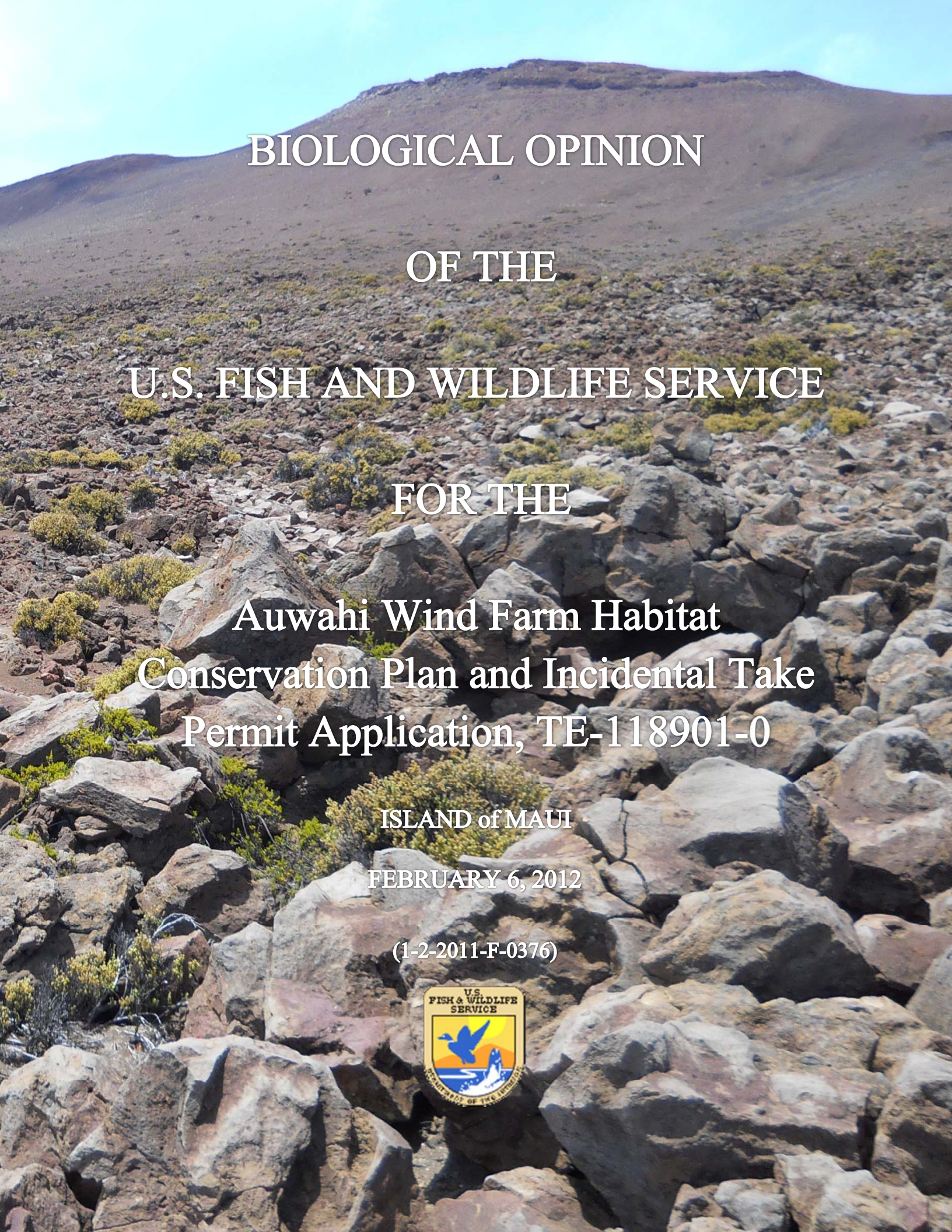

BIOLOGICAL OPINION

OF THE

U.S. FISH AND WILDLIFE SERVICE

FOR THE

Auwahi Wind Farm Habitat Conservation Plan and Incidental Take Permit Application, TE-118901-0

ISLAND of MAUI

FEBRUARY 6, 2012

(1-2-2011-F-0376)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
1-2-2011-F-0376

Memorandum

To: Chief, Division of Consultation and Conservation Planning
Pacific Regional Office
Portland, Oregon

From: Field Supervisor, Pacific Islands Fish and Wildlife Office
Honolulu, Hawaii

Subject: Auwahi Wind Farm Habitat Conservation Plan and Incidental Take Permit Application, TE64153A-0

This document represents the U.S. Fish and Wildlife Service's (Service) biological opinion (Opinion) regarding our proposed issuance of an Endangered Species Act (ESA) section 10(a)(1)(B) incidental take permit (Permit) for the Auwahi Wind Farm in east Maui, Hawaii. Auwahi Wind Energy LLC (the Applicant or Auwahi), a subsidiary of Sempra Generation, which is a subsidiary of San Diego, California-based Sempra Energy applied for a permit to develop and operate an eight-turbine wind energy generation facility (wind farm or Project) and implement the Auwahi Habitat Conservation Plan (HCP) pursuant to the requested Permit. This Opinion addresses impacts of Permit issuance and project implementation to the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), Hawaiian petrel *(Pterodroma sandwichensis)*, Hawaiian goose (*Branta sandvicensis*), and Blackburn's sphinx moth (*Manduca blackburni*). The above species are hereafter referred to as the "Covered Species." Impacts of mitigation actions to listed plants and critical habitat are addressed in our December 23, 2011, memorandum to the record. This Opinion was prepared in response to your January 5, 2012, request for initiation of formal consultation in accordance with section 7 of the ESA of 1973, as amended (16 U.S.C. 1531 et seq.).

This Opinion is based upon information in the following documents: (1) the Auwahi Wind Farm HCP (Tetra Tech 2012), which is herein incorporated by reference; (2) the Auwahi Wind Farm HCP Final Environmental Assessment (EA) (Service 2012); (3) the Recovery Plan for the Hawaiian Hoary Bat (*Lasiurus cinereus semotus*) (Service 1998); (4) the Hawaiian Dark-rumped Petrel and Newell's Manx Shearwater Recovery Plan (Service 1983); (5) the Draft Revised Recovery Plan for the Nene or Hawaiian goose (*Branta sandvicensis*) (Service 2004); (6) the Recovery Plan for the Blackburn's sphinx moth (Service 2005); (7) other biological literature

cited herein (*see* Literature Cited); and (8) other information in our files. A complete administrative record of this consultation is on file at the Service's Pacific Islands Fish and Wildlife Office in Honolulu, Hawaii.

Consultation History

On January 5, 2012, the Service's Pacific Regional Office submitted a formal request for consultation on the proposed Permit action to the Pacific Islands Fish and Wildlife Office

1.0 DESCRIPTION OF THE PROPOSED ACTION

Activities Covered Under the Proposed Permit and HCP

Project Overview

The Service proposes to issue a Permit to the Applicant for the incidental take of the Covered Species by HCP - covered activities associated with the construction and operation of Auwahi, a new eight-turbine, 21-megawatt (MW) wind energy generation facility, and to approve the proposed HCP addressing, in part, measures the Applicant will take to minimize and mitigate the impacts of incidental take of the Covered Species.

The proposed action is detailed in the HCP (Tetra Tech 2012) and the Final EA for the proposed Permit action (Service 2011), which are incorporated herein by reference. Table 1 summarizes the Applicant's requested levels of incidental take for each of the Covered Species; Table 2 outlines the Applicant's proposed measures to mitigate the impacts of incidental take for each of the Covered Species. Take tiers were established to facilitate mitigation planning and implementation given uncertainty regarding potential project impacts to Covered Species. Tier levels were set based on calculations and risk assessments summarized in this Opinion and detailed in the HCP.

Table 1. Amount of Anticipated Take Requested at Tier 1, Tier 2, and Tier 3 levels.

Covered Species	Tier of Take	Take /Impact over 25-year Permit Term
Hawaiian Hoary Bat	Tier 1 Tier 2 Tier 3	5 adults and 2 juvenile 10 adults and 4 juveniles 19 adults and 8 juveniles
Hawaiian Petrel	Tier 1 Tier 2 Tier 3	19 adults/ immatures and 7 nestlings/eggs 32 adults/ immatures and 12 nestlings/eggs 64 adults/ immatures and 23 nestlings/eggs
Hawaiian Goose	Not Applicable	5 adults/immatures/nestlings/eggs
Blackburn's Sphinx Moth	Not Applicable	Habitat Loss: Development of 0.3 ac (0.1 ha) of native habitat and 27.7 ac (11.2 ha) of degraded Blackburn's sphinx moth habitat.; capture and translocation of larvae; injury or mortality if undetected within project footprint.

Table 2. Proposed Mitigation for Covered Species.

Covered Species	Tier 1 or One-Time	Tier 2	Tier 3
Hawaiian hoary bat	Auwahi shall restore 126.5 acres (ac) (51 hectares (ha)) of pasture and non-native forest to native forest (42 ac (17 ha) restored and conserved per male bat taken) and put 198 ac into a permanent conservation easement at the Waihou Mitigation Area of Ulupalakua Ranch.	Auwahi shall conduct a radio telemetry study to determine bat home range and core area sizes in pasture and native forest on Maui.	Auwahi shall restore an additional 195 ac (79 ha) of native forest and put into permanent conservation easement an additional 236 ac (96 ha) of private land at the Waihou Mitigation Area or, with Agency approval, contribute to a pooled-partnership for bat mitigation at the Kahikinui Forest Project or other appropriate bat mitigation site.
Hawaiian petrel	Auwahi shall increase survival and reproduction of petrels nesting in 44 known active burrows at the 500 ac (202 ha) Kahikinui colony for 20 years.	If Tier 1 mitigation does not offset Tier 2 take, Auwahi shall, to the extent necessary to offset Tier 2 take, augment predator control at Kahikinui (increase the number of burrows managed or increase management intensity), conduct predator control to conserve the 74 active burrows at the 328-ac (133 ha) ATST mitigation site for remainder of 20-year period, or implement a combination of the above.	Auwahi shall, to the extent necessary to offset Tier 2 take, augment predator control at Kahikinui (increase the number of burrows managed or increase management intensity), conduct predator control to conserve the 74 active burrows at the ATST mitigation site for remainder of 20-year period, or implement a combination of the above.
Hawaiian goose	Auwahi shall fund construction of a predator-fenced pen to enable egg and gosling rescue at Haleakala National Park.	Not Applicable	Not Applicable
Blackburn's sphinx moth	Funding to the LHWRP* to restore dryland forest in the Auwahi Forest Restoration Project; outplanting of the moth's larval and adult host plants.	Not Applicable	Not Applicable

*LHWRP – Leeward Haleakala Watershed Restoration Partnership; ATST – Advanced Technology Solar Telescope.

Action Area

The action area consists of all areas to be affected directly or indirectly by the action including access roadways, wind turbine footprints, associated facilities, overhead collection lines, and meteorological towers. The action area also includes mitigation sites, where actions will be implemented to benefit the Covered Species. Potential adverse impacts of mitigation site fence installation and vegetation management to critical habitat and listed plants were determined to be not likely to adversely affect listed species and critical habitat.

Auwahi proposes to construct and operate a wind farm with a net generating capacity of 21 MW, augmented with a battery energy storage system in east Maui, Hawaii. In addition to the wind turbine generators (WTG) and the battery energy storage system, the Project includes an electrical collection system, an operations and maintenance facility and related infrastructure, an approximately 9-mile (mi) (15-kilomteter (km), 34.5-kilovolt (kV) generator-tie line, an interconnection substation, and an approximately 27-mi (44-km) construction access route from the Port of Kahului to the Project site (Figure 1). Construction is expected to begin in March 2012, and the Project is expected to be operational in December 2012. The Project will be located almost entirely on the Auwahi Parcel of the Ulupalakua Ranch, approximately 10 mi south of Kula, in the Hana, Kula, and Kihei Districts of Maui. It consists of three major components:

- A 1,466-ac (593-ha) wind farm site, located on the southern portion of the Auwahi Parcel that is bordered by the Pacific Ocean to the south and Upcountry Piilani Highway to north with state-owned undeveloped lands adjacent to the west and east of the site.
- An approximately 9-mi (14 km), 34.5-kV generator-tie line and an interconnection substation that will facilitate the connection of the wind farm to the Maui Electric Company's electrical grid system. The generator-tie line will originate within the wind farm site and extend north and west on Ulupalakua Ranch property, crossing both Upcountry Piilani Highway and Kula Highway to connect to the existing Wailea-Kealahou 69-kV transmission line at the proposed point of interconnection located approximately 1 mile east of the Wailea substation.
- An approximately 27-mi (43 km) construction access route for the transportation of equipment from Kahului Harbor to the proposed wind farm site. The construction access route will primarily follow existing state and county highways as well as approximately 4.6 mi (7.4 km) of pastoral roads between Makena Alanui Road and Upcountry Piilani Highway. These pastoral roads are collectively referred to as Papaka Road and are located on Ulupalakua Ranch and several other private and publicly owned parcels.

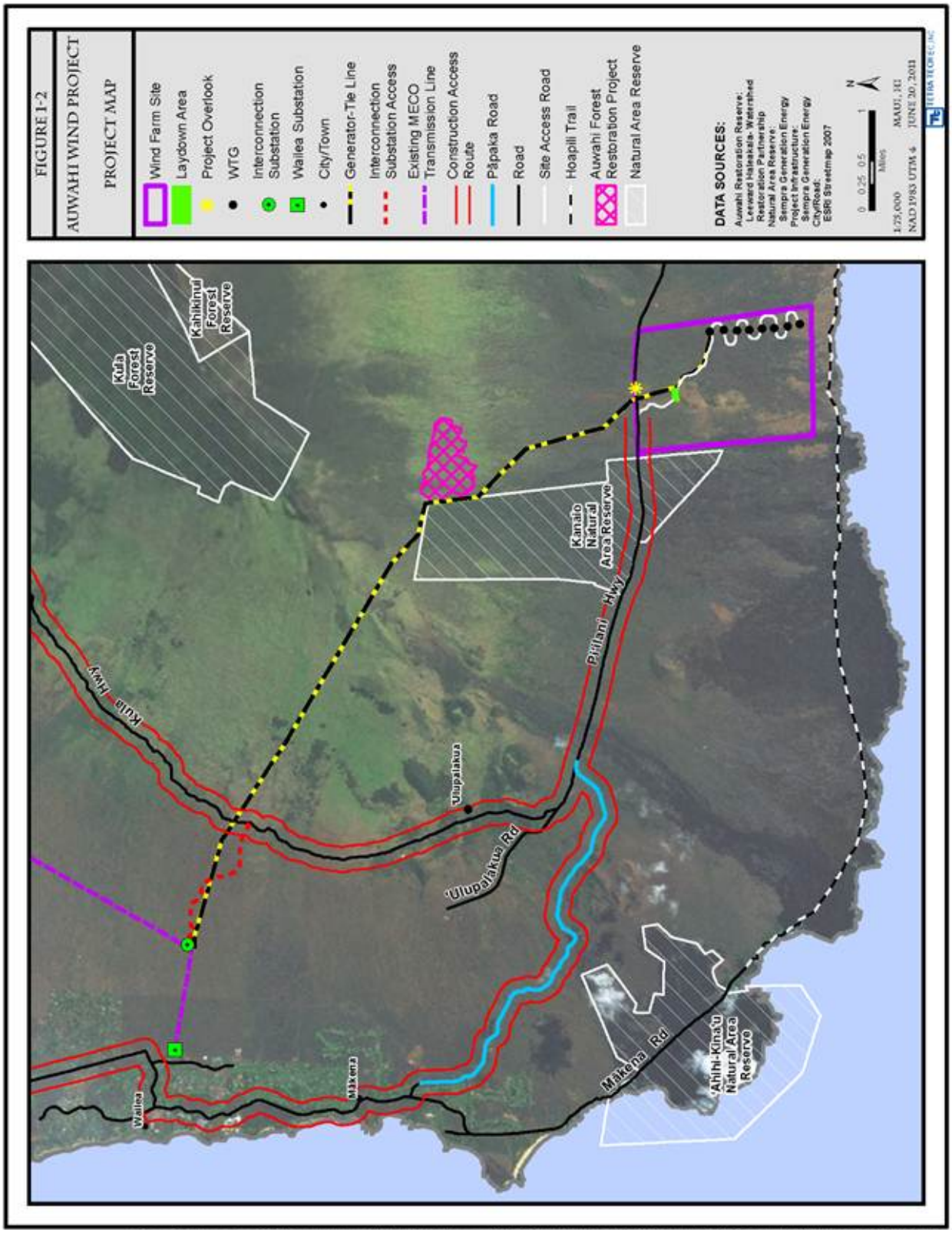


Figure 1. Auwahi wind farm project site.

Project Description Summary

The proposed Permit action and HCP entail the Applicant's completion of the following actions: 1) construction, operation, and decommissioning of a wind farm site; 2) improvement of access roads; 3) development and maintenance of a transmission line; and 4) implementation of mitigation actions.

Project Design and Components

Wind Farm Development and Operations

The wind farm site will include the following facilities: turbine pads and access roads, construction staging and equipment laydown area, WTGs, underground and overhead electrical collection systems, an operations and maintenance building, and one permanent or two temporary meteorological towers.

Turbine Pads

Auwahi will install eight 3.0-MW Siemens wind turbines. The 3.0-MW Siemens WTG is a gearless direct-drive machine with a hub height of 263 ft (ft; 80 m) and a rotor diameter of 331 ft (101 m), resulting in a maximum height (height to the top of the blade) of 428 ft (130.5 m).

Construction Activities. At the WTG locations, an average area of approximately 2.4 ac (1 ha) will be cleared and graded to provide a level and stable surface for the tower components and erection crane. The WTGs will be assembled at each laydown area immediately before installation utilizing a combination of forklifts, medium-size cranes and a main erection crane (as large as 600 tons (544 metric tons)), located on a compacted gravel crane pad. Medium-size cranes will also be utilized for off-loading and erection or setting of the various tower and WTG generation components. Construction equipment working in these areas will include both wheeled and tracked vehicles. Approximately 3,100 cubic yards (2,370 cubic m) of concrete will be installed in the construction of foundations for the WTGs, meteorological tower(s), the operations and maintenance building, and other equipment pads. Rock anchors may be used for foundation construction instead of concrete. Existing batch plants on Maui will supply all of the Project's concrete requirements. Staging of concrete trucks will occur within the construction staging area.

Operation and Maintenance Activities. Following construction, the cleared and leveled areas at the WTG pads will be reseeded with natural and pasture vegetation. An average area of approximately 0.3 ac (0.1 ha) will be kept cleared of vegetation during the years of wind farm operation. The graveled areas around the WTG pads will be maintained by grading and compacting to minimize erosion. During the operations phase of the Project, preventative maintenance and troubleshooting activities will be routinely performed on each WTG. These activities will typically include an inspection and servicing of all major mechanical components, lubrication systems, generators, blades, electrical and transformer components, communication and supervisory control and data acquisition components, and meteorological instrumentation. Routine servicing typically does not require heavy equipment, such as large cranes, but does require service vehicle access.

However, in the event of a major component replacement (e.g., blades or generators), heavy equipment similar to that used during construction, will be required. If a major component replacement were necessary, the access road, crane pad, and staging area will be used in a similar manner as for the original assembly area, with similar disturbance and mitigation.

Access Roads

Construction Activities. A series of internal access roads will be constructed within the wind farm site to accommodate construction and maintenance activities. The internal access roads will be approximately 20 ft (6 m) wide with 9-ft wide (3-m wide) shoulders on each side (38 ft (12 m) total width) during construction. Shoulders may be expanded to 16 ft (5 m) wide in certain defined areas to allow for adequate passage for the crawler crane and transport trucks, and will include turn-around areas at certain WTG pad locations. The total temporary disturbance required during construction of the road will depend on the amount of cut-fill in any one area but will be greater than the width of the road and could expand to 138 ft (42.1 m) wide. In total the access roads will be approximately 3.6 mi (5.8 km) long. All access roads will have a gravel surface and stormwater collection and erosion control features will be maintained throughout Project construction and operation.

Operation and Maintenance Activities. During operations, road widths will be maintained at 25 ft (7.6 m) to 38 ft (11.6 m) wide. Access roads will be maintained in good working order by grading and compacting to minimize naturally occurring erosion. Maintenance vehicles and service trucks will continue to use the access roads for routine maintenance of the WTGs.

Construction Staging and Equipment Laydown Area

Construction Activities. The construction staging and equipment laydown area will consist of an approximately 4.9-ac (2.0-ha) compacted gravel pad constructed adjacent to the proposed collector switchyard. Construction activities consist of clearing and grubbing, topsoil stripping, grading to control stormwater runoff and drainage, compaction, utility trenching, and placement of aggregate surfacing. Following construction, the temporary affected area will be restored and planted with native vegetation or pasture grasses.

Operation and Maintenance Activities. Following construction, gravel will be removed from the temporary construction staging and laydown area and the area will be restored with natural vegetation. A permanent, 0.2-ac (0.08-ha) storage area will be maintained during operations and maintenance to store spare WTG components, such as blades. The permanent operations and maintenance building providing offices for the plant operations and maintenance staff and vehicle parking for plant operations will be in this area. The graveled areas for parking and spare parts will be maintained by the operations staff to minimize erosion and control stormwater runoff and drainage.

