

**Final Programmatic Environmental Impact Statement
Addressing the Issuance of Incidental Take Permits for Four
Wind Energy Projects in Hawai‘i**

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Prepared by

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Title of Proposed Action: Final Programmatic Environmental Impact Statement Addressing the Issuance of Incidental Take Permits for Four Wind Energy Projects in Hawai‘i

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County/State: Honolulu, Maui, and Hawai‘i Counties/State of Hawai‘i

Abstract: The U.S. Fish and Wildlife Service (Service) has received four requests for Incidental Take Permits from wind energy companies in accordance with section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*). The Applicants include: Auwahi Wind, LLC (Auwahi Wind); Kawaihoa Wind, LLC (Kawaihoa Wind), Kaheawa Wind Power II, LLC (KWP II); and Tawhiri Power, LLC (Pakini Nui Wind), collectively referred to as “Applicants.” The Applicants operate existing, land-based wind energy facilities on the Hawaiian Islands of O‘ahu, Maui, and Hawai‘i. The Applicants have determined that operation and maintenance of their respective wind energy facility has the potential to result in the incidental take of one or more of the following federally listed species: the Hawaiian hoary bat (*Lasiurus cinereus semotus*); Hawaiian goose (*Branta sandvicensis*); and the Hawaiian petrel (*Pterodroma sandwichensis*) (collectively referred to as Covered Species).

This Final Programmatic Environmental Impact Statement has been prepared by the Service pursuant to the National Environmental Policy Act (NEPA)(42 USC 4321 *et seq.*) to evaluate the effects of the Service’s proposed action to issue ITPs for each Project operation and maintenance activities. The Service will make four separate permit decisions. However, due to project similarities, the Service is combining the NEPA analyses in this programmatic document. Key issues include (1) the impact on the listed species that would likely result from such taking; (2) the steps an applicant would carry out to minimize and mitigate those impacts and the funding that will be available to implement such steps; (3) alternative actions to the requested taking that an applicant considered and the reasons why such alternatives are not being utilized; and (4) other measures the Service may require as being necessary or appropriate for the purposes of carrying out the habitat conservation plans.

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ACRONYMS AND ABBREVIATIONS

Act or ESA	Endangered Species Act
Applicants or Projects	Auwahi Wind, LLC; Kawaihoa Wind, LLC; Kaheawa Wind Phase II, LLC; Tawhiri Power, LLC
Auwahi Wind	Auwahi Wind, LLC
BCI	Bat Conservation International
CARE	Carcass retention
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Covered Species	Hawaiian hoary bat, Hawaiian goose, and Hawaiian petrel
DBEDT	Department of Business, Economic Development, and Tourism
DOFAW	Division of Forestry and Wildlife
DLNR	Hawai'i Department of Land and Natural Resources
EA	Environmental Assessment
EoA	Evidence of Absence
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESRC	Endangered Species Recovery Committee
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
FPEIS	Final Programmatic Environmental Impact Statement
FR	Federal Register
GE	General Electric
HCP	Habitat Conservation Plan
HECI	Hawai'i Clean Energy Initiative
HECO	Hawai'i Electric Company
HELCO	Hawaiian Electric Light Company
HILT	Hawai'i Islands Land Trust
HWA	Helemano Wilderness Area
HRS	Hawai'i Revised Statutes
HVNP	Hawai'i Volcanoes National Park
ITL	Incidental Take License
ITP	Incidental Take Permit
ITS	Incidental Take Statement
Kawaihoa Wind	Kawaihoa Wind, LLC
KESRP	Kaua'i Endangered Seabird Recovery Project
KWP I	Kaheawa Wind Power I, LLC
KWP II	Kaheawa Wind Power II, LLC
LLC	Limited Liability Company
LWSC	Low wind speed curtailment
MECO	Maui Electric Company
NAR	Natural Area Reserve
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOI	Notice of Intent

NPS	National Park Service
NWR	National Wildlife Refuge
OHA	Office of Hawaiian Affairs
Pakini Nui Wind	Tawhiri Power
PCMP	Post-construction monitoring plan
PEIS	Programmatic Environmental Impact Statement
PIERC	Pacific Island Ecosystems Research Center
SEEF	Searcher efficiency
Service or USFWS	U.S. Fish and Wildlife Service
SHPD	State Historic Preservation Department
TPL	Trust for Public Land
U.S.C.	United States Code
USGS	United States Geological Survey
WTG	Wind turbine generators

UNITS OF MEASURE

ac	acres
ft	feet or foot
in	inches
kV	kilovolt
kWh	kilowatt hour
MGD	million gallons per day
mi	miles
mph	miles per hour
MW	megawatt
m/s	meters per second

GLOSSARY

The following is a list of important terms and their definitions used throughout this document to familiarize readers with agency and resource terminology.

Endangered Species Act – A Federal law (16 U.S.C. §1531 *et seq.*) enacted in 1973 to provide for the conservation and recovery of endangered and threatened species and the ecosystems upon which they depend.

Habitat Conservation Plan – A required part of an application for an Incidental Take Permit (ITP) under section 10(a)(2)(A) of the ESA. An HCP describes: (1) the impact on the listed species likely to result from such taking; (2) the steps an applicant will carry out to minimize and mitigate those impacts and the funding that will be available to implement such steps; (3) alternative actions to the requested taking that an applicant considered and the reasons why such alternatives are not being utilized; and (4) other measures the U.S. Fish and Wildlife Service (Service) may require as being necessary or appropriate for the purposes of the plan.

Incidental Take Permit – A permit issued by the Service to any private, non-Federal entity proposing to undertake an otherwise lawful activity that is reasonably expected to result in the take (e.g., harass, harm, pursue, hunt, shoot, wound, or kill) of individuals of an endangered or threatened animal species. In order for the Service to issue an ITP the following criteria must be met: (1) the taking will be incidental to otherwise lawful activities; (2) an applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking; (3) the applicant will ensure that adequate funding for the plan will be provided; (4) the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild; and (5) the applicant will carry out any other measures the Service requires as necessary or appropriate for the purposes of the plan (50 CFR 17.32(b)(2)).

National Environmental Policy Act – A Federal law (42 U.S.C. §4321 *et seq.*) enacted in 1970 requiring all Federal agencies to consider the environmental impacts of their proposed actions on the human environment. Proposed Federal actions subject to NEPA compliance include approving, funding, permitting, or carrying out proposed Federal actions. NEPA also established the President's Council on Environmental Quality (CEQ).

Programmatic Environmental Impact Statement – A type of NEPA review that assesses the environmental impacts of a proposed policy, plan, program, or suite of projects that share similar geography, impacts, and timing, as well as other features that warrant a combined assessment.

Take – A prohibited action under Section 9 of the ESA. Under section 3 of the ESA, the term “take” means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct relative to endangered or threatened species protected under the ESA.

Mitigation – The term “mitigation” is defined in NEPA regulations as: (1) avoiding the impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (3) rectifying the impact by

repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (5) compensating for the impact by replacing or providing substitute resources or environments (40 CFR 1508.20(a–e)). Under ESA Section 10 ITPs, mitigation involves off-setting the impacts of the unavoidable taking of covered species to the maximum extent practicable.

Minimization – To reduce the impacts to a resource. In relation to compliance with the ESA, it is reduction of the effects, up to and including incidental taking, to a covered species.

ESA 4(d) Rule – A special rule pursuant to section 4(d) of the ESA for species listed as threatened that exempts blanket take prohibitions to incentivize specific proactive conservation efforts.

Hysteresis – LWSC regime that offsets the “cut-out” and “cut-in” speeds such that it will take a higher average wind speed (raised cut-in speed) for the turbines to return to operation after stopping due to LWSC.

‘Aumākua – In Native Hawaiian culture, ‘aumākua are family or personal gods or deified ancestors who might assume the shape of various animals.

EXECUTIVE SUMMARY

Introduction

This Final Programmatic Environmental Impact Statement (FPEIS), prepared by the U.S. Fish and Wildlife Service (Service), evaluates the effects of our proposed action to issue Incidental Take Permits (ITP) pursuant to Section 10(a)(1)(B) of the Endangered Species Act (ESA) of 1973, as amended (16 USC 1531 *et seq.*, 1539), for operation, maintenance, and mitigation activities associated with four existing, land-based wind energy facilities. The Applicants are: Auwahi Wind, LLC (Auwahi Wind); Kawaioloa Wind, LLC (Kawaioloa Wind) Kaheawa Wind Phase II, LLC (KWP II); and Tawhiri Power, LLC (Pakini Nui Wind), collectively referred to as “Applicants” or “Projects.” Because all four projects share similar geography, impacts to listed species, and proposed conservation, minimization, and mitigation measures, the Service is combining the National Environmental Policy Act (NEPA) analysis in this FPEIS; however, the Service will make four separate permit decisions. The proposed Projects are located on the Hawaiian Islands of O‘ahu, Maui, and Hawai‘i. Mitigation to benefit listed species is proposed on the islands of Kaua‘i, O‘ahu, Maui, and Hawai‘i.

The Service, in coordination with the Applicants, has determined that Project activities have the potential to result in incidental take of Hawaiian hoary bat (‘ōpe‘ape‘a in Hawaiian; *Lasiurus cinereus semotus*); Hawaiian goose (nēnē; *Branta sandvicensis*); and the Hawaiian petrel (‘ua‘u; *Pterodroma sandwichensis*). Each species is listed as endangered under Section 4 of the ESA and are collectively referred to as Covered Species. The four Applicants are requesting incidental take for Hawaiian hoary bats. In addition, Kawaioloa Wind and Pakini Nui are requesting take of Hawaiian petrel and Pakini Nui and KWP II are requesting take of Hawaiian goose. This FPEIS evaluates the environmental impacts associated with implementation of the four Habitat Conservation Plans (HCP) accompanying the four ITP applications and detailing the impacts and measures to minimize and mitigate take.

Three of the four Projects are seeking amendments to existing ITPs. The three Projects seeking amendments are Auwahi Wind (original permit number: TE64153A-0), Kawaioloa Wind (original permit number: TE59861A-0) and KWP II (original permit number: TE27260A-0). The Service previously conducted NEPA analyses for each of these three projects individually. The Service signed a Finding of No Significant Impact (FONSI) for Auwahi Wind on February 23, 2012, and released the Final Environmental Assessment (EA) (USFWS 2012), which addresses compliance with NEPA for the issuance of Auwahi’s 2012 ITP and HCP. The Service signed a FONSI for Kawaioloa Wind on December 8, 2011, and released the Final EA (USFWS 2011a) addressing compliance with NEPA for the issuance of Kawaioloa’s 2011 ITP and HCP. The Service signed a FONSI for KWP II on January 3, 2012, and released the Final EA (USFWS 2011b) addressing compliance with NEPA for the issuance of KWP II’s 2011 ITP and HCP. The fourth project, Pakini Nui, has been operational since 2007, but has not previously obtained an ITP and no previous NEPA evaluation for incidental take has been conducted.

The Service has identified and evaluated alternatives in this FPEIS that focus on Project alternatives and additional conservation strategies that could be implemented to minimize take of the Covered Species.

Proposed Action and Purpose and Need Summary

The proposed Federal actions being evaluated in this FPEIS are the issuance of four separate ITPs pursuant to Section 10(a)(1)(B) of the ESA. The purpose of each proposed Federal action is to respond to each of the four ITP applications and to determine whether to approve, deny, or approve with conditions the individual requests for take authorization.

Summary of Alternatives

Alternative 1 - No Action Alternative

The No Action Alternative evaluates conditions as they would occur over the foreseeable future if the Service denied issuance of an ITP to the Applicants and if the Applicants did not implement their respective HCPs for the Covered Species. Under this alternative, the Applicants would continue to conduct wind energy facility operations in accordance with existing State and Federal regulations. The Applicants would remain subject to the prohibition on unauthorized taking of state and federally listed species. The Service expects that each Applicant would act in a reasonable manner to avoid unauthorized take of the Covered Species over and above their existing permit authorizations (as applicable). To achieve this, the Service assumes that all Applicants would shut-off wind turbine operations at night to avoid unauthorized take of Hawaiian hoary bat and minimize risk of take to the Hawaiian petrel. The three Applicants seeking to amend their permits would continue to operate during the day in accordance with their existing permits in order to meet their minimum required power production. KWP II would additionally shut-off wind turbine operations during the day should take of Hawaiian goose exceed or be projected to exceed authorized take levels in their existing ITP. Pakini Nui would also shut-off wind turbine operations during the day to avoid take of Hawaiian goose. The Applicants would also implement other avoidance measures to limit the potential for take of listed species to occur. Any take that occurs over and above existing permit limits would not be authorized and would remain unmitigated.

The following activities are associated with the Applicants' wind energy facility operations under the No Action Alternative:

- Post-construction monitoring for downed wildlife
- Previously authorized incidental take and mitigation activities
- Other facility activities:
 - Wind turbine operations during daylight hours
 - General facility and grounds maintenance

Alternative 2 – Proposed Action and Applicants' Preferred Alternative

Under the Proposed Action, the Service would issue a separate ITP (amendment or a new ITP) to each of the four Applicants, authorizing incidental take of the Covered Species. The new or amended ITP/HCP would be implemented as proposed by each Applicant, including mitigation and minimization actions to address the effects of the incidental take. The Applicants' operations and activities would be subject to the terms and conditions of the ITP/HCP, as well as existing

regulatory standards. Under the Proposed Action Alternative, the three Applicants with HCPs/ITPs currently in effect would continue to conduct their previously authorized mitigation activities as outlined in the No Action Alternative, in addition to the mitigation described in their HCP amendment.

Alternative 3 – Increased Curtailment

This alternative was developed to analyze the most practicable minimization measure to the actions proposed in the Applicants' HCPs (Alternative 2) that would result in a reduction of take of the Hawaiian hoary bat at each of the facilities, but allow the Applicants to meet their minimum required power production. Under Alternative 3, the Service would issue the ITPs authorizing a lower level of Hawaiian hoary bat take than what is anticipated by the Applicants in their new or amended HCPs. Under this alternative, wind facility operations and maintenance activities would be shut down at all Applicant wind turbines during nighttime hours from April 15 through September 15, when Hawaiian hoary bats are observed to be rearing young and are most active. The cessation of operations during this timeframe would result in a minimization of the take of adult Hawaiian hoary bats and eliminate indirect take of juvenile bats. Low wind speed curtailment activities, listed under Alternative 2 and in the Applicants' HCPs, would be implemented during the remainder of the year (September 16 – April 14). Mitigation actions and corresponding monitoring activities would be reduced commensurate with take levels for each Applicant.

Summary of Environmental Consequences

The four projects are constructed and operating. Because of this, the alternatives do not propose any new construction or refurbishment of structures at the wind energy facilities. Based on the scoping process and internal coordination, the Service selected a range of environmental resources to consider in this PEIS: Geology and Soils, Hydrology and Water Resources, Natural Hazards (Flooding and Wildfire), Vegetation, Wildlife and Biodiversity, Protected Species, Cultural Resources, Public Services and Utilities, and Agriculture. None of the alternatives would be expected to result in the irreversible loss of natural resources, such as water resources, soils, or agricultural or timber land and mitigation actions would provide benefit to soils and water resources through soil stabilization and watershed habitat improvement.

Implementation of the conservation strategies and mitigation actions under the alternatives would require the minor use of resources, such as fossil fuels for vehicles and equipment operation. Overall, however, implementation of those strategies and actions would result in a net benefit to the Covered Species by preserving and enhancing the Hawaiian hoary bat habitat and foraging resources for perpetuity, minimizing potential for predation of the Hawaiian goose and Hawaiian petrel, and improving species' productivity.

For the majority of the Affected Environmental resources evaluated, the potential impacts associated with Alternatives 2 and 3 are anticipated to be minor and generally beneficial compared to the No Action Alternative, with the exception of the potential loss of cultural resources. Alternatives 1, 2, and 3 all require the implementation of conservation strategies that would ensure permanent adverse effects from the potential take of the Covered Species is

avoided (Alternative 1), or minimized and offset (Alternatives 2 and 3) consistent with ESA Section 10(a)(2)(B) issuance criteria. Therefore, the potential unavoidable adverse effects would be limited.

Cumulative Effects

Cumulative effects are the impact on the environment that results from the incremental impact of these actions when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR 1508.7). The potential for cumulative effects from each Alternative would mainly occur from collision-related fatalities affecting bird and bat species. Cumulatively significant impacts would be greatest for those species where the local populations are subject to additional risk factors that threaten population levels, such as is the case for the Covered Species. Additional cumulative impacts expected include impacts to cultural resources and to public services and utilities.

Comparison of Alternatives

The environmental effects of the two Action Alternatives were compared to the effects associated with the No Action Alternative for each of the four Projects to determine the differing level of effects the action alternatives would have on each Affected Resource. Most of the effects associated with the Alternatives analyzed were related to the implementation of mitigation actions because the wind turbine facilities are all constructed and in operation. No new construction is proposed at any of the Project sites.

Effects to Geology and Soils, Hydrology and Water Resources, Natural Hazards, Vegetation, and Wildlife and Biodiversity were greater under Alternative 2, compared to the No Action Alternative, for all four Projects, due to the necessary implementation of mitigation actions included in the Applicants proposed HCPs. Effects attributable to the implementation of Alternative 3 would be less than under Alternative 2, but still greater than under the No Action Alternative because of the decreased mitigation acreage needed.

All four Projects are requesting authorization of take of the Hawaiian hoary bat in the HCPs. The estimated annual rate of take and the total authorized take of the Hawaiian hoary bat would be significantly higher under Alternative 2 (Proposed Action Alternative), compared to the No Action Alternative. The take associated with Alternative 2 would also be higher than Alternative 3 (Increased Curtailment Alternative) for all four Projects, due to Alternative 3's requirement of complete nighttime shut-down of the wind turbines during the Hawaiian hoary bat breeding season.

Kawailoa and Pakini Nui are requesting take of the Hawaiian petrel in their HCP amendment and HCP, respectively. Because petrels have been known to fly into large obstacles, including stationary wind turbines, there would be no difference in the anticipated effects to the petrel from any of the three alternatives evaluated. KWP II and Auwahi have authorized take of Hawaiian petrel in their existing HCPs.

