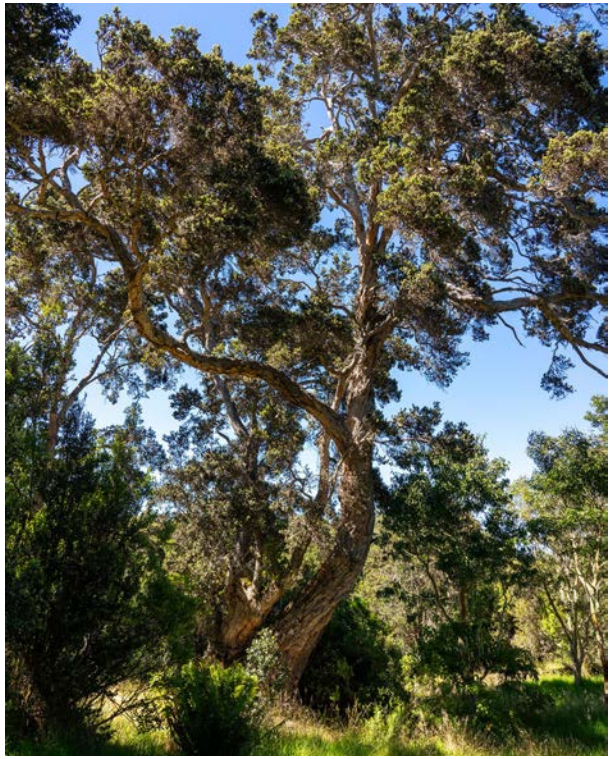
- Decentralized electric system installation would be a part of individual projects.
- Conduit or sleeves are recommended installed below roads during road system improvements for flexible improvements to a centralized electric system and its power grid.

Project Schedule

- Design: 12 months
- Contracting & Procurement: 5 months
- Construction: 4 months

Cost Estimation (2021 dollars, assumes constructed separately from other facilities)

- Construction Budget: $1,025,500
- Design & Other Construction Costs: $805,110
- Contingency: 25%
- Total Funding Need: $2,288,263




PLANT
PONO
TRAIL
RATED
4x4

6

DESIGN GUIDANCE

DESIGN GUIDANCE

VISITOR (AND STAFF) EXPERIENCE

The Refuge is a nationally significant resource, and while the Station is an operations and maintenance facility, volunteers are a critical part of delivering mission and are invited onto the Station site. As such, those areas that volunteers experience should be well-designed and encourage volunteerism through comfort and reflection of the National Wildlife Refuge they are within.

Visitor facility design is well represented by the acronym ADROIT: Arrival, Decompression, Reception, Orientation, Interpretation and Transformation. The most successful implementation of this is when the visitor experience begins at (or before) the entry to a site. The below is an excellent summary of the use of ADROIT as a planning framework (taken from June 14, 2017 GWWO Architects Blog blog entry by Alan Reed titled "Achieving an ideal visitor experience: The ADROIT approach").

A: Arrival: is the first impression of a place or site. Ideally, one sees their destination prior to parking or disembarking other forms of transportation. In doing so, the stress associated with trying to understand and navigate in an unfamiliar environment is minimized

D: Decompression: is the journey between arrival and actually entering a building or site. This phase allows time to cleanse one's minds of their journey or daily stresses and prepare for their visit. Effective decompression happens over a meaningful amount of time and distance and ideally incorporates some initial interpretation. Often, clients are conflicted about the idea of decompression and the need to accommodate the disabled or elderly. While these are important considerations, more often than not, solutions can be found without sacrificing the opportunity for decompression.

R: Reception: is the formal entry to the resource and should be visible upon Arrival. Reception may be as simple as a sign at a trailhead or park, or in the case of a building, a lobby, or welcome desk. If possible, this area should be manned by someone able to answer any questions one may have prior to their interpretive experience.

O: Orientation: provides visitors with an understanding of the opportunities available so they can plan their visit. In the case of a natural site, orientation is typically limited to a map of trails and destinations, with information such as distances, difficulty of terrain, etc. Conversely, in a large visitor center, orientation is often multifaceted, including maps, interactive touch screens, orientation films, and access to staff for specific questions. Regardless of the vehicle, proper orientation is critical to a comprehensive and enjoyable visit.

I: Interpretation: over-arches the entire visitor experience and should begin the moment one enters the site. It is accomplished through a variety of vehicles and venues that range from simple two dimensional displays to interactive exhibits and 4D theater experiences. In the case of living history sites or museums, much of the message may be delivered via costumed interpreters or docents. The most effective interpretation includes a rich mix of strategies to reach the widest possible audience.

T: Transformation: is the ultimate goal of the visitor experience. Successful visitor and interpretive facilities do more than just provide information, they touch people on many levels, allowing them to make personal connections to the subject matter and inspiring them to learn more. Imparting that knowledge and an appreciation of the resource(s) in a clear and memorable way is the key to transformation.

ADROIT forms the sequential basis of the visitor experience through the magnitude or absence of each of the six elements. Those facilities that have all five elements results in the final element Transformation. The application of ADROIT must balanced and recognize the project's vision and mission, demand/capacity, the changing landscape, and protect the existing resources.