Operations and Maintenance Building

Construction Activities. An operations and maintenance building will be constructed within the proposed laydown area. The building footprint and concrete slab will be approximately 50 ft by 80 ft (15 m by 24 m), an area of 0.1 ac (0.04 ha). The operations and maintenance building will be a pre-engineered, metal building with an operations room, offices, communications equipment, a warehouse, storage space, a kitchen area, and bathrooms. In addition to the interior facilities, there will be parking and permanent outdoor storage for major components such as replacement WTG blades adjacent to the operations and maintenance building. The approximately 0.1-ac (0.04-ha) parking and outdoor storage area will be constructed with compacted gravel and will likely be enclosed by a 7-ft (2-m)-high chain-link fence topped by three strands of barbed wire, with posts set in concrete. Utilities for the operations and maintenance building will include a septic system, an onsite well or water storage tank, electricity, and communication services. A septic system will be designed based on the results of the percolation test to be completed during future geotechnical studies. This septic system and all utilities will be designed in compliance with all applicable state and county regulations and requirements.

Operation and Maintenance Activities. Activities associated with the operations and maintenance building will include basic maintenance and upkeep of the facility. Permanent infrastructure will include water and wastewater systems, potentially an onsite well, and a septic system.

Meteorological Monitoring Towers

Construction Activities. One permanent met tower or two temporary met towers will be installed to measure and record weather data to track the performance of the WTGs. Meterological towers would have a height of 262 ft (80 m), guy radius of 208 ft (63 m), and a tower rating of 80 miles per hour (mph) (129 kilometers per hour (kph)) wind speed. If temporary meterological towers are used, one will be removed by the end of construction and the other would be up for approximately five years. Either a lattice tower or a monopole tower would be installed. For determining impacts, a conservative approach for the permanent guyed met tower (fitted with bird diverters and white, 1-inch [2.5-cm] poly tape) would be to assume a circular area with a 210-ft (64-m) horizontal radius (guy radius). This would be a maximum total impact area of approximately 3.1 ac (1.2 ha), of which 0.2 ac (0.1 ha) would be permanently impacted. Construction of the permanent met tower would require site preparation (e.g., clearing and grubbing); grading; installation of a foundation, underground electrical and communication lines; and onsite assembly of the tower. Disturbance for the temporary met towers has already been accounted for in disturbance areas for other project components.

Operation and Maintenance Activities. Meteorological towers require routine monitoring and maintenance activities during their operation, but do not typically require heavy equipment for servicing.

Underground Electrical Collection System

Construction Activities. Power generated by each of the WTGs will be collected by a series of underground power cables. These underground power cables will transition to two

above ground, pole-mounted circuits at the northernmost WTG location. The trenches for the underground cables will be excavated by rubber tire or tracked vehicle. Blasting may be required to install the trenches. The cable trench will be backfilled to protect the cables from damage or possible contact and to provide appropriate media for heat dissipation from the cables. Approximately 3 ac (1.2 ha) of temporary ground disturbance will be necessary to construct the underground electrical collection system. Following construction, the collection system trenches will be marked to avoid inadvertent excavation and the surface will be restored and replanted with natural vegetation.

Operation and Maintenance Activities. Using small trucks, qualified personnel will routinely monitor, inspect, and maintain the communication and electrical collector cables throughout the operations and maintenance phase of the Project. Heavy construction or excavation equipment may be used to disturb the soil if an underground cable fails and needs to be repaired or replaced.

34.5-kV Generator-tie Line

Construction Activities. The 34.5-kV generator-tie line will connect the wind farm site with the 69-kV interconnection substation, where power will be connected to the Maui Electric Company lines. The generator-tie line will be suspended on approximately 175 wood poles. The poles will support the two three-phase 34.5-kV generator-tie line (i.e., six conductors), associated insulators and accessories, and an optical ground wire. The poles will be within a 60 ft (18 m) wide, 9 mi (14.5 km) long corridor. The poles are anticipated to be approximately 60 ft (18 m) tall, similar to the existing wood poles supporting Maui Electric Company's Wailea-Kealahou transmission line. Taller poles may be required along a small section of the generator-tie line (less than 1,000 ft (305 m)) if it is necessary to span a Fresnel (beam) zone along the alignment. Generator-tie line structures could approach approximately 100 ft (31 m) in height. Poles with guy wires will only be used at inflection points along the generator-tie line and will be fewer than 10% of the overall poles. Temporary disturbance associated with the generator tie-line will be approximately 63.0 ac (25.2 ha). The generator-tie line will have a height at or below 60 ft (18 m) above the ground (height at the poles with lines sagging between poles). Conductors will be arranged vertically, such that the static ground wire will be positioned above the generator-tie line. This configuration, versus a horizontal arrangement, was selected to maximize efficiency by minimizing the need for an additional transmission line corridor should future users wish to tie-in to the line. The generator-tie line will be designed to minimize the potential for collision by birds by fitting an approximately 1.6 mile (1.0 km) stretch identified as having the highest collision risk with bird flight diverters. Permanent disturbance associated with generator-tie line structures will be approximately 2.0 ac (0.8 ha).

Operations and Maintenance Activities. Qualified personnel will routinely monitor, inspect, and maintain the generator-tie line facilities throughout the operations and maintenance phase. These maintenance activities will be accomplished with the use of off-road vehicles and light trucks. Heavy construction equipment will only be required if overhead facilities need to be repaired or replaced.

69-kV Interconnection Substation

Construction Activities. An area of approximately 6.4 ac (2.6 ha) will be cleared and graded during construction of the interconnection substation and approximately 5.0 ac (2.0 ha) will be permanently cleared and fenced. The substation will be shared by Auwahi and Maui Electric Company. The substation area will be cleared and graded to control stormwater runoff and the substation pad will be compacted. Foundations and below-grade conduit will be installed for the components. Vehicle access will be developed on the east and north sides of the substation, with a fence line separating the Auwahi and Maui Electric Company facilities. Following installation of all equipment, a final layer of crushed rock surfacing will be placed and a perimeter fence will be erected and grounded. The substation area will include the battery energy storage system that consists of batteries, inverters, step up transformers, and a control system to meet Hawaiian Electric Company performance requirements. The design life of the battery energy storage system is 20 years. The battery energy storage system will consist of approximately ten 50-foot (15.2-m) shipping containers of battery cells. A portion of the battery cells may need to be replaced at intervals of approximately five years. The interconnection substation access road from Kula Highway that was improved to build the substation will be used for battery removal and replacement. The removed batteries will be shipped off island as part of the manufacturers recycling program. Depending on the type of battery, the capacity of the battery energy storage system can fade over time, so additional capacity will be installed to compensate for the anticipated capacity fade. The facility could add more energy storage within the cleared area to further smooth the wind power.

Operation and Maintenance Activities. Maintenance activities will include routine inspections of each component and monitoring of equipment and electronics according to the manufacturer's recommendations and owner's requirements, and in accordance with regulatory requirements. Routine maintenance of the interconnection substation will not typically require heavy construction equipment. However, if a major component failure occurred (e.g., a failure of a main transformer) then heavy equipment will be required to replace the component. All maintenance activities will occur within the 6.4 ac (2.6 ha) 69-kV interconnection substation project footprint.

69-kV Interconnection Substation Access Road

Construction Activities. The proposed interconnection substation site is located approximately 1.7 mi (2.8 km) below Kula Highway. To the maximum extent possible, the access road to the interconnection substation will follow the route of existing ranch roads. The existing ranch roads and proposed newly constructed road areas will be 20 ft (6.1 m) wide with a maximum grade of 15% and a minimum turning radius of 100 ft (30.5 m) so that trucks carrying transformers can access the site. Approximately 16.3 ac (6.5 ha) will be disturbed during construction of the substation access road, of which 4.2 ac (1.7 ha) will be permanently impacted. The road will have an all-weather graveled surface with adequate compaction to accommodate the specialized transportation equipment. The road will be designed to adequately manage stormwater runoff and minimize erosion. Drainage measures could include ditches and culverts to collect and convey stormwater. Following construction, any deteriorated roadway surfaces will be repaired and restored.

Operation and Maintenance Activities. Following construction, the access road to the 69-kV interconnection substation will be used for routine operations and maintenance activities but it will be closed to the public. The access roads will be maintained in good working order by grading and compacting to minimize erosion.

Construction Access Route

Most of the materials and equipment required for the Project, including the turbine components and construction materials and equipment, will be imported to Maui through Kahului Harbor, the island's only commercial port, and then transported to the Project site. The construction access route consists of two routes 1) the Papaka Route (Route A) extends from Kahului to the Mokulele Highway, through Kihei, Wailea, and Makena, and along Upcountry Piilani Highway to the wind farm site; and 2) the Kula Route (Route B), a more direct route from Kahului Harbor, uses Haleakala and Kula highways. Several portions of Route B do not have dimensions or weight limits adequate for the size of transport truck required for hauling turbine components; however, this route is suitable for other construction vehicles such as worker vehicles, dump trucks, and typical semi-trucks.

Because most of the major turbine components are considered "superloads," special transportation equipment (e.g., multi-axle transport trailers, Schnabel trailers with hydraulic lifts, and steerable blade-trailers) will be required. To accommodate these superloads, portions of Kula Highway (referred to as Upcountry Piilani Highway) and Papaka Road will require permanent modifications. Approximately nine bumps with a rise greater than 20 inches (50.9 centimeters) over a 100-foot (30.5-meter) length may require modification and possibly two S-curves will need to be widened. The level of modification will depend on a number of factors including selection of the transportation provider (by the construction contractor) and availability of specialized transportation equipment. For example, if it were determined that the removal of a bump was required, the construction contractor could either (1) re-contour the road profile by removing the bump, or (2) temporarily fill in the areas approaching and exiting the bump (i.e., provide a more gradual transition). The affected zones of construction could be 200 to 400 ft (61 to 122 m) long, and will typically be limited to the existing width of the road including the shoulders. Curve widening may be required in one or two locations. The construction contractor will excavate the inside shoulder of the curve to provide a smoother, horizontal transition into and away from the curve. The affected zones of construction could be 200 to 400 ft (61 to 122 m) long and may extend 40 to 50 ft (12 to 15 m) onto the inside shoulder of the curve. Any temporary or permanent road modifications proposed by the construction contractor will be coordinated with the County of Maui.

Temporary road improvements will also be necessary at the intersections of Piilani Highway and Wailea Ike Drive, Wailea Ike Drive and Wailea Alanui Drive, and Makena Alanui Road and Makena Golf Road. These improvements will all occur within the existing road bed for the Project. Following construction, the construction access route will continue to be used for normal public traffic and routine operations and maintenance activities. A total of approximately 50.6 ac (20.2 ha) will be disturbed in association with construction access route modifications, of which 11.2 ac (4.5 ha) will be permanently developed.

Wind Farm Site Clean-Up

All portions of the Project will be maintained in an orderly and clean manner throughout construction. At the completion of the construction phase, a final cleanup of all components of the Project will be done. All construction-related waste will be properly handled in accordance with county, state, and Federal policies and permit requirements and removed from the area for disposal or recycling as appropriate. Areas with disturbed soil that will not be used during operations will be stabilized and returned to native vegetation; most of the project area will continue to serve as pasture for Ulupalakua Ranch cattle operations.

Decommissioning and Restoration

The Project has an estimated life of 20 years based on the projected useful life of the WTGs. After that time, the Applicant will evaluate whether to continue operations of the Project or decommission it. The Project could potentially be upgraded and repowered with renegotiated leases and permits (not addressed in this Opinion). If the Project is decommissioned, the goal of decommissioning would be to remove the power generation equipment and return the site to a condition as close to its pre-construction state as possible within two years as contractually required in both the Land Lease with Ulupalakua Ranch and the power purchase agreement with Maui Electric Company. All decommissioning- and restoration-related waste will be properly handled and disposed of or recycled, as appropriate, in accordance with county, state, and Federal laws and permit requirements. Foundations would be removed to a depth below grade, and roads would be left for use by Ulupalakua Ranch. Major activities required for decommissioning will typically occur in reverse order to those of construction and are listed below:

- WTG foundation and meteorological tower removal. Concrete and steel will be hauled offsite. Foundations will be filled with native weed-free aggregate and soils;
- Electrical collection system removal for above-ground structures and decommissioning in place for below-ground cables;
- Sale or demolition of the operations and maintenance building. The on-site septic system will be abandoned consistent with state and local requirements, unless needed for a future use of the site;
- Generator-tie line removal. Foundation holes will be filled with native weed-free soil;
- Road removal (as required by permit and/or site control agreements by landowners). Road disturbances will be re-graded to original contours where cut and fill made recontouring feasible. Any roads left in place will become the responsibility of the landowner;
- Grading disturbed areas to preconstruction contours where feasible;
- Revegetation with native or pasture grass species to ensure establishment of vegetation. Where applicable, restored areas will be stabilized and returned to cattle grazing; and

- Recycling and disposal of materials, WTG components, and any hazardous and regulated materials and wastes will be conducted per applicable local, state, and federal regulations.

The objective of decommissioning would be to restore the visual and ecological character of the landscape and also remove effects to other environmental and public resources that may have occurred as a result of Project operations.

Construction and Operation Avoidance and Minimization Measures

Measures to minimize the potential impacts that Auwahi may have to listed species incorporated into the site design and configuration include:

General Project Development Measures

A daytime speed limit of 25 mph (40 kph) and a nighttime speed limit of 10 mph (16 kph) will be observed on Project area roads to minimize the potential for vehicle collisions with Covered Species.

Truck and heavy-equipment traffic will be limited to existing disturbed areas as much as possible.

The spread of invasive, non-native plant species caused by Project construction will be minimized through cleaning and inspecting equipment coming to the site and by replanting disturbed areas with native species or pasture grasses to be compatible with continued grazing. Trash, especially food stuffs, will be removed from the construction area on a weekly basis to avoid attraction of ants and other animals such as cats (*Felis catus*), Indian mongoose (*Herpestes javanicus)*, and rats *(Rattus* spp) that may negatively affect the Covered Species.

Erection of turbine blades may occur at night because it can't be completed when winds are strong. Turbine blade erection is scheduled to take a total of 16 work shifts. As construction is currently scheduled, all turbine blade erection should be completed before September 1, 2012. Should turbine blade installation occur after September 1, all practicable measures will be taken to avoid use of lights at night one week before or after each new moon. If construction lighting is used, a biological monitor will be on-site. If a seabird is attracted to construction lighting, the lighting will be turned off as soon as human health and safety permit. The biological monitor will be prepared to recover and transport a downed seabird for rehabilitation.

A Project biologist will be on-staff during Project operations to conduct post-construction monitoring surveys, to assist with mitigation implementation, to educate construction and other on-site workers about endangered species avoidance and minimization measures and to address any potential wildlife issues that may arise.

Pre-construction Surveys and Timing Considerations

To minimize impacts to Blackburn's sphinx moth habitat, the aiea (*Nothocestrum latifolium*) within the project footprint will be permanently fenced and avoided during construction; maiapilo (*Capparis sandwichiana*) and moon flower (*Ipomoea* spp.), moth food plants,

that can be avoided within the areas of disturbance will also be flagged and temporarily fenced to ensure direct impacts are avoided during construction.

A survey and relocation plan for the Blackburn's sphinx moth, based on Service and DOFAW protocol, will be implemented by a qualified entomologist. Pre-construction clearance surveys will be conducted 90 days prior to the start of construction for Blackburn's sphinx moth adults and larvae. These surveys will identify and map plants in the Solanaceae family (i.e., tree tobacco (*Nicotiana glauca*), the plant species Blackburn's sphinx moths are most commonly associated with) and those plants with Blackburn's sphinx moth or larvae within the Project area. Unoccupied Solanaceous plants will be removed to prevent future use by the Blackburn's sphinx moth. Should any larvae or moths be found just prior to construction, the larvae and moths will be removed and relocated by the authorized entomologist to an approved nearby location outside the area of disturbance that contains suitable moth habitat to avoid direct take. These occupied areas will be flagged and avoided during construction until the moth or larvae can be relocated. The pre-construction surveys and associated plant removal/moth relocation will help to reduce the likelihood of the Blackburn's sphinx moth occurring in the Project area during construction and ultimately the potential direct take from ground disturbance during construction.

Auwahi will maximize the amount of construction activity that can occur in daylight during the seabird breeding season to minimize the use of nighttime lighting that could be an attraction to seabirds. Construction at night will be necessary for small time periods (i.e., a few hours) in the event that high winds above 25 mph (40 kph) during daytime hours prohibit safe turbine erection. The need for erecting the turbine towers at night will be determined by Auwahi and is anticipated to be infrequent and restricted to the period of September to December 2012. Additional limited Project activities, such as the transportation of some Project equipment and the pouring of concrete pads, may occur at night as well to minimize daytime construction traffic, but will be kept to a minimum. Each turbine foundation will require one day to pour the concrete; a total of 8 days spaced throughout May to August 2012. In instances where nighttime construction is unavoidable, lighting will be limited to one tower at a time, providing that doing so does not compromise worker safety. An environmental monitor will be onsite during those periods of night construction. If the monitor observes that any Covered Species are being attracted to the construction lighting, such lighting will be turned off as soon as it is safe to do so. In the unlikely event that construction lighting results in the grounding of Covered Species, the monitor will retrieve and assist such individuals in accordance with the Downed Wildlife Protocols.

Hawaiian hoary bats roost in non-native and native woody vegetation that is at least 15 ft (4.5 m) or taller. To minimize potential impacts to the Hawaiian hoary bat, woody plants greater than 15 ft (4.5 m) tall will not be removed or trimmed between June 1 and September 15 during the installation and ongoing maintenance of the Project structures.

<u>Project Components and Siting Considerations</u>

At the time of installation, the permanent meteorological tower guy wires will be fitted with bird flight diverters and white, 1-inch (2.5-cm) poly tape, to increase visibility and

subsequently increase the likelihood of avoidance by the seabirds and bats. Swift (2004) and Penniman and Duvall (2006) found that the incorporation of strips of white, non-reflective electric fence polytape or similar material into fences reduced the risk of Hawaiian petrel collision. The wind farm is sited in an area with limited forested areas to avoid potential impacts to bat roosting habitat.

The proposed WTG model has significantly slower rotational speeds (6 to 16 rotations per minute (rpm)) compared to older designs (28.5 to 34 rpm). This increases the visibility of turbine blades during operation and decreases collision risk (Thelander et al. 2003). Additionally, the selection of the 3.0-MW Siemens model results in the least ground disturbance because only 8 turbines will be installed compared to the other turbine models considered that would have required 15 or 10 turbines (1.5-MW GE and 2.3-MW Siemens).

A Federal Aviation Administration endorsement of a minimal lighting plan has been requested to reduce the likelihood of attracting or disorienting seabirds, bats, and insects.

To minimize potential impacts to wildlife, onsite lighting at the operations and maintenance building and substation will consist only of fixtures that will be shielded, directed downward, and triggered by a motion detector. These lights will be utilized only when workers are at the site at night.

The proposed substation and interconnect to Maui Electric Company's transmission lines will be designed and installed using industry-standard measures to reduce the possibility of wildlife collisions by fitting bird flight diverters on the generator-tie line in high risk areas. Based on site-specific design work conducted to date, the maximum height of the generator-tie lines will be 65.5 ft (20 m) above ground level to reduce the potential for collision by seabirds.

These measures will also avoid and minimize Project impacts to Migratory Bird Treaty Act-(MBTA) protected species to the extent possible. The Applicant has committed to implementing a post-construction monitoring program to assess project-related impacts to avian species and will use the results of this monitoring to ensure that impacts to MBTA-protected species are avoided and minimized to the extent possible.

Iliahi (Sandalwood, *Santalum freycinetianum* var. *lanaiense*) and red ilima (*Abutilon menziesii*) are the only listed endangered plant species documented during botanical surveys of the Project vicinity. Prior to construction, additional botanical surveys will be conducted to identify any occurrences of these or any other listed plant species in areas proposed for development based on the final project design. All listed plants will be fenced and avoided during construction.

The listed plant species that occur within the Auwahi project vicinity are known to occur in dryland forests on Maui including within the nearby Auwahi Forest Restoration Project and the lower elevations of the Kahikinui Forest Project. Forest restoration conducted at the Waihou Mitigation Area (Hawaiian hoary bat mitigation) and Auwahi Forest Restoration Project (Blackburn's sphinx moth mitigation) will benefit special status and rare plants that occur in the vicinity of the Auwahi project by protecting and restoring native vegetation communities.

The project has been designed to avoid impacts to listed and candidate plant species. The fence enclosures to be installed around each aiea, iliahi, and red ilima adjacent to Project disturbance areas will increase the long-term viability of each plant and provide protection from ungulates that will not otherwise occur. Therefore, there are no direct impacts to these plants. To address the Service's concern that the project will affect existing lands which hold the potential for supporting listed species in the future, Auwahi agreed to outplant a total of 10 additional plants for each species (aiea, iliahi, and red ilima) into fenced conservation areas at Ulupalakua Ranch. In addition, the Auwahi Forest Restoration Project (described in the Blackburn's sphinx moth mitigation section of this project description) includes the plantings of aiea and iliahi and, therefore, will benefit these species directly.

As part of the Blackburn's sphinx moth mitigation, 250 outplantings of aiea per restored acre (over a 6 acre mitigation area) will be installed at the Auwahi Forest Restoration Project. Because this number of plants far exceeds the number requested by the Service, there is no need for additional outplantings of this species.

Invasive Plant Species Management

Auwahi will work actively to minimize the ingress of invasive plant species such as fireweed (*Senecio madagascariensis*), a pasture weed that is highly toxic to grazing livestock and quick to recolonize disturbed areas. Auwahi will implement measures to minimize and avoid the introduction of invasive species to Ulupalakua Ranch including:

All equipment, materials, and vehicles brought onto the site during construction will be cleaned and inspected to prevent the introduction of invasive or harmful non-native species. An inspection station will be located at the staging area close to Piilani Highway.

To minimize the introduction and spread of invasive plant species, potential off-site sources of materials (e.g., gravel, fill) will be inspected, and the import of materials from sites that are known or likely to contain seeds or propagules of invasive species will be prohibited.