KWP II and Pakini Nui are requesting take of the Hawaiian geese in their HCPs. There would be no difference in the anticipated effects to the Hawaiian goose from the two action alternatives

evaluated because the Hawaiian goose is active during daylight and nighttime hours and the likelihood of take would not be reduced by curtailment of nighttime operations. The other two Projects have not requested take or amended take of the Hawaiian goose because they do not occur in the vicinity of the projects; therefore, there would be no effects under any of the three Alternatives.

Because the four Projects are already constructed, there would be no impacts to historical or archaeological resources at the Project sites. Coordination with Hawai'i's State Historic Preservation Department is currently underway for the proposed mitigation sites. If historical or archaeological resources are discovered at any of the mitigation areas, best management practices would be implemented to insure avoidance of those resources. Therefore, there would be no effects to historical or archaeological resources from the Project or mitigation sites under any of the alternatives. However, individual Hawaiian hoary bats and Hawaiian petrels may be considered as having special cultural significance as 'aumākua (personal or family gods, or deified ancestors that may take the form of an animal). They are also important to native Hawaiian cultural practitioners. Based on this cultural importance, the No Action Alternatives would result in negligible to minor cultural resource effects at the three facilities requesting take of Hawaiian petrel. Alternative 2 would result in the greatest Cultural Resource effects based on the higher amount of take for the Hawaiian hoary bat, with Alternative 3 somewhere in between.

Scoping Comments

Public scoping was conducted to identify issues and concerns pertaining to the issuance of the four requested ITPs and the content of this PEIS. Based on the scoping process and internal coordination, the Service identified three major concerns and their contributing factors to address in this PEIS. The first major concern was the potential for increased risk of local extirpation of Hawaiian hoary bat populations. The second major concern was that cumulative impacts, when added to the proposed action, may negatively affect the statewide populations for the Covered Species. The third major concern was that potential harm to the threatened Newell's shearwater ('a'ō; *Puffinus auricularis newelli*) and the endangered band-rumped storm-petrel ('akē'akē; *Oceanodroma castro*) may not be fully addressed by the proposed action. The Service considered all scoping comments received during the public comment period on the preparation of this PEIS. Substantive public comments were considered in the development of the scope and content of this document.

Public Outreach

The Service published a Notice of Intent (NOI) to prepare a PEIS in the *Federal Register* on June 1, 2018 (83 FR 25475–25479) (USFWS 2018a), and to announce three public scoping meetings on the islands of Hawai'i, Maui, and O'ahu (i.e., one meeting per island). The official public comment period began with the publication of the NOI and ended on July 2, 2018. The public scoping meetings were held on June 18, June 20 and June 21, 2018, and 12 comment letters were received from stakeholders and non-profit or community organizations.

The Federal Register Notice of Availability (NOA) for the Draft PEIS was published in the Federal Register on April 26, 2019 for public review in accordance with the requirements set forth in NEPA

(42 USC 4321 *et seq.*) and its implementing regulations (40 CFR 1500–1508) . Public comments were accepted during a 45-day period following publication of the NOA. Three public meetings were held on the islands of Hawai'i, Maui and O'ahu (one on each island), during the comment period. Comments received were be considered in assessing environmental impacts and potential mitigation in the FPEIS. During the public comment period the Service received 45 written comment letters, including two from elected State officials, two from other federal agencies, and two from non-governmental organizations. Appendix K includes a summary of the NOA comment period and a tale with a breakdown of individual comments, the Service's response to the comments and where in the PEIS or HCPs modification were made based on the comments.

CHAPTER 1 – PURPOSE AND NEED OF THE PROPOSED ACTIONS

The U.S. Fish and Wildlife Service (Service) received four requests for Incidental Take Permits (ITPs) from wind energy companies in accordance with section 10(a)(1)(B) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. §1531 *et seq.*). The Applicants include: Auwahi Wind, LLC (Auwahi Wind); Kawaioloa Wind, LLC (Kawaioloa Wind) Kaheawa Wind Power II, LLC (KWP II); and Tawhiri Power, LLC (Pakini Nui Wind), collectively referred to as “Applicants” or “Projects.” The Applicants (**Table 1-1**) operate existing, land-based wind energy facilities on the Hawaiian Islands of O‘ahu, Maui, and Hawai‘i.

Table 1-1. Applicants requesting ITPs covering operation and maintenance of their respective wind energy projects.

Company	Wind Project	Island	Location Area	Type of ITP
Auwahi Wind, LLC	Auwahi Wind	Maui	‘Ulupalakua Ranch in east Maui	Amendment (Original Permit TE64153A-0)
Kawaioloa Wind, LLC	Kawaioloa Wind	O‘ahu	North Shore above Hale‘iwa town	Amendment (Original Permit TE59861A-0)
Kaheawa Wind Phase II, LLC	KWP II	Maui	Kaheawa Pastures Above Mā‘alaea town	Amendment (Original Permit TE27260A-0)
Tawhiri Power, LLC	Pakini Nui Wind	Hawai‘i	Ka Lae or South Point	New ITP

The Applicants have determined that operation and maintenance of their respective wind energy facility has the potential to result in the incidental take of one or more of the following federally listed species: the Hawaiian hoary bat (‘ōpe‘ape‘a in Hawaiian; *Lasiurus cinereus semotus*); Hawaiian goose (nēnē; *Branta sandvicensis*); and the Hawaiian petrel (‘ua‘u; *Pterodroma sandwichensis*) (collectively referred to as Covered Species) (**Table 1-2**).

In response to the above four permit applications, the Service will make four separate permit decisions. However, because all four projects share similar geography, impacts to listed species, and proposed minimization and mitigation measures, the Service is combining the National Environmental Policy Act (NEPA) analysis in this programmatic document (hereafter referred to as a Programmatic Environmental Impact Statement or PEIS). This approach is consistent with *Final Guidance for Effective Use of Programmatic NEPA Reviews* published by the Council on Environmental Quality (CEQ) on December 23, 2014 (79 Federal Register [FR] 76986–76990). A combined/programmatic NEPA analysis is the most efficient and comprehensive way to consider the impacts of these four actions on the human environment.

This FPEIS evaluates the environmental impacts associated with implementation of the four habitat conservation plans (HCPs) accompanying the four ITP applications. The HCPs include (1) the impact on the listed species that would likely result from such taking; (2) the steps an

applicant would carry out to minimize and mitigate those impacts and the funding that will be available to implement such steps; (3) alternative actions to the requested taking that an applicant considered and the reasons why such alternatives are not being utilized; and (4) other measures the Service may require as being necessary or appropriate for the purposes of the plan.

Table 1-2. Covered Species under the Proposed Actions.

Species Common / Hawaiian Name (Scientific Name)	Listing Status within the Plan Area	
	Federal	State
Hawaiian hoary bat / 'ōpe'ape'a (<i>Lasiurus cinereus semotus</i>)	Endangered (35 FR 16047)	Endangered
Hawaiian goose / nēnē (<i>Branta sandvicensis</i>)	Endangered ¹ (32 FR 4001)	Endangered
Hawaiian petrel / 'ua'u (<i>Pterodroma sandwichensis</i>)	Endangered (32 FR 4001)	Endangered

¹ On April 2, 2018, the Service published a Proposed Rule to reclassify the Hawaiian goose from endangered to threatened with an accompanying 4(d) rule to exempt forms of take to facilitate conservation of the Hawaiian goose and expansion of their range (83 FR 13919–13942).

1.1 NEED

The need for the proposed action is to fulfill Service responsibilities under section 10(a)(1)(B) of the ESA. Pursuant to the requirements of section 10 of the ESA, the Service reviews applications from non-Federal entities requesting permits for the incidental take of endangered and threatened species.

The need which the proposed actions are intended to address is each Applicants' take of federally listed Covered Species incidental to the operations of their respective wind energy production facilities. Per the requirements of the ESA, the Applicants need an ITP for continued operations of their individual wind projects to be in compliance with the take prohibitions under section 9(a) of the ESA.

In addition to the Service's legal requirement to render a decision on each of the four ITP applications, on-the-ground conditions reflecting exceedance of three of the Applicants' originally permitted take levels for Hawaiian hoary bat warrant amendments to their existing ITPs to address that take. A fourth Applicant, Pakini Nui Wind, is currently operating a wind facility that has had documented take of Hawaiian hoary bats, but has not previously applied for or held an ITP.

1.2 PURPOSE

The purpose of the Service's proposed action is to respond to each of the four ITP applications and to determine whether to approve, deny, or approve with conditions each individual request

for take authorization. In doing so, the Service will fulfill its ESA Section 10(a)(1)(B) obligations. The purpose of the Service's action is to ensure the four wind energy facilities: comply with the requirements of the ESA; effectively implement measures to minimize and mitigate the impacts of the taking on covered listed species that occur at each project area; and, consistent with our legal authorities, each HCP contributes to the recovery of the Hawaiian hoary bat, Hawaiian petrel, and the Hawaiian goose by protecting and enhancing the ecosystems on which these species depend at ecologically appropriate scales.

1.2.1 GOALS AND NEEDS OF THE APPLICANTS

In developing the FPEIS, the Service also considered the goals and needs of the four Applicants as well as the public interest, pursuant to 43 CFR 46.420(a)(2). The goals of the Applicants are to assist the State of Hawai'i in reaching the Hawai'i Clean Energy Initiative (HCEI). The HCEI was launched in 2008 when the State of Hawai'i and the U.S. Department of Energy signed a Memorandum of Understanding to collaborate on the reduction of Hawai'i's dependence on imported fossil fuels. In 2014, HCEI renewed Hawai'i's commitment to setting clean energy goals that include:

- Achieving the nation's first-ever 100% renewable portfolio standards by the year 2045;
- Reducing electricity consumption by 4,300 gigawatt-hours by 2030; and
- Reducing petroleum use in Hawai'i's transportation sector which accounts for two-thirds of the state's overall energy use.

Nearly 30% of renewable energy generated on the islands of Hawai'i, Maui, and O'ahu is sourced solely from land-based wind (HECO et al. 2018). The goal of the Applicants is to come into compliance with State and Federal Endangered Species regulations, while continuing to operate their existing, operational wind generation facilities under their existing Power Purchase Agreements through the State of Hawai'i's Public Utilities Commission.

While the Service has considered the goals and needs of the Applicants, it is the Service's purpose and need for the action that informed the range of alternatives considered in this FPEIS and that will serve as the eventual basis for the selection of an alternative.

1.3 APPLICABLE STATE AND FEDERAL LAWS AND REGULATIONS

The activities covered under each of the four Projects, inclusive of minimization and mitigation measures, are subject to numerous Federal and State regulations and other applicable guidelines. Federal and State laws relating to wind farm siting and/or noise requirements are not applicable to the proposed action or alternatives and therefore are not included here because all four of the Applicants' Projects are already constructed and operational.

1.4 SUMMARY OF THE SCOPING PERIOD

Public scoping was conducted to identify issues and concerns pertaining to the issuance of the four requested ITPs and the content of this PEIS. The scoping process involved solicitation of comments from the public, as well as feedback from other agencies and organizations **Appendix**

A contains a detailed report of the scoping process conducted and a summary of scoping comments received.

The Service published a Notice of Intent (NOI) to prepare a PEIS in the *Federal Register* on June 1, 2018 (83 FR 25475–25479), and to announce three public scoping meetings on the islands of Hawai‘i, Maui, and O‘ahu (i.e., one meeting per island). The NOI provided information on the background and purpose of the proposed action, provided preliminary information about the public scoping meetings, and advised that public comment would be requested upon completion of the PEIS. The official public comment period began with the publication of the NOI and ended on July 2, 2018. The public meetings were also advertised in press releases to local newspapers, as well as through social media and electronic email list serves.

The Service considered all scoping comments received during the public comment period on the preparation of the draft PEIS and this FPEIS. Substantive public comments were considered in the development of the scope and content of this document.

1.5 MAJOR ISSUES IDENTIFIED DURING SCOPING

Based on the scoping process and internal coordination, the Service identified three major concerns and their contributing factors to address in the draft PEIS and FPEIS.

Issue 1: Increased risk of local extirpation of Hawaiian hoary bat populations.

The Hawaiian hoary bat was listed as endangered under the ESA in 1970. Section 3 of the ESA defines the term “endangered” as any species which is in danger of extinction throughout all or a significant portion of its range. No historic or current population estimates, that have reasonable certainty, exist for this subspecies, though recent studies and ongoing research have shown Hawaiian hoary bats to be broadly distributed across all of the major Hawaiian Islands (**Appendix G**; USFWS 2019). The Hawaiian hoary bat was listed based on apparent habitat loss and limited knowledge of its distribution and life history requirements. The bat is active in the early evenings, throughout the night, and during the early morning hours. For a description of the Hawaiian hoary bat, including information on its island-specific distribution and patterns of movement, refer to Section 3.8 and the synopsis of new information on the Hawaiian hoary bat (**Appendix G**; USFWS 2019).

The following factors contribute to a perceived risk of local extirpation of Hawaiian hoary bat populations:

- Uncertainty of the risk posed by increased take to the population due to the absence of historic or current Hawaiian hoary bat population estimates. Refer to Sections 3.6 and 5.3 for further discussions on addressing this issue.
- Uncertainty associated with the take projections which are influenced by bat behavior and the advent of technological advancements that will reduce take.
- Reliability of adaptive management measures to prevent take exceedance.

- Reliability of Applicant-proposed mitigation projects to effectively compensate for the impact of the taking due to the paucity of information on the biological needs of Hawaiian hoary bats. Refer to Section 2.2 for further discussion in addressing this issue with regard to each projects proposed mitigation.

Issue 2: Cumulative impacts, when added to the proposed action, may negatively affect the statewide populations for three endangered species (the Hawaiian hoary bat, Hawaiian petrel, and the Hawaiian goose).

The combined, incremental effects of human activity are referred to as cumulative impacts. The assessment of cumulative impacts in NEPA documents is required by CEQ regulations (40 CFR 1508.7). Chapter 5 provides further discussion in addressing this issue.

Issue 3: Potential harm to the threatened Newell's shearwater ('a'o; *Puffinus auricularis newelli*) and the endangered band-rumped storm-petrel ('akē'akē; *Oceanodroma castro*) may not be fully addressed by the proposed action.

The Newell's shearwater and the band-rumped storm petrel are seabirds found within the Hawaiian Islands. Their status with regard to each Project's turbine site is addressed in Section 2.6.3.

1.6 RESOURCE AREAS TO BE ANALYZED

Based on the scoping process and internal coordination, the Service selected a range of environmental resources to consider in this PEIS: Geology and Soils, Hydrology and Water Resources, Natural Hazards (Flooding and Wildfire), Vegetation, Wildlife and Biodiversity, Protected Species, Cultural Resources, Public Services and Utilities, and Agriculture. The Service selected these resources based on their potential to be affected by the Federal action (proposed approval of the four ITP applications, including implementation of minimization and mitigation measures under each of the four HCPs) or its alternatives, and the likely extent of the effect. Consistent with NEPA, potential impacts to these resources are described in terms of direct and indirect effects of each alternative for the four Projects evaluated separately (Chapter 4), and cumulatively with other known and foreseeable impacts (Chapter 5).

The Service considered the potential effects of the Federal action on other environmental resources, and determined that the PEIS does not need to discuss these other resources in detail because there would be no or very limited potential for effects. The four wind energy facilities are already constructed and in operation. The proposed action or alternatives would have no effect on wind energy facility size or project siting. A complete list of these other resources, and the reasons they are excluded from detailed analysis, are as follows.

- Noise levels or acoustic environment. Wind energy facility operations can result in increased noise levels in the surrounding environment; however, all alternatives in this PEIS would not significantly alter the surrounding noise levels at any of the wind energy facilities or mitigation sites, compared to their existing conditions.

- Air quality. All alternatives would have no effect on existing emissions or National Ambient Air Quality Standards.
- Visual resources or aesthetics. While the construction of a wind energy facility often alters a view plan or visual resources, all alternatives in this PEIS including the no action alternative, would have no effect on visual resources or aesthetics because the projects are already constructed.
- Hazardous and regulated materials and waste. All alternatives would have no effect on storage or use of regulated materials and waste.
- Recreation and tourism. While several of the Applicant-proposed mitigation projects involve the use of remote national park lands or the designation of new multi-use state lands, these projects would have no effect on current recreation or tourism opportunities.
- Transportation highways and roadways. Alternatives in this PEIS do not propose construction of new highways or measurable use of highways or roadways within the areas analyzed.
- Public infrastructure and services. The proposed action and alternatives do not propose measurable use of public infrastructure and therefore would have no effect on public infrastructure or services.
- Military readiness. While Applicant-proposed mitigation projects involve the use of lands near existing military installations, these lands are buffer areas designated to sustain natural habitats, open space, and working lands near military installations and therefore would have no effect on military readiness.
- Socioeconomics and Environmental Justice. As the projects are already constructed and spread across the islands, the socioeconomic impacts of the wind facilities have already been analyzed and no new resource impacts are expected from the current alternatives.

1.7 ISSUES OUTSIDE THE SCOPE OF THIS ANALYSIS

The scoping process identified issues or concerns that were beyond the Service's decision-making authority for this project. The PEIS Scoping Report is included as **Appendix A**. A detailed list of these issues, and the reasons they are excluded from detailed analysis, are as follows.

- **Wind energy facilities are impactful to wildlife, therefore other alternatives for energy should be considered.** Because the four Projects are already constructed and in operation, all alternatives, including the No Action Alternative, would have no effect on whether or not the wind facilities persist. It is outside of the Service's regulatory jurisdiction to consider dismantling and re-developing these energy facilities.
- **Disclose the adverse effects of nighttime noise at the four existing wind farms.** The four wind energy facilities are already constructed and in operation. Analysis of nighttime noise effects was included in previous environmental reviews that considered facility siting, construction, and operation effects, conducted prior to the energy facilities beginning operations for those projects seeking an amended ITP (Planning Solutions, Inc. 2010, USFWS 2011a,b, USFWS 2012). The Service action and its alternatives would not increase nighttime operations at any of the Projects.
- **Kawailoa Wind adversely affects easement access for adjacent property owners.** The environmental analysis for land use effects at the wind facility was included in previous

environmental reviews that considered facility siting, construction, and operation effects, conducted prior to the energy facility beginning operations (USFWS 2011a). The proposed Federal action and its alternatives considered herein would not alter the existing facility footprint or change existing roads at or near the facility, therefore there would be no land access effects at the wind facility.