Vehicle operators transporting materials to the Project site from off site will be required to follow protocols for removing soils and plant material from vehicles and equipment prior to entry onto the site.

The Hawaii Department of Agriculture and Maui Invasive Species Commission will be consulted to establish protocols and training orientation methods for screening invasive species introductions during construction.

As part of the fire management plan, Auwahi will conduct surveys for invasive species of fire-prone grasses, with an emphasis on barbed wire grass and fountaingrass (*Pennisetum setaceum*). The survey extent will include, at a minimum, areas within 33 ft (10 m) of disturbance resulting from construction within the wind farm site, the connection substation site, and within roadways constructed or utilized more than once monthly for wind farm construction or maintenance. Individuals or colonies of alien invasive grasses observed will be exterminated by Auwahi via a means that includes killing the root system.

Fire Prevention During Construction and Operation

Fire risk associated with generator-tie line construction and operation is low. Fires may be ignited by the WTGs, along the generator-tie line, or at the battery energy storage system. One area of concern is along the pinch point corridor between the State Natural Area Reserve land and the Auwahi Forest Restoration Project, due to the proximity of native habitat. However, the probability of a fire associated with the generator-tie line is approximately 0.05% over the lifetime of the Project (see the Fire Management Plan in Appendix C of the HCP). Downed generator tie-lines represent an ignition threat which usually stems from a weather event that causes degraded wood poles to blow over in high winds, or from a hazard tree coming into contact with the line itself. In addition to downed lines, poorly maintained lines can produce sparks and arcing that may cause a fire ignition in rare cases. Thus, design and maintenance are keys to the integrity of the line.

As noted above, the generator-tie line will consist of a vertically arranged three-phase 34.5-kV line with six conductors. As configured the line is capable of carrying the entire wind farm output. During normal operations, assuming full output from the wind farm, only half of the plant output will be carried on each individual circuit. Under these conditions the current flow on each circuit will be approximately 211 Amperes and the associated conductor temperature will be 132 degrees Fahrenheit (F), far below the design temperature criteria of 212 degrees F for calculating line clearances. Therefore, the generator-tie line will easily maintain the minimum required 18.5-ft (5.6-m) ground clearance under maximum line sag conditions at 212 degrees F. Consequently, there should be no issue with line conductors sagging down towards the ground and starting a fire based on the National Electric Safety Code design for this line. In the unlikely event that the full plant output of 24 MW is carried on a single circuit, current flow will be 423 Amperes and conductor temperature will be 171 degrees F, also well below the design criteria of 212 degrees F. With full wind farm plant output on only one of the two circuits, the single circuit will load within 80 percent of the maximum design rating, which is a typical engineering design standard. It is important to note that design calculations are based on wind speed of 2 ft per second (0.6 m per second) or 1.62 mph (2.61 kph) and 104 degrees F ambient temperature assumptions. In reality, the line will be fully loaded only when wind speeds are above 29 mph (47 kph), so there will be a significant natural cooling effect to reduce conductor temperature even further below the calculated value of 171 degrees F at 1.36 mph (2.19 kph). This effect is one of the benefits of loading a generator-tie line for a wind project.

Auwahi will incorporate measures to address extreme wind design conditions. Although the line voltage is 34.5 kV, Auwahi will use one class higher insulators (69 kV) for added strength and shorten the span lengths between poles to withstand severe weather conditions and strong wind uplift forces due to undulating topography near the line. The benefit of higher rated insulators will be greater arcing and leakage distance to counteract salt contamination, soiling (i.e., build up on exterior of the insulator due to dust or pollution), and provide greater horizontal conductor separation to reduce the source of ignition (electrical faults). Basically, the design of the generator-tie line will reduce the risk of fire because the line will be normally operated with each circuit carrying only half of the full wind farm output and be structurally designed to meet or exceed standards and withstand extreme weather conditions.

To further reduce the risk of fire during construction and operations, Auwahi will implement the measures outlined in the Fire Management Plan and conduct regular maintenance of the generator-tie line and the turbines. These measures will including the following:

- A scheduled maintenance system will be established by Auwahi during Project operations as a repository of key information about fire prevention activities associated with the generator-tie line. This system will be used and updated by Project operations and maintenance personnel who are trained in fire management practices. The system will also maintain records of best practices in fire prevention. One way to improve fire prevention performance over the long term is to adopt practices that have proven to be valuable and effective elsewhere in the industry and can be applied at the Project.
- The generator-tie line poles will be inspected regularly to determine if there is any degradation or structural problem preventing them from withstanding high winds. As part of the fire management plan, trained personnel will maintain the generator-tie line conductors and remove any overhanging limbs or trees, as necessary, to prevent branches from falling onto the power line. However, most of the generator-tie line traverses pasture.
- Generator-tie line insulators will be maintained as needed. Furthermore, vegetation will be maintained at least 16 ft (5 m) radius around the conductors in all directions. Most of the generator-tie line traverses pasture. Brushing or brush removal around the base of the poles is a precautionary measure to prevent fires from starting or keep them from spreading and affecting the integrity of wood pole structures along the generator-tie line. Furthermore, regular grazing by cattle, which is an ongoing aspect of Ulupalakua Ranch activities, minimizes fuel loading.

Auwahi is part of a one billion dollar wildfire liability insurance program through its parent corporation, Sempra Energy. The insurance coverage not only pays for bodily injury and repair/replacement of the dwellings and personal property of third parties but also pays for replanting and refurbishing of vegetation that is damaged by wildfires caused by the legal liability of Auwahi in the operations of the wind farm.

Fire risk associated with WTG operation is much lower than fire risk of other turbine models considered for Project use. The direct drive design of the Siemens 3.0-MW turbine eliminates the gearbox and therefore the need for gearbox lubricating oil inside the nacelle. Therefore, this WTG design has no risk of gearbox-related fires that have occurred in other turbine models.

Monitoring and Reporting Project-Related Impacts

Collision of Covered Species with the WTGs, temporary and permanent meteorological towers, overhead collection lines, and cranes used for construction of the turbines will be monitored and reported to track take and evaluate effectiveness of minimization measures. Survival and reproductive success will be monitored at mitigation sites to track the benefits of mitigation. Periodic and annual reports will be developed to track implementation of the HCP.

Monitoring and reporting will ensure legal compliance with the provisions and take limitations of the HCP and the Permit, and effectiveness of the mitigation efforts. Monitoring will ensure that the authorized levels of take are not exceeded, and that the effects of take are minimized and mitigated as outlined in the HCP. Monitoring will also assess the success of the HCP's mitigation program. The HCP's adaptive management strategy provides a mechanism for modifying or adding minimization measures or adjusting mitigation to incorporate monitoring results. Annual reports will be provided to the Service and State of Hawaii Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW) to enable independent verification that Auwahi has performed required tasks and activities according to the provisions of the HCP. As part of agency compliance monitoring, DOFAW may conduct Auwahi-funded independent monitoring tasks sufficient to determine compliance, including independent assessment of searcher efficiency, carcass removal, and net recovery benefit targets and criteria. Pursuant to HRS 195D, and prior agreement, all costs required for that compliance monitoring shall be paid by the applicant.

Monitoring Take

A post-construction monitoring plan (Appendix E of the HCP) will be implemented as a means to document impacts to the Covered Species as a result of operation of the Project, and to ensure compliance with the authorized provisions and take limitations of the HCP and Permit. The monitoring protocol is consistent with post-construction monitoring being conducted, or proposed, for other wind projects in Hawaii and elsewhere in the continental United States (Erickson et al. 2004; Arnett 2005; Kerns et al. 2005; KWP 2008, 2009; Tetra Tech 2008; Arnett et al. 2009; SWCA 2010). Any changes to the protocol from the baseline provided herein would require review and approval by the Service and DLNR. A condition of the Permit ensures the Service may direct Auwahi to increase post-construction monitoring intensity or duration, or modify calculations of project take.

Key components of the post-construction fatality monitoring plan include:

1. Use of Auwahi technical staff and/or third-party contractors trained by experienced biologists with expertise in wind turbine-bird/bat interaction studies and implementing wind energy post-construction monitoring protocol;
2. Standardized searches to detect downed Covered Species and any other species will be conducted during the initial 2-year post-construction monitoring period under the operating wind turbines approximately once per week from March through September and then two times per week during the petrel fledging period in October and November (8-week period). In December to February, surveys will be conducted monthly and thereafter as determined necessary based upon the results of initial monitoring including searcher efficiency and carcass removal. Search intensity may be modified based on the result of the initial monitoring period;
3. Carcass removal and searcher efficiency trials to adjust observed fatality numbers for bias associated with the removal of carcasses by scavengers or other means and the ability of searchers to locate carcasses, respectively;

4. A Wildlife Education and Incidental Reporting Program for reporting incidental observations of Project-related fatalities within the wind farm site and the generator-tie line made by onsite staff;
5. Downed Wildlife Protocol for the recovery, handling, and reporting of downed wildlife; and
6. After the initial 2 years of monitoring, monitoring efforts may be reduced in frequency, with approval of DOFAW and the Service, if available data suggest a low frequency or potential for fatalities of Covered Species. The Wildlife Education and Incidental Reporting Program will supplement the post-construction mortality monitoring to report potential wildlife injuries or fatalities.

The Wildlife Education and Incidental Reporting program will be executed for contractors, Project staff members, and other Ulupalakua Ranch staff who are on site on a regular basis. Staff members will be provided with printed reference materials that include: photographs of each of the Covered Species and information on their biology and habitat requirements; threats to the species onsite; and measures being taken for their protection under this HCP. This training will enable staff to identify the Covered Species that may occur in the Project area, record observations of these species, and take appropriate steps for documentation and reporting when any Covered Species is encountered during construction or operation of the Project including when downed birds or bats are found. The Wildlife Education and Incidental Reporting program will facilitate incidental reporting of observations within the wind farm site, as well as within the generator-tie line corridor where Auwahi and Ulupalakua Ranch staff are regularly present during the course of normal Project and ranch operations. Incidental reporting will inform the Project post-construction monitoring program of any wildlife fatalities that occur outside of standardized fatality surveys within the Project, as well as provide supplementary information on impacts associated with the generator-tie line where standardized post-construction monitoring will not occur. The program will be prepared by a qualified biologist and will be approved in advance by the Service and DOFAW.

The protocol for recovery, handling, and reporting of downed wildlife has been developed in cooperation with the Service and DOFAW. Regular Project staff will be trained in this protocol during the wildlife education briefings and will be responsible for documenting observed fatalities or injury to wildlife. The Service and DOFAW will be notified promptly upon discovery of an injured or dead state- or federal-listed species. The Downed Wildlife Protocol is included in the Project post-construction monitoring plan. This protocol includes procedures to follow upon the discovery of a downed seabird or bat including a prioritized contact list of DOFAW and Service staff; and guidelines for handling, if permitted, injured wildlife or carcasses.

Federal- or state-listed species found injured or dead will be left in place for collection by the Service or DOFAW personnel or collected and frozen if directed by the Service or DOFAW.

Estimating Indirect Take

Monitoring of direct take will also be used to assess Project-related indirect take. It is assumed

that take of an adult seabird or bat during the breeding season may result in the indirect loss or take of a dependent young. Thus, for every seabird or bat carcass detected during the breeding season, modifiers will be applied to estimate indirect take to account for the likelihood that a given adult is reproductively active, the likelihood that the loss of a reproductively active adult results in the loss of its young, and average reproductive success.

Non-Fatality Monitoring of Wildlife at the Wind Farm Site

Hawaiian Hoary Bats

Monitoring for Hawaiian hoary bats will occur at both the Project site and the mitigation site. Auwahi will conduct bat acoustic monitoring during the first 2 years of operation at the Project. Monitoring at the mitigation site will be accomplished by using radio telemetry of Hawaiian hoary bats.

Reporting

Auwahi will prepare and submit annual reports summarizing the results of post-construction monitoring and mitigation conducted to date. Report components will include a summary of:

1. Post-construction fatality monitoring conducted to date including a description of survey protocol implemented, any adjustments made subsequent to the previous reporting period, and a summary of turbine operational parameters;
2. Direct take, including both observed and adjusted levels, for each species and associated indirect take calculations;
3. Other downed wildlife documented and incidental observations (fatalities documented independently of the standardized searches);
4. A discussion of the efficacy of the current monitoring protocols and whether or not adjustments need to be made;
5. A summary of HCP mitigation efforts conducted to date and the success of these efforts based on the results of mitigation monitoring;
6. Recommended changes to the mitigation plan, if any, based on the results of mitigation monitoring;
7. A discussion of changed circumstances or adaptive management measures (if necessary);
8. Survival of aiea, iliahi, and red ilima fenced within the Project disturbance area will be documented at the end of construction as required by the Service; and
9. Annual survival of 10 outplanted aiea, iliahi, and red ilima for 3 years following outplanting as required by the Service.
10. Reproductive success and survival of seabirds at mitigation site(s);
11. Results of telemetry studies indicating bat usage at mitigation sites;

12. Survival of aiea planted at Blackburn's sphinx moth habitat restoration mitigation site.

Annual reports will be submitted to the Service and DOFAW by August 31 of each year to coincide with DOFAW's fiscal year end. Auwahi will confer with the Service and DOFAW following the submittal of the annual report to review the results and discuss future HCP implementation issues. Annual reports will also be made available to the State of Hawaii Endangered Species Recovery Committee (ESRC).

In accordance with the Project Downed Wildlife Protocol, Service and DOFAW biologists will be notified by phone within 24 hours of the discovery of a dead or injured individual of the Covered Species. A Downed Wildlife Incident Report will be filed within 3 business days and cumulative adjusted take will be reported to the Service and DOFAW within 3 weeks. All non-covered avian species will be documented, following the protocol for downed Covered Species. Auwahi will consult with the Service and DOFAW to review the results of post-construction monitoring annually in relation to anticipated maximum anticipated take limits to assess how close the Project is to exceeding established tiers, and will discuss changed circumstances or adaptive management measures as necessary.

Mitigation

Mitigation measures proposed by Auwahi to compensate for the expected impacts of the project on Covered Species were selected in collaboration with biologists from the Service, DLNR-DOFAW, the National Park Service, the National Science Foundation, and with members of the ESRC. The mitigation proposed to compensate for impacts to Covered Species is based on anticipated levels of incidental take as determined through on-site surveys, modeling, and the results of post-construction monitoring conducted at other wind projects in Hawaii and elsewhere in the U.S. Mitigation will offset expected direct and indirect take.

The proposed mitigation and adaptive management measures detailed in the Awauhi HCP are summarized below. Mitigation will be implemented in tiers to offset the tiers of take (see Table 1). The Tier 1 level of mitigation will be implemented even if no project-related mortality is detected. If calculations indicate the project's incidental take for a species will exceed the Tier 1 level over the 20-year term of the Permit, the Applicant will implement mitigation sufficient to offset the Tier 2 or Tier 3 level of take for that species. Benefits of mitigation will be monitored and calculations of mitigation benefit will be completed and reported for Agency confirmation.

Hawaiian Hoary Bat Mitigation

Mitigation for the Hawaiian hoary bat was designed to offset the project's anticipated bat take: Tier 1 (5 adults and 2 juvenile), Tier 2 (an additional 5 adults and 2 juveniles), and Tier 3 (an additional 9 adults and 4 juveniles). Mitigation will be conducted to offset take at the Tier 1 and Tier 2 levels even if no mortality is detected. If monitoring indicates that take is occurring at the Tier 3 level, mitigation will be increased as summarized below. Tier 1 and Tier 3 take will be offset by restoring and conserving, in perpetuity, native forest habitat for the Hawaiian hoary bat. Tier 2 mitigation entails Hawaiian hoary bat research (Table 3).

Table 3. Comparison of Existing Conditions and Proposed Conditions After Bat Mitigation Is Implemented.

Plot	Acres – to be forested	Acres – potential foraging	Acres – total bat benefit	Existing Conditions	Proposed Conditions
Tier 1 Mitigation					
Cornwell Spring Area	41	9.3	50.3	Agricultural Easement, 50% forested in koa (*Acacia koa*) and ohia (*Metrosideros polymorpha*) forest, and ~20% in non-native forest.	Conservation easement (perpetuity), ungulate fencing, plant with native understory plants and koa and other native trees, remove non-native trees.
Kaumaea Loko area	61	14.5	75.5	Agricultural easement, ~5% with native tree.s	Conservation easement (perpetuity), ungulate fencing, plant with native understory plants and koa and other native trees
Duck ponds	53	20	73	Agricultural easement, ~60% forested, dominated by non-native trees.	Conservation easement (perpetuity), ungulate fencing, plant with native understory plants and koa and other native trees.
Total Tier 1	**155**	**43.8**	**198.8**		
Tier 3: Puu Makua	195	41	236	Agricultural easement, ~10 % forested	Conservation (perpetuity), Ungulate Fencing, Plant with native understory plants and koa and other native trees
Tier 3 Total Acres	**195**	**41**	**236**		

Mitigation for Tier 1 Take of the Hawaiian Hoary Bat

Within 155 ac (63 ha) of the Waihou Mitigation Area of Ulupalakua Ranch, Auwahi shall restore 126.5 ac (51 ha) of pasture and non-native forest to native forest (42 ac (17 ha) restored and conserved per male bat taken) and put 198 ac (80 ha) (the restored forest area plus existing native forest and pasture foraging grounds surrounding the forest) into a permanent conservation easement within 210 days of issuance of the Permit. Take of individual bats will be offset by permanently increasing Maui's Hawaiian hoary bat carrying capacity.

Forest restoration mitigation for the Hawaiian hoary bat by Auwahi was developed by the Service, DOFAW, and bat experts at the U.S. Geological Survey (USGS), and involved identifying measures believed most likely to contribute to the recovery of the species. Fencing, ungulate removal, and native forest restoration at the Waihou Mitigation Area will be conducted to create and provide for permanent conservation of additional native forest habitat for the Hawaiian hoary bat at a ratio of 42 ac (17 ha) per male bat taken (half a male bat's core area). The Tier 1 habitat restoration mitigation for bats is based on the recommendations received from the Service and DOFAW in May 2011. The Service and DOFAW received the results of Home Range Tools for ArcGIS®, Version 1.1 (compiled September 19, 2007) calculations based on Hawaiian hoary bat tracking data collected by USGS-Biological Resources Division (BRD) Wildlife Ecologist, Dr. Frank Bonaccorso. This dataset from a two-week tracking study indicates that the mean core area of rainforest habitat on the island of Hawaii used by 14 male bats was 84.3 ac (34.1 ha) per bat and the average size of the core area utilized by the 11 females in the dataset was 41.2 ac (16.7 ha) per bat. Male bat core areas do not appear to overlap; female core areas may overlap with male core areas. A core area was defined as the area that incorporates 50% of tracked movements; therefore, the Service and DOFAW assume that the core area is a minimum habitat requirement for a male bat. Restoration within the Waihou Mitigation Area (Figure 2) will provide additional bat breeding, foraging, and traveling habitat and will provide a forested corridor among existing conservation areas (Kula Forest Reserve, Auwahi Forest Restoration Project, and the Kanaio Forest Reserve).

The Waihou Mitigation Area is a mosaic of vegetative communities dominated by pastureland (Figure 3). All parcels have had some level of plantings, although on a small scale, and are enclosed with cattle fencing. The Cornwell Spring area is partially forested with koa and Pacific ash with the remainder pastureland. The Kaumaea Loko area is currently dominated by kikuyu grass and matching funding from the USDA Natural Resources Conservation Service is currently available to add an ungulate-proof fence and to reforest portions of the area by outplanting. The Duck Ponds are partially forested with Monterey pines and the remainder is pastureland, while Puu Makua is dominated by pastureland. None of these parcels are currently protected by a conservation easement or have guaranteed funding for long-term management measures such as forest restoration, ungulate removal, and invasive species control management.

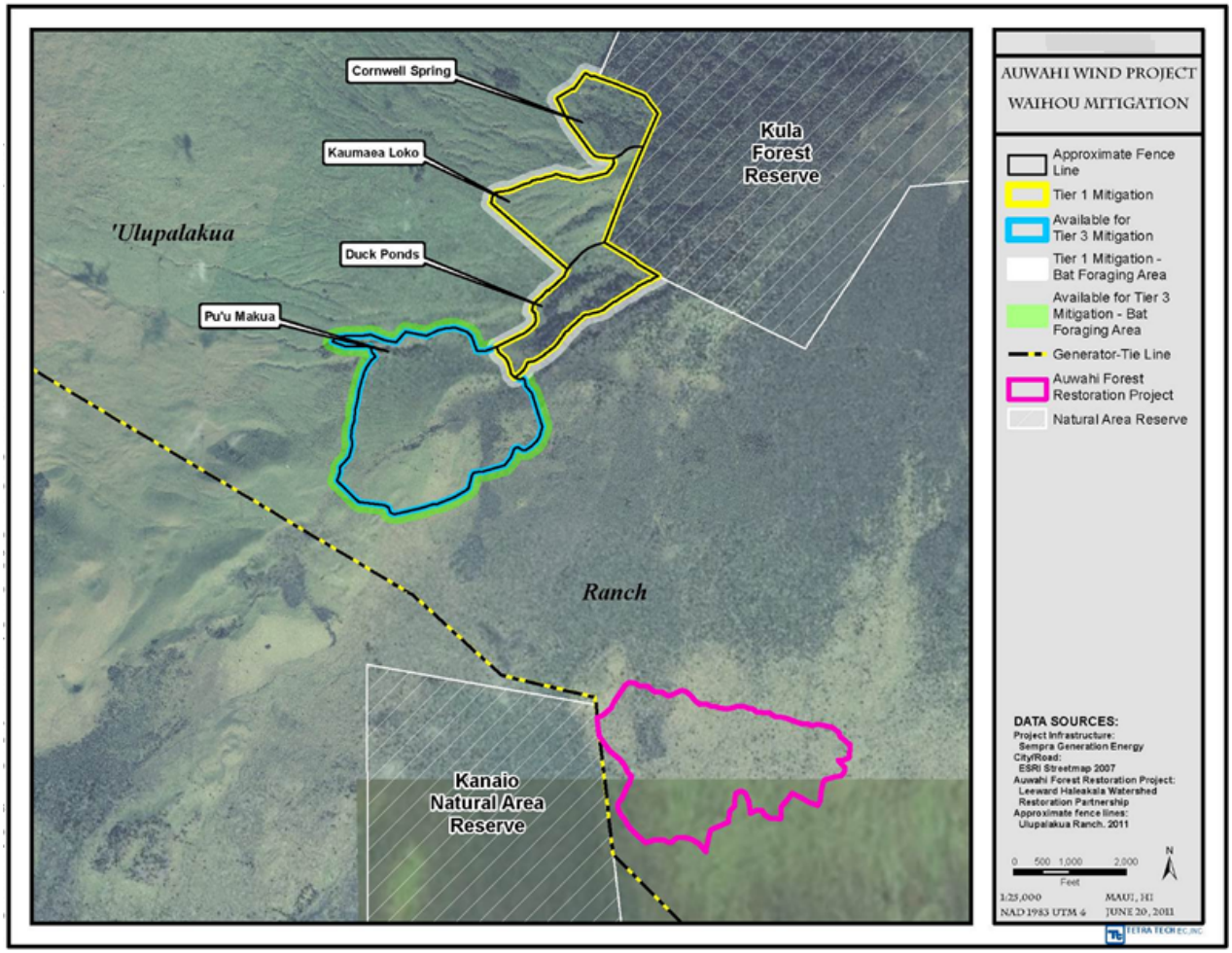


Figure 2. Hawaiian hoary bat reforestation mitigation areas (Waihou Mitigation Area, in yellow, blue, and green) and Blackburn's sphinx moth habitat restoration area (Auwahi Forest Restoration Project, in pink).

After 6 years, mitigation fencing will be completed and ungulates will have been removed from within the fenced area. Over the 25-year Permit term the fence shall be maintained and the area shall be kept free of ungulates. After 25 years, the cover of invasive species (excluding kikuyu grass) in the managed areas shall be less than 50%. After 25 years, reforested areas within the Waihou mitigation area shall have greater than 50% cover of native woody plants and the overstory plants will be primarily koa and ohia.

Figure 3. Photos of the Waihou Mitigation Area.

Mitigation for Tier 2 Take of the Hawaiian Hoary Bat

The Tier 2 requested take level for bats is 10 adults and 4 juveniles. To mitigate for the Tier 2 requested take, Auwahi shall fund and ensure the implementation and completion of research projects that contribute to the overall knowledge of the Hawaiian hoary bat on Maui, as described below. Auwahi will initiate this research within 2 years of the issuance of the Permit regardless of take levels. This research project will be used to monitor the success of the Tier 1 mitigation.

Auwahi will provide $150,000 to $300,000 for a Hawaiian hoary bat research project to provide additional data that contribute to the knowledge of the Hawaiian hoary bat's use of habitat on Maui. Auwahi will work with a qualified bat biologist, approved by DOFAW and the Service, to either design a radio telemetry study or other appropriate studies within the mitigation area to help evaluate bat population trends on Maui, as recommended in the Hawaiian hoary bat recovery plan. If the radio-telemetry option is chosen, it will be designed to: 1) estimate male and female core areas and home ranges; 2) identify habitat associated with foraging and roosting; and 3) collect data for genetic evaluation of effective population size. Data will be collected over an approximately 4- to 8-week period after the young of the year have become independent. Data will be collected in 3 separate years. The initial year of data collection will be within 2 years of commercial operation of the wind farm and during the initial restoration efforts of the mitigation parcel. The second and third years of data collection will be at years 8 and 16 of commercial operation of the Project. This will ensure that data have been collected when the mitigation site is in different stages of vegetative development.

A formal research plan and study design will be provided to the Service and DOFAW for review within 1 year of the issuance of the Permit. The research plan will be finalized before the initiation of the study, which will occur within 2 years after the issuance of the Permit. Research reports will be completed after each year's data collection and for the later years will include a comparison to the previous year's results. Reports will be provided to the Service and DOFAW as part of Auwahi's annual reports. If logistical or other constraints prevent the execution of the

study described above, Auwahi will provide a total of $150,000 to $300,000 towards a different applied research study, as agreed upon by the Service and DOFAW.

Mitigation for Tier 3 Take of the Hawaiian Hoary Bat

The Tier 3 requested take level is 19 adults and 8 young. The 8 juveniles represent approximately 2 adult bats. Thus, the Tier 3 requested take level equates to a total of 21 adult bats (an additional 10 adult bats over the Tier 2 level). Should the Tier 3 mitigation be required, Auwahi will use the results of the research conducted to date in Tier 2 and data from other applicable studies to identify appropriate mitigation measures to be implemented potentially including the restoration of forest habitat using native species.

Auwahi will focus mitigation efforts on one or more alternate mitigation sites and/or additional research in consultation with and subject to the approval of the Service and DOFAW. Selection of site and mitigation focus will depend on agency recommendation and timing, such that mitigation activities will integrate with and enhance ongoing management actions at the selected site. The Waihou Mitigation Area, the Kahikinui Forest Project, and the Auwahi Forest Restoration Project will serve as potential Tier 3 mitigation sites for bat mitigation. Tier 3 alternatives include:

1. Additional Forest Restoration on Ulupalakua Ranch: Within the Waihou Mitigation Area Auwahi would restore forest and establish a permanent conservation easement at a ratio of 42 ac (17 ha) restored and conserved per male bat taken. A 195-ac (79-ha) area has been set aside at the Waihou Mitigation Area for Tier 3 bat mitigation use by Auwahi.
2. Should DOFAW establish a pooled-partnership for bat mitigation at the Kahikinui Forest Project or another appropriate bat mitigation site during the term of this HCP, Auwahi will consider this as a possible mitigation option in lieu of some or all of the Tier 3 mitigation described above, subject to approval by DOFAW and the Service.

Hawaiian Petrel Mitigation

The Permit authorizes take of Hawaiian petrel in three tiers of take: Tier 1 (19 adults, 7 fledglings) and Tier 2 (32 adults, 12 fledglings), and Tier 3 (64 adults, 23 fledglings). Auwahi shall implement predator control to increase the survival and reproduction of Hawaiian petrels occupying a colony at the Kahikinui Forest Project site, and the Advanced Technology Solar Telescope (ATST) mitigation site on State land adjacent to Haleakala National Park (Figure 4). Mitigation benefits will accrue based on measured results, as the managed population's adult survival and reproductive effort exceeds those at a control site and the project, over a 20-year period, increases the Maui Hawaiian petrel population to offset the number lost due to incidental take by Auwahi. Auwahi will control predators to conserve a population of Hawaiian petrels to the extent necessary to, over a 20-year period, offset both Tier 1 and Tier 2 levels of take. This initial management may include a sizeable enough population to offset the Tier 3 level of take, depending on burrow distribution.

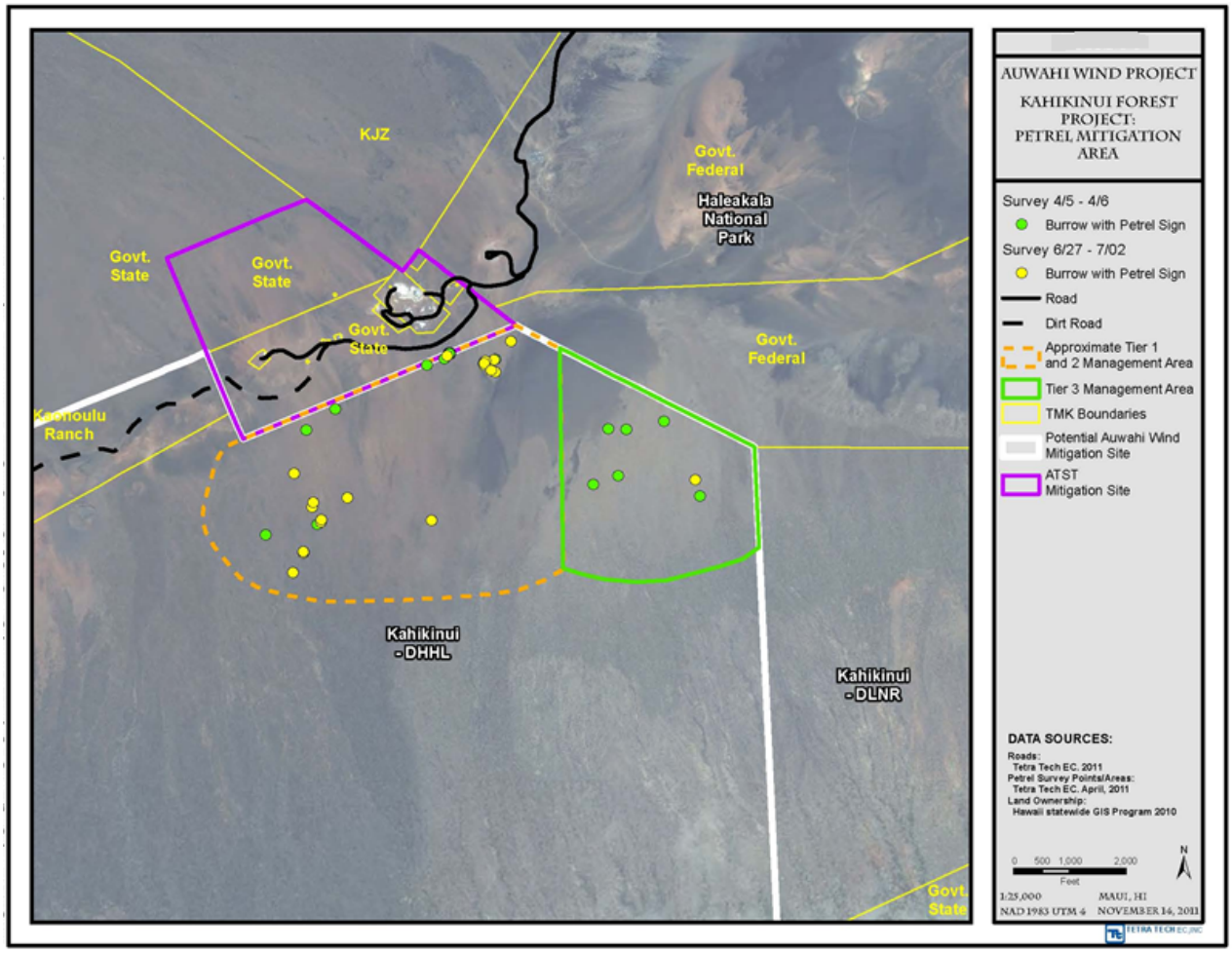


Figure 4. Hawaiian petrel mitigation sites (Kahikinui (outlined in orange and green) and ATST (outlined in purple).

Kahikinui Forest Project

The Applicant will implement predator control to conserve a Hawaiian petrel colony the Applicant discovered at Kahikinui Forest Project, leeward Haleakala, on State of Hawaii land. Cat and mongoose control, using live traps, snares, and other methods (which may reduce rat populations as well) will be implemented. Auwahi detected 33 active burrows within the Kahikinui Forest Project area in April, June, and July 2011, surveys (see Figure 4).

Auwahi may implement rat control or install predator fencing at the Kahikinui Forest Project in order to increase the reproductive success of the petrels, thereby reducing the number of active burrows that will need to be managed, overall, to offset anticipated take. Subsequent years of rodent control use may be needed to achieve mitigation targets and the net benefit to the species. The timeline for implementing petrel mitigation is outlined in Table 4.

Table 4. Estimated Petrel Mitigation Timeline

Date	Event
March 2012	Project construction initiated
Spring/Summer 2012	Comprehensive burrow survey
December 2012	Project in commercial operation
Fall 2012 (or prior to vertical construction of WTGs)	Finalize petrel management plan
Winter 2012-2031	Initiate and execute predator management and monitoring

Measured rates of reproductive effort, reproductive success, and adult and juvenile survival at Kahikinui will be compared to vital rates measured at the ATST petrel mitigation control site. The National Science Foundation (NSF) has proposed 6 years of monitoring at 30 active burrows within this control site which is also located on Haleakala. This comparison will provide a measure of fledglings and adults accrued. Fledglings accrued will be the net increase in pair productivity of petrels over that of baseline productivity estimates for petrels under unmanaged conditions. Likewise, the adults accrued will be the difference in adult survival rates at the managed site (Kahikinui) over that under unmanaged conditions. Reproductive effort, reproductive success, and juvenile and adult survival rates agreed to by the Agencies may be used in place of control site monitoring data.

Any predator control initiated will be conducted for 20 years to ensure benefits of mitigation persist through the Permit term. Preliminary assessments of feasibility of predator fencing indicate predator fence installation does not meet the Applicant's feasibility criteria; predator fencing may be installed in conjunction with predator control, if, in coordination with the Service and DOFAW, the Applicant determines it is feasible. Adaptive management provisions in the HCP enable modifications to the project design to accommodate incorporation of new information and new technology.

ATST Mitigation Site

The ATST mitigation site (see Figure 4) is located on the leeward slope of Haleakala adjacent to the Kahikinui Forest Project parcel and currently supports 74 active burrows (Service 2011b) as described below. Population modeling indicates 2 years of management of the ATST site (or protection of a comparable number of Hawaiian petrels at Kahikinui) may be necessary to offset the remainder of the Tier 3 take. The approximately 328-ac (133-ha) ATST mitigation area surrounding the Haleakala Observatories, adjacent to the western perimeter of Haleakala National Park, will be managed by the NSF to compensate for ATST construction project impacts to the Hawaiian petrel. The ATST mitigation area will be fenced with ungulate-proof fence, ungulates will be removed from within the fence line, and predator control and monitoring efforts will be completed. Predator control conducted under the ATST HCP will consist of short-term cat trapping and rodent control conducted around the petrel colony (ATST 2010). Predator trapping will involve placement of traps within and adjacent to the colony. The placement of

traps will be based on topography, access, and the location of burrows, to avoid disturbance or other adverse impacts to petrels. In addition to cat trapping, the NSF will also install and maintain a rodent control grid within and adjacent to the petrel colony for the 50-year life of the ATST project (ATST 2010).

Burrow monitoring under the ATST State HCP (and Federal project description) will be conducted in accordance with "Standard Operating Procedure for Surveying Uau Burrows" (Hodges 1994, pp. 14-18) and Hodges (2001, p. 311), currently implemented at Haleakala National Park. Petrel burrows within the mitigation area will be monitored at least twice per month for direct and indirect signs of activity and fledging, based on standard definitions provided in the above referenced document. The ATST project is likely to offset take requested in their State HCP within 6 to 10 years of the beginning of construction. At that point, the ATST project will no longer continue predator trapping and burrow monitoring efforts. Auwahi will, if necessary to offset project take, assume these mitigation activities at the ATST site once a net mitigation benefit for the ATST has been reached. The duration of ongoing maintenance and monitoring will be determined based on the level of mitigation required in coordination with the Service and DOFAW.

Haleakala National Park

If the predator control needs to be expanded to achieve the necessary Auwahi mitigation, Auwahi will assume management of additional burrows, such as those at Haleakala National Park, to ensure mitigation benefits are achieved during the Permit term. Auwahi would provide funding or assist Haleakala National Park with management and monitoring efforts of the Hawaiian petrel colony in the crater or another more remote location within Haleakala National Park. Auwahi will contribute funds toward or assist with implementing predator control and monitoring. Currently predator control efforts include established trap lines that are managed along the edges of colonies, the entrance road, and gulches where predators may potentially travel. Trapping and monitoring protocols will follow the protocols that have already been established by the Park for managing the colony and being implemented (Hodges and Nagata 2001; Bailey pers. comm. 2010 and 2011).

A detailed predator trapping and monitoring regime will be outlined in a separate petrel management plan which Auwahi will develop, with Service and DOFAW approval, prior to the construction of the vertical portions of the WTGs. The plan will be based on the known spatial distribution of the petrel burrows within the management area. The management plan will describe the type of mitigation methods to be used, the timing of mitigation efforts (e.g., trapping and monitoring), the spatial arrangement of the traps, and other logistics associated with implementing mitigation activities (i.e., costs, topographical challenges, weather-related concerns, cultural and archaeological resources concerns, access, and visual concerns). Trapping and monitoring protocols will be consistent with protocols established by the Park for managing the Haleakala National Park colony (Bailey pers. comm. 2010; Hodges and Nagata 2001), and will also take into consideration recommendations of other recognized experts in seabird colony management. Auwahi may need to revise elements of the management plan for the mitigation area over time based on the best available information. Changes to the management activities will be made with approval of the Service and DOFAW and updates will be provided as part of

the annual report. If it is apparent that take levels specified for Tiers 1 or 2 are likely to be exceeded, Auwahi will begin implementing Tier 3 mitigation prior to reaching the Tier 3 take level.

Hawaiian Goose Mitigation

At the recommendation of the Nene Recovery Action Group, Auwahi shall, within the first year of wind farm operation, contribute $25,000 to Haleakala National Park to build a predator fence and pen at the Park to support egg and gosling (and adult) rescue. Hawaiian geese are particularly vulnerable to predation during nesting and before the goslings fledge and the Hawaiian goose population at the Park is subject to high predation of eggs and goslings by cats, rats, and mongoose. This management activity will contribute to increasing reproductive success of the Park's Hawaiian goose population, and, therefore, will provide a net benefit to the species. A summary of the benefits accrued as a result of this action will be included in the HCP's annual reports.

Blackburn's Sphinx Moth Mitigation

The Blackburn's sphinx moth conservation program is designed to avoid and minimize injury to Blackburn's sphinx moth adult, larva, and eggs to the maximum extent practicable. The construction site will be kept free of Blackburn's sphinx moth larval host plants and larvae in the three months prior to construction. In addition, loss of Blackburn's sphinx moth habitat will be mitigated by Auwahi. Loss of Blackburn's sphinx moth native habitat will be offset at a ratio of 2 ac (0.8 ha) of native forest restored for each acre of native habitat disturbed within the project footprint. Loss of degraded Blackburn's sphinx moth habitat will be offset by restoring 0.2 ac (one fifth of an acre) of native habitat for each acre that is permanently developed. Native habitat was defined based on the presence of Blackburn's sphinx moth host plants, even if the site is dominated by non-native plants, whereas degraded habitats were those areas which were unoccupied by Blackburn's sphinx moth host plants. Auwahi shall fund the LHWRP to complete the project's Blackburn's sphinx moth habitat restoration at the Auwahi Forest Restoration Project, where restoration of pasture to native forest was in 1997 by a coalition of private and public agencies spearheaded by the USGS and Ulupalakua Ranch (see Figure 2). The Auwahi Forest Restoration Project is located in an area of with a high density Blackburn's sphinx moth occupancy. Dryland forest restoration will entail: 1) fencing tracts of high quality forest to exclude ungulates; 2) eliminating kikuyu grass and other invasive species using both herbicides and hand pulling; and 3) outplanting of native tree, shrub, vine, and grass species that were elements of the original forest community (USGS 2006).

Mitigation acreage calculations were based on botanical surveys conducted in March and April 2011. Auwahi will develop 0.3 ac of native habitat and will mitigate for this loss by restoring 0.6 ac (0.2 ha) (0.3 ac (0.1 ha) x 2 = 0.6 ac (0.2 ha)) of native dryland forest. Permanent impacts to 27.7 ac (11.2 ha) of degraded Blackburn's sphinx moth habitat will be offset with the restoration of 5.5 ac (2.2 ha) (27.7 ac (11.2 ha) x 0.2 = 5.5 ac (2.2 ha)) of native forest. In total, 6 ac (2 ha) of native dryland forest restoration will be funded by Auwahi at the Auwahi Forest Restoration Project site.

In addition to funding dryland forest restoration at the Auwahi Forest Restoration Project site, Auwahi shall also provide funding to the LHWRP for aiea outplanting in addition to other native species in the Auwahi Forest Restoration Project (USGS 2006). The LHWRP will restore dryland forests, which will benefit native wildlife in general, and will further enhance this habitat for Blackburn's sphinx moth by planting approximately 250 stems of aiea per acre of mitigation.

The initial payment for the first 3 ac (1.2 ha) of restoration will be made to the LHWRP within 30 days of Permit issuance and the remaining funds paid within 3 months. The full 6 ac (2.4 ha) will be planted within 3 years of the payment to the LHWRP. All costs provided in the HCP are estimates based on costs provided by the LHWRP. The Applicant is committed to providing the funds necessary to complete the required mitigation and to ensuring that the proposed mitigation plan is carried out.

2.0 STATUS AND BASELINE OF THE SPECIES

Status of the Species

Hawaiian Hoary Bat

Species Description

The Hawaiian hoary bat is medium-sized (0.5 to 0.8 ounces) nocturnal, insectivorous bat, with a wingspan of 10.5 to 13.5 inches. "Hoary" refers to the white-tinged, frosty appearance of the bat's grayish brown or reddish brown fur. Although females are slightly larger than males, forearm lengths are similar in both genders. These bats are not colonial, and roost solitarily in tree foliage (Service 1998, pp. 8-10).

The Hawaiian hoary bat is classified under the Family Vespertilionidae of the Suborder Microchiroptera, and is one of three recognized hoary bat subspecies. The other two subspecies are *Lasiurus cinereus cinereus*, one of the most common and widespread bats in North America, and *Lasiurus cinereus vilosissimus*, which occurs in South America and the Galapagos (Shump and Shump 1982, pp.1-5). Morphologically, the Hawaiian hoary bat may have diverged significantly from the North American form, as Hawaiian hoary bats are about 45% smaller. Nonetheless, preliminary genetic analysis indicates the Hawaiian hoary bat may be derived from the North American hoary bat.