- **Consider the adverse effect of influencing rainfall and site-specific climate at wind energy facilities, due to the operation of wind turbines.** The environmental analysis for effects to water resources and climate, including wind patterns, were considered in previous environmental reviews for the projects seeking an amended ITP (Planning Solutions, Inc. 2010, USFWS 2011a,b, USFWS 2012). The Federal action and its alternatives would have no effect to water resources or local climate patterns at or near the four wind energy facilities.
- **Consider a wildlife-friendly or bird-smart approach for wind turbine design and related infrastructure.** Modification of existing turbine design is outside the scope of the proposed Federal actions considered herein. However, an evaluation of different wind turbine designs and their effects to wildlife may be warranted for new wind energy projects not yet constructed.

1.8 DECISIONS TO BE MADE

The Service must decide whether to issue, issue with conditions, or deny each of the four ITP applications pursuant to the requirements of Section 10(a)(1)(B) of the ESA. In accordance with Section 10(a)(2)(B) of the ESA, each Applicant is required to prepare an HCP, and in reaching its decision to issue an ITP or not, the Service must find that:

- The taking will be incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.
- The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking.
- The applicant will ensure that adequate funding for the conservation plan will be provided.
- The taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild; and
- Other measures that the Service may require as necessary or appropriate for purposes of the conservation plan will be met and plan implementation will be assured.

1.9 ADDITIONAL PUBLIC INVOLVEMENT

A Notice of Availability of the Draft PEIS was published in the Federal Register on April 26, 2019 by the Service (84 FR 17875-17897) in accordance with the requirements set forth under NEPA implementing regulations (40 CFR 1506.6). Public comments were accepted during the 45-day public comment period which ended June 10, 2019. Three public open-house meetings were held during the comment periods:

- O'ahu, May 21, 2019 at Waialua Elementary School, Waialua, Hawai'i
- Maui, May 22, 2019 at Kula Elementary School, Kula, Hawai'i
- Hawai'i island, May 23, 2019 at Na'alehu Community Center, Na'alehu, Hawai'i

The Service received a total of 45 comment letters, emails, or faxes, including two from federal agencies (Department of the Army, U.S. Army Garrison Hawaii; and U.S. Environmental Protection Agency, Region 9), two from State of Hawai'i Senators (Senator Gil Riviere, District 23; Senator Glenn Wakai, District 15), three from environmental organizations (Sierra Club of Maui, Center for Biological Diversity, and American Bird Conservancy), one from a business (Ka'u Realty), and 37 from the general public. Service responses to the comments received were incorporated into the FPEIS. **Appendix K** summarizes the Service's responses to substantive comments received during the public comment period and identifies sections in the FPEIS that have been modified as a result of a response to a public comment.

Following issuance of this Final EIS, the Service will publish four separate RODs documenting its decision on whether or not to issue an ITP to each of the four Applicants no earlier than 30 days after the Final PEIS is published. The Service does not have formal administrative appeal procedures for NEPA decisions. Judicial review of a Service NEPA decision can be accomplished through the Administrative Procedures Act (5 U.S.C. §500 *et seq.*).

CHAPTER 2 – ALTERNATIVES INCLUDING THE PROPOSED ACTION

NEPA directs Federal agencies to consider a reasonable range of alternatives that could accomplish the agency's purpose and need and to present those alternatives in comparative form (40 CFR 1502.14). To warrant detailed evaluation, the alternative must be reasonable and meet the purpose and need (Sections 1.1 and 1.2). The CEQ, has provided further guidance on the scope of alternatives to be considered in an EIS. According to CEQ, the emphasis is on what is "reasonable" rather than on whether the proponent or applicant likes or is itself capable of carrying out a particular alternative. Reasonable alternatives include those that are practical or feasible from a technical and economic standpoint and using common sense rather than simply desirable from the standpoint of the applicant (CEQ 1981). This PEIS examines reasonable alternatives to the proposed actions at issue herein.

Three types of alternatives are considered in this PEIS: (1) No Action; (2) Proposed Action; and (3) Increased Curtailment. Sections 2.1 - 2.3 provide a detailed description of all alternatives and Section 2.5 presents the alternatives in a comparative form. **Appendix B** is a tabular summary of the alternatives analyzed in detail in the PEIS, and includes the types of activities that would occur under each alternative. Additional alternatives considered but eliminated from detailed evaluation are summarized in Section 2.6.

2.1 ALTERNATIVE 1 – NO ACTION ALTERNATIVE

This alternative has been developed to evaluate conditions as they would occur over the foreseeable future if the Service did not issue an ITP for individual projects covering take of the Hawaiian hoary bat, Hawaiian petrel, and the Hawaiian goose, and if the Applicants did not implement their respective HCPs for these species. Under this alternative, the Applicants would continue to conduct wind energy facility operations in accordance with existing State and Federal regulations. The Applicants would remain subject to the prohibition on unauthorized taking of state and federally listed species. The Service expects that each Applicant would act in a reasonable manner to avoid unauthorized take of the Covered Species over and above their

existing permit authorizations (as applicable). To achieve this, the Service assumes that all Applicants would shut-off wind turbine operations at night to avoid unauthorized take of Hawaiian hoary bat and Hawaiian petrel. The three Applicants seeking to amend their permits would continue to operate during the day in accordance with their existing permits in order to meet their minimum required power production. KWP II would additionally shut-off wind turbine operations during the day should take of Hawaiian goose exceed or be projected to exceed authorized take levels in their existing ITP. Any take that occurs over and above existing permit limits would not be authorized and would remain unmitigated. The applicable regulations that provide the framework for implementing the No Action Alternative are summarized in Section 1.3.

We considered continuing existing operations with no changes as a possible no-action alternative, but eliminated it from further consideration (see Section 2.6.5).

The following activities are associated with the Applicants' wind energy facility operations under the No Action Alternative:

- Post-construction monitoring for downed wildlife
- Previously authorized incidental take and mitigation activities
- Other facility activities:
 - Wind turbine operations during daylight hours
 - General facility and grounds maintenance

Due to site-specific characteristics, and the terms and conditions of any original HCPs in effect, the activities listed above vary for each wind project. Specific activities that would occur as part of the No Action Alternative are described in subsequent sections for each of the four wind projects. The project-specific No Action Alternatives below serve as the benchmark against which the effects of all other alternatives are measured.

2.1.1 ALTERNATIVE 1A – AUWAHI WIND

Auwahi Wind is located on the privately-owned 'Ulupalakua Ranch in South Maui (see HCP for a map of the project location). Auwahi Wind received an ITP (Permit Number TE64153A-0) in February 2012, and began commercial operations in December 2012. The wind facility consists of eight, 3.0-megawatt (MW) Siemens Wind Turbine Generators (WTGs). Each WTG has a height of 428 ft as measured from the ground to the tip of the blade. The following documents serve as a reference point and the basis for the Auwahi Wind No Action Alternative. These documents are incorporated by reference and cited in the Bibliography section of this PEIS.

- State of Hawai'i Final Environmental Impact Statement accepted on August 23, 2011 (Tetra Tech 2011). This EIS addresses compliance with state laws for the construction and operation of the Auwahi Wind project.
- The Service Finding of No Significant Impact (FONSI), signed on February 23, 2012, and the Final Environmental Assessment (EA) (USFWS 2012), which addresses compliance with NEPA for the issuance of Auwahi's 2012 ITP and HCP.

- Final Auwahi Wind Farm Project Habitat Conservation Plan (Tetra Tech 2012), which contains the terms and conditions of the Auwahi Wind 2012 ITP (Permit Number TE64153A-0), which remains in effect.

Under this alternative, Auwahi Wind would not be issued a major amendment to modify their 2012 ITP to increase take of the Hawaiian hoary bat. Auwahi Wind would continue activities authorized under their 2012 ITP, including incidental take up to the following amounts: 21 Hawaiian hoary bats; 87 Hawaiian petrels; 5 Hawaiian geese; and all Blackburn's sphinx moth (*Manduca blackburni*) larvae and eggs within the facility footprint. Auwahi Wind would operate their eight 3.0-MW wind turbines during daylight hours, augmented with an 11-MW battery storage system and feather turbine blades year-round from one hour before sunset to one hour after sunrise at all project turbines (full nighttime turbine shutdown) to avoid Hawaiian hoary bat take. Ancillary structures at the facility include an underground electrical collection system, an operation and maintenance facility, an approximately 9-mile 34.5-kV above-ground generator-tie line, and an interconnection substation. All facility structures would remain the same under the No Action Alternative.

Auwahi Wind Post-construction Monitoring for Downed Wildlife

Auwahi Wind conducts monitoring for downed wildlife in accordance with their Post-Construction Monitoring Plan (PCMP) and associated adaptive management provisions for direct take of wildlife species to help ensure compliance with the authorized provisions and take limitations of the ITP and HCP (Tetra Tech 2012, 2019a). The Auwahi Wind PCMP includes systematic searches at all eight turbines inside the 328-ft radius surrounding the tower base. Auwahi Wind uses a canine search team to conduct searches for injured or deceased wildlife every 3 to 4 days. Auwahi Wind would also continue to implement searcher efficiency and carcass persistence trials to obtain data that are used to estimate actual take levels of federally listed species throughout the life of the project. Refer to **Appendix C** for a description of these trials and how the resulting data are used to estimate actual take levels for federally listed species, including the Hawaiian hoary bat.

Auwahi Wind Mitigation Activities

Auwahi Wind engages in several previously authorized mitigation activities designed to provide conservation benefits to the Hawaiian petrel and the Hawaiian hoary bat that are expected to continue under the No Action Alternative. Auwahi Wind would continue Hawaiian petrel mitigation activities near the summit of Haleakalā in the 2019 breeding season and continue into subsequent years to offset anticipated take. Hawaiian petrel mitigation activities include predator control in the form of trapping feral cats (*Felis catus*), rats (*Rattus spp*), mice (*Mus spp.*) and mongoose (*Herpestes javanicus*), combined with Hawaiian petrel burrow monitoring within a 328-acre area (see HCP for a map of the project location) of State land known to support an existing petrel breeding colony. Hawaiian hoary bat mitigation activities for permitted levels of take are conducted within the 130-acre Pu'u Makua site within the Waihou Mitigation Area. Hawaiian hoary bat mitigation activities include: maintenance of the Pu'u Makua ungulate exclusion fence built by Auwahi Wind in 2013; invasive vegetation removal of tropical ash

(*Fraxinus uhdei*), bocconia (*Bocconia frutescens*), black wattle (*Acacia mearnsii*), Monterey pine (*Pinus radiata*) and blackberry (*Rubus argutus*); maintenance of out-planted native trees consisting of koa (*Acacia koa*), 'ōhi'a (*Metrosideros spp.*), 'a'ali'i (*Dodonea viscosa*) and māmane (*Sophora chrysophylla*); and vegetation monitoring to ensure preservation of bat habitat.

Previously authorized mitigation activities for the Hawaiian goose and the Blackburn's sphinx moth have been successfully completed according to the terms and conditions of the Auwahi Wind ITP and HCP (Tetra Tech 2012), and therefore are not included under the No Action Alternative.

2.1.2 ALTERNATIVE 1B – KAWAILOA WIND

Kawailoa Wind is located on privately-owned Kamehameha Schools property on the North Shore of O'ahu near the town of Hale'iwa (see HCP for a map of the project location). Kawailoa Wind received an ITP (Permit Number TE59861A-0) in December 2011 and began commercial operations in November 2012.

The wind facility consists of 30, 2.3-MW WTGs. Each WTG has a height of 493 ft, measured from the ground to the tip of the blade. Ancillary structures at the facility include an operation and maintenance building, an approximately 4-mile 46 kV above-ground connector line and a 7.2 mi 46 kV underground connector line, a 1.4 ac electrical substation, two 1.8 ac interconnection facilities, and an optional battery energy storage system. All facility structures would remain the same under the No Action Alternative. The following documents serve as a reference point and the basis for the Kawailoa Wind No Action Alternative. These documents are incorporated by reference and cited in the Literature Cited section of this PEIS.

- The State of Hawai'i Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) FONSI, signed on September 27, 2011, and Final EIS that address compliance with state laws for the issuance of Kawailoa's 2011 ITP and HCP.
- The Service's FONSI, signed on December 8, 2011, and Final EA (USFWS 2011a) that address compliance with NEPA for the issuance of Kawailoa's 2011 ITP and HCP.
- The Kawailoa Wind Power Final HCP (SWCA 2011b) and the terms and conditions of the Kawailoa Wind 2011 ITP (Permit Number TE59861A-0), which remains in effect.

Under this alternative, Kawailoa Wind would not be issued a major amendment of their 2011 ITP to include the Hawaiian petrel and to increase their authorized take level of the Hawaiian hoary bat. Kawailoa Wind would continue activities authorized under their 2011 ITP, including incidental take up to the following amounts: 60 Hawaiian hoary bats; 12 Hawaiian ducks (koloa maoli; *Anas wyvilliana*); 18 Hawaiian moorhen ('ālae 'ula; *Gallinula galeata sandvicensis*, also known as the Hawaiian gallinule); 18 Hawaiian coots ('ālae kea; *Fulica americana alai*); 24 Hawaiian stilts (kukuluae'o; *Himantopus mexicanus knudseni*); and 15 Newell's shearwaters ('a'o; *Puffinus auricularis newelli*). The Service assumes that Kawailoa Wind would operate their 30, 2.3-MW wind turbines normally during daylight hours.

After the draft PEIS was published on April 26, 2019, NRG acoustic bat deterrents were installed on all 30 turbines at Kawaihoa Wind in May-June 2019. Because there is uncertainty as to the effectiveness of deterrents at reducing bat take, operation of the turbines at night would continue to pose a risk to bats unless the deterrents are 100% effective, thus under this alternative, Kawaihoa would be expected to feather turbine blades year-round from one hour before sunset to one hour after sunrise at all project turbines (full nighttime turbine shutdown) to fully avoid further take of Hawaiian hoary bats and minimize the potential for take of Hawaiian petrel.

Kawaihoa Wind Post-construction Monitoring for Downed Wildlife

Kawaihoa Wind conducts monitoring for downed wildlife in accordance with their PCMP and associated adaptive management provisions (SWCA 2011b). The Kawaihoa Wind PCMP is conducted to monitor direct take of wildlife species to ensure compliance with the ITP and the provisions and take limitations in the HCP (SWCA 2011b; Tetra Tech 2019b). The Kawaihoa Wind PCMP includes searches at all 30 turbines twice per week, within a 115-ft radius surrounding the tower base. The turbine plots are primarily searched by a canine search team, every 3.5 days on average. All search plots are mowed every three to four weeks to a height of three to four inches, depending on the type of mower used. Vegetation in the search plots consist mainly of non-native grasses and low-lying vegetation: Guinea grass (*Megathyrsus maximus*), Bermuda grass (*Cynodon dactylon*), and *Mimosa pudica*. Kawaihoa Wind also conducts searcher efficiency and carcass persistence trials to obtain data that are used to estimate actual take levels of federally listed species throughout the life of the project (**Appendix C**).

Kawaihoa Wind Mitigation Activities

Kawaihoa Wind engages in several previously authorized mitigation activities designed to provide conservation benefits to the following ESA-listed species: the Hawaiian duck, Hawaiian moorhen, Hawaiian coot, and the Hawaiian stilt (collectively referred to as “Hawaiian water birds”); and the Hawaiian hoary bat. The following management activities for these species occur within the 150-acre ‘Uko‘a wetland located north of Hale‘iwa:

- Manual removal of invasive water hyacinth (*Eichhornia crassipes*);
- Predator monitoring, trapping and removal of feral pigs (*Sus scrofa*), mongoose, feral cats, rats, and mice;
- Maintenance and repairs of a 40-ac ungulate exclusion fence built by Kawaihoa Wind within the ‘Uko‘a wetland area; and
- Monitoring of Hawaiian hoary bat activity subsequent to previous habitat enhancements.

Additionally, Kawaihoa Wind funded and continues to support three research projects focused on the Hawaiian hoary bat:

- *Modeling Foraging Habitat Suitability of the Hawaiian Hoary Bat*. This study began in February 2017 and is being conducted by the United States Geological Survey (USGS) on the island of O‘ahu. The study aims to integrate videography, echolocation, and insect trapping to more directly determine bat occurrence and activity, in contrast to previous approaches that relied solely on acoustic detections. Study results are expected in 2019.

- *Hawaiian Hoary Bat Conservation Genetics*. This study began in 2017 and is being conducted by the USGS with genetic sampling occurring across the Hawaiian Islands and through available collections. The study aims to document genetic variability and demographic information, including gender of bat carcasses retrieved at wind farm facilities in Hawai'i.
- *Hawaiian Hoary Bat Acoustic Surveys*. This study began in 2017 and is being conducted by Western EcoSystems Technology, Inc. on the island of O'ahu. The 5-year study aims to provide island-specific information on bat occupancy/distribution and island-specific estimates of detection probabilities.

All mitigation activities as described above are expected to continue under the No Action Alternative. Previously authorized mitigation activities for the Newell's shearwater have been successfully completed according to the terms and conditions of the Kawailoa Wind ITP and HCP (SWCA 2011d) and therefore are not included under the No Action Alternative.

2.1.3 ALTERNATIVE 1C – KAHEAWA WIND POWER II

Kaheawa Wind Power II (KWP II) is located on State land above the town of Mā'alaea on the southwestern portion of the island of Maui (see HCP for a map of the project location). KWP II received an ITP (Permit Number TE27260A-0) in January 2012 and began commercial operations in July 2012. The wind facility consists of 14 General Electric 1.5-MW WTGs. Each WTG has a height of 328 ft, measured from the ground to the tip of the blade. The following documents serve as a reference point and the basis for the KWP II No Action Alternative. These documents are incorporated by reference and cited in the Bibliography section of this PEIS.

- The State of Hawai'i Final EIS (Planning Solutions 2010) accepted on May 19, 2010, addressing compliance with state laws for the construction and operation of the KWP II wind project.
- The Service's FONSI, signed on January 3, 2012, and Final EA (SWCA 2011b) addressing compliance with NEPA for the issuance of KWP II 2011 ITP and HCP.
- The KWP II Wind Energy Generation Facility HCP (SWCA 2011c) and the terms and conditions of the KWP II 2011 ITP (Permit Number TE27260A-0), which remains in effect.