Listing Status

The Hawaiian hoary bat was listed as an endangered species in October 13, 1970 (Service 1970), pursuant to the Endangered Species Preservation Act of 1966. The original recovery plan was approved in May 11, 1998. A species five-year review has been conducted on September 30, 2011 pursuant to Section 4(c)(2). Critical habitat has not been designated for the Hawaiian hoary bat (Service 1970).

Historic and Current Distribution

The Hawaiian hoary bat is endemic to the State of Hawaii where it is the only existing, native terrestrial mammal. The Hawaiian hoary bat is known to reside on Hawaii, Maui, Oahu, Lanai, Molokai and Kauai, with the largest populations likely on Hawaii and Kauai. There are no population estimates for the Hawaiian hoary bat. Unsubstantiated population estimates across the State have ranged from hundreds to a few thousand individuals (Service 1998, p. 14).

Hawaiian hoary bats have been observed year-round in a wide variety of habitats and elevations below 7,500 ft. (2,286 m), and a few sightings from limited surveys have been reported as high as 13,199 ft. (4,023 m). Hawaiian hoary bats have been detected in both wet and dry areas of Hawaii but seem to be more abundant on the drier leeward side (Jacobs 1994, p. 199) and generally less abundant in wet areas (Kepler and Scott 1990, p. 62). Only three researchers have examined spatial and temporal variation in occurrence patterns of bats in Hawaii, with conflicting conclusions about possible altitudinal or regional migration (Jacobs 1994, pp. 193-200; Menard 2001, pp. 1-149; Tomich 1986, pp. 1-30).

Life History

A comprehensive life history assessment for the Hawaiian hoary bat is lacking. Furthermore, the existing information on population status and habitat ecology is often conflicting. Hawaiian hoary bats roost in a variety of tree species, both native and non-native, during the day and forage in a wide range of habitat types during the night (Gorresen et al 2008, pp. 13-16; Service 1998, pp. 12-13). There is no information on the Hawaiian hoary bat's average life span, age at first reproduction, and survivorship, or on how age and reproductive condition affect its food habits, habitat selection, home range size, and movement patterns.

A few studies have documented Hawaiian hoary bats in a wide range of locations and habitat types on the island of Hawaii. Bats observed along 611 mi (983 kilometers) of forest bird survey transects and incidentally elsewhere on Hawaii during 1976-1983, at elevations from sea level to 10,007 ft. (3,050 m), were more frequently associated with non-native vegetation (64%), such as tall eucalyptus and other exotic plants, than with native vegetation (19%) (Kepler and Scott 1990, p. 61). Visual observations and echolocation detections at 22 sites in southeast Hawaii, however, found no significant differences in bat activity among native or non-native vegetation types (Reynolds *et al* 1998, pp. 153-157). In addition, 57% of all bat activity was noted at open sites, forest edges, lava flows, volcanic pit craters, residential and agricultural clearings, and roads. Foraging bats at 14 survey sites over a range of altitudes were more frequently associated with native vegetation (44%) than non-native (16%) or mixed (9%) vegetation (Jacobs 1993, p. 22). Bats were detected most often in native mesic koa-ohia forest vegetation at 13 sites in, and adjacent to, Hakalau Forest National Wildlife Refuge (Cabrera 1996, p. 238). All reports of bat occurrences may be biased to varying degrees by sampling efforts concentrated along roads and forest edges.

Roosting habitat for the Hawaiian hoary bat is sparsely documented. However, Dr. Frank Bonaccorso's current research project utilizing radio-tracking with more than 30 Hawaiian hoary bats, reveals all the bats studied roost in trees and all roost more than 20 ft. (6 m) off the ground (Bonaccorso 2009b, pers. comm.). North American hoary bats roost 10 to 16 ft. (3 to 5 m) above

the ground, mostly in hardwood trees (Shump and Shump 1982, p. 3). Hawaiian hoary bats have been observed in a wide variety of trees, including native species (*Metrosideros polymorpha*; *Pandanus tectorius*; *Styphelia tameiameiae*), Polynesian-introduced species (*Aleurites moluccana*), and post-contact introduced species (*Syzygium cumini*) (Service 1998, p. 13). Bats also have been occasionally observed in fern clumps, low scrub, rock crevices, macadamia nut orchards, and buildings (Tomich 1986, p. II-24).

Hawaiian hoary bats forage in a variety of open and vegetated habitats, including open fields, lava flows, open ocean in bays near shore, and streams and ponds. Hawaiian hoary bats on Hawaii forage in both relatively closed habitats near vegetation (such as clearings in lowland mesic ohia forest or town parks) as well as in open habitats and forest edges (Jacobs 1993a; Tomich 1974, pp. 10–13). Foraging generally occurs three to 492 ft. (1 to150 m) above the ground or open water, 3 to 50 ft. (1 to 15 m) above the ground in closed forest habitats, and up to 100 ft (30 m) and more above tree canopy (Service 1998, p. 10). The Service and DOFAW received the results of Home Range Tools for ArcGIS®, Version 1.1 (compiled September 19, 2007) calculations based on Hawaiian hoary bat tracking data collected by USGS-BRD Wildlife Ecologist, Dr. Frank Bonaccorso. This dataset from a two-week tracking study indicates that the mean core area of rainforest habitat on the island of Hawaii used by 14 male bats was 84.3 ac (34.1 ha) per bat and the average size of the core area utilized by the 11 females in the dataset was 41.2 ac (16.7 ha) per bat. Male bat core areas do not appear to overlap; female core areas may overlap with male core areas. A core area was defined as the area that incorporates 50% of tracked movements.

As with other life history parameters, little is known about the breeding biology of Hawaiian hoary bats. Females of most temperate, autumn-breeding, insectivorous bat species become pregnant in the spring by delayed ovulation and fertilization, and young are cared for exclusively by the female. The breeding cycle of the Hawaiian hoary bat on the island of Hawaii consists of pregnancy (April to June), with pups born in May or June; lactation (June through early August and possibly to September); post-lactation, after pups have fledged (September to December); and pre-pregnancy (January to March) (Menard 2001, p. 35). Like North American hoary bats, Hawaiian hoary bat females are believed to give birth to two young at a time. North American hoary bat pups cling to the mother at the roost tree during the day, where she leaves them hanging on a twig while she forages at night (Shump and Shump 1982, p. 3), and Hawaiian hoary bats are presumed to behave similarly. Female North American hoary bats adjust their foraging behavior to meet the increasing energy demands of pregnancy and lactation (Barclay 1989, pp. 31-37). Because newborn bats cannot thermoregulate very well in tree-foliage roosts, the mother's foraging activity may be constrained by the need to roost periodically with her young to keep them warm. Thus, foraging behavior changes with reproductive condition, and females with non-volant young may forage at different times of night and perhaps in different habitats than other bats. Preliminary evidence indicates that pregnant and lactating female Hawaiian hoary bats on Hawaii may prefer roosting in lowland areas rather than in the cooler highlands, perhaps because the warmer lowland environment promotes faster juvenile growth (or, alternatively, because insect food sources may be more readily available) (Menard 2001, pp. 52-105).

Threats

The major threats to the Hawaiian hoary bat are assumed to be the same as those that threaten many bat species in general (Harvey *et al* 1999, p. 13; Service 1998, p. 15). Bats have the slowest reproductive rate and the longest life-span of all mammals of their size (Barclay and Harder 2003, pp. 209-256). Thus, any mortality of breeding-age adults, particularly females, constrains the recovery of the subspecies. The main factor limiting recovery was thought to be habitat loss, primarily the availability of roosting sites as suitable roosting habitat is particularly important to pregnant and lactating females and non-volant young (Service 1998, p. 15). Other possible threats identified in the recovery plan may include: roost disturbance, predation by native hawks and non-native feral cats, pesticide use (either directly or by impacting prey species), and alteration of prey availability due to introduction of non-native insects. In addition, occasional instances of Hawaiian hoary bat mortality due to collisions with vehicles and structures have been documented (Kepler and Scott 1990, p. 60; Kuhn 2009; Menard 2001, p. 136; Tomich 1986, pp. I 1-30). Clearing of vegetation in areas where there are non-volant bat pups may result in the injury or death of those young. Hoary bats are impaled on barbed wire in the continental United States (Anderson 2002; Iwen 1958, p. 438; Wisely 1978, p. 53) and in Hawaii (Burgett 2009, pers. comm.; Jeffrey 2007, pers. comm.; Mansker 2008, pers. comm.; Marshall 2008, pers. comm.).

Conservation Needs of the Species

The overall recovery strategy for the Hawaiian hoary bat is to rely on research that can provide information on the subspecies' abundance and distribution, life history, and habitat associations. The primary recovery goal is to conduct research essential to the conservation of the Hawaiian hoary bat. Research should focus on developing standardized survey and monitoring protocols for determining abundance and distribution, roosting habitat associations, basic life history biology, and food habits. Other recovery goals are to protect and manage current populations by identifying and managing threats, including protection of key roosting and foraging areas; conduct a public education program; evaluate progress towards recovery; and revise recovery criteria as necessary (Service 1998, p. 18-20).

Ongoing Conservation Actions

The Service, DOFAW, and Bat Conservation International (BCI, a non-profit conservation and education organization) are stakeholders in a public-private Hawaiian Hoary Bat Research Cooperative (Cooperative) which collaboratively prioritizes and funds management-oriented research on the Hawaiian hoary bat's abundance, distribution, and habitat requirements. Major stakeholders include private landowners, agricultural and commercial forestry interests, environmental groups, local governments, and Federal and State agencies. Most of the Cooperative's current funding is provided by the Service's Cooperative Endangered Species Conservation Fund (Section 6 of the Endangered Species Act) grants to the State.

Hawaiian Petrel

Taxonomy and Species Description

The Hawaiian petrel is a medium-sized seabird in the family Procellariidae (shearwaters, petrels, and fulmars). The Hawaiian petrel is a large petrel; it is approximately 16 inches long (40 cm)

and has a wing span of about three ft (90 cm). It has a dark gray head, wings, and tail, and a white forehead and belly. The Hawaiian petrel has a stout grayish-black bill that is hooked at the tip, and ft that are pink and black. The Hawaiian petrel was formerly treated as a subspecies of *P. phaeopygia*, and was commonly known as the dark-rumped petrel (Service 1983, pp.1-2). The Hawaiian petrel was reclassified as a full species in 1993 because of differences in morphology and vocalization (Sibley and Monroe 1993). In 1997 the evolutionary split was confirmed by genetic analyses (Browne *et al* 1997).

Historic and Current Distribution

The Hawaiian petrel was once abundant on all of the main Hawaiian Islands, except Niihau. Today, Hawaiian petrels breed in high-elevation colonies, primarily on east Maui and Mauna Loa on Hawaii Island, on Lanai, and to a lesser extent, on Kauai, and probably Molokai, Lehua, and sea stacks off Kahoolawe.

Based on pelagic observations, the total population including juveniles and subadults was estimated at 20,000 with a breeding population of 4,500 to 5,000 pairs in 1995 (Spear et al. 1995, p. 629). There have been no total population estimates made since then. Approximately 1,430 breeding pairs are known to occur in the mountains of east Maui. Approximately 1,000 Hawaiian petrel burrows have been found in Haleakala National Park, Maui (Bailey, pers. comm. 2011b) and an additional 600 breeding pairs are thought to occupy unsurveyed areas of the Haleakala Crater Rim (SWCA 2011a). In addition, approximately 55 breeding pairs occupy the ATST mitigation site (ATST 2010) and the Auwahi project detected an additional 33 active burrows at Kahikinui (Tetra Tech 2012). Ainley (SWCA 2011a, Appendix 25, p. 2) estimates there is a declining population of 600 breeding pairs of Hawaiian petrels nesting in the West Maui Mountains. The colony on Mauna Loa is estimated to be approximately 75 breeding pairs (Hu, pers. comm. 2008). Kauai populations are difficult to assess, and Cooper and Day (1994, p. iv) estimated there were between 1,400 and 7,000 individuals on that island in 1993. Ainley et al. (1997, p. 28) estimated that there were 1,600 breeding pairs of Hawaiian petrel on Kauai. A breeding colony of the Hawaiian petrel was rediscovered on Lanai in 2006, near the summit of Lanaihale. Although the petrel colony was historically known to occur, its status was unknown and thought to have dramatically declined until surveys were conducted in 2006 (Penniman, pers. comm. 2007). The nesting habitat used by the Hawaiian petrel colony on Lanai is delineated by the approximate area of the uluhe ferns (*Dicranopteris linearis*). Monitoring and research on this population is ongoing, and its size has not been estimated with statistical confidence, but the population appears to be similar in abundance to the Haleakala population, where the largest number of breeding birds is currently known to exist (Penniman, pers. comm. 2011).

Life History

Seabirds nest on land and spend much of their time at sea where they are known to feed on squid, small fish, and crustaceans displaced to the surface by schools of tuna (Simons 1985). Hawaiian petrels have been tracked taking single trips exceeding 6,200 mi (10,000 km) circumnavigating the north Pacific during the nestling stage (Adams *et al*. 2006). Hawaiian petrels have been recorded in the Gulf of Alaska (Bourne 1965). Annual survival rates for Hawaiian petrels range from 0.93 (in years with no predation to approximately 0.85 (estimated survival under moderate predation at Haleakala (Simons 1984 p. 1070).

Like other procellariiformes, Hawaiian petrels are highly philopatric, returning to the same burrow and mate each year (Simons 1985 pp. 233-234). Beginning in mid-February to early-March, after a winter absence from Hawaii, breeding and non-breeding birds visit their nests regularly at night. After a period of social activity and burrow maintenance they return to sea until late April, when they return to the colony site and egg-laying commences. From mid-March to mid-April, birds visit their burrows briefly at night on several occasions. Then breeding birds return to sea until late April or early May, when they return to lay and incubate their eggs (Simons 1985). Non-breeding birds visit the colony from February until late July (Simons and Hodges 1998, pp. 13-14). Information provided by Bailey and Duvall (December 9, 2010), confirmed by Fein's analysis of burrow camera data for the ATST site (Fein, pers. comm. 2009) indicating birds intermittently occupy their burrows during the day during this period as well. Many non-breeders are young birds seeking mates and prospecting for nest sites, but some proportion is thought to be mature adults that will not breed.

The mean date of egg-laying recorded on Haleakala in 1980 and 1981 was May 8 (Simons 1985 p. 234). The percentage of years in which adult females laid eggs was estimated to be 89% (Simons 1985 p. 234). Fecundity (fledglings produced per egg laid) appears to be primarily dependent on rate of predation. Moderate predation is likely to depress fecundity to 0.49 (Simons 1985 p. 237). Although Hawaiian petrel nests may fail when they abandon and crush eggs during incubation, higher fecundity (0.72 (Simons 1984 p. 1068)) occurs when predators are absent. Annual survival for juveniles at sea is 0.834 (Simons 1984 p. 1070).

Cooper and Day found that Hawaiian petrels flew inland to their nesting areas primarily between sunset and the point of complete darkness. In the morning hours, Hawaiian petrels first move to sea while it was completely dark, starting 60 minutes prior to sunrise, and movement rates increased rapidly until they peaked just after the point of complete darkness had been crossed and movement continued at a decreasing rate until sunrise (Cooper and Day 1995, pp. 32-34). Peak fledging, when young seabirds make their first flight to sea, occurs between September 1 and December 1 (Penniman, 2012 pers. comm).

Habitat Description

On Hawaii and Maui, Hawaiian petrels nest in the cold, xeric environment above 8,000 ft primarily in national parks. On Kauai, there is evidence that Hawaiian petrels nest at lower elevations in densely vegetated rainy environments (Ainley et al. 1997, p. 24). Hawaiian petrels are colonial and nest in burrows, crevices in lava, or under ferns. Burrows detected on Haleakala occur almost exclusively on lava substrates; burrows are located within existing crevasses or excavated in softer material adjacent to rock to boulder-sized lava fragments. Their burrows are generally 3- to 6-ft (1- to 1.8-m) long (from entrance to nest chamber), although some may be as long as 30 ft (9.1 m) (Simons and Hodges 1998, p. 14).

Threats, Recovery Strategies, and Ongoing Conservation Measures

Hawaiian petrels were abundant and at one time, widely distributed; their bones have been found in archaeological sites throughout the archipelago (Olson and James 1982a, p. 32). This species has no natural terrestrial predators other than the Hawaiian short-eared owl, (*Asio flammeus sandwichensis*, pueo). Early Polynesian hunting; predation by introduced mammals such as

Polynesian rats (*Rattus exulans*), dogs, and pigs; and habitat alteration caused initial decline of the Hawaiian petrel population and probably its extirpation from Oahu (Olson and James 1982b, p. 634). The introduction of cats, mongoose, and two additional species of rats (*R. rattus* and *R. norvegiceus*) since Euro-American contact along with accelerating habitat loss has led to small relict colonies of Hawaiian petrels in high-elevation, remote locations. The primary reason for the relatively large numbers of petrels and their successful breeding around Haleakala summit today is the fencing and intensive predator control maintained by Haleakala National Park since about 1982. If current elevated levels cat of predation continue, significant declines in even the Park's relatively protected Hawaiian petrel population are likely (Bailey pers. comm., 2011). Elsewhere on Maui and in Hawaii, the Hawaiian petrel faces severe threats from non-native predators including rats, cats, mongoose, and introduced barn owls (*Tyto alba*). Ainley (SWCA 2011a, Appendix 25, p. 2) estimates there is a declining population of 600 breeding pairs of Hawaiian petrels nesting in the West Maui Mountains and population modeling indicates predation impacts may render this relatively large population functionally extinct in 27 years (SWCA 2011a, Appendix 24, p. 8). Other significant anthropogenic sources of Hawaiian petrel mortality are light attraction and collision with communications towers, power transmission lines and poles, fences, and other structures (Simons and Hodges 1998, pp. 21-22). Fallout of fledglings, making their first flight to the open ocean, is greatest during the week prior to and following the new moon between September 1 and December 1 (Penniman pers. comm. 2012). These problems are likely to be exacerbated by continuing development and urbanization throughout Hawaii. Predator control in key habitat areas, the establishment of bird salvage-aid stations, and light attraction studies have been initiated to help conserve the Hawaiian petrel.

The recovery goals for the Hawaiian petrel include: 1) protect and enhance existing colonies; 2) create new colonies; 3) mitigate new and existing threats by a) implementing prioritized management actions, and b) undertaking research and outreach to support those actions. Actions identified to accomplish these goals for Hawaiian petrel include conducting surveys for existing colonies, controlling threats at the highest priority colonies, and minimizing and monitoring terrestrial threats away from the colonies (light attraction, power line collisions).

A Kaui Island-Wide HCP is being prepared to address adverse human impacts to seabirds on that island. In addition, DOFAW has been conducting auditory surveys for new areas containing nesting Hawaiian petrels through the Kauai Endangered Species Recovery Program and will use colony ranking criteria to identify areas where recovery actions can be most successful. The State has developed a management plan for the Hono o Na Pali NAR that includes feral ungulate control, but little work has been implemented due to the lack of funding. A 400-ac portion of the privately-owned Upper Limahuli Preserve has been fenced to create an ungulate free area known to contain nesting Hawaiian petrels. Efforts to control feral cats within the Preserve has begun, but the landowner does not have funds to sustain the efforts (Standley, pers. comm. 2011).

Several of these Hawaiian petrel nesting colonies will be protected from predators pursuant to the Kauai Island Utility Cooperative HCP. Efforts to conserve nesting colonies of Newell's shearwater also benefit Hawaiian petrel, but they have been primarily limited to constructing ungulate fencing around remaining areas of relatively intact habitat (Wainiha Valley, Upper Limahuli Valley, etc.). The only active control of cats and/or rats within an area occupied by

nesting Hawaiian petrels on Kauai (on private property in Upper Limahuli Valley) began in 2009, but the program has no secure funding source to continue the efforts beyond that which will be available through a the Kauai Island Utility cooperative HCP.

Efforts to recover and release downed, but still living, seabirds through the Save our Shearwaters program also apply to Hawaiian petrels. Efforts underway to reduce the level of light attraction and power line collisions described for Newell's shearwater also reduce these threats to Hawaiian petrel.

Hawaiian goose

Taxonomy and Species Description

The Hawaiian goose is a medium-sized goose, with an overall length of approximately 63 to 69 centimeters (25-27 inches). The plumage of both sexes is similar (Service 2004, p.4). This species is adapted to a terrestrial and largely non-migratory lifestyle in the Hawaiian Islands with limited freshwater habitat (Service 2004, p.iii). Compared to the related Canada Goose (*Branta canadensis*), Hawaiian goose wings are reduced by about 16% in size and their flight is weak (Service 2004, p.21). Although Hawaiian geese are capable of inter-island and high altitude flight flight, they do not migrate from the archipelago (Banko *et al* 1999, p.9).

Historic and Current Distribution

It is speculated that Hawaiian geese were once widely distributed among the main Hawaiian Islands, however, subfossil evidence has not been found on Oahu or Niihau (Service 2004, p.6). The fossil record indicates the prehistoric (prior to 1778) range of the Hawaiian goose was much greater than was observed after colonization by Europeans (Banko *et al* 1999). However, it is difficult to estimate Hawaiian goose population numbers, either pre-Polynesian or pre-European contact because there is a limited understanding of species composition, or even the gross structure, of the vegetation prior to the arrival of the Polynesians (Service 2004, p.7). By 1952, approximately 30 Hawaiian geese remained. The release of captive-bred Hawaiian geese, which began in 1960, helped save the species from imminent extinction (Service 2004, p.2-3). As a result of such programs, wild populations of Hawaiian geese now occur on four of the main Hawaiian islands. As of 2009, the statewide population of wild Hawaiian geese was estimated to have reached 1,888-1,938 individuals; the wild populations on the islands of Hawaii, Maui, Molokai and Kauai were estimated to have 457, 416, 165, and 850-900 individuals, respectively (Marshall, pers. comm. 2010; USFWS & NRCS 2010).