Under this alternative, KWP II would not be issued a major amendment of their 2012 ITP to increase their authorized take level for the Hawaiian hoary bat and the Hawaiian goose. KWP II would continue activities authorized under their 2012 ITP, including incidental take up to the following amounts: 11 Hawaiian hoary bats, 30 Hawaiian geese, 8 Newell's shearwater, and 43 Hawaiian petrel. KWP II would operate their 14, 1.5-MW wind turbines during daylight hours and feather turbine blades year-round from one hour before sunset to one hour after sunrise at all project turbines (full nighttime turbine shutdown) to fully avoid further take of Hawaiian hoary bats. If take of Hawaiian geese exceeds the currently authorized take level, KWP II would also cease operation of turbines during daylight hours. Ancillary structures at the facility include an operation and maintenance building, an electrical substation, a battery energy storage system, a 0.23 mi overhead connector line, and an underground electrical connection system connecting the KWP II to the nearby KWP I wind facility. All facility structures would remain the same under the No Action Alternative.

KWP II Post-construction Monitoring for Downed Wildlife

KWP II conducts monitoring for downed wildlife in accordance with their PCMP and associated adaptive management provisions (SWCA 2011a) as modified in coordination with the Service and DOFAW as part of their adaptive management procedures. The KWP II PCMP is conducted to monitor direct take of wildlife species to ensure compliance with the ITP the HCP (SWCA 2011, 2018b). The KWP II PCMP includes searches at all 14 turbines every seven days, within a 229.7-ft radius surrounding the tower base. Turbine plots and nearby facility roads are primarily searched by a canine search team, with visual searchers conducting about 14% of searches per year. Vegetation within the turbine search plots is suppressed using hand management tools (spray packs and weed whackers) in order to improve monitoring efficiency. KWP II also conducts searcher efficiency (SEEF) and carcass retention trials (CARE) to obtain data that are used to estimate actual take levels of federally listed species throughout the life of the project (**Appendix C**).

KWP II Mitigation Activities

KWP II engages in several previously authorized mitigation activities designed to provide conservation benefits to the following species: the Newell's shearwater, Hawaiian petrel, Hawaiian goose, and the Hawaiian hoary bat. The following management activities for the Newell's shearwater and Hawaiian petrel occur within two 4.5-ac enclosures built by KWP II in Makamaka'ole, West Maui:

- Predator monitoring, trapping, and removal of rats, mice, and mongoose;
- Maintaining culvert tubes and matting to prevent soil erosion immediately inside and outside enclosures;
- Out-planting the following species to stabilize soil and provide seabird nesting habitat: the 'uki (*Machaerina augustifolia*), 'ōhi'a, naupaka kuahiwi (*Scaveola gaudichaudii*), and the manono (*Kadua affinis*);
- Manual herbicide and weeding to remove the following non-native species: *Clidemia hirta*, *Tibouchina* spp., *Melinis minutiflora*, and *Psidium* spp.; and
- Monitoring for seabird activity using game cameras and night surveys.

Two years of funding (\$162,750) was provided by KWP II to DLNR DOFAW in fiscal year 2017 to begin predator control to protect Hawaiian goose breeding sites on Maui. Predator control is expected to continue until mitigation requirements for the Hawaiian goose have been successfully completed. Management activities for the Hawaiian hoary bat began in 2014 and consist of bat habitat management (reforestation and fence maintenance) within a 340-ac section of the Kahikinui Forest Reserve, Maui.

All mitigation activities as described above are expected to continue under the No Action Alternative in accordance with the terms and conditions of KWP II HCP and ITP (SWCA 2011a).

2.1.4 ALTERNATIVE 1D – PAKINI NUI WIND

The Pakini Nui Wind is located on land owned by DHHL and Kamehameha Schools in the Ka Lae or South Point district on Hawai'i Island (see HCP for a map of the project location). Apollo Energy Corporation purchased and re-powered the retired Kamaoa Wind Farm which had began commercial operation in 1987. Tawhiri Power LLC, a subsidiary of Apollo Energy, leased additional property from DHHL about 1.5 mi from the 100 ac Kamaoa Wind Farm and renamed this new property Pakini Nui Wind. The purchase power agreement with Hawai'i Electric Light Company was approved by the Public Utilities Commission on March 10, 2005. The 37 Mitsubishi turbines located at the nearby 9.3-megawatt Kamaoa Wind Farm, were replaced by 14 GE turbines at Pakini Nui Wind and went into Service in April 2007. Each WTG has a height of 328 ft, measured from the ground to the tip of the blade.

Under the No Action Alternative, Pakini Nui Wind would not be issued an ITP to take the following federally listed species: the Hawaiian hoary bat; Hawaiian goose; and the Hawaiian petrel; and mitigation activities to provide a conservation benefit for these species would not be conducted. Any take of federally listed species occurring incidental to operation of the project would not be authorized and Pakini Nui would assume the risk of enforcement under the ESA if they continued operating the project without an ITP.

Under the No Action alternative, Pakini Nui Wind would conduct the following activities:

- Cease to operate the 14, 1.5-MW wind turbines because of the risk to the Hawaiian hoary bat, Hawaiian petrels and Hawaiian goose. Ancillary structures at the facility include an operation and maintenance building, meteorological tower, a 1.3 ac electrical substation, a 6-mi above ground transmission line, and a 1- mi underground connector line.
- Conduct monthly on-site facility equipment checks using 2- and 4-wheel drive vehicles across two miles of facility roads.
- Routine vegetation management of areas surrounding the turbines.

Pakini Nui Wind has conducted limited, voluntary post-construction monitoring to document downed wildlife at the project site since operations began in 2007 (SWCA 2015a,b,c, 2018a). The first Hawaiian hoary bat carcass was documented on August 31, 2013, indicating that an unauthorized incidental take of an endangered species had occurred at the project site. Pakini Nui Wind has stated that the following minimization/avoidance measures currently employed at the facility would continue to be implemented:

- Minimize nighttime activities to avoid the use of lighting that could attract Hawaiian petrels and band-rumped storm-petrels and possibly Hawaiian hoary bats.
- Minimize use of on-site lighting at buildings and use shielded fixtures only on infrequent occasions when workers are at the project at night.
- Observe a speed limit of 25 mi per hour (mph) while driving in the project area to minimize potential for collision with any State or Federal protected species, in the event they are using on-site habitat or are injured. If Hawaiian geese are observed at or near the site, a speed limit of 15 mph would be observed.

- Avoid use of barbed wire within the leased project area because it poses an entangling risk to Hawaiian hoary bats.
- If gaps in grazing activity occur, maintain vegetation height within the leased area so as not to attract Hawaiian goose breeding behavior.
- Refrain from purposely approaching and maintain a 100-ft distance by foot or vehicle from Hawaiian geese when present in the project area to avoid erratic flight behavior that may increase turbine strike risk.
- Minimize open water that may attract the Hawaiian goose.

While the Service cannot be assured of the continued implementation of the above measures under the No Action alternative, failure of these measures to be implemented could have potential enforcement action implications for Pakini Nui Wind.

2.2 ALTERNATIVE 2 – PROPOSED ACTION

Under the Proposed Action, the Service would issue a separate ITP (amendment or a new ITP) to each of the four Applicants, authorizing incidental take of the Covered Species. The new or amended ITP/HCP would be implemented as proposed by each Applicant, including mitigation and minimization actions to address effects of the incidental take. The Applicants' operations and activities would be subject to the terms and conditions of the ITP/HCP, as well as existing regulatory standards. Under the Proposed Action Alternative, the three Applicants with HCPs/ITPs currently in effect would continue to conduct their previously authorized mitigation activities as outlined in Section 2.1, No Action Alternative, in addition to the mitigation described in their HCP amendment. We refer to the HCP for a map of Project locations and proposed mitigation areas.

2.2.1 ALTERNATIVE 2A – AUWAHI WIND

Under Alternative 2A, the Service would issue an amendment to Auwahi Winds' original ITP (TE64153A-0) to increase authorized take up to an additional 119 Hawaiian hoary bats in the form of harm or lethal injury over a 25-year permit term set to expire in 2037. The configuration of the energy facility and duration of the original ITP would remain unchanged. Anticipated incidental take would occur according to specific tiers of take, as defined in **Table 2-1**. The Auwahi HCP amendment would comprise Tiers 4, 5, and 6.

New Species Protection Measures for the Hawaiian Hoary Bat

Auwahi Wind would implement the following baseline minimization measures and continue these measures for the duration of the permit, unless specific adaptive management triggers are reached that would initiate an adaptive management action. These baseline minimization measures are:

- Implement LWSC for all eight turbines with a 5.0 m/s cut-in speed November through July (all months without LWSC at higher cut-in speeds), from 30 minutes before sunset to 30 minutes after sunrise; and,

- Implement increased nighttime LWSC with a 6.9 m/s cut-in speed for all eight turbines, from 30 minutes before sunset to 30 minutes after sunrise, for the months of August to October, when data from the first five years of operation has shown that most bat fatalities have occurred. The use of LWSC involves stopping the rotation of turbine blades during periods of low wind speeds. Refer to **Appendix D** for more information on how LWSC is used as a species protection measure.

Table 2-1. Auwahi Wind proposed tiers of take for the Hawaiian hoary bat.

Tier	Cumulative Estimated Take	Take in Tier ¹	Basis for Take within Designated Tier ²
1	5	5	Estimate developed in approved HCP.
2	11	6	Estimate developed in approved HCP.
3	21	10	Estimate developed in approved HCP.
4 (New)	81	60	Assumed reduction in take rate of 70% in years 2018-2032 (relative to the current take rate).
5 (New)	115	34	Assumed reduction in take rate of 50% in years 2018-2032 (relative to the current take rate).
6 (New)	140	25	Assumed reduction in take rate of 30% in years 2018-2032 (relative to the current take rate). Represents baseline condition for estimated take request.

¹Each tier represents the total take requested (i.e., take is not additive across tiers).

²The scenarios described are representative of conditions that could result in take being limited to each specific tier. Many factors may affect take, and none of these can be known in advance. All scenarios use Evidence of Absence model (EoA) and data through September 30, 2018.

To ensure that the minimization measures are effective, Auwahi Wind would implement the adaptive management strategy described in their HCP amendment. The effectiveness of the minimization measures in achieving reductions in bat take would be quantified using the Baseline Fatality Rate as estimated in the Evidence of Absence (EoA) model (Dalthorp et al. 2017) using Project post-construction mortality monitoring data. The Baseline Fatality Rate is the average annual fatality rate calculated using all prior years of post-construction mortality monitoring data in EoA. Refer to **Appendix C** for more information on the EoA model.

The adaptive management framework for the Auwahi minimization program consists of:

1. Regular comparison of the Baseline Fatality Rate to the Threshold Value based on monitoring data will be conducted in 2020, 2025, and 2030, to determine if adaptive management provisions are triggered. The Threshold Value is calculated as the total (originally authorized and newly requested) direct take (129 Hawaiian hoary bats) divided by the expected operational life of the project (20 years). For Auwahi Wind, the Threshold Value is 6.45 (129 direct take estimated by EoA / 20 years of operation). Comparing the Baseline Fatality Rate to the Threshold Value would allow Auwahi Wind to ensure actual take remains below the permitted take.
2. Implement responsive actions in the event the Baseline Fatality Rate is below, greatly below, or above the specified Threshold Value. Section 7.4 in Auwahi Winds' HCP amendment

(Tetra Tech 2019a) provides details on actions that would be taken given each potential future scenario.

Actions to Mitigate Incidental Take of the Hawaiian Hoary Bat

Tier 4 Mitigation Actions

Auwahi Wind Tier 4 mitigation actions would be conducted on 1,752 ac of mixed pasture and forested land owned by 'Ulupalakua Ranch on Maui (see HCP for a map of the project location). The mitigation area includes the Waihou Area, the Duck Ponds, Cornwell, and Kaumea Loko parcels identified in the Auwahi Wind HCP original HCP (Tetra Tech 2012) as potential mitigation areas. The parcels within the Waihou Area were identified in the approved HCP for future possible mitigation tiers, but were not used during implementation of the approved HCP. Refer to Tetra Tech 2011 and USFWS 2012 for a description of the anticipated effects of the mitigation actions described below.

Under the proposed Tier 4 mitigation, the property and existing pastures would continue to be used for seasonal grazing, but new management actions would be implemented to protect and enhance bat foraging and roosting habitat. To achieve this mitigation objective, Auwahi Wind would (1) create forested linear landscape features (i.e., hedgerows) that can be used as foraging and roosting substrate and travel corridors, and (2) provide suitable, consistent water resources for the Hawaiian hoary bat. Auwahi Wind would also implement fire management actions and provide for legal protection of the mitigation area in the form of a conservation easement. Auwahi Wind would reforest the hedgerows within the 1,556 ac of pasture land (excluding the Waihou Area). The pasture lands would be reforested to a minimum density of approximately 20% or 311 ac of forest cover. Within the hedgerows, trees would be planted to a density of approximately 200 trees per acre or at a 15-ft spacing. The hedgerows would be at least 80 ft wide (6 trees across) to provide linear landscape features, wind breaks, and foraging substrates for the Hawaiian hoary bat. The width of hedgerows was developed in coordination with the USGS.

The hedgerows would be planted with fast-growing native or endemic trees and understory species, with a preference for fast-growing native species. The selection of tree species would be subject to availability and the suitability of tree species for Hawaiian hoary bats. Koa (*Acacia koa*) is preferred as it is expected to provide available insect biomass, available night roost locations, and is fast growing. A'ali'i (*Dodonaea viscosa*) is preferred for the understory. Koa and a'ali'i are selected as preferred hedgerow species because they have been demonstrated to be associated with both an increased abundance and diversity of insect species (Peck et al. 2015, Tetra Tech 2019a). No tree species known to be a threat to native ecosystems would be used, as determined by the Hawai'i Weed Risk Assessment (Daehler et al. 2004).

The hedgerows would be fenced where necessary to prevent ungulates from damaging the out-planted trees. Auwahi Wind would install fencing to surround the reforestation areas where required, and prevent the ingress of ungulates and promote the long-term habitat suitability of the reforested areas.

Following the recommendations from Bat Conservation International (BCI) (Taylor and Tuttle 2007), Auwahi Wind would retrofit existing water troughs with wildlife egress structures to provide water resources for the Hawaiian hoary bat and ensure that any bats or wildlife that fall into the water can escape without drowning. These retrofitted troughs would have a minimum surface area of 10 ft by 2.5 ft and an approximate depth of 1 to 2 ft (Taylor and Tuttle 2007). Nearby vegetation and fencing that controls livestock access to the water features would be removed if necessary (or fence lines will be rerouted if appropriate) based on recommendations by Jackrel and Matlack (2010) and Taylor and Tuttle (2007) to ensure that bat flight paths to the water tanks are not obstructed.

Auwahi Wind would install two new larger ponds. The ponds would have an approximate minimum size of 20 ft in diameter and a volume of 50,000 gallons. The minimum size of the pond was selected based on BCI recommendations for ponds which can be utilized by most bat species, and a greater surface area would be utilized where possible. The exact size and shape of the ponds would depend on the site conditions. The pond design would incorporate varying water depth to facilitate insect species associated with shallows that serve as prey for bats. The two 50,000 gallon ponds described above, sited adjacent to the Kula Forest reserve, would also be designed to facilitate the aerial firefighting efforts essential for wildland fire prevention and serve as dip tanks. The addition of these larger ponds would allow for helicopters to fight fires to protect not only the Mitigation Area, but also adjacent lands including the Kula State Forest Reserve, Waihou Area, and the Kanaio Natural Area Reserve (NAR).

To provide for permanent protection of the Tier 4 mitigation area, Auwahi Wind would fund a conservation easement that would be overseen by the Hawaiian Islands Land Trust (HILT). This easement would not supersede the existing agricultural easement but would impose additional servitudes which are necessary and appropriate for carrying out the bat-focused conservation measures, described above. As the easement grantee, HILT would ensure compliance with the covenants, terms, conditions and restrictions contained in the easement. Where the conservation easement differs from the agricultural easement the more restrictive easement would apply.

The additional protections or restrictions which would be imposed on the 1,752-ac mitigation area through the conservation easement include:

- Prohibiting removal of trees over 15 ft tall during the bat pupping season (April 1 through September 15);
- Protection of the hedgerows from removal;
- Maintaining ponds and troughs according to this mitigation plan;
- Prohibitions on the use of insecticides;
- Prohibiting artificial stocking of ponds with fish known to reduce insect populations; and
- Prohibiting the use of barbed wire when installing fencing or other such structures.

The parcel management provided by HILT includes:

- Holding rights surrendered by the landowner;
- Protection and preservation of the property set forth in the easement;
- Enforcement of the restrictions put forth in the easement; and

- Access to the lands in the easement for annual or more frequent monitoring for compliance with easement conditions.

In order to verify the success of mitigation actions, Auwahi Wind would systematically monitor Hawaiian hoary bat activity levels or appropriate surrogates within the mitigation area, to include the following activities:

- Acoustic monitoring to detect presence or absence and the number of feeding buzzes to indicate Hawaiian hoary bat foraging occurring;
- Baseline acoustic monitoring outside of the mitigation area to serve as a reference;
- Thermal videography to document Hawaiian hoary bat behavior at ponds and/or water troughs;
- Ponds will be checked quarterly to ensure correct operation and repaired as soon as practicable before the next quarterly check.
- Quarterly baseline insect monitoring, followed by semiannual (twice yearly) insect monitoring conducted in years 1, 2, 3, 5, 7, 9, and 11. Monitoring would consist of one malaise trap set-up for one month at three different locations. Following the sampling, the insects would be identified to order and the abundance of each order will be reported in the annual report.
- All data would be analyzed after years 0, 1, 2, 3, 5, 7, 9, and 11. Data analysis would compare the covariates of trough, ponds, and hedgerows to determine the impacts of each management action and the overall Hawaiian hoary bat abundance and detectability at the site. The results of this analysis would be summarized in the annual report following the completion of each year.

The primary monitoring success criteria is to discern an increase in bat activity at the site. Secondary goals include increasing forest cover to 20% within the pasture through hedgerows and determining the impacts of management actions and verification that management actions are consistent with the management program. Based on the analysis of the monitoring data, adaptive management may be implemented to include, but not be limited to, changing the forest species composition in reforested areas or replacing trees that have not survived, adding additional ponds, and/or hedgerows, and reforestation at higher densities within the Waihou parcel.

Tier 5 and 6 Mitigation Actions

The Tier 5 and 6 take levels require mitigation for 34 and 25 Hawaiian hoary bats, respectively (**Table 2-2**). Mitigation for Tiers 5 and 6 would likely focus on restoration and management of 690 and 508 ac, respectively, in the Von Tempsky Parcel of the Kamehamehenui Forest in east Maui to improve bat foraging and roosting habitat. If, at the time of planning for the next Tier that parcel is not available or suitable another area will be chosen based on the selection criteria and considerations provided in **Appendix B**. Prior to triggering Tier 5 or 6, Auwahi Wind will coordinate with DOFAW and the Service to establish two acoustic monitoring locations to document parcel-specific Hawaiian hoary bat baseline activity prior to implementing mitigation actions. Upon triggering of the planning stage of a future tier, Auwahi will work with DOFAW and the Service to develop a site-specific mitigation implementation plan based on best science at the time. Actions proposed consist of the out-planting of native tree species to build the

vertical vegetative structure and canopy cover necessary for bat roosting. Heterogeneous vegetative structure is expected to provide shelter for insect species that are the prey for Hawaiian hoary bats, and the preferred “edge habitat” for Hawaiian hoary bat foraging (Jantzen 2012, H.T. Harvey 2019). Another anticipated action is the creation of water features, which are likely to increase bat usage of the site. In addition, Auwahi Wind anticipates removing invasive plant and animal species, which negatively impact bat roosting and foraging habitat. Auwahi will coordinate with DOFAW once the State’s comprehensive multi-use management plan is developed and approved to ensure the plan proposed by Auwahi Wind is compatible with DOFAW’s plan (BLNR 2019). In collaboration with DOFAW, Auwahi Wind may implement a portion of the DOFAW comprehensive plan upon approval by the Service.

Table 2-2. Triggers for Auwahi Wind to initiate mitigation between tiers.

Tier ¹	Cumulative Authorized Take Under ITP/ITL (No. of Bats)	Allowed Take in Each Tier (No. of Bats)	Trigger for Initiating Additional Mitigation ²
Tiers 1 – 3	0 – 21	21	Mitigation completed or initiated for Tiers 1 – 3; planning for Tier 4 Mitigation has been initiated in conjunction with this Amendment.
Tier 4 (New)	22 – 81	60	If the 80% upper credible limit of cumulative take (direct + indirect) \geq 66 bats, initiate finalizing Tier 5 mitigation plan.
Tier 5 (New)	82 – 115	34	If the 80% upper credible limit of cumulative take (direct + indirect) \geq 106 bats, initiate finalizing Tier 6 mitigation plan.
Tier 6 (New)	116 – 140	25	If the 80% upper credible limit of cumulative take (direct + indirect) \geq 133 bats prior to year 2031, initiate consultation with Service and DOFAW.

¹ Each tier represents the total take requested (i.e., take is not additive among tiers).

² The EoA software would be used to calculate the 80% upper credible limit of cumulative direct take; the calculation of indirect take is described in **Appendix E**.

In order to verify the success of mitigation actions, Auwahi Wind will systematically monitor Hawaiian hoary bat activity levels beginning approximately three months after management actions have started. Acoustic monitoring will be designed to provide coverage of at least one or more detectors every 85 ac which is 3-7 times higher density than similar studies (Gorresen et al. 2015, Todd et al. 2016). Insect sampling will occur for one month with a malaise trap two times per year. All data will be statistically analyzed using best science methods and reported in the annual report. Additional monitoring using best science at the time will be detailed in the Auwahi Wind site-specific management implementation plan to ensure interim success criteria are met. In addition to monitoring for changes in bat activity which will inform ongoing and

future actions, Auwahi Wind will include success criteria for the restoration and land improvement actions that are specific, measurable, achievable, relevant, and are time-line associated in the site-specific management implementation plan approved by the Service and DOFAW. These criteria will provide interim measures of success to ensure mitigation is on track and timely.

Based on the analysis of the monitoring data, adaptive management may be implemented to include, but not be limited to, increasing the intensity or extent of the management activities such as increasing planting density; increasing the diversity of management actions such as adding additional canopy or understory species; or altering the management actions implemented, such as moving from reforestation to other limiting factors of the bats identified by the best science at the time.

2.2.2 ALTERNATIVE 2B – KAWAILOA WIND

Under Alternative 2B, the Service would issue an amendment to Kawaiiloa Wind's original ITP (TE59861A-0) to authorize take up to 19 adult Hawaiian petrels and 5 nestlings, and increase anticipated take up to an additional 160 Hawaiian hoary bats in the form of harm or lethal injury. The total take request of 220 represents a 25% reduction from the original request of 265 that was published in the draft PEIS. The 220 is based on achieving a 25% reduction in the current rate of bat take due to the deployment of NRG bat deterrents at all 30 turbines. Bat deterrents were installed in May-June 2019, after the publication of the draft PEIS. Other than installation of the bat deterrent operating and monitoring system, the configuration of the energy facility and duration of the original 20-year ITP, of which there are 14 years remaining, would remain unchanged. Anticipated incidental take would occur according to specific tiers of take, as defined in **Table 2-3**. For bats, the Kawaiiloa Wind HCP amendment would comprise Tiers 4, 5, and 6.

After the draft PEIS was published on April 26, 2019, NRG acoustic bat deterrents were installed on all 30 turbines at Kawaiiloa Wind in May-June 2019. Because there is uncertainty as to the effectiveness of deterrents at reducing bat take, operation of the turbines at night would continue to pose a risk to bats. Studies on the US mainland have shown effectiveness to range from 20-100% (Arnett et al. 2013, Hein et al. 2018, Weaver et al. 2018; Lillian 2019). Thus under this alternative, Kawaiiloa would be expected to feather turbine blades year-round from one hour before sunset to one hour after sunrise at all project turbines (full nighttime turbine shutdown) to fully avoid further take of Hawaiian hoary bats and minimize the potential for take of Hawaiian petrel.

New Species Protection Measures for the Hawaiian Hoary Bat and Hawaiian Petrel

In addition to the minimization measures provided in the existing HCP (SWCA 2011d) Kawaiiloa Wind would implement the following baseline minimization measures to minimize the risk of take of the Hawaiian hoary bat:

1. Extend LWSC to year-round from sunset to sunrise.
2. Increase LWSC from 5.0 m/s to a cut-in speed of 5.2 m/s through a 0.2 m/s hysteresis to increase the "down time" of the wind turbines, and reduce the number of stop/start events per

night by extending the rolling average time from 10 to 20 minutes. Hysteresis is a LWSC regime that offsets the “cut-out” and “cut-in” speeds such that it will take a higher average wind speed (raised cut-in speed) for the turbines to return to operation after stopping due to LWSC. LWSC at Kawaiiloa results in turbines being removed from service with feathering, resulting in a rotor speed of 1 revolution per minute or less. All Project turbines individually monitor wind speed using turbine-mounted anemometers, and are programmed to shut off when wind speeds are 5.0 m/s or lower and to start up again when wind speeds reach 5.2 m/s based on a 20 min rolling average. This increase in cut in speed and longer rolling average minimizes stop starts and the collision risk for bats.

3. Conduct an ultrasonic acoustic bat deterrent “proof of concept” test, in collaboration with NRG Systems. NRG Systems installed an ultrasonic acoustic bat deterrent system at turbine 30, where the most bat fatalities (16%) have been detected as of December 31, 2017, to evaluate the effectiveness of the deterrent specific to Hawaiian hoary bats. The deterrent was deployed in July 2018. Effectiveness at reducing bat activity levels was evaluated using thermal imaging over a 60-day study period to document the bat approach paths and activity in relation to the rotor swept area at turbine number 30. Data collected at the Project site would supplement the results of NRG Systems’ ongoing testing at wind farms on the Continental U.S. Results of NRG Systems’ testing and those of other deterrent systems would be used to inform Kawaiiloa Wind minimization measures. No bat fatalities were detected at turbine 30 since the deployment of the bat deterrent in July 2018.
4. Since the publishing of the draft PEIS in April 2019, Kawaiiloa Wind has installed NRG bat deterrents in May-June, 2019 on all 30 turbines. This is the first multi-turbine evaluation in Hawaii.

Table 2-3. Kawaiiloa Wind proposed tiers of take for the Hawaiian hoary bat.

Tier	Requested Take	Take in Tier¹	Basis for Take within Designated Tier²
1	20	20	Estimate developed in approved HCP
2	40	20	Estimate developed in approved HCP
3	60	20	Estimate developed in approved HCP
4 (New)	115	55	Mitigation offset of the Helemano Wilderness Area purchase
5 (New)	200	85	Assumes reduction in take rate of 50% in years 2022-2032 (relative to the current take rate) due to deterrents ³
6 (New)	220	20	Assumes a 25% reduction in take ⁴

¹ Each tier represents the total take requested within that tier (i.e., take is not additive among tiers).

² The scenarios are representative of the conditions that could result in take being limited to each specific tier. Many factors may affect estimates, and none of these can be known in advance. All scenarios use EoA analysis and data through September 30, 2018.

³ Kawaiiloa Wind installed bat deterrent technology on all 30 turbines in May- June 2019 and assumes the technology will achieve a 50% reduction in the current rate of take for Hawaiian hoary bat for Tier 5.

⁴ Tier 6 represents a scenario that assumes deterrent technology is 25% effective at reducing the current rate of take.

The take avoidance and minimization measures previously implemented for the Newell’s shearwater also minimize the risk of Hawaiian petrel take. These measures are described in detail in Section 5.3 of the original HCP (SWCA 2011b), and include: minimizing on-site lighting at

buildings; implementing a Wildlife Education and Observation Program to reduce vehicle collision risk; and following Avian Power Line Interaction Committee guidelines for overhead collection lines.

Actions to Mitigate the Impacts of Incidental Take of the Hawaiian Petrel and the Hawaiian Hoary Bat

Hawaiian Petrel Mitigation Actions

To compensate for impacts to the Hawaiian petrel, Kawaihoa Wind would fund predator control and monitoring work at the Hanakāpī'ai and Hanakoa seabird colonies within the State's Hono O Nā Pali NAR in 2020. Hanakāpī'ai encompasses 138 ac of mid- to high-elevation terrain in northern Kaua'i. The Hanakoa colony encompasses 58 ac and is located in the western portion of the Hono o Nā Pali NAR.

Specific activities would include:

- Removing predators (rats, feral cats, feral pigs, and non-native barn owls (*Tyto alba*)) surrounding nest sites within Hanakāpī'ai and Hanakoa. Rodents would be controlled using automatic resetting traps (A-24, Goodnature, NZ). Cat trapping would consist of cage traps and Conibears. Pigs would be removed using a combination of targeted trapping and firearms. Non-native barn owls would be removed in areas of high seabird activity by targeted shooting and trapping.
- Monitoring seabird activity using cameras, song meters, and on the ground surveys. Metrics recorded would include: seabird call rates, number of burrows, reproductive success, number of fledglings, and number of depredation events.
- Monitoring predator activity using cameras, traps, and on the ground surveys.
- Responding to spikes in seabird depredation events, to include increased predator trapping across the entire NAR and at major predator ingress points into the NAR.

Tier 4 Mitigation Actions for the Hawaiian Hoary Bat

Kawaihoa Wind Tier 4 mitigation actions consist of contributing \$2,750,000 to the Trust for Public Land (TPL) for the purchase of a 2,882-acre area termed the Helemano Wilderness Area (HWA). The HWA encompasses four parcels located in Central O'ahu. Funds provided by Kawaihoa Wind, in combination with funding commitments from six other partners including federal and state partners would provide TPL with sufficient secure funding to purchase the four HWA parcels. Following purchase of the lands by TPL, the land would be transferred to DOFAW and managed for multiple uses, including for the benefit of the Hawaiian hoary bat. Research would be incorporated into the overall management plan for the area that would focus on identifying optimal habitat or limiting factors for the Hawaiian hoary bat. The land deed would include the requirement that HWA be managed in perpetuity for the protection of habitat and conservation of listed endangered species including the Hawaiian hoary bat, 20 species of listed plants, and other rare species as per the funding awards. For details see the Kawaihoa HCP amendment (Tetra Tech 2019b).

Tier 5 and 6 Mitigation Actions for the Hawaiian Hoary Bat

Mitigation for the Hawaiian hoary bat for Tiers 5 and 6 would be guided by goals identified in the Final Kawaiiloa Wind HCP Amendment (Tetra Tech 2019b) which are hereby incorporated by reference, Hawaiian Hoary Bat Recovery Plan (USFWS 1998), conservation and management priorities identified by the Service and DOFAW, and any information available on the species' survival and recovery needs. Mitigation would consist of one or both of the following: land protection/preservation of habitat (i.e., easement or acquisition) and habitat restoration/land management. A detailed site-specific mitigation implementation plan would be developed at the time each tier is triggered (**Table 2-4**), and the plan would be reviewed and approved by the Service and DOFAW. This approach allows Kawaiiloa Wind to describe the preferred mitigation based on current information, while leveraging information that will be learned from ongoing Hawaiian hoary bat research projects that address some of the existing information gaps, best available science, and current Service and DOFAW guidance.

Within six months after reaching the tier trigger, Kawaiiloa Wind would submit a site-specific mitigation implementation plan to Service and DOFAW for the next tier of mitigation, which would include the plan area, the mitigation actions, measures of success, monitoring, how the mitigation will offset take, and cost estimates. This should provide sufficient time for comment and feedback necessary for such a plan to be approved by the Service and DOFAW, given the current two year lead time between triggering and exceeding a current tier take limit. Funding assurances for the developed mitigation plan are required to be in place prior to triggering the next tier.

Table 2-4. Triggers for Kawaiiloa Wind to initiate mitigation between tiers.

Mitigation Tier	Mitigation Planning Trigger	
	Description	Cumulative Take Estimate ¹
Planning for Tier 5 Mitigation	75% of Tier 4 authorized take limit	86 bats
Planning for Tier 6 Mitigation	75% of Tier 5 authorized take limit	150 bats

¹ Take represents the cumulative take including prior tiers.

Should habitat protection or preservation be identified for Tiers 5 and 6, Kawaiiloa Wind would continue to coordinate with TPL, Service, DOFAW, and others to identify key parcels that would benefit the Hawaiian hoary bat. Land would be protected and preserved through acquisition, easement, or other legal conservation instrument. For this mitigation option, the following selection criteria would be used to identify a suitable mitigation parcel:

- The mitigation parcel is on the Island of O‘ahu.
- A minimum of 20.3 ac would be used to offset one Hawaiian hoary bat (based on the median bat core use area identified from data by Bonaccorso et al. 2015).
- The mitigation parcel includes land acquisition/protection or protection plus management actions (rather than protection alone).

- The mitigation parcel faces a threat such as development or other threats that are not consistent with suitable or high value Hawaiian hoary bat habitat (e.g., level of protection, intact versus degraded habitat, etc.). Parcels that are at risk of development, deforestation, or other degradation will have a higher priority than those not at risk.
- Larger parcels are typically preferable to smaller parcels. However, the location of a smaller parcel (e.g., adjacent to another larger area that supports bats or is being restored to support bats) could make it more attractive as a mitigation site.
- The mitigation parcel would be protected in perpetuity (i.e., fee simple, conservation easement, or other arrangement agreed upon by Kawaiiloa Wind and the agencies). Proposed management practices are consistent with Hawaiian hoary bat roosting and/or foraging habitat.
- Recent evidence of Hawaiian hoary bat activity has been identified at the mitigation parcel or neighboring parcels that would indicate bat use of the mitigation parcel, in conjunction with suitable habitat on the mitigation parcel.

Should habitat restoration or management be identified for Tiers 5 and 6, Kawaiiloa Wind would fund management activities targeted at 1,725-acre area to mitigate for 85 bats in Tier 5, and a 406-acre area to mitigate for 20 bats in Tier 6. Kawaiiloa Wind would conduct habitat restoration/management actions in one of three areas, listed in order of priority:

- Option 1; Kawaiiloa Wind would fund restoration in the central Ko'olau Watershed located in central O'ahu within the upper portions ahupua'a from Waiawa to Kahauiki. The area encompasses approximately 12,000 acres, from which specific restoration areas can be selected. The elevation range of the site is between 110 feet and 1,700 feet. The Hawaiian hoary bat has been documented to have low levels of acoustic activity within the management area (Starceovich et al. 2019, Bonaccorso et al. 2019). The existing closed canopy, monotypic non-native forest would be restored to a diverse native forest along riparian buffers, planting ground cover, native shrubs, or native trees to create open water ways and foraging access to riparian areas, maintain the riparian habitat, and monitor bats insects and vegetation to determine the effectiveness of the actions on achieving the success criteria. This option was only described as an alternative option in the draft PEIS. Additional details are provided here and in Appendix B to better describe the option.
- Option 2: Kawaiiloa Wind would fund management activities to be conducted by DOFAW at HWA, specifically to benefit the Hawaiian hoary bat. These activities would include fencing portions of HWA; control of feral ungulates, rodents, and invasive plant species; control of erosion through plantings and other methods; and reforestation with native and non-invasive hardwood tree species.
- Option 3: Kawaiiloa Wind would contribute funds to DOFAW for management activities to occur within the Waimea Native Forest, including fencing; controlling invasive species such as feral ungulates, plants, and other species; and planting native trees and plants.
- Option 4: If Options 1-3 are not feasible at the time of planning, Kawaiiloa Wind would work with DOFAW and the Service to identify an alternative parcel on O'ahu to conduct or fund bat habitat management/restoration as part of Tier 5 and/or 6 mitigation based on selection criteria listed in **Appendix B** and in the Kawaiiloa Final HCP Amendment (Tetra Tech 2019b). Management actions implemented at an alternative parcel would likely include activities similar to those proposed at HWA and Waimea Native Forest, such as fencing to

keep out ungulates, ungulate removal, removal of invasive plants, restoration of water features, and plantings of non-invasive vegetation for roosting or promoting insect prey for the Hawaiian hoary bat. Should this option be chosen, Kawailoa Wind would work with DOFAW and the Service to develop a site-specific mitigation implementation plan to restore habitat for the benefit of the Hawaiian hoary bat based on best science at the time.

The Kawailoa Wind HCP Amendment incorporates strong adaptive management and triggers to ensure the project provides the benefits and offset for take, based on the best science available.