Hawaiian geese use shrublands and grasslands and human-altered habitats ranging from coastal to alpine environments (Banko 1988, Banko *et al* 1999). On Hawaii and Maui, Hawaiian geese nest, raise their young, forage, and molt in grassy shrublands and sparsely vegetated lava flows. Some populations on these islands move seasonally from montane foraging grounds to lowland nesting areas. On Kauai, where mongooses are absent, Hawaiian geese are primarily found utilizing lowland habitats (Service 2004, p.19).

Life History

Hawaiian geese have an extended breeding season with eggs reported from all months except May, June, and July, although the majority of birds in the wild nest between October and March (Banko *et al* 1999, p.4). Nesting peaks in December and most goslings hatch from December to January (Banko *et al* 1999). The Hawaiian goose nests 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, the young remain in the nest for 1 to 2 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. During molt, adults are flightless for a period of 4 to 6 weeks, generally attaining their flight feathers at about the same time as their offspring. When 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 Hawaiian goose reaches sexual maturity at 1 year of age, but usually does not form pair bonds until the second year. Females tend to nest near their natal nesting area, while males more often disperse (Banko *et al* 1999).

Habitat Description

As mentioned earlier, the current distribution of wild Hawaiian geese has been highly influenced by the location of release sites for captive-bred birds. Hawaiian geese are known to occupy various habitat and vegetation community types ranging from coastal dune vegetation and non-native grasslands (such as golf courses, pastures, and rural areas) to sparsely vegetated low- and high-elevation lava flows, mid-elevation native and non-native shrubland, cinder deserts, native alpine grasslands and shrublands, and open and non-native alpine shrubland-woodland community interfaces (Banko *et al* 1999, pp.4-6). Hawaiian geese are browsing grazers; the composition of their diet depends largely on the vegetative composition of their surrounding habitats and they appear to be opportunistic in their choice of food plant as long as they meet nutritional demands (Banko *et al* 1999, pp.6-8; Woog and Black 2001, p.324). Hawaiian geese may exhibit seasonal movements to grasslands in periods of low berry production and wet conditions that produce grass with a high water content and resulting higher protein content. The sites used by Hawaiian geese for nesting range from coastal lowland to subalpine zones and demonstrate considerable variability in physiognomic features (Banko *et al* 1999, pp.4-5). However, the distribution of Hawaiian goose nesting sites is influenced by the location of release sites of captive-bred individuals (Banko *et al* 1999).

Threats, Recovery Strategy, and Ongoing Conservation Measures

Approximately 30 Hawaiian geese remained in the wild in 1952 (Service 2004, p.2). The Hawaiian goose was named Hawaii's State bird on May 7, 1957 (Service 2004, p.46) and captive-breeding efforts began in the 1960s (Service 2004, p.2). The Hawaiian goose was federally listed as Endangered in 1967 (Service 2004, p.3). The Service has not designated critical habitat for the Hawaiian goose (Service 2004, p.3). The Hawaiian goose is also listed as Endangered by the State of Hawaii (Service 2004, p.iii). Although the number of wild Hawaiian geese has substantially increased since 1952, the Hawaiian goose remains to be one of the most endangered geese in the world (Service 2004, p.3).

The current threats to Hawaiian goose recovery are: 1) predation by introduced mammals (especially mongooses, cats, rats, dogs, and feral pigs); 2) insufficient nutritional resources due to habitat degradation; 3) limited availability of suitable habitat due to habitat loss, fragmentation, and degradation; and 4) human-caused disturbance (including habituation to humans) and mortality (especially death due to road collisions). Additional factors that may be affecting Hawaiian goose recovery but require further research include: 1) behavioral problems associated with small population sizes, captive-bred birds, and loss of genetic diversity; and(2) avian disease and parasites (Service 2004, p.27-28; Marshall, pers. comm. 2010).

The Service published a Draft Revised Recovery Plan for the species in 2004, and initiated a 5-year Review in 2009. The overall goal of the Service's "Draft Revised Recovery Plan for the Nene or Hawaiian Goose *(Branta sandvicensis)*" is to remove the Hawaiian goose from the Federal List of Endangered and Threatened Wildlife and Plants (delisting). The plan establishes a framework within which recovery actions are undertaken to ensure the long-term survival of the Hawaiian goose and to control or reduce the threats to the species to the extent that it is no longer in danger of extinction and warrants delisting. The interim goal is to accomplish increases in population sizes and geographic distribution of Hawaiian geese concomitant with control of threats sufficient to consider reclassification or downlisting of this endangered species to threatened status. To reach the recovery goal, there must be multiple self-sustaining Hawaiian goose populations on Hawaii, Maui Nui (Maui, Molokai, Lanai, & Kahoolawe), and Kauai, for at least 15 years. Additionally, the threats to the species must be reduced to allow for the long-term viability of these populations, and sufficient suitable habitat must be identified, protected, and managed in perpetuity on each of these islands such that the species no longer meets the definition of endangered or threatened under the ESA (Service 2004, p.49-50).

With the exception of Kauai, most wild populations of Hawaiian geese are not self-sustaining (Marshall, pers. comm. 2010). The Service defines "self-sustaining" as maintaining or increasing established population levels without additional releases of captive-bred Hawaiian geese, although habitat manipulation, such as predator control or pasture management, may need to be continued. Downlisting may be considered separately for a subset of the Hawaiian goose population if that population subset is shown to meet the definition of a distinct population segment and satisfy additional recovery criteria set forth by the Service (Service 2004, p.iv). Consideration for delisting can occur once all of the downlisting criteria have been met, and all population levels have shown a stable or increasing trend (from downlisting levels) for a minimum of 15 additional years (i.e. at least 30 years) (Service 2004, p.vi).

Captive releases have been an important part of the Hawaiian goose recovery strategy, however; the Service has determined that future releases of captive-bred Hawaiian geese must occur only at appropriate locations (i.e. sites chosen in relation to suitability of habitat in general, and uses of surrounding areas), and in conjunction with predator control, monitoring, and habitat maintenance (Marshall, pers. comm. 2010). In order for Hawaiian goose populations to survive, they must have relatively predator-free breeding areas and sufficient food resources; human-caused disturbance and mortality must be minimized and genetic and behavioral diversity maximized. At the same time, Hawaiian geese are highly adaptable, successfully utilizing a gradient of habitats, ranging from highly altered to completely natural, which bodes well for the recovery of the

species (Service 2004, pp. iv-vi). Since 1962, the majority of Hawaiian goose releases has occurred on at Haleakala National Park on East Maui. Since 1994, Hawaiian geese have also been released at Hanaula in the West Maui mountains (Medeiros, pers. comm., 2007). Little is known about the exact distribution and movements of the birds released at Hanaula, although they have been recorded as far west as Lahaina and as far east as Haleakala National Park, indicating that at least some birds from this release site move extensively around the island (Medeiros, pers. comm. 2011).

Blackburn's Sphinx Moth

Species Description

The Blackburn's sphinx moth is one of Hawaii's largest native insects, with a wingspan of up to 5 in (12 cm). Like other sphinx moths in the family Sphingidae, it has long, narrow forewings, and a thick, spindle-shaped body tapered at both ends. It is grayish brown in color, with black bands across the apical (top) margins of the hind wings, and five orange spots along each side of the abdomen. The larva is a typical, large "hornworm" caterpillar, with a spine-like process on the dorsal (upper) surface of the eighth abdominal segment. Caterpillars occur in two color forms, a bright green or a grayish form. This variation in color does not appear until the fifth instar (the fifth stage between molts) (Van Gelder and Conant 1998, pp. 24-25). Both color forms have scattered white speckles throughout the dorsum (back), with the lateral (side) margin of each segment bearing a horizontal white stripe, and segments four to seven bearing diagonal stripes on the lateral margins (Riotte 1986, pp. 84-85).

The Blackburn's sphinx moth was listed as endangered on February 1, 2000 (USFWS 2000, pp. 4770-4779). In 2003 critical habitat was designated for the Blackburn's sphinx moth on the islands of Hawaii 24,597 ac (9,954 ha), 4,252 ac (Kahoolawe (1,721 ha), Maui (six units, 23,496 ac (9,509 ha)), and Molokai 3,105 ac (1,256 ha) (USFWS 2003, pp. 34710-34766). These designations includes habitat on State and private lands totaling 55,451 ac (22,440 ha) (USFWS 2003, pp. 34710-34766).

Historic and Current Distribution

Reports by early naturalists indicate the species was once widespread and abundant, at least during European settlement on nearly all the main Hawaiian Islands (Riotte 1986, p. 88). Very few specimens of the moth had been seen since 1940, and after a concerted effort by staff at the Bishop Museum to relocate this species in the late 1970s, it was considered to be extinct (Gagné and Howarth 1985, p. 5). In 1984, a single population was rediscovered on Maui (Riotte 1986, p. 80), and subsequently, populations on Hawaii, Kahoolawe, and Lanai were rediscovered (USFWS 2005, pp. 9-10; Duvall, pers. comm., 2011). Moth population numbers are believed to be small based upon past sampling results, however, no reasonably accurate estimate of population exists due to the adult moths' wide-ranging behavior and its overall rarity (A. Medeiros, USGS-BRD, pers. comm., 1998; Van Gelder and Conant 1998, pp. 7-16). Before humans arrived, dry and mesic shrubland and forest covered about 2,034,369 ac (823,283 ha) on all the main islands, and it is likely the moth inhabited much of that area (USFWS 2005, p. 16).

The Blackburn's sphinx moth has been recorded from the islands of Kauai, Kahoolawe, Oahu, Lanai, Molokai, Maui, and Hawaii, and has been observed from sea level to 5,000 ft (1,525 m) elevation (USFWS 2005, p. 10; Duvall, pers. comm., 2011). Most historical records were from coastal or lowland dry forest habitats in areas receiving less than 50 in (127 cm) annual rainfall. On the island of Kauai, the moth was recorded only from the coastal area of Nawiliwili. Populations were known from Honolulu, Honouliuli, and Makua on leeward Oahu, and Kamalo, Mapulehu, and Keopu on Molokai. On Hawaii, it was known from Hilo, Pahala, Kalaoa, Kona, and Hamakua. It appears this moth was historically most common on Maui, where it was recorded from Kahului, Spreckelsville, Makena, Wailuku, Kula, Lahaina, and West Maui. Historical records are lacking for the islands of Kahoolawe and Lanai. The moth has been observed there only in very recent years during biological surveys conducted for various restoration activities on these islands.

Life History

Sphingid moths in general are known to exploit nutritious but low-density, low-apparency host plants such as vines and sapling trees (Kitching and Cadiou 2000). Larvae of the Blackburn's sphinx moth feed on plants in the nightshade family (Solanaceae). Native host plants include trees within the aiea genus *Nothocestrum* (Riotte 1986, p. 89), on which the larvae consume leaves, stems, flowers, and buds (B. Gagne, pers. comm., 2010). Three of the species in this genus are federally listed as endangered: aiea, located on Maui, Molokai, Lanai, Oahu and Kauai; *Nothocestrum breviflorum*, located on the island of Hawaii, and *Nothocestrum peltatum*, located only on the island of Kauai. There are also four native species in the popolo genus *Solanum* (*i.e.*, *Solanum americanum*, *S. incompletum*, *S. nelsonii*, and *S. sandwicense*) that may also be host plants, though there is only evidence of moth larvae utilizing *Solanum sandwicense* (Rubinoff and San Jose 2010, p. 55). Many of the other host plants recorded for this species are not native to the Hawaiian Islands, and include commercial tobacco (*Nicotiana tabacu)*, tree tobacco (*Nicotiana glauca*), and possibly Jimson weed (*Datura stramonium*) (Riotte 1986, p. 89).

In general, sphingid moths can develop from egg to adult in as little as 56 days (Williams 1947, p. 10), but pupae may remain in a state of torpor (inactivity) in the soil for up to a year (B. Gagné, pers. comm., 1994; Williams 1931, p. 373). Adult sphingid moths have been found throughout the year (Riotte 1986, p. 88) and are known to feed on nectar. In general, sphingids are known to live longer than most moths because of their ability to feed and take in water from a variety of sources, rather than relying only upon stored fat reserves. Because they live longer than most moths, female sphingid moths have less time pressure to mate and lay eggs, and often will take more time in locating the best host plants for egg laying (Kitching and Cadiou 2000).

In their 1998 study, Van Gelder and Conant never observed Blackburn's sphinx moth adults feeding or attempting to feed on artificial flowers or native morning glory (*Ipomea* spp.) flowers provided within their enclosures, and captive-reared adult moths lived no longer than 12 days. Subsequently, however, three field observations of feeding Blackburn's sphinx moth adults have been made. One observation occurred within the Kanaio Beach area of southeast Maui, where Blackburn's sphinx moth adults were seen feeding upon the nectar of the native Hawaiian morning glory species (*Ipomea indica*) (D. Hopper, USFWS, pers. comm. 1997). The second observation was made in the upper Kanaio Natural Area Reserve where a single Blackburn's

sphinx moth adult was also seen feeding upon the nectar of koali awa (D. Hopper, *in litt*., 2002). The third observation occurred within a 10 ac (4 ha) exclosure located in the Auwahi dry forest area included within the Ahihi-Kinau Natural Area Reserve – Ulupalakua-Auwahi-Kanaio Unit (Leeward Maui) (F. Duvall, DOFAW, pers. comm. 2005). This observation involved an adult moth feeding upon the nectar of a native halepepe (*Pleomele auwahiensis*) flower. It is expected the native Hawaiian species of caper maiapilo (*Capparis sandwichiana*), and iliee (*Plumbago zeylanica*) are also likely native adult Blackburn's sphinx moth food sources. All three species, *C. sandwichiana*, *P. zeylanica*, and *I. indica* bear flowers which possess some characters suggestive of moth pollination, including nocturnal anthesis (opening at night), light coloration, or the emittance of strong fragrances (*C. sandwichiana*) upon opening. Notable differences in proboscis length between the sexes ranging from 14 to 38 millimeters (6 to 15 inches) have been documented (Van Gelder and Conant 1998, p. 28). If further research demonstrates the validity of this potential characteristic of Blackburn's sphinx moth sexual dimorphism, the difference may indicate a division of adult foraging resources in the wild.

Blackburn's sphinx moth larvae sightings have only been documented between the months of October and May, but adult moths have been found throughout the year (Riotte 1986, p. 88). During 14 surveys conducted between August 15, 1996 and May 29, 1997, Van Gelder and Conant (1998, p.14) noted the presence of eggs on host plants and substantial variation in larval length throughout the Blackburn's sphinx moth breeding season. Van Gelder and Conant (1998, p. 15) hypothesized that Blackburn's sphinx moth either produce eggs during more than one generation each "season," or produce eggs during a single generation with an extended adult emergence time and/or laying period of several weeks.

Plant species composition in the moth's habitat varies considerably depending on location and elevation, but some of the most common native plants in areas where the moth occur are lama (*Diospyros sandwicensis*), hao (*Rauvolfia sandwicensis*), ohe (*Reynoldsia sandwicensis*), alaa (*Pouteria sandwicensis*), aalii (*Dodonaea viscosa*), wiliwili (*Erythrina sandwicensis*), and naio (*Myoporum sandwicense*) (USFWS 2005, p. 13).

The largest populations of Blackburn's sphinx moths, on Maui and Hawaii, are associated with trees in the genus *Nothocestrum* (Van Gelder and Conant 1998, pp.14-15). For example, the large stand of *Nothocestrum* trees within Kanaio Natural Area Reserve, Maui, is likely the largest in the State (Medeiros *et al*. 1993, p. 19), and may explain why the moth occurs with such regularity in the Kanaio area (A. Medeiros, USGS-BRD, pers. comm., 1994). *Nothocestrum* is a genus of four species endemic to the Hawaiian Islands (Symon 1999, pp. 1251-1278). *Nothocestrum* species currently occur on Kauai, Oahu, Molokai, Lanai, Hawaii, and Maui. One species, *N. longifolium*, primarily occurs in wet forests, but can occur in mesic forests as well. Three species, *N. latifolium*, *N. breviflorum*, and *N. peltatum*, occur in dry to mesic forests, the habitat in which the moth has been most frequently recorded. Moth larvae have been documented feeding on two *Nothocestrum* species, *N. latifolium* and *N. breviflorum*; it is likely that *N. peltatum* and *N. longifolium* are suitable host plants for larval moths as well, although *N. peltatum* has declined to such low numbers it will be difficult for the moth to find any trees in recent years. This is supported not only by the fact that they are closely related to known larval hosts, but also because there are past historical records of the moth occurring on the islands of Kauai and Oahu, where

aiea (*N. latifolium*) is not abundant and *N. breviflorum* does not occur. Furthermore, the species is known to feed on a variety of native and non-native Solanaceae.

Threats, Recovery Strategy, and Ongoing Conservation Measures

The primary threats to the Blackburn's sphinx moth include: habitat loss and degradation from urban and agricultural development and wildfires and direct impacts from non-native parasitoids and predators.

Dry to mesic forest habitats in Hawaii have been severely degraded due to past and present land management practices including ranching, the impacts of introduced plants and animals, wildfire, and agricultural development (Cuddihy and Stone 1990, pp. 17-107). Currently, the areas of dry to mesic shrub and forest habitats below 5,000 ft (1,525 m) that are, or could potentially be, suitable for Blackburn's sphinx moth are approximately 367,161 ac (148,588 ha). With the prediction that mesic habitat serves important moth seasonal foraging and refugia needs, it thus appears the moth's range has declined on the order of 82% since humans arrived in Hawaii 1,600 years ago (HBMP 2000; Kirch 1982) and continues to be threatened by development and degradation by fire and ungulates (USFWS 2005, p. 16).

The primary predatory threat to Blackburn's sphinx moth is introduced ants, introduced birds (e.g., Japanese white-eye (*Zosterops japonicus*); Van Gelder and Conant 1998, p. 17), and introduced reptiles (Van Gelder and Conant 1998, p. 18). Ants, family Formicidae, are not a natural component of Hawaii's arthropod fauna, and the Blackburn's sphinx moth evolved in the absence of predation pressure from ants. Ants can be particularly destructive predators because of their high densities, recruitment behavior, aggressiveness, and broad range of diet (Reimer 1993, p. 19-20). Seven ant species are significant threats to Blackburn's sphinx moth: the big headed ant (*Pheidole megacephala*), the Argentine ant (*Iridomyrmex humilis*), the long-legged ant (*Anoplolepis longipes*), *Ochetellus glaber* (no common name), the red imported fire ant (*Solenopsis invicta*), the tropical fire ant (*Solenopsis geminata*), and the Papuan thief ant (*Solenopsis papuana*) (USFWS 2005, pp. 28-30). The big headed ant is found on all of the islands where Blackburn's sphinx moth occur and it is known to be a predator of eggs and caterpillars of native Lepidoptera, and can exterminate entire populations (Zimmerman 1948, pp. 173-174). The Argentine ant is found on seven of the main Hawaiian Island and has been found to impact native insects (Cole *et al*. 1992, pp. 1113-1322; Krushelnycky *et al*. 2005, pp. 5-9). The long-legged ant occurs on Kauai, Oahu, Maui, and Hawaii (Reimer *et al.* 1990, p. 44; Holway *et al.* 2002). Impacts to endemic *Tetragnatha* spiders were reported by Gillespie and Reimer (1993, pp. 21-23) and Hill *et al*. (2003, pp. 1969-1984) reported on the species' impacts to the vegetation and insect communities of the Seychelles. *Ochetellus glaber* is found on Kahoolawe, Kauai, Oahu, Maui, and Hawaii (Nishida 2002, p. 169; Starr *et al.* 2004, p. 52) and was reported to have preyed upon or scavenged a Blackburn's sphinx moth larvae (A. Medeiros, pers. comm., 1998). The tropical fire ant and Papuan thief ant are found on seven of the main Hawaiian Island (Reimer et al. 1990, p. 44). Ants, including the tropical fire ant are known to be the most significant and consistent mortality factor on eggs, and probably larvae, of the common eggfly (*Hypolimnas bolina*), a butterfly on Guam (Nafus 1993a, p. 19; 1993b, pp. 143-144). The red imported fire ant has not made it to the Hawaiian Islands. Jetter and others (2002) found the red imported fire ant

to be a significant threat to the endangered primonse sphinx moth (*Euproserpinus euterpe*) and will likely be a threat to the Blackburn's sphinx moth.

The primary threat of parasitism to Blackburn's sphinx moth are from non-native braconid, ichneumonid, and trichogrammatid wasps and tachinid flies. Most species of non-native baconid and ichneumonid wasps that parasitize Lepidoptera, moths and butterflies, are not host-specific, but attack caterpillars or pupae of a variety of species (Zimmerman 1948, pp. 174-175, 1978, pp. 94-98; Funasaki *et al*. 1988, pp.111) and have become the dominant larval parasitoids even in intact, high-elevation, native forest areas of the Hawaiian Islands (Zimmerman 1948, pp. 174-175; F. G. Howarth *et al*., *in litt*. 1994). These wasps lay their eggs within the eggs or caterpillars of Lepidoptera. Upon hatching, the wasp larvae consume internal tissues, eventually killing the host. At least one species established in Hawaii, *Hyposoter exiguae* (no common name), is known to attack the tobacoo hornworm and the related tomato hornworm in North America (Carlson 1979, pp. 676-677). This wasp is recorded on Kauai, Oahu, Molokai, Maui, and Hawaii Island (Nishida 2002, pp. 171) and is a recorded parasitoid of the lawn armyworm (*Spodoptera maurita*) on tree tobacco on Maui (Swezey 1927, pp. 404-405). Because of the rarity of Blackburn's sphinx moth, no documentation exists of non-native braconid and ichneumonid wasps parasitizing the species. However, given the abundance and the breadth of available hosts of these wasps; they are considered significant threats to the moth (Howarth 1983, pp. 239-244; Howarth *et al*., *in litt*. 1994; F.G. Howarth, pers. comm. 1994; Gagne and Howarth 1985, p. 77).