2.2.3 ALTERNATIVE 2C – KAHEAWA WIND POWER II

Under Alternative 2C, the Service would issue an amendment to KWP II’s original ITP (TE27260A-0) to increase authorized take up to an additional 27 Hawaiian hoary bats and an additional 14 Hawaiian goose in the form of harm or lethal injury, over a 20-year period term set to expire January 2032. The configuration of the energy facility and duration of the original ITP would remain unchanged. Anticipated incidental take would occur according to specific tiers of take, as defined in **Table 2-5**.

Table 2-5. Kaheawa Wind Power II proposed tiers of take for the Hawaiian goose and Hawaiian hoary bat.

Common Name	Scientific Name	Tier	Twenty-Year Take Limit
Nēnē (Hawaiian goose)	<i>B. sandvicensis</i>	Tier 1	Up to 21 total nēnē: 18 adults/immatures and 3 fledglings
		Tier 2	Up to 30 total nēnē: 27 adults/immatures and 3 fledglings
		New Tier 3	Up to 44 adult nēnē
‘Ōpe‘ape‘a (Hawaiian hoary bat)	<i>L. cinereus semotus</i>	Tier 1	Up to 7 adults ¹
		Tier 2	Up to 11 adults ²
		New Tier 3	Up to 30 adult bats
		New Tier 4	Up to 38 adult bats

¹ This was revised to be equivalent to 7 adult bats in a clarification letter from Service and DOFAW (2014-TA0260), dated May 20, 2014.

² This was revised to be equivalent to 11 adult bats in a clarification letter from Service and DOFAW (2014-TA0260), dated May 20, 2014.

New Species Protection Measures for the Hawaiian Hoary Bat

Kaheawa Wind II would implement the following baseline minimization measure to minimize the risk to the Hawaiian hoary bat:

- Low wind speed curtailment currently is implemented at night from February 15 through December 15 annually by raising the cut-in speed of the project's wind turbines to 5.5 m/s between sunset and sunrise. Curtailment will be extended if fatalities are found outside the initial proposed curtailment period with approval of Service and DLNR. Curtailment may also be modified with the approval of DOFAW and Service if site-specific data demonstrate a lack of bat activity during certain periods, or if experimental trials are conducted that demonstrate that curtailment is not reducing collision risk at the project during the entire curtailment period.

Avoidance and minimization measures for the Hawaiian goose will remain unchanged and are described in detail in Section 4.3 of the original Kaheawa Wind Power II HCP (SWCA 2011a).

Actions to Mitigate Incidental Take of the Hawaiian Goose and Hawaiian Hoary Bat

Tier 3 Mitigation Actions for the Hawaiian Goose

Mitigation actions for the Hawaiian goose would include continuing to fund predator control and fence maintenance at either the Pi'iholo Ranch pen or at the Haleakalā Ranch pen on Maui. As an adaptive management provision, if annual review of the results of ongoing mitigation indicates take offset is not accruing in advance of take, then the wildlife agencies may require additional predator control measures at established sites or implement predator control measures at additional popular nesting and foraging sites on Maui. Funding would be provided to employ personnel and/or provide equipment to implement predator control measures, monitor efforts, and provide status reports to the Service and DOFAW. Proposed predator removal measures may consist of deploying traps, leg holds and/or snares, or cattle egret control.

Proposed Success Metrics/Specific Adaptive Management:

- 1) Results of each year's efforts will be reviewed by the Service and DOFAW.
- 2) Based on the annual review, the agencies would provide suggested changes to the scope of work (if warranted). These could include increasing trap effort, changing trap types, finding a new area to attempt to manage and protect or build an addition to the Pi'iholo Ranch pen or the Haleakalā Ranch pen.
- 3) If after two years of effort at the Pi'iholo Ranch pen or the Haleakalā Ranch pen less than an annual average of three fledglings are produced, this site may be abandoned or an additional pen created at Pi'iholo Ranch, Haleakalā Ranch, or predator control planned at nesting sites such as those historically near Olowalu and Lahainaluna on Maui.
- 4) Funding would be provided for whatever scope of work is effective until all Hawaiian goose mitigation is complete for Tier 3.

Tier 3 and 4 Mitigation Actions for the Hawaiian Hoary Bat

Tier 3 mitigation for the Hawaiian hoary bat would consist of targeted research to reduce uncertainty in mitigation effectiveness and improve the ability to develop quantifiable mitigation

practices for the Hawaiian hoary bat. In order to avoid further delays, Kaheawa began voluntarily working with Service and DOFAW, in 2015, to develop a mitigation plan for research to better understand bat movements, roosting behavior and diet. Although research is an uncommon form of compensatory mitigation under section 10 of the ESA, the Service identified that research which informed on-the-ground management actions and life history parameters necessary to recover Hawaiian hoary bats was one of the highest priorities for the species and an appropriate form of compensatory mitigation. Refer to the KWP II HCP amendment (SWCA 2018b) for a detailed scope of work and research plan being conducted by the USGS and Pacific Island Ecosystems Research Center (PIERC). Although this plan has not been formally approved by the Service and DOFAW, Kaheawa Wind has contracted with and begun funding the USGS/PIERC research in FY 2018. If the research project is not proceeding as intended, according to quarterly and annual reviews, the principal investigator and the Service and DOFAW would determine what steps would be required to accomplish the goals as expected. Additional costs may be required and would be expected to be paid by Kaheawa Wind to fulfill the stated goals.

Tier 4 mitigation for the Hawaiian hoary bat would consist of purchasing land on Maui that is not already in conservation, Hawaiian hoary bats are known to be present, and the land parcel is in danger of being developed or compromised. The approximate acreage per bat would be 60-80 ac or 480-640 ac total for eight bats. The specific parcel would be determined when funding and planning for Tier 4 take is triggered. Tier 4 take would be triggered when the estimated take at the 80% credibility level for Tier 3 reaches 75% of its current limit. Prior to any planned land purchase, bat detectors would be deployed to ensure that bats are present on or near the parcel. At least 10 bat detectors would be deployed throughout the parcel for at least three months. Hawaiian hoary bats would need to occur on at least three detectors during the assessment period for the proposed parcel to be viable for purchase. Alternatively, mitigation for Tier 4 may occur through an approved federal and state Hawaiian hoary bat in lieu fee program, should one be available.

2.2.4 ALTERNATIVE 2D – PAKINI NUI WIND FARM

Under Alternative 2D, the Service would issue a new ITP to Pakini Nui Wind authorizing the following amounts of incidental take: up to 26 Hawaiian hoary bats; up to three Hawaiian petrels; and up to three Hawaiian goose, in the form of harm or lethal injury, over a 10-year permit term. The configuration of the energy facility would remain unchanged.

Species Protection Measures for the Hawaiian Hoary Bat, Hawaiian goose, and Hawaiian Petrel

- Implement LWSC that would consist of operating all turbines at an individually automated 10-minute average cut-out speed of 5.0 m/s and a 10-minute average cut-in speed of 5.5 m/s between the hours of 6:00/6:30 p.m. and 6:30/7:00 a.m. The turbines would be curtailed on an individual basis as determined by on-board turbine anemometry. When offline, blades would be feathered. Rotational speeds when feathered are less than can be measured with the installed equipment (< 0.1 revolutions per minute). Refer to **Appendix D** for more information on how LWSC is used as a species protection measure.

- Only emergency work would be scheduled during nighttime hours to avoid the use of nighttime lighting.
- Shielded fixtures would be used for all lighting during the infrequent occasions when workers are in the project area at night. Outdoor lighting would be fully shielded. Outdoor lights would be restricted to what are needed for safety reasons and would only be used in emergency situations. Otherwise, no nighttime activities would occur on-site.
- A speed limit of 25 mph while driving within the project area would be enforced. This would help minimize collisions with protected species in the event they are using habitat in the project area. If Hawaiian goose are observed at or near the project area, a speed limit of 15 mph would be observed.
- The use of a top strand of barbed wire around the project area would be avoided to reduce or eliminate the possibility of entangling Hawaiian hoary bats.
- Purposely approaching and maintaining a distance (by foot or vehicle) of 100 ft from any Hawaiian goose present in the project area, would be enforced. This measure would minimize erratic flight behavior that may increase collision risk.
- Open water areas that may attract the Hawaiian goose would not be created.
- Should the wind facility be decommissioned during the life of the ITP, these minimization measures would also apply to the decommissioning period.

Pakini Nui Wind Post-construction Monitoring for Downed Wildlife

Pakini Nui Wind would conduct monitoring for downed wildlife in accordance with their PCMP and associated adaptive management provisions (SWCA 2018a) in coordination with the Service and DOFAW. The Pakini Nui Wind PCMP would be conducted to monitor direct take of wildlife species to ensure compliance with the ITP and HCP (SWCA 2018a) if approved. The Pakini Nui Wind PCMP includes searches at all 14 turbines every seven days primarily with canine search teams. See **Appendix C** for an in-depth discussion of compliance monitoring inputs and requirements for each project.

Because of the strong prevailing wind that blows consistently from the east (between 70 and 90 degrees) for more than 90% of the time, it was agreed, with USFWS and DOFAW concurrence (meeting with the USFWS and DOFAW, February 20, 2014), that the search area be adjusted to increase the chances of locating a fatality if it were blown downwind, although bats could fall into the upwind direction during low wind speed conditions. The wind turbine search plot extends 197 ft upwind and 295 ft downwind from the turbine base. Turbine plots and nearby facility roads are primarily searched by a canine search team, with visual searchers conducting about 14% of searches per year. Vegetation within the turbine search plots is kept short to improve monitoring efficiency. Pakini Nui Wind also conducts SEEF and CARE trials to obtain data that are used to estimate actual take levels of federally listed species throughout the life of the project. See **Appendix C** for an in-depth description of compliance monitoring factors, density weighted search areas and rigorous requirements.

Actions to Mitigate Incidental Take of the Hawaiian Hoary Bat, Hawaiian Petrel and Hawaiian Goose

Mitigation Actions for the Hawaiian Hoary Bat

Pakini Nui Wind would partner with HVNP to restore 1,200 ac of degraded lowland mesic-wet 'ōhi'a forest within the Kahuku Unit of HVNP (see HCP for a map of the project location). The HVNP has fenced large tracts of land within the mitigation project area and removed ungulates to reduce the immediate threat to native plants. Pakini would provide \$1,463,728 to conduct 1,200 ac of forest restoration within HVNP that would be permanently protected by the National Park Service (NPS). Restoration activities would consist of controlling invasive plants, planting native trees and shrubs, and scarification around existing koa trees to regenerate the existing koa seed bank. The restoration mitigation project area, which is adjacent to the Ka'ū Forest Reserve, provides habitat for a number of rare, threatened, and endangered species, including the Hawaiian hoary bat and Hawaiian goose.

Habitat restoration falls outside of the NPS mission, and there is currently no management plan for the Kahuku Unit of HVNP. Outside funding, such as these mitigation funds, is necessary to implement restoration to improve the habitat for rare species. The mitigation work proposed in this HCP and funded by Pakini Nui would not be completed with government funds if private funds were not provided (Rhonda Loh, pers. comm 2017). HVNP provides habitat for several ESA-listed species. Restoration actions to address all these species in HVNP would require considerable funds in addition to HVNP's operating funds. This forest restoration mitigation project provides an opportunity for this mitigation program to contribute to the conservation of multiple species in an area with long-term preservation guarantees that would not otherwise be restored.

The forest restoration mitigation project objectives would include the following:

- Prevent establishment of target weed species to promote natural recovery and an increase in native biodiversity.
- Plant 90,000 nursery-reared seedlings to facilitate forest recovery in 1,200 ac of degraded former pasture in the Kahuku Unit according to defined methods and implementation schedule.
- Evaluate vegetation community changes within the forest restoration mitigation project area.
- Evaluate bat activity and arthropod diversity within the forest restoration mitigation project area.

Methods to achieve the above objectives include the following:

- Works crews would conduct ground searches to locate target weed species. Global positioning system data would be collected for areas searched and the number of plants treated. Targeted species for removal would include blackberry, strawberry guava, kāhili ginger, and Christmas berry. Control methods would follow established HVNP prescribed treatments
- Plant 90,000 nursery-reared seedlings and remove grasses surrounding select existing koa trees using herbicide or mechanical scarification. Seeds of native tree and shrub species would be collected within the local area and processed for propagation at the HVNP native

plant facility. The native plant facility would be kept free of pest species; individuals would be rigorously monitored and sanitized before planting to avoid contamination of target locations. Prior to planting and seed broadcasting, alien grasses would be temporarily suppressed by applying a 2% solution of imazapyr and glyphosate. In addition, grasses around select existing koa trees would be removed either with herbicide or mechanical scarification to regenerate koa from the seed bank.

- Planting and scarification would be strategically placed to link existing forest fragments or build biodiversity around existing solitary trees.
- To monitor forest restoration mitigation project success, vegetation monitoring plots would be established both within and outside of the forest restoration mitigation project area to evaluate impacts of management actions on the vegetation community composition and structure. Pre-planting/scarification plots (baseline) would be established and reevaluated at year 10 of the permit. Results of the monitoring would be compared to the baseline to determine if native biodiversity and the canopy cover have changed significantly.

Forest restoration success would be achieved when the following tasks are completed:

- 1,200 ac are swept for control of target weed species according to established HVNP-prescribed treatments to promote natural native plant establishment.
- 90,000 native tree and shrub seedlings are planted, areas around existing koa trees are scarified, and at least 60% of produced seedlings survive for one year.
- Vegetation monitoring plots are established within each of the restoration sections to evaluate impacts of management actions on the vegetation community composition and structure, seedling survival is monitored one year post-planting, and native species richness and canopy cover/species are re-surveyed.
- Monitoring results indicate the following when compared with the baseline:
 - 60% seedling survival one year following planting/scarification
 - Native species richness significantly increases over time
 - The canopy comprises entirely native tree species
 - An increase of bat activity and invertebrate diversity
- Status and results of the restoration and monitoring efforts (including expenses) are provided in annual reports to DOFAW and the Service.

Adaptive management actions would be taken if the Service, after reviewing the submittal of the forest restoration mitigation project year four report, determined that success criteria would not be achieved. Adaptive management actions would consist of a combination of one or more of the following actions: reapplying herbicide, rebroadcasting seed, planting additional seedlings, conducting additional scarification, increasing or altering monitoring activity, or other actions necessary to achieve the success criteria.

Mitigation Actions for the Hawaiian Petrel

Pakini Nui Wind would provide funding to HVNP to conduct fence maintenance and monitoring activities encompassing over 600 ac of protected Hawaiian petrel nesting habitat. HVNP completed a barrier fence encompassing the 600 ac in 2016. Funding from Pakini Nui Wind would be used to complete annual fence inspections and respond to potentially damaging events, such as a severe storm, in a timely manner to minimize potential impacts to nesting birds. Pakini

Nui Wind would also fund monitoring activities using remote cameras within and immediately surrounding the enclosure, to monitor for predators and obtain data on Hawaiian petrel reproductive success.

Mitigation Actions for the Hawaiian Goose

Pakini Nui Wind would contract with DOFAW to construct a new 7-ac breeding pen on Hawai'i Island. The new 7-ac pen would contain two reservoirs. The predator-proof fence would be constructed during the first year of the Hawaiian goose mitigation project. The remaining funds would be used to maintain the fence and enclosure, completing tasks such as repair of fences, purchase of vegetation maintenance equipment (i.e., lawn mowers and weed trimmers), repair of the reservoir to maintain year-round water, and control of predators. The increase in the number of fledglings produced after pen construction would be determined through near-daily monitoring by DOFAW employees. Fledglings would be banded at 8–12 weeks in age, and fledging would be considered successful when a chick leaves the breeding pen on its own.

Adaptive management would be triggered if at least four fledglings (80% of mitigation amount) have not been produced from the pen by the third breeding season following pen construction. Adaptive management actions would include changes to the trapping protocol to increase the chances of nest success and/or increased monitoring to ensure documentation of fledging success.

2.3 ALTERNATIVE 3 – INCREASED CURTAILMENT (ACTION ALTERNATIVE)

This alternative was developed to analyze the most practicable minimization measure to the actions proposed in the Applicants' HCPs (Alternative 2) that would result in a reduction of take of the Hawaiian hoary bat at each of the facilities, but allow the Applicants to continue to produce a reduced level of power. Under Alternative 3, the Service would issue the ITPs authorizing a lower level of Hawaiian hoary bat take than what is requested by the Applicants in their new or amended HCPs. Under Alternative 3, wind facility operations and maintenance activities would be shut down at all Applicant wind turbines during nighttime hours from April 15 through September 15, when Hawaiian hoary bats are pregnant or observed to be rearing young and are most active. The cessation of operations during this timeframe would result in a minimization of the take of adult Hawaiian hoary bats and eliminate indirect take of juvenile bats. Low wind speed curtailment activities, described in Alternative 2 would be implemented during the remainder of the year (September 16 – April 14). Mitigation actions and corresponding monitoring activities would be reduced commensurate with reduction in take levels of the Covered Species, as described below for each Applicant.

This alternative was chosen as a uniform approach for all projects because it is the single most effective means of reducing take levels proven at this time for Hawaiian hoary bats, regardless of project-specific differences. Varying levels of LWSC and the future use of deterrents may provide a way to reduce take of the Covered Species, but it is not possible to analyze the reduction in take associated with the use of these methods based on information available today. Thus, curtailing turbine operations during nighttime hours during the bat breeding season is considered the most certain action to minimize take at each of the four projects. Implementation

of this alternative is anticipated to reduce direct Hawaiian hoary bat fatalities at each project site and wholly eliminate indirect take (mortality of dependent juveniles).

Under the increased curtailment conditions, Alternative 3 operations would result in an increase in energy production across all Applicants' projects compared to what would occur under the No Action Alternative, but less energy production compared to Alternative 2 (**Table 2-6**). None of the Alternatives analyzed would result in full time energy production for the entire year. The reduction estimates are based on the proportion of the time the turbines would be operating including minimization shutdowns versus full time operation.

It is expected that operation and maintenance activities would generally be the same as described under Alternative 1. The same type and level of activities would likely be required to operate and maintain all Applicant WTGs. **Appendix F** details the modelling methods used to determine the level of Hawaiian hoary bat take reduction for each Applicant. The following sections describe the reduced mitigation management activities for each Applicant, under Alternative 3.