Small wasps in the family Trichogrammatidae parasitize insect eggs, with numerous adults sometimes developing within a single host egg. Several non-native species are established in Hawaii (Nishida 2002, pp. 180), including *Trichogramma minutum* (no common name), which is known to attack the sweet potato hornworm in Hawaii (Fullaway and Krauss 1945, pp. 99). In 1929, the wasp *Trichogramma chilonis* (no common name) was purposefully introduced into Hawaii as a biological control agent for the Asiatic rice borer (*Chilo suppressalis*) (Funasaki *et al*. 1988, pp. 136). The wasp parasitizes the eggs of a variety of Lepidoptera in Hawaii, including sphinx moths (Funasaki *et al*. 1988, pp. 136).

Two species of tachinid flies, *Lespesia archippivora* and *Chaetogaedia monticola*, were purposefully introduced to Hawaii for control of army worms (Funasaki *et al*. 1988, pp. 140-141; Nishida 2002, pp. 116). These flies lay their eggs externally on caterpillars, and upon hatching, the larvae burrow into the host, attach to the inside surface of the cuticle, and consume soft tissues (Etchegaray and Nishida 1975a, pp. 42-43). In North America, *Chaetogaedia monticola* is known to attack at least 36 species of Lepidoptera in 8 families, including sphinx moths; *Lespesia archippivora* is known to attack over 60 species of Lepidotera in 13 families, including sphinx moths (Arnaud 1978, pp.136). These species are on record as parasites of a variety of Lepidoptera in Hawaii and are believed to depress populations of at least two species of native moth (Lai 1988, pp. 188-187). Over 40% of the caterpillars of the monarch butterfly (*Danaus plexippus*) on Oahu are parasitized by *Lespesia archippivora* (Etchegaray and Nishida 1975b, pp. 35-37).

Conservation Needs of the Species
Actions needed to recover the Blackburn's sphinx moth are detailed below. For additional information on these recovery actions see the recovery plan (USFWS 2005).

- Site/area/habitat protection – Protection, management, and restoration of Blackburn's sphinx moth habitat and wild *Nothocestrum* spp. host plant populations.
- Monitoring protocol development – Development and implementation of a detailed long-term monitoring program.
- Reintroduction/ translocation implementation – Re-establish and augment wild moth populations within the species' historic range, through captive propagation if necessary.
- Captive propagation protocol development – Continue efforts to develop and refine captive propagation techniques for the species.
- Threats research – Identify primary predators, competitors, and parasites of Blackburn's sphinx moth and develop and implement appropriate control measures.
- Ungulate control – Remove ungulates and restore habitat in management units.

Ongoing Conservation Actions
Conservation efforts that have been implemented to help support the recovery of the Blackburn's sphinx moth or its host plant are detailed below.

- Ungulate exclosure – Exclosures of various sizes have been constructed in management units on Kauai to protect potential host plants for the species (M. Clark, USFWS, pers. comm. 2008). In addition, ungulate exclosures and, in some cases, ungulate control has been undertaken in various locations on Kauai Lanai, Molokai, Maui, and Hawaii (Medeiros 2006, pp. 1-4; DLNR 2007, pp.1-9; J. Higashino, USFWS, pers. comm. 2008).
- Habitat and natural process management and restoration – Forest restoration, including outplanting of aiea (*Nothocestrum* spp.), has been undertaken in management units on Kauai (M. Clark, USFWS, pers. comm. 2008). Efforts to outplant *Nothocestrum* species have been undertaken in various locations on Maui and Hawaii (Allen 2000, pp.1037-1041; Medeiros 2006, pp.1-4). However, additional management is needed in these management units to help achieve the recovery of the Blackburn's sphinx moth.
- Threats research – Efforts to develop control measures for some potential predators, like the big-headed ant (*Pheidole megacephala*) and Argentine ant (*Linepithema humile*), have met with some success (Peck *et al*. 2007, p. 91; Snook *et al*. 2008, p. 56).

Reintroduction / translocation protocol development – Rubinoff and San Jose (2010, pp. 53-59) undertook efforts to develop captive propagation techniques for the Blackburn's sphinx moth in 2005 and 2009 which could support a reintroduction program on Kauai.

Environmental Baseline

The environmental baseline describes the status of the species or critical habitat and the past and present factors (adverse and beneficial) affecting the species or critical habitat in the action area for the proposed action at the time of consultation. Unrelated Federal actions within the action area that have already undergone formal or informal consultation are also a part of the environmental baseline.

Hawaiian Hoary Bat

Although the Auwahi project site has few trees and is unlikely to be frequented by roosting and breeding Hawaiian hoary bats, the site is likely to be used by foraging bats. The wind turbines will be erected in an area with widely scattered trees dominated by grass and shrubs. Because bat roosting and breeding is limited to trees taller than 15 ft (5 m), Hawaiian hoary bat use of the wind farm site is likely to be limited to feeding. Hawaiian hoary bats have been observed in the Project area (David and Guinther 2011). However, Hawaiian hoary bats were not observed or acoustically detected during radar surveys at the Project site during July and October 2006 surveys (Hamer 2010a) or at any time during diurnal surveys on site (Montgomery 2008, David and Guinther 2011). Biologists recorded a single Hawaiian hoary bat audio detection and observed bat-like targets on the radar screen during the Spring 2010 surveys (Hamer 2010a). Two Anabat detectors were erected on the temporary met tower located within the turbine string in July 2010 and monitoring is ongoing. To date, very low levels of bat activity have been recorded. Results of acoustic monitoring surveys within the wind farm site indicate that over a one year period of monitoring (July 2010 through August 2011), a total of 78 bat passes were recorded resulting in 0.12 bat passes per detector night, with a maximum of 5 bat calls recorded in one night. These results are consistent with the lack of forest within the Project to provide suitable habitat for roosting and breeding, suggesting that the occurrence of this species in the Project area is likely infrequent and associated with transiting and foraging. This level of bat activity is low in comparison to similar studies on both the mainland and Hawaii (Bonaccorso pers. comm. 2008; Kepler and Scott 1990; Menard 2001), as expected due to the low number of suitable foraging and roosting trees within the Project area.

<u>Role of the Action Area in the Conservation of the Hawaiian Hoary Bat</u>
Hawaiian hoary bat populations on the islands of Hawaii, Kauai, and Maui must be well distributed, naturally reproducing, and stable or increasing in size for at least five consecutive years following downlisting before delisting is considered. The Auwahi project site constitutes a portion of the Hawaiian hoary bat's range on Maui. The project site may provide feeding grounds for the Hawaiian hoary bat at the southernmost area of Maui.

The Waihou Mitigation Area (see Figure 2), currently provides feeding and breeding habitat for the Hawaiian hoary bat. It is adjacent to existing forested conservation areas (Kula Forest Reserve, Auwahi Forest Restoration Project, and the Kanaio Forest Reserve).

Hawaiian Petrel

Although Hawaiian petrels do not currently nest at the project site, the Auwahi wind turbine structures will be constructed in airspace used by a subset of the approximately 1,430 Hawaiian petrel breeding pairs coming to shore in the east Maui mountains. East Maui's 1,430 breeding pairs constitute approximately 30% of the Hawaiian petrel's range-wide breeding population. The highest concentration of East Maui petrel burrows is within the crater of the dormant shield volcano. Several large valleys to the north and east of the crater are the most heavily used transit routes for seabirds accessing the crater interior nest sites. Although the Auwahi wind project site is not within a primary route used by petrels accessing nesting sites on Haleakala, Hawaiian petrel passage rates are high in the project area.

Radar surveys conducted at the Project in October 2006 and May 2010 documented mean passage rates of 12.01 (fall) and 7.31 (spring) petrel targets per hour (Hamer 2010a). The spring passage rates are expected to be higher than the fall rates because the non-breeders are still on-island during the spring. The relatively higher fall 2006 data may include an unknown number of sooty terns (Hamer pers. comm. 2010) as they were detected by outside observers but could not be distinguished from targets on the radar screen. Radar surveys have also been conducted by other entities in the vicinity of where the Auwahi generator-tie line crosses a ridge that is adjacent to the communication towers owned by Island Airwaves. The towers are located on the Ulupalakua Ranch within a 3-acre (1.2-ha) parcel at an elevation of approximately 4,450 ft (1,356 m). Radar surveys were conducted over five nights in 2007. Petrel passage rates over this area averaged 2.3 petrel targets per hour (Gall and Day 2007 as cited in USFWS 2008).

Role of the Action Area in the Conservation of the Hawaiian Petrel
Hawaiian petrels nest in the mountains and feed at sea. Unobstructed airspace between ocean feeding grounds and nest sites is necessary for petrel survival and reproduction. Auwahi will be constructed in airspace used by a portion of the approximately 1,430 breeding pairs of Hawaiian petrels occupying the east Maui mountains. The Kahikinui and ATST mitigation sites contain approximately 5.6% of the breeding Hawaiian petrels in east Maui.

Hawaiian Goose

The approximately 400 Hawaiian geese on Maui are found primarily within Haleakala National Park, at elevations between 6,300 ft and 7,700 ft (1,920 m and 2,347 m) (Banko et al. 1999). They also occur in the West Maui Mountains, and around the towns of Lahaina and Wailuku (USFWS 2004) and in the plains of the central Maui isthmus. Hawaiian geese breed, feed, socialize, and loaf in areas believed to have historically been used by geese, north of the project site. Hawaiian goose recovery planning may entail translocation and management of a historic Hawaiian goose area several miles east of the Project that is no longer used by geese. Hawaiian geese infrequently transit the project area in their movements among the heavily used sites north of the project site. During radar surveys on May 26, 2010, seven overlapping Hawaiian goose vocalizations were heard adjacent to the Project area. Geese had not historically been recorded in the Project area, Ulupalakua Ranch staff had not incidentally observed them there, and they were not observed or heard vocalizing during any other surveys conducted or incidentally.

Role of the Action Area in the Conservation of the Hawaiian Goose
Although Hawaiian geese are not known to feed, breed, or socialize within the project footprint, the project area provides unobstructed airspace Hawaiian geese traverse in their movements among breeding sites.

Blackburn's sphinx moth

The Blackburn's sphinx moth historically was most common on Maui where the largest and most persistent population of this species currently occurs. The largest remaining stand of aiea trees in Hawaii is located on Maui in the Kanaio Natural Area Reserve, adjacent to the Project (Mitchell et al. 2005). The Service designated critical habitat for this species in the vicinity of the Project, in critical habitat unit 9. Although the Auwahi parcel of Ulupalakua Ranch was originally considered for inclusion in the critical habitat unit, ultimately the Ulupalakua Ranch land (and the Haleakala Ranch) was excluded from the critical habitat unit because "the landowners ongoing conservation activities on these ranches provided more benefits for the species than would be provided by critical habitat designation" (USFWS 2005c, p. 38). Unit 9 contains what is likely the largest extant moth population or meta-population in the moth's range. This unit contains native aiea and introduced larval host plants as well as numerous nectar-supplying plants for adults. Areas within this unit may serve as a source area for local populations.

Botanical surveys conducted in March and April 2011, indicate there is 0.3 ac (0.1 ha) of native habitat and 27.7 ac (11.2 ha) of degraded Blackburn's sphinx moth habitat within the project footprint. The species' non-native host plant, tree tobacco, has been observed within the project area during the invertebrate and botanical resources surveys conducted in 2007, 2010, and 2011. In 2010 and 2011, aiea plants were documented within the wind farm site and along the generator-tie line corridor. In 2008, three adult male Blackburn's sphinx moths and one larva (located on examined tobacco plants) were observed in the Project area during invertebrate surveys (Montgomery 2008). No larvae were observed on the eight aiea plants examined outside the generator-tie line corridor. In March and April, 2011, an additional survey for Blackburn's sphinx moth was conducted to capture wet season conditions. Seven larvae and two eggs were observed on tree tobacco plants adjacent to the construction access route; three additional tree tobacco showed possible evidence of larvae feeding.

Role of the Action Area in the Conservation of the Blackburn's sphinx moth
The Blackburn's sphinx moth feeds, breeds, and shelters in the native and degraded habitats in the action area. The Kanaio area, where the project is located, contains what is likely the largest extant moth population or meta-population in the moth's range. This unit contains native aiea and introduced larval host plants as well as numerous nectar-supplying plants for adults. Habitat in the project area is likely to contribute to the reproductive success and survival of the Blackburn's sphinx moth in the Kanako area.

3.0 EFFECTS OF THE ACTION

Wind energy generation facilities in Hawaii are relatively new and few wildlife monitoring impact studies have been conducted to document the direct or indirect impact of wind energy facilities on wildlife. Post-construction monitoring to document downed wildlife has been conducted at the Kaheawa Wind Power facility since operations began in June 2006 (KWP 2008b, 2008c). This monitoring offers the best presently available information into the potential impacts of the Auwahi WTGs.

Construction and operation of Auwahi creates the potential for listed species to collide with WTGs, temporary and permanent meteorological towers, overhead collection lines, and cranes used during the construction phase of the project. The wind power project will provide a source of additional electricity which could be growth inducing and result in additional take. In addition, additional turbines and powerlines may be added to the Auwahi project. Pursuant to the ESA, adverse impacts occurring as a result of an increase in the project scope and any additional development interdependent with the Auwahi project would be assessed in biological opinions and mitigated to the maximum extent practicable via development and implementation of Habitat Conservation Plans or Federal projects.

The following five types of "take" are analyzed in the Auwahi HCP (Tetra Tech 2012):

Direct take:	Individuals that are killed or injured colliding with turbines or associated on-site structures that are found during post-construction monitoring.
Indirect take:	The adult birds or bats lost to direct take could have been tending eggs or dependent young. The loss of these adults will then also lead to the loss of the eggs or dependent young. Loss of eggs or young will be indirect take attributable to the Project.
Unobserved direct take:	Estimated direct take of unobserved individuals based on searcher efficiency and scavenging trial results. Unobserved take accounts for individuals that are killed by collision with project components but that are not found by searchers for various reasons, including vegetation cover and carcass removal by scavenging.
Unobserved indirect take:	Loss of dependent young from unobserved direct take.
Estimated total take:	Sum of the above four types of take.

Estimating the potential for each listed species to collide with project components (direct take) was done using the results of on-site surveys, information about the Project design, and the results of post-construction monitoring at the Auwahi facility. The fatality estimate models developed for Auwahi incorporated rates of species occurrence, observed flight heights, encounter-rates with

turbines and meteorological towers, and estimates of the species abilities to avoid project components. Post-construction monitoring will be used to estimate actual rates of take.

The Auwahi HCP identifies three tiers for levels of total take for the Hawaiian hoary bat and Hawaiian petrel to facilitate mitigation planning: Tier 1, Tier 2, and Tier 3. Because take may have occurred, even if there is a lack of evidence of take, the Applicant has committed to complete mitigation to offset the Tier 1 and Tier 2 levels of take even if no mortality is detected. A single level of take of the Hawaiian goose and direct and indirect impacts to Blackburn's sphinx moth are addressed in the HCP.

Effects of the Action to the Hawaiian Hoary Bat

Activities that may affect the Hawaiian hoary bat in the proposed Auwahi project area include construction and operation of turbines and a meteorological tower. Low rates of activity by the Hawaiian hoary bat have been detected in the Auwahi project area. Mitigation for take of the Hawaiian hoary bat will include habitat restoration and research.

Take Impacts

Based on the analysis in the Auwahi HCP (Tetra Tech 2012, pp. 5-1 - 5-4), Auwahi is requesting authorization to take up to 19 adult and eight young bats. Those analyses are herein incorporated by reference. Of this total, Tier 1 includes the death or injury of 5 adults and 2 juveniles; Tier 2 includes the death or injury of up to 10 adults and 4 juveniles; Tier 3 includes the death or injury of up to 19 adults and 8 juvenile bats. Site-specific data gathered by Auwahi supports the results presented in the Auwahi HCP. The Service concurs with Auwahi's assessment of project impact because the Auwahi HCP's fatality estimates were based on the best available information on the expected amount of Hawaiian hoary bat take.

Effects of the Hawaiian Hoary Bat Mitigation Program

Tier 1 Mitigation

Auwahi is requesting authorization to take up to five adults and two juveniles for Tier 1, which, with an estimated 30% survival rate of juveniles to adulthood (Humphrey 1982), equates to a total of six adults. Assuming a 50:50 adult sex ratio, the potential take of six adults would result in the take of up to three adults of each sex. Mitigation for bats killed by collision with project structures will be offset with habitat restoration which will, over time, increase Maui's Hawaiian hoary bat carrying capacity. To mitigate for Tier 1 take of the Hawaiian hoary bat under the Auwahi HCP, Auwahi shall restore 126.5 ac (51 ha) of pasture and non-native forest to native forest and put 126.5 ac (51 ha) into a permanent conservation easement at the Waihou Mitigation Area on Ulupalakua Ranch. This mitigation will result in 42 ac (17 ha) of habitat restoration and permanent conservation per male bat taken. The Service and DOFAW received the results of Home Range Tools for ArcGIS®, Version 1.1 (compiled September 19, 2007) calculations based on Hawaiian hoary bat tracking data collected by USGS-BRD Wildlife Ecologist, Dr. Frank Bonaccorso. This dataset from a two-week tracking study indicates that the mean core area of rainforest habitat on the island of Hawaii used by 14 male bats was 84.3 ac (34.1 ha) per bat and the average size of the core area utilized by the 11 females in the dataset was 41.2 ac (16.7 ha) per bat. Male bat core areas do not appear to overlap; female core areas may overlap with male core

areas. A core area was defined as the area that incorporates 50% of tracked movements; therefore, the Service and DOFAW assume that the core area is a minimum habitat requirement for the Hawaiian hoary bat. By implementing habitat restoration and putting into place the permanent conservation easement, Auwahi will increase Maui's Hawaiian hoary bat carrying capacity.

Auwahi's restoration of 126.5 ac (51 ha) of forest will increase Maui's Hawaiian hoary bat carrying capacity by an additional 1.5 male bats. This habitat is expected to also support female and juvenile bats with habitat overlapping that of the males. Restoration within the Waihou Mitigation Area will provide additional bat breeding, foraging, and traveling habitat and will provide a forested corridor with state reserves (Kula Forest Reserve, Auwahi Forest Restoration Project, and the Kanaio Forest Reserve) occupied by bat habitat. The benefits of the forest restoration and the perpetual conservation easement will extend in perpetuity. Forest restoration is likely to be successful because it has been successfully implemented at similar sites.

Tier 2 Mitigation
To mitigate for Tier 2 take, Auwahi shall complete radio telemetry research to determine the core area and habitat use patterns of the Hawaiian hoary bat on Maui. Radio telemetry research will provide basic information about the species use of dry and mesic habitats needed to better understand the conservation needs of the species (Service 1998). In addition, radio telemetry research will enable Auwahi to confirm the benefits of Tier 1 mitigation forest restoration.

Tier 3 Mitigation
Auwahi is requesting authorization to take an additional 9 adults and four juveniles (for a total of up to 19 adults and eight juveniles) for Tier 3, which, with an estimated 30% survival rate of juveniles to adulthood (Humphrey 1982), equates to a total of 22 adults. Assuming a 50:50 adult sex ratio, the take of 22 adults would result in the take of 11 adults of each sex.

Auwahi Wind will use the results of the Tier 1 and 2 mitigation and other best available science at the time Tier 3 mitigation is needed to identify appropriate mitigation measures to be implemented that may include restoration of bat habitat or additional bat research. Should habitat restoration be deemed appropriate by the Service and DOFAW, an approximately 195-ac (79 ha) area has been set aside at the Waihou Mitigation Area to satisfy all or a portion of Auwahi Wind's Tier 3 bat mitigation. In addition, a pooled-partnership for bat mitigation at the Kahikinui Forest Project, or other appropriate bat mitigation site could be used with Agency approval. Tier 3 mitigation plans may be modified based on the results of Tier 2 bat habitat usage research. By implementing habitat restoration and putting into place a permanent conservation easement, it is anticipated that Auwahi will increase Maui's Hawaiian hoary bat carrying capacity by 1.5 male bats and the three female bats that may overlap with the males.

<u>Summary of the Effects of the Action on the Hawaiian Hoary Bat</u>
Because the abundance and distribution of the Hawaiian hoary bat throughout its range is not well known, it is difficult to gauge the effect that take of Hawaiian hoary bats resulting from the proposed project may have on the population of this species. Hawaiian hoary bats foraging in otherwise unobstructed airspace in the WTG vicinity may be killed and injured by the turning

rotor blades. No more than 19 adults and 8 young are expected to be taken over the 25-year Permit term. Although the proposed take authorization levels are likely to adversely impact the overall population of the Hawaiian hoary bat on Maui, the proposed reforestation project is likely to mitigate those impacts and should increase Hawaiian hoary bat carrying capacity on Maui. Forest restoration is likely to be successful because it has been successfully implemented in similar sites. In addition, Auwahi Wind's completion of radio telemetry research will facilitate Hawaiian hoary bat recovery planning.