Table 2-6. Estimate of energy production resulting from year-round nighttime curtailment (Alternative 1), proposed low wind speed curtailment (Alternative 2), and seasonal nighttime cut-off in combination with low wind speed curtailment (Alternative 3) proportional to full time turbine operation.

	Relative Energy Production ¹ (%)		
	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3 (Increased curtailment)
Auwahi Wind	50	80	68
Kawailoa Wind	50	80	68
KWP II	50	80	68
Pakini Nui Wind	50	80	68

¹ All estimates generated by the Service based on the assumption that the reduction in energy generation is proportional to the reduction in hours of turbine operation.

2.3.1 ALTERNATIVE 3A – AUWAHI WIND

Under Alternative 3A, the Service would issue an ITP amendment to Auwahi Winds' original ITP (TE64153A-0) to increase authorized take of up to an additional 94 Hawaiian hoary bats in the form of harm or lethal injury through the end of the 25-year permit term ending in year 2037. The increased take authorization would add two additional tiers of take, Tiers 4 and 5. Tier 4 would authorize take of an additional 60 bats and Tier 5 would authorize take of an additional 34 bats. In order to minimize incidental take that is requested currently in their HCP amendment, Auwahi Wind would shut down turbine operations at night, from April 15 through September 15. This

time-frame is when Hawaiian hoary bats are most active and are pregnant or raising juveniles. The configuration of the existing wind energy facility would remain unchanged.

Species Protection Measures for the Hawaiian Hoary Bat

Auwahi Wind would implement the following baseline minimization measures and continue these measures for the duration of the permit, unless specific adaptive management triggers are reached that would initiate an adaptive management action. These baseline minimization measures are:

- Implement LWSC for all eight turbines with a 5.0 m/s cut-in speed November through April 15, from 30 minutes before sunset to 30 minutes after sunrise; and
- Implement increased nighttime LWSC with a 6.9 m/s cut-in speed for all eight turbines, from 30 minutes before sunset to 30 minutes after sunrise, from September 15 thru October. The use of LWSC involves stopping the rotation of turbine blades during periods of low wind speeds.

To ensure that the minimization measures are effective, Auwahi Wind would implement an adaptive management strategy, as described in their HCP amendment. The effectiveness of the minimization measures in achieving reductions in bat take would be quantified using the Baseline Fatality Rate as estimated in the EoA model (Dalthorp et al. 2017) using Project post-construction mortality monitoring data. The Baseline Fatality Rate is the average annual fatality rate calculated using all prior years of post-construction mortality monitoring data in EoA. Refer to **Appendix C** for more information on the EoA model.

The adaptive management framework for the Auwahi minimization program under Alternative 3A is the same as proposed in their HCP Amendment and described in Alternative 2A, which consists of:

1. Comparison of the Baseline Fatality Rate to the Threshold Value based on monitoring data will be conducted in 2020, 2025, and 2030, to determine if adaptive management provisions are triggered. The Threshold Value is calculated as the total (originally authorized and newly requested) direct take (129 Hawaiian hoary bats) divided by the expected operational life of the project (20 years). For Auwahi Wind, the Threshold Value is 6.45 (129 direct take estimated by EoA/20 years of operation). Comparing the Baseline Fatality Rate to the Threshold Value would allow Auwahi Wind to ensure actual take remains below the permitted take.
2. Implement responsive actions in the event the Baseline Fatality Rate is below, greatly below, or above the specified Threshold Value.

Actions to Mitigate Incidental Take of the Hawaiian Hoary Bat

Tier 4 Mitigation Actions

Auwahi Wind Tier 4 mitigation actions would be conducted on 1,752 ac of mixed pasture and forested land owned by 'Ulupalakua Ranch on Maui. Mitigative actions would include reforestation and creating water sources to enhance bat foraging habitat on the ranch lands. The mitigation area includes the Waihou Area, the Duck Ponds, Cornwell, and Kaumea Loko parcels identified in the Auwahi Wind HCP (Tetra Tech 2012) as potential mitigation areas. The parcels within the Waihou Area were identified in the approved HCP for future possible mitigation tiers,

but were not used during implementation of the approved HCP. Refer to Chapter 4 for a full description of the anticipated effects of these mitigation actions described below.

Under the proposed Tier 4 mitigation, the property and existing pastures would continue to be used for seasonal grazing, but new management actions would be implemented to protect and enhance bat foraging and roosting habitat. To achieve this mitigation objective, Auwahi Wind would (1) create forested linear landscape features (i.e., hedgerows) that can be used as foraging and roosting substrate and travel corridors, and (2) provide suitable, consistent water resources for the Hawaiian hoary bat. Auwahi Wind would also implement fire management actions and provide for legal protection of the mitigation area in the form of a conservation easement.

Auwahi Wind would reforest the hedgerows within the 1,556 ac of pasture land (excluding the Waihou Area). The pasture lands would be reforested to a minimum density of approximately 20% or 311 ac of forest cover. Within the hedgerows, trees would be planted to a density of approximately 200 trees per acre or at a 15-ft spacing. The hedgerows would be at least 80 ft wide (6 trees across) to provide linear landscape features, wind breaks, and foraging substrates for the Hawaiian hoary bat. The width of hedgerows was developed in coordination with the USGS. The hedgerows would be planted with fast-growing native or endemic trees and understory species, with a preference for fast-growing native species. The selection of tree species would be subject to availability and the suitability of tree species for Hawaiian hoary bats. Koa (*Acacia koa*) is preferred as it is expected to provide available insect biomass, available night roost locations, and is fast growing. A'ali'i (*Dodonaea viscosa*) is preferred for the understory. Koa and a'ali'i are selected as preferred hedgerow species because they have been demonstrated to be associated with both an increased abundance and diversity of insect species (Peck et al. 2015, Tetra Tech 2019a). No tree species known to be a threat to native ecosystems would be used, as determined by the Hawai'i Weed Risk Assessment (Daehler et al. 2004).

The hedgerows would be fenced where necessary to prevent ungulates from damaging the out-planted trees. Auwahi Wind would install fencing to surround the reforestation areas where required, and prevent the ingress of ungulates and promote the long-term habitat suitability of the reforested areas.

Following the recommendations from BCI (Taylor and Tuttle 2007), Auwahi Wind would retrofit existing water troughs with wildlife egress structures to provide water resources for the Hawaiian hoary bat and ensure bats or wildlife that fall into the water can escape without drowning. These retrofitted troughs would have a minimum surface area of 10 ft by 2.5 ft and an approximate depth of 1 to 2 ft (Taylor and Tuttle 2007). Nearby vegetation and fencing that controls livestock access to the water features would be removed if necessary (or fence lines will be rerouted if appropriate) based on recommendations by Jackrel and Matlack (2010) and Taylor and Tuttle (2007) to ensure that bat flight paths to the water tanks are not obstructed.

Auwahi Wind would install two new larger ponds. The ponds would have an approximate minimum size of 20 ft in diameter and a volume of 50,000 gallons. The minimum size of the pond was selected based on BCI recommendations for ponds which can be utilized by most bat species, and a greater surface area would be utilized where possible. The exact size and shape of the ponds would depend on the site conditions. The pond design would incorporate varying water depth to

facilitate insect species associated with shallows that serve as prey for bats. The two 50,000 gallon ponds described above, sited adjacent to the Kula Forest reserve, would also be designed to facilitate the aerial firefighting efforts essential for wildland fire prevention and serve as dip tanks. The addition of these larger ponds would allow for helicopters to fight fires to protect not only the Mitigation Area, but also adjacent lands including the Kula State Forest Reserve, Waihou Area, and the Kanaio NAR.

To provide for permanent protection of the Tier 4 mitigation area, Auwahi Wind would fund a conservation easement that would be overseen by the HILT. This easement would not supersede the existing agricultural easement but would impose additional servitudes which are necessary and appropriate for carrying out the bat-focused conservation measures, described above. As the easement grantee, HILT would ensure compliance with the covenants, terms, conditions and restrictions contained in the easement. Where the conservation easement differs from the agricultural easement the more restrictive easement would apply.

The additional protections or restrictions which would be imposed on the 1,752-ac mitigation area through the conservation easement include:

- Prohibiting removal of trees over 15 ft tall during the bat pupping season (April 1 through September 15);
- Protection of the hedgerows from removal;
- Maintaining ponds and troughs according to this mitigation plan;
- Prohibitions on the use of insecticides;
- Prohibiting artificial stocking of ponds with fish known to reduce insect populations; and
- Prohibiting the use of barbed wire when installing fencing or other such structures.

The parcel management provided by HILT includes:

- Holding rights surrendered by the landowner;
- Protection and preservation of the property set forth in the easement;
- Enforcement of the restrictions put forth in the easement; and
- Access to the lands in the easement for annual or more frequent monitoring for compliance with easement conditions.

In order to verify the success of mitigation actions, Auwahi Wind would systematically monitor Hawaiian hoary bat activity levels or appropriate surrogates within the mitigation area, to include the following activities:

- Acoustic monitoring to detect presence or absence and the number of feeding buzzes to indicate Hawaiian hoary bat foraging occurring;
- Baseline acoustic monitoring outside of the mitigation area to serve as a reference;
- Thermal videography to document Hawaiian hoary bat behavior at all water features (troughs and ponds);
- Quarterly baseline insect monitoring, followed by semiannual (twice yearly) insect monitoring conducted in years 1, 2, 3, 5, 7, 9, and 11. Monitoring would consist of one malaise trap set-up for one month at three different locations. Following the sampling, the

insects would be identified to order and the abundance of each order will be reported in the annual report.

- All data would be analyzed after years 0, 1, 2, 3, 5, 7, 9, and 11. Data analysis would compare the covariates of trough, ponds, and hedgerows to determine the impacts of each management action and the overall Hawaiian hoary bat abundance and detectability at the site. The results of this analysis would be summarized in the annual report following the completion of each year.

The primary monitoring success criteria is to discern an increase in bat activity at the site. Secondary goals include determining the impacts of management actions and verification that management actions are consistent with the management program. Based on the analysis of the monitoring data, adaptive management may be implemented to include but not be limited to, changing the forest species composition in reforested areas or replacing trees that have not survived, adding additional water troughs, ponds, and/or hedgerows, and reforestation at higher densities within the Waihou parcel.

Tier 5 Mitigation Actions

Mitigation for Tier 5 for 34 bats, would focus on restoration and management of 690 ac in the Von Tempsky Parcel of the Kamehamehame Forest in east Maui to improve bat foraging and roosting habitat. If, at the time of planning, that parcel is not available or suitable another area will be selected based on the selection criteria and considerations provided in **Appendix B**. Prior to triggering Tier 5, Auwahi Wind will coordinate with DOFAW and the Service to establish two acoustic monitoring locations to document parcel-specific Hawaiian hoary bat baseline activity prior to implementing mitigation actions. Upon triggering of the planning stage of a future tier, Auwahi will work with DOFAW and the Service to develop a site-specific mitigation implementation plan based on best science at the time. Actions proposed consist of the out-planting of native tree species to build the vertical vegetative structure and canopy cover necessary for bat roosting. Heterogeneous vegetative structure is expected to provide shelter for insect species that are the prey for Hawaiian hoary bats, and the preferred “edge habitat” for Hawaiian hoary bat foraging (Jantzen 2012, H.T. Harvey 2019). Another anticipated action is the creation of water features, which are likely to increase bat usage of the site. In addition, Auwahi Wind anticipates removing invasive plant and animal species, which negatively impact bat roosting and foraging habitat. Auwahi will coordinate with DOFAW once the State’s comprehensive multi-use management plan is developed and approved to ensure the plan proposed by Auwahi Wind is compatible with DOFAW’s plan (BLNR 2019). In collaboration with DOFAW, Auwahi Wind may implement a portion of the DOFAW comprehensive plan upon approval by the Service.

In order to verify the success of mitigation actions, Auwahi Wind will systematically monitor Hawaiian hoary bat activity levels beginning approximately three months after management actions have started. Acoustic monitoring will be designed to provide coverage of at least one or more detectors every 85 ac which is 3-7 times higher density than similar studies (Gorresen et al. 2015, Todd et al. 2016). Insect sampling will occur for one month with a malaise trap two times per year. All data will be statistically analyzed using best science methods and reported in the annual report. Additional monitoring using best science at the time will be detailed in the Auwahi Wind site-specific management implementation plan to ensure interim success criteria are met. In addition to monitoring for changes in bat activity which will inform ongoing and

future actions, Auwahi Wind will include success criteria for the restoration and land improvement actions that are specific, measurable, achievable, relevant, and are time-line associated in the site-specific management implementation plan approved by the Service and DOFAW. These criteria will provide interim measures of success to ensure mitigation is on track and timely.

Based on the analysis of the monitoring data, adaptive management may be implemented to include, but not be limited to, increasing the intensity or extent of the management activities such as increasing planting density; increasing the diversity of management actions such as adding additional canopy or understory species; or altering the management actions implemented, such as moving from reforestation to other limiting factors of the bats identified by the best science at the time.

2.3.2 ALTERNATIVE 3B – KAWAILOA WIND POWER

Under Alternative 3B, the Service would issue an amendment to Kawailoa Wind's original ITP (TE59861A-0) to authorize take up to 123 Hawaiian hoary bats, and 19 adult and 5 nestling Hawaiian petrels through the permit term ending in year 2032. The amendment would result in two additional tiers of take, Tier 4 and Tier 5. In order to minimize incidental take that is requested currently in their HCP amendment, Kawailoa Wind would shut down turbine operations at night, from April 15 through September 15. This timeframe is when Hawaiian hoary bats are most active and are pregnant or raising juveniles. The configuration of the existing wind energy facility would remain unchanged.

Species Protection Measures for the Hawaiian Hoary Bat and Hawaiian Petrel

Kawailoa Wind would implement the following baseline minimization measures to minimize the risk of take of the Hawaiian hoary bat:

1. Extend LWSC with a cut-in speed of 5.0 m/s at all turbines from sunset to sunrise between September 15 and April 15.
2. Increase LWSC cut-in speed to 5.2 m/s through a 0.2 m/s hysteresis to increase the "down time" of the wind turbines, and reduce the number of stop/start events per night by extending the rolling average time from 10 to 20 minutes. Hysteresis is a LWSC regime that offsets the "cut-out" and "cut-in" speeds such that it will take a higher average wind speed (raised cut-in speed) for the turbines to return to operation after stopping due to LWSC. LWSC at Kawailoa results in turbines being removed from service with feathering, resulting in a rotor speed of 1 revolution per minute or less. All Project turbines individually monitor wind speed using turbine-mounted anemometers, and are programmed to shut off when wind speeds are 5.0 m/s or lower and to start up again when wind speeds reach 5.2 m/s, thereby increasing the cut-in speed and extending the period during which collision risk for bats is minimized.
3. Conduct an ultrasonic acoustic bat deterrent "proof of concept" test, in collaboration with NRG Systems. NRG Systems installed an ultrasonic acoustic bat deterrent system at turbine 30, where the most bat fatalities (16%) have been detected as of December 31, 2017, to evaluate the effectiveness of the deterrent specific to Hawaiian hoary bats. The deterrent was deployed in July 2018. Effectiveness at reducing bat activity levels would be evaluated using thermal imaging over a 60-day study period to document the bat approach paths and activity

in relation to the rotor swept area at turbine 30. Data collected at the Project would supplement the results of NRG Systems' ongoing testing at wind farms on the Continental United States. Results of NRG Systems' testing and those of other deterrent systems would be used to inform Kawaiiloa Wind minimization measures. No bat fatalities were detected at turbine 30 since the deployment of the bat deterrent in July 2018.

4. Since the publishing of the draft PEIS in April 2019, Kawaiiloa Wind installed NRG bat deterrents in May-June, 2019 on all 30 turbines.

The take avoidance and minimization measures previously implemented for the Newell's shearwater also minimize the risk of Hawaiian petrel take. These measures are described in detail in Section 5.3 of the approved HCP (SWCA 2011b), and include: minimizing on-site lighting at buildings; implementing a WEOP to reduce vehicle collision risk; and following APLIC guidelines for overhead collection lines.

Actions to Mitigate the Impacts of Incidental Take of the Hawaiian Petrel and the Hawaiian Hoary Bat

Hawaiian Petrel Mitigation Actions

To compensate for impacts to the Hawaiian petrel, Kawaiiloa Wind would fund predator control and monitoring work at the Hanakāpī'ai and Hanakoa seabird colonies within the State's Hono O Nā Pali NAR in 2020. Hanakāpī'ai encompasses 138 ac of mid- to high-elevation terrain in northern Kaua'i (Figure 6). The Hanakoa colony encompasses 58 ac and is located in the western portion of the Hono o Nā Pali NAR (Figure 6).

Specific activities would include:

- Removing predators (rats, feral cats, feral pigs, and non-native barn owls (*Tyto alba*)) surrounding nest sites within Hanakāpī'ai and Hanakoa. Rodents would be controlled using automatic resetting traps (A-24, Goodnature, NZ). Cat trapping would consist of cage traps and Conibears. Pigs would be removed using a combination of targeted trapping and firearms. Non-native barn owls would be removed in areas of high seabird activity by targeted shooting and trapping.
- Monitoring seabird activity using cameras, song meters, and on the ground surveys. Metrics recorded would include: seabird call rates, number of burrows, reproductive success, number of fledglings, and number of depredation events.
- Monitoring predator activity using cameras, traps, and on the ground surveys.
- Responding to spikes in seabird depredation events, to include increased predator trapping across the entire NAR and at major predator ingress points into the NAR.

Tier 4 Mitigation Actions for the Hawaiian Hoary Bat

Kawaiiloa Wind Tier 4 mitigation actions would consist of contributing \$2,750,000 to the TPL for the purchase of a 2,882-acre area termed the HWA in the northern lower Ko'olau Mountains on O'ahu. The HWA encompasses four parcels located in Central O'ahu (Figure 7). Funds provided by Kawaiiloa Wind, in combination with funding commitments from six other partners including federal and state partners would provide TPL with sufficient secure funding to purchase the four HWA parcels. Following purchase of the lands by TPL, the land would be

transferred to DOFAW and managed for multiple uses, including for the benefit of the Hawaiian hoary bat. Research would be incorporated into the overall management plan for the area that would focus on identifying optimal habitat or limiting factors for the Hawaiian hoary bat. The land deed would include the requirement that HWA be managed in perpetuity for the protection of habitat and conservation of listed endangered species including the Hawaiian hoary bat, 20 species of listed plants, and other rare species as per the funding awards. For details see the Kawailoa HCP amendment (Tetra Tech 2019b).