Effects of the Action on the Hawaiian Petrel

Take Impacts

The results of fatality modeling presented in the Auwahi HCP (Tetra Tech 2012, pp. 5-4 through 5-8) indicate a total of up to 64 adult and 23 nestling Hawaiian petrels are likely to be killed or injured, directly or indirectly, by operation of the Auwahi project over the 25-year term of the proposed Permit. Those analyses are herein incorporated by reference. Of this total, Tier 1 includes the death or injury of 19 adults and seven nestling petrels; Tier 2 includes the death or injury of up to 32 adult and 12 nestling petrels; Tier 3 includes the death or injury of up to 64 adults and 23 nestlings. If juvenile survival rate of 0.8034 (Simons 1984 p. 1070) is applied to fledglings for six years at-sea before adulthood, each juvenile taken is comparable to the take of 0.26 adults (and Tier 1 take is comparable to take of 21 adults, Tier 2 is comparable to take of 36 adults, and Tier 3 is comparable to take of 71 adult Hawaiian petrels). The proposed incidental take will reduce the Maui population by up to 2%.

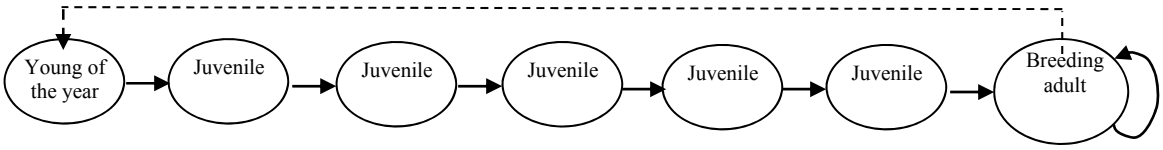
The Service concurs with this assessment of impact because the Auwahi HCP's fatality modeling results were based on the best available information on the expected amount of petrel take. Site-specific radar data gathered by Auwahi supports the results presented in the Auwahi HCP.

Effects of the Hawaiian Petrel Mitigation Program

Take of Hawaiian petrels will be offset by Auwahi's mitigation program. Predator control will be implemented to increase survival and reproduction of Hawaiian petrels on Maui to the extent needed to offset take resulting from the project. For the purposes of mitigation planning and implementation, mitigation will be implemented in tiers corresponding to the three tiers of take.

Anticipated Benefits of In-Situ Predator Control at Kahikinui

To evaluate the benefits of predator control we adapted a deterministic matrix model, developed by Tetra Tech (Tetra Tech 2012, p. 6-21). This general model is commonly used in population ecology to calculate the population growth rate (i.e., lambda) using stage-specific information on survival and reproduction. A lambda value of 1.0 indicates a stable population, less than 1.0, a declining population, and greater than 1.0 an increasing population. Tetra Tech created a seven-stage matrix model where stage one represents the young that survive to enter the local population, stages two through six represent non-breeding juveniles, and stage seven is breeding adults (Figure 5).



Note: Solid arrows represent survival between stages and the dashed arrow represents reproduction.

Figure 5. Visualization of a Hawaiian Petrel Matrix Model (Tetra Tech 2012, p. 6-14).

Demographic values (Simons 1984) for vital rates under baseline conditions and under conditions where petrels are protected by varying levels of predator control (Table 5) were input into the population model to calculate the anticipated benefits of the Auwahi mitigation actions.

Table 5. Vital Rates used in the Population Model for Current Condition and Anticipated Conditions Under Predator Control and the Associated Population Growth Rate (Lambda).

	Survival – Breeding Adults	**Survival – Juvenile**	**Fledglings per Female**	**Female Fledgling per female**	**Lambda**
Moderate predation (No predator control)	0.850	0.8034	0.55	0.245	0.933
Mild predation (Predator trapping)	0.900	0.8034	0.60	0.300	0.978
Minimal predation (Predator exclusion fencing + trapping)	0.930	0.8034	0.72	0.360	1.009

Auwahi evaluated population and net benefit projections under scenarios with and without predator control as followings:

1. **Estimate the starting size of the breeding population (i.e., population at time T):** Auwahi first estimated the number of active burrows that might be found on the mitigation sites and then adjusted this number to reflect the number of breeding pairs. The number of breeding pairs is equal to the number of breeding females, which is the starting size of the breeding population.

2. **Estimate population size of the breeding population over the Project's operation period of 20 years (i.e., population size at time T+1):** For the first year, Auwahi took the starting size of the breeding population and multiplied it by lambda to generate the breeding population size in the following year (T+1). For each subsequent year, Auwahi took the breeding population size in each subsequent year and multiplied it by lambda.

3. **Calculate size of adult population (breeders + nonbreeders) at a colony:** After the population management period, the population of active breeders is adjusted upwards to account for the observation that, in any given year, 25% of the adult population at a colony does not breed (Simons 1984).

4. **Evaluate success of predator control program:** At the end of the 20-year projections (i.e., the duration of the Kahikinui mitigation program proposed in this HCP), the relative benefit of a given predator control program is assessed by taking the difference in the number of adults in the unmanaged population versus to two predator control scenarios.

Based on the preliminary assessments of burrow availability and activity at Kahikinui, Tetra Tech performed an iterative series of analyses for a population of 25 breeding pairs (33 active burrows) and 33 breeding pairs (44 active burrows, as many active burrows are occupied by non-breeding birds) (Table 6). If baseline predation rates used in the model are confirmed and the proposed predator control strategy achieves the "Mild Predation" scenario, the realized benefit after 20 years is projected to range between 26 and 34 adult petrels thereby mitigating take at both the Tier 1 and much or all (depending on juveniles at-sea) of the Tier 2 level of take. If the proposed predator control strategy achieves the "Minimal Predation" scenario, the realized benefit after 20 years is projected to range between approximately 61 and 81 adult petrels (Table 6), thereby mitigating take of most if not all of the Tier 3 level of take.

Table 6. Population and Net Benefit Projections for Three Predator Control Scenarios at Kahikinui.

	33 Active Burrows			**44 Active Burrows**		
	Moderate Predation	**Mild Predation**	**Minimal Predation**	**Moderate Predation**	**Mild Predation**	**Minimal Predation**
Number of active burrows	33	33	33	44	44	44
% of active burrow with breeding pairs	75	75	75	75	75	75
# of breeding females	24.8	24.8	24.8	33	33	33
Year 1	24.8	24.8	24.8	33	33	33
Year 2	23.1	24.2	25.0	30.8	32.3	33.3
Year 3	21.5	23.7	25.2	28.7	31.6	33.6
Year 4	20.1	23.2	25.4	26.8	30.9	33.9
Year 5	18.8	22.6	25.7	25.0	30.2	34.2
Year 6	17.5	22.1	25.9	23.3	29.5	34.5
Year 7	16.3	21.7	26.1	21.8	28.9	34.8
Year 8	15.2	21.2	26.4	20.3	28.2	35.1
Year 9	14.2	20.7	26.6	18.9	27.6	35.5
Year 10	13.3	20.3	26.8	17.7	27.0	35.8
Year 11	12.4	19.8	27.1	16.5	26.4	36.1
Year 12	11.5	19.4	27.3	15.4	25.8	36.4
Year 13	10.8	19.0	27.6	14.4	25.3	36.7

	33 Active Burrows			44 Active Burrows		
	Moderate Predation	**Mild Predation**	**Minimal Predation**	**Moderate Predation**	**Mild Predation**	**Minimal Predation**
Year 14	10.0	18.5	27.8	13.4	24.7	37.1
Year 15	9.4	18.1	28.1	12.5	24.2	37.4
Year 16	8.7	17.7	28.3	11.7	23.6	37.7
Year 17	8.2	17.3	28.6	10.9	23.1	38.1
Year 18	7.6	17.0	28.8	10.2	22.6	38.4
Year 19	7.1	16.6	29.1	9.5	22.1	38.8
Year 20	6.6	16.2	29.3	8.8	21.6	39.1
Number of Breeding Adults after 20 years	13.3	32.4	58.7	17.7	43.2	78.2
Total number of adults after 20 years	17.7	43.2	78.2	23.6	57.7	104.3
Benefit from Moderate to Mild	25.6			34.1		
Benefit from Moderate to Minimal	60.6			80.8		

If the predator control for additional burrows is needed to achieve the necessary mitigation, Auwahi shall assume management of additional burrows at Kahikinui and/or at the ATST mitigation parcel (and, if needed, within Haleakala National Park). The ATST site (see Figure 4) is located on the leeward slope of Haleakala adjacent to the Kahikinui Forest Project parcel and currently supports 74 active burrows (Service 2011b) as described below. If the National Science Foundation's ATST mitigation actions achieve a "Mild Predation" scenario, the Service (Service 2011b) estimates that 45 actively breeding pairs will reside at the ATST site at the time when Auwahi will assume ATST site management. If the proposed predator control strategy achieves the "Mild Predation" scenario, the realized benefit after an additional 10 years is projected to be 34 adult petrels (see Table 7). If Auwahi's predator control strategy achieves the "Minimal Predation" scenario, the model indicates the anticipated benefit after an additional 10 years is calculated to be approximately 66 adult petrels, (see Table 7 If either worst-case scenario occurs (i.e., the proposed predator control only achieves a "Mild Predation" demographic condition or Tier 3 take occurs), Auwahi's commitment to mitigation at both Kahikinui and ATST (if necessary) is likely to be adequate to offset all three tiers of Hawaiian petrel take. However, if additional mitigation effort is needed to fully offset project take, Auwahi Wind shall implement additional predator control at Haleakala National Park.

There is some potential for seabirds to get caught in predator traps, and on rare occasions this can result in the death of the bird. Trapping and monitoring at mitigation sites will closely follow Park-established protocols including appropriate trap placement and regular monitoring. Therefore, potential adverse impacts to seabirds as a result of the proposed mitigation are not anticipated. The Park has measured a capture rate of 0.17 Hawaiian petrels captured per 100 predator traps per year (Bailey pers. comm. 2011).

Table 7. Population and Net Benefit Projections for Three Predator Control Scenarios for Ten Years of ATST Mitigation Site Management.

	Moderate Predation	Mild Predation	Minimal Predation
Year 11	45.0	45.0	45.0
Year 12	42.0	44.0	45.4
Year 13	39.2	43.0	45.8
Year 14	36.5	42.1	46.2
Year 15	34.1	41.2	46.6
Year 16	31.8	40.3	47.1
Year 17	29.7	39.4	47.5
Year 18	27.7	38.5	47.9
Year 19	25.8	37.7	48.3
Year 20	24.1	36.8	48.8
Number of Breeding Adults after 20 years	48.2	73.7	97.6
Total number of adults after 20 years	64.3	98.2	130.1
Benefit from Moderate to Mild	33.9		
Benefit from Moderate to Minimal	65.8		

If diphacinone (or another rodenticide) is used to control rats Hawaiian petrels are not expected to be attracted to the toxin or eat organisms that have been contaminated. Thus, the use of rodenticides is not anticipated to negatively impact seabird populations (DOFAW 2009b).

Summary of Effects of the Action on the Hawaiian Petrel

The results of fatality modeling presented in the Auwahi HCP (Tetra Tech 2012 on pages 5-4 through 5-8) indicate a total of up to 64 adult and 23 nestling Hawaiian petrels are likely to be killed or injured, directly or indirectly, by operation of the Auwahi project over the 25-year term of the proposed Permit. This impact, if not mitigated, is likely to reduce the Maui Hawaiian petrel population by approximately 2%. Auwahi shall implement predator control at Kahikinui and, if necessary, the ATST mitigation site or Haleakala National Park, sufficient to offset requested take of the Hawaiian petrel.

Although it is not currently used for Hawaiian petrel breeding, the wind farm project site does serve as unobstructed airspace through which Hawaiian petrels traverse in their movements between their breeding area and ocean feeding grounds. The wind development will increase the level of obstruction within the airspace, resulting in mortality of Hawaiian petrels, as discussed above. After the wind farm is constructed, airspace around the turbines will continue to be adequate for transit of the local Hawaiian petrel population.

Effects of the Action on the Hawaiian Goose

Take Impacts

Hawaiian geese infrequently transit the project area in their movements among the heavily used sites north of the project site. During radar surveys on May 26, 2010, seven overlapping

Hawaiian goose vocalizations were heard adjacent to the Project area. Geese had not historically been recorded in the Project area, Ulupalakua Ranch staff have not observed them in the vicinity, and they were not observed or heard vocalizing during any other surveys conducted to date on the Project. The results of fatality assessments presented in the Auwahi HCP (Tetra Tech 2012a) indicate a total of up to five adult, immature, fledgling Hawaiian geese or eggs are likely to be killed or injured, directly or indirectly, by operation of the Auwahi project over the 25-year term of the proposed action. Those modeling results are herein incorporated by reference. The Service concurs with this assessment of impact because the Auwahi HCP's fatality estimates are based on the best available information regarding the expected take of the Hawaiian goose. Site-specific data gathered by Auwahi supports the results presented in the Auwahi HCP.

Effects of Mitigation to the Hawaiian goose

Auwahi shall contribute $25,000 to Haleakala National Park to build a predator-fenced area at the Park to support egg, gosling, and adult rescue. Hawaiian geese are particularly vulnerable to predation during nesting and before the goslings fledge and the Hawaiian goose population at the Park is subject to high predation of eggs and goslings by cats, rats, and mongoose. Mitigation for project-related take will be provided through increased Hawaiian goose reproductive success and survival at managed pen sites over that expected to occur in the absence of management. This management activity will increase the survival and reproductive success of the Park Hawaiian goose population, and therefore more than offset Auwahi's take of five Hawaiian geese.

Effects of the Action on Range-Wide Distribution of the Hawaiian Goose

The most current statewide population estimate for the Hawaiian goose is between 1,300 and 1,500 individuals, with 416 birds on Maui (Annie Marshall 2010, pers. comm.). Auwahi's requested take of five individuals over the 25-year Permit term represents approximately 0.3% of the range-wide population and 1.2% of the Maui population. Because the Hawaiian goose has a high rate of fecundity and birds are long-lived, this loss of five birds over the 25-year Permit period is not expected to result in a decline in the Maui population.

Proposed mitigation will offset all take to compensate for project impacts by increasing the survival and reproductive success of Hawaiian geese at Haleakala National Park. Therefore, Maui's Hawaiian goose population will not be lower as a result of project implementation, than it would have been in the absence of the project.

Effects of the Action to the Blackburn's Sphinx Moth

Habitat Loss

The Blackburn's sphinx moth feeds, breeds, and shelters in the native and degraded habitats in the action area. The Kanaio area, where the project is located, contains what is likely the largest extant moth population or meta-population in the moth's range. This unit contains native aiea and introduced larval host plants as well as numerous nectar-supplying plants for adults. Habitat in the project area is likely to contribute to the reproductive success and survival of the Blackburn's sphinx moth in the Kanako area. The project will permanently reduce the availability of host plants for the Blackburn's sphinx moth within the project footprint.

Auwahi will permanently remove 0.3 ac (0.1 ha) of the Blackburn's sphinx moth's native habitat and 27.7 ac (11.2 ha) of degraded Blackburn's sphinx moth habitat within the project footprint. The species' non-native host plant, tree tobacco, has been observed within the project area during the invertebrate and botanical resources surveys conducted in 2007, 2010, and 2011. In 2010 and 2011, aiea plants were documented within the wind farm site including areas along the generator-tie line corridor. In 2008, three adult male Blackburn's sphinx moths and one larva (located on examined tobacco plants) were observed in the Project area during invertebrate surveys (Montgomery 2008). No larvae were observed on the eight aiea plants examined outside the generator-tie line corridor. In March and April, 2011, an additional survey for Blackburn's sphinx moth was conducted under wet season conditions. Seven larvae and 2 eggs were observed on tree tobacco plants adjacent to the construction access route; three additional tree tobacco showed possible evidence of larvae feeding.

Auwahi's habitat loss will be offset with the restoration of 5.5 ac (2.2 ha) (27.7 ac x 0.2 = 5.5 ac) of native forest. In total, 6 ac (2 ha) of native dryland forest restoration will be funded by Auwahi at the Auwahi Forest Restoration Project site. Dryland forest restoration by the LHWRP at the Auwahi Forest Restoration Project site, funded by Auwahi Wind, will entail propagation and outplanting of planting approximately 250 stems of aiea (an important Blackburn's sphinx moth larval host plant) per acre of mitigation in addition to outplanting other native species (USGS 2006). This dryland forest restoration will benefit native wildlife in general, and will further enhance this habitat for Blackburn's sphinx moth.

Direct Impacts and Capture for Translocation

Pre-construction surveys will be conducted to minimize the likelihood the construction site is occupied by Blackburn's sphinx moth (particularly larvae) individuals during construction. Host plants will be kept cleared of Blackburn's sphinx moth larvae within the three months prior to construction. Larvae found within the project site will be removed and relocated to the same species of host plant, where possible, in the vicinity of where the moth or larvae were found but well outside of the Project disturbance area. Although larvae are large and visible, and pupae are not known to occupy the soil for more than three months direct impacts from clearing and construction activities minimized by the pre-construction survey and translocation actions. However, eggs, larva, and pupae within the project footprint not detected in surveys may be injured or killed as a result of the Auwahi project.

There is some evidence that insects may be attracted to turbines. However, because adult Blackburn's sphinx moths most likely do not fly high enough to occur within the rotor swept area of the WTGs because they tend to stay close to the host plants (Montgomery, pers. comm., 2011) direct mortality from the blades is unlikely to occur.

The proposed generator-tie line is located adjacent to the Kanaio Reserve, one of two regional populations of the moth that are regarded as possible source areas for dispersing or colonizing moth adults. Therefore, there is the possibility that individual adult moths could wander into work areas as they disperse, and be at risk of collision with construction equipment or vehicles; however, site speed limits of 25 mph or less have been established to minimize the likelihood of collision.

4.0 CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local or private actions that are reasonably certain to occur within the area of action subject to consultation. Future Federal actions will be subject to the consultation requirements established in section 7 of the Act and, therefore, are not considered cumulative for the proposed action.

Auwahi is situated on private agricultural land on the lower slopes of Haleakala in east Maui. Widespread grazing by non-native ungulates and wildfires ignited by the public and lightning will continue to degrade Blackburn's sphinx moth habitat because most habitat on Maui is not protected by ungulate fencing or afforded adequate fire protection. Although no additional development is planned at Ulupalakua Ranch at this time, land zoned for agriculture in the vicinity of the interconnect station is likely to be reclassified to enable development of new golf course and housing projects. The development will reduce the extent of Blackburn's sphinx moth habitat. Lighting associated with this expanded development is likely to increase the risk of fallout to the Hawaiian petrel. Increased development may increase the density of mammalian predators adversely affecting the reproductive success and survival of the Hawaiian petrel, Hawaiian goose, and Hawaiian hoary bat. Areas of mowed grass and standing water maintained in association with the new development are likely to attract the Hawaiian goose to areas where it will be exposed to vehicle strike and increased predation. Pursuant to the ESA, these impacts would be assessed in biological opinions and mitigated to the maximum extent practicable via development and implementation of Habitat Conservation Plans.

State and private conservation actions within the Auwahi Forest Restoration Project and the 8.000-ac ((3,237-ha) Kahikinui Forest Project will increase the extent and quality of habitat for all of the Covered Species.

5.0 CONCLUSION

After reviewing the current status of the Covered Species, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that implementation of the proposed action is not likely to jeopardize the continued existence of the Hawaiian hoary bat, Hawaiian petrel, Hawaiian goose, and the Blackburn's sphinx moth. The Service reached this conclusion because, as described in the Effects of the Action section above, the proposed mitigation program for each Covered Species is likely to offset, and in some cases more than offset, the impacts of the proposed taking in a manner that is consistent with addressing the survival and recovery needs of these species in the affected area.

6.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations promulgated pursuant to section 4(d) of the ESA prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat

modification or degradation that results in death or injury to listed species by significantly impairing behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2) of the ESA, taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The proposed Auwahi HCP and its associated documents clearly identify anticipated impacts to affected listed species likely to result from the proposed taking and the measures that are necessary and appropriate to minimize and mitigate those impacts. All conservation measures described in the proposed HCP, together with the terms and conditions described in any associated Implementing Agreement and any section 10(a)(1)(B) permit or permits issued with respect to the proposed HCP, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement pursuant to 50 CFR 402.14(i). Such terms and conditions are non-discretionary and must be undertaken for the exemptions under section 10(a)(1)(B) and section 7(o)(2) of the ESA to apply. If Auwahi fails to adhere to these terms and conditions, the protective coverage of the section 10(a)(1)(B) permit and section 7(o)(2) may lapse. The amount or extent of incidental take anticipated under the proposed Auwahi HCP is as described in the HCP and its accompanying section 10(a)(1)(B) permit. Associated reporting requirements and provisions for disposition of dead or injured animals are described in the section 10(a)(1)(B) Permit.

7.0 CONSERVATION RECOMMENDATIONS

Sections 2(c) and 7(a) (1) of the ESA direct Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are Service suggestions regarding discretionary agency activities to promote the recovery of listed species.

The process of developing an HCP essentially necessitates the incorporation of this approach into the planning process. In the case of the Auwahi HCP, the Service intends to coordinate with Auwahi and Ulupalakua Ranch to maximize potentially mutually beneficial conservation actions with actions being undertaken within and around the project area.

8.0 RE-INITIATION NOTICE

This concludes formal consultation on the proposed issuance of the section 10(a)(1)(B) incidental take permit to Kaheawa Wind Power II, LLC. As required in 50 CFR §402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified

in a manner that causes an adverse effect on a listed species that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by this action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending re-initiation.

If you have any questions regarding any of the information contained in this Opinion, please contact Fish and Wildlife Biologist Dawn Greenlee (phone: 808-792-9400).

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