Tier 5 Mitigation Actions for the Hawaiian Hoary Bat

Mitigation for the Hawaiian hoary bat for Tier 5 would be guided by goals identified in the Final Kawailoa Wind HCP Amendment (Tetra Tech 2019b), Hawaiian Hoary Bat Recovery Plan (Service 1998), conservation and management priorities identified by the Service and DOFAW, and any information available on the species' survival and recovery needs. Mitigation would consist of one or both of the following: land protection/preservation (i.e., easement or acquisition) or restoration/land management of a minimum of 163 ac of bat habitat. A detailed site-specific mitigation implementation plan would be developed at the time Tier 5 is triggered and the plan would be reviewed and approved by the Service and DOFAW. This approach allows Kawailoa Wind to describe the preferred mitigation based on current information, while leveraging information that will be learned from ongoing Hawaiian hoary bat research projects that address some of the existing information gaps, best available science, and current Service and DOFAW guidance.

Within six months after reaching the tier trigger, Kawailoa Wind would submit a site-specific mitigation implementation plan to Service and DOFAW for the Tier 5 mitigation, which would include the plan area, the mitigation actions, measures of success, monitoring, how the mitigation will offset take, and cost estimates. This should provide sufficient time for comment and feedback necessary for such a plan to be approved by the Service and DOFAW, given the current 2 year lead time between triggering and exceeding a current tier take limit. Funding assurances for the developed mitigation plan are required to be in place prior to triggering the next tier.

Should habitat protection or preservation be identified for Tier 5, Kawailoa Wind would continue to coordinate with TPL, Service, DOFAW, and others to identify key parcels that would benefit the Hawaiian hoary bat. Land would be protected and preserved through acquisition, easement, or other legal conservation instrument. For this mitigation option, the following selection criteria would be used to identify a suitable mitigation parcel:

- The mitigation parcel is on the island of O'ahu.
- A minimum of 20.3 ac would be used to offset one Hawaiian hoary bat (based on the median bat core use area identified from data by Bonaccorso et al. 2015).
- The mitigation parcel includes land acquisition/protection or protection plus management actions (rather than protection alone).
- The mitigation parcel faces a threat such as development or other threats that are not consistent with suitable or high value Hawaiian hoary bat habitat (e.g., level of protection, intact versus degraded habitat, etc.). Parcels that are at risk of development, deforestation, or other degradation will have a higher priority than those not at risk.

- Larger parcels are typically preferable to smaller parcels. However, the location of a smaller parcel (e.g., adjacent to another larger area that supports bats or is being restored to support bats) could make it more attractive as a mitigation site.
- The mitigation parcel would be protected in perpetuity (i.e., fee simple, conservation easement, or other arrangement agreed upon by Kawaiiloa Wind and the agencies). Proposed management practices are consistent with Hawaiian hoary bat roosting and/ or foraging habitat.
- Recent evidence of Hawaiian hoary bat activity has been identified at the mitigation parcel or neighboring parcels that would indicate bat use of the mitigation parcel, in conjunction with suitable habitat on the mitigation parcel.

Should habitat restoration or management be identified for Tier 5, Kawaiiloa Wind would fund management activities targeted at 163-acre area to mitigate for 8 bats in Tier 5. Kawaiiloa Wind would conduct habitat restoration/management actions in one of three areas, listed in order of priority:

- Option 1; Kawaiiloa Wind would fund restoration in the central Ko‘olau Watershed located in central O‘ahu within the upper portions ahupua‘a from Waiawa to Kahauiki. The area encompasses approximately 12,000 acres, from which a specific restoration area can be selected. The elevation range of the site is between 110 feet and 1,700 feet. The Hawaiian hoary bat has been documented to have low levels of acoustic activity within the management area (Starcevich et al. 2019, Bonaccorso et al. 2019). The existing closed canopy, monotypic non-native forest would be restored to a diverse native forest along riparian buffers, planting ground cover, native shrubs, or native trees to create open water ways and foraging access to riparian areas, maintain the riparian habitat, and monitor bats insects and vegetation to determine the effectiveness of the actions on achieving the success criteria. This option was only described as an alternative option in the draft PEIS. Additional details are provided here and in Appendix B to better describe the option.
- Option 2: Kawaiiloa Wind would fund management activities to be conducted by DOFAW at HWA, specifically to benefit the Hawaiian hoary bat. These activities would include fencing portions of HWA; control of feral ungulates, rodents, and invasive plant species; control of erosion through plantings and other methods; and reforestation with native and non-invasive hardwood tree species.
- Option 3: Kawaiiloa Wind would contribute funds to DOFAW for management activities to occur within the Waimea Native Forest area, including fencing; controlling invasive species such as feral ungulates, plants, and other species; and planting native trees and plants.
- Option 4: If Options 1-3 are not feasible at the time of planning, Kawaiiloa Wind would work with DOFAW and the Service to identify an alternative parcel on O‘ahu to conduct or fund bat habitat management/restoration as part of Tier 5 mitigation based on selection criteria listed in **Appendix B**. Management actions implemented at an alternative parcel would likely include activities similar to those proposed at HWA and Waimea Native Forest, such as fencing to keep out ungulates, ungulate removal, removal of invasive plants, restoration of water features, and plantings of non-invasive vegetation for roosting or promoting insect prey for the Hawaiian hoary bat. Should this option be chosen, Kawaiiloa Wind would work with DOFAW and the Service to develop a site-specific mitigation implementation plan to restore habitat for the benefit of the Hawaiian hoary bat.

2.3.3 ALTERNATIVE 3C – KAHEAWA WIND POWER II

Under this alternative, the Service would issue an amendment to KWP II's existing ITP (9TE27260A-0) to add take for an additional 15 Hawaiian hoary bats and 14 Hawaiian geese through the permit term ending in year 2032. The amendment would add one additional Tier (#3) of mitigation to the existing permit. In order to minimize incidental take that is requested currently in their HCP amendment, KWP II would shut down turbine operations at night, from April 15 through September 15. This timeframe is when Hawaiian hoary bats are most active and are pregnant or raising juveniles. The configuration of the existing wind energy facility would remain unchanged.

Species Protection Measures for the Hawaiian Hoary Bat

KWP II Wind would implement the following baseline minimization measure to minimize the risk to the Hawaiian hoary bat:

- Low wind speed curtailment currently will be implemented at night from February 15 through April 15 and September 15 through December 15 annually by raising the cut-in speed of the project's wind turbines to 5.5 m/s between sunset and sunrise. Curtailment will be extended from December 15 to February 15 if fatalities occur outside the proposed curtailment period, with approval of Service and DLNR. Curtailment may also be modified with the approval of DOFAW and Service if site-specific data demonstrate a lack of bat activity during certain periods, or if experimental trials are conducted that demonstrate that curtailment is not reducing collision risk at the project during the entire curtailment period.

Avoidance and minimization measures for the Hawaiian goose will remain unchanged and are described in detail in Section 4.3 of the approved Kaheawa Wind Power II HCP (SWCA 2011c).

Actions to Mitigate Incidental Take of the Hawaiian Goose and Hawaiian Hoary Bat

Tier 3 Mitigation Actions for the Hawaiian Goose

Mitigation actions for the Hawaiian goose would include continuing to fund predator control and fence maintenance at the Pi'iholo Ranch pen on Maui. As an adaptive management provision, if annual review of the results of ongoing mitigation indicates take offset is not accruing in advance of take, then the wildlife agencies may require additional predator control measures at established sites or implement predator control measures at additional popular nesting and foraging sites on Maui. Funding would be provided to employ personnel and/or provide equipment to implement predator control measures, monitor efforts, and provide status reports to the Service and DOFAW. Proposed predator removal measures may consist of deploying traps, leg holds and/or snares, or cattle egret control.

Proposed Success Metrics/Specific Adaptive Management:

1. Results of each year's efforts will be reviewed by the Service and DOFAW.
2. Based on the annual review, the agencies would provide suggested changes to the scope of work (if warranted). These could include increasing trap effort, changing trap types, finding a new area to attempt to manage and protect or build an addition to the Pi'iholo Ranch pen.

3. If after two years of effort at the Pi'iholo Ranch pen less than an annual average of three fledglings are produced, this site may be abandoned or an additional pen created at Pi'iholo Ranch or predator control planned at nesting sites such as those historically near Olowalu and Lahainaluna on Maui.
4. Funding would be provided for whatever scope of work is effective until all Hawaiian goose mitigation is complete for Tier 3.

Tier 3 Mitigation Actions for the Hawaiian Hoary Bat

Tier 3 mitigation for the Hawaiian hoary bat would consist of targeted research to reduce uncertainty in mitigation effectiveness and improve the ability to develop quantifiable mitigation practices for the Hawaiian hoary bat. The three-year research project, being conducted by the USGS, will help determine the Hawaiian hoary bats' average home range size, habitat use, diet composition, and mother-pup demographics at roosting sites on Hawai'i Island, at an approximate cost of \$950,000. In order to avoid further delays, KWP II began voluntarily working with Service and DOFAW, in 2015, to develop a mitigation plan for research to better understand bat movements, roosting behavior and diet. Although research is an uncommon form of compensatory mitigation under section 10 of the ESA, the Service identified that research which informed on-the-ground management actions and life history parameters necessary to recover Hawaiian hoary bats was one of the highest priorities for the species and an appropriate form of compensatory mitigation. Refer to the KWP II HCP amendment (SWCA 2018b) for a detailed scope of work and research plan being conducted by the USGS and PIERC. Although this plan has not been formally approved by the Service and DOFAW, Kaheawa Wind II has contracted with and begun funding the USGS/PIERC research in FY 2018. If the research project is not proceeding as intended, according to quarterly and annual reviews, the principal investigator and the Service and DOFAW would determine what steps would be required to accomplish the goals as expected. Additional costs may be required and would be expected to be paid by Kaheawa Wind to fulfill the stated goals.

2.3.4 ALTERNATIVE 3D – PAKINI NUI WIND

Under this alternative, the Service would issue an ITP to Pakini Nui Wind to allow take of 16 Hawaiian hoary bats, 3 Hawaiian petrels, and 3 Hawaiian geese through a permit term ending in year 2029. In order to minimize incidental take that is currently requested in their HCP, Pakini Nui Wind would shut down turbine operations at night, from April 15 through September 15. This timeframe is when Hawaiian hoary bats are most active and are pregnant or raising juveniles. The configuration of the existing wind energy facility would remain unchanged.

Species Protection Measures for the Hawaiian Hoary Bat and Hawaiian Petrel

- Between September 15 and April 15, Pakini Nui Wind would implement LWSC that would consist of operating all turbines at an individually automated 10-minute average cut-out speed of 5.0 m/s and a 10-minute average cut-in speed of 5.5 m/s between the hours of 6:00/6:30 p.m. and 6:30/7:00 a.m. The turbines would be curtailed on an individual basis as determined by on-board turbine anemometry. When offline, blades would be feathered. Rotational speeds when feathered are less than can be measured with the installed equipment

(< 0.1 revolutions per minute). Refer to **Appendix D** for more information on how LWSC is used as a species protection measure.

- Only emergency work would be scheduled during nighttime hours to avoid the use of nighttime lighting.
- Shielded fixtures would be used for all lighting during the infrequent occasions when workers are in the project area at night. Outdoor lighting would be fully shielded. Outdoor lighting would be restricted to what is needed for safety reasons and would only be used in emergency situations. Otherwise, no nighttime activities would occur on-site.
- A speed limit of 25 mph while driving within the project area would be enforced. This would help minimize collisions with protected species in the event they are using habitat in the project area. If Hawaiian goose are observed at or near the project area, a speed limit of 15 mph would be observed.
- The use of a top strand of barbed wire around the project area would be avoided to reduce or eliminate the possibility of entangling Hawaiian hoary bats.
- Purposely approaching and maintaining a distance (by foot or vehicle) of 100 ft from any Hawaiian goose present in the project area, would be enforced. This measure would minimize erratic flight behavior that may increase collision risk.
- Open water areas that may attract the Hawaiian goose would not be created.
- Should the wind facility be decommissioned during the life of the ITP, these minimization measures would also apply to the decommissioning period.

Actions to Mitigate Incidental Take of the Hawaiian Hoary Bat, Hawaiian Petrel and Hawaiian Goose

Mitigation Actions for the Hawaiian Hoary Bat

Pakini Nui Wind would partner with HVNP to restore 738 ac of degraded lowland mesic-wet 'ōhi'a forest within the Kahuku Unit of HVNP that would be permanently protected by the NPS. The HVNP has fenced large tracts of land within the mitigation project area and removed ungulates to reduce the immediate threat to native plants. Restoration activities would consist of controlling invasive plants, planting native trees and shrubs, and scarification around existing koa trees to regenerate the existing koa seed bank. The restoration mitigation project area, which is adjacent to the Ka'ū Forest Reserve, provides habitat for a number of rare, threatened, and endangered species, including the Hawaiian hoary bat and Hawaiian goose.

The forest restoration mitigation project objectives would include the following:

- Prevent establishment of target weed species to promote natural recovery and an increase in native biodiversity.
- Plant at least 50,000 nursery-reared seedlings to facilitate forest recovery in 738 ac of degraded former pasture in the Kahuku Unit according to defined methods and implementation schedule.
- Evaluate vegetation community changes within the forest restoration mitigation project area.
- Evaluate bat activity and arthropod diversity within the forest restoration mitigation project area.

Methods to achieve the above objectives include the following:

- Work crews would conduct ground searches to locate target weed species. Global positioning system data would be collected for areas searched and the number of plants treated. Targeted species for removal would include blackberry, strawberry guava, kāhili ginger, and Christmas berry. Control methods would follow established HVNP-prescribed treatments for each species.
- Plant at least 50,000 nursery-reared seedlings and remove grasses surrounding select existing koa trees using herbicide or mechanical scarification. Seeds of native tree and shrub species would be collected within the local area and processed for propagation at the HVNP native plant facility. The native plant facility would be kept free of pest species; individuals would be rigorously monitored and sanitized before planting to avoid contamination of target locations. Prior to planting and seed broadcasting, alien grasses would be temporarily suppressed by applying a 2% solution of imazapyr and glyphosate. In addition, grasses around select existing koa trees would be removed either with herbicide or mechanical scarification to regenerate koa from the seed bank.
- Planting and scarification would be strategically placed to link existing forest fragments or build biodiversity around existing solitary trees.
- To monitor forest restoration mitigation project success, vegetation monitoring plots would be established both within and outside of the forest restoration mitigation project area to evaluate impacts of management actions on the vegetation community composition and structure. Pre-planting/scarification plots (baseline) would be established and reevaluated at year 10 of the permit. Results of the monitoring would be compared to the baseline to determine if native biodiversity and the canopy cover have changed significantly.

Forest restoration success would be achieved when the following tasks are completed:

- 738 ac are swept for control of target weed species according to established HVNP-prescribed treatments to promote natural native plant establishment.
- 50,000 native tree and shrub seedlings are planted, areas around existing koa trees are scarified, and at least 60% of produced seedlings survive for one year.
- Vegetation monitoring plots are established within each of the restoration sections to evaluate impacts of management actions on the vegetation community composition and structure, seedling survival is monitored 1 year post-planting, and native species richness and canopy cover/species are re-surveyed.
- Monitoring results indicate the following when compared with the baseline:
 - 60% seedling survival 1 year following planting/scarification
 - Native species richness significantly increases over time
 - The canopy comprises entirely native tree species
 - An increase of bat activity and invertebrate diversity
- Status and results of the restoration and monitoring efforts (including expenses) are provided in annual reports to DOFAW and the Service.

Adaptive management actions would be taken if the Service, after reviewing the submittal of the forest restoration mitigation project year 4 report, determined that success criteria would not be achieved. Adaptive management actions would consist of a combination of one or more of the

following actions: reapplying herbicide, rebroadcasting seed, planting additional seedlings, conducting additional scarification, increasing or altering monitoring activity, or other actions necessary to achieve the success criteria.

Mitigation Actions for the Hawaiian Petrel

Pakini Nui Wind would provide funding to HVNP to conduct fence maintenance and monitoring activities encompassing over 600 ac of protected Hawaiian petrel nesting habitat. HVNP completed a barrier fence encompassing the 600 ac in 2016. Funding from Pakini Nui Wind would be used to complete annual fence inspections and respond to potentially damaging events, such as a severe storm, in a timely manner to minimize potential impacts to nesting birds. Pakini Nui Wind would also fund monitoring activities using remote cameras within and immediately surrounding the enclosure, to monitor for predators and obtain data on Hawaiian petrel reproductive success.

Mitigation Actions for the Hawaiian Goose

Pakini Nui Wind would provide funding to DOFAW to construct a new 1.25-ac breeding pen on Hawai'i Island. The predator-proof fence would be constructed during the first year of the Hawaiian goose mitigation project. The remaining funds would be used to maintain the fence and enclosure, completing tasks such as repair of fences, purchase of vegetation maintenance equipment (i.e., lawn mowers and weed trimmers), repair of the reservoir to maintain year-round water, and control of predators. The increase in the number of fledglings produced after pen construction would be determined through near-daily monitoring by DOFAW employees. Fledglings would be banded at 8–12 weeks in age, and fledging would be considered successful when a chick leaves the breeding pen on its own.

Adaptive management would be triggered if at least four fledglings (80% of mitigation amount) have not been produced from the pen by the third breeding season following pen construction. Adaptive management actions would include changes to the trapping protocol to increase the chances of nest success and/or increased monitoring to ensure documentation of fledging success.

2.4 COMMON ELEMENTS OF ALTERNATIVES 2 AND 3

Before describing the details of the Proposed Action, the following subsections provide an overview of features common among the action alternatives: changed and unforeseen circumstances; adaptive management; and tiers of take.

2.4.1 CHANGED AND UNFORESEEN CIRCUMSTANCES

Regulations for implementing Section 10 of the ESA require that an HCP specify the procedures to be used for dealing with changed and unforeseen circumstances that may arise during the implementation of an HCP (50 CFR 17.22(b)(iii)(B); 50 CFR 17.22(b)(5)). Changed circumstances are those changes affecting a species or geographic area covered by the HCP that can reasonably be anticipated and planned for by the applicant and the Service at the time of the HCP's preparation (50 CFR 17.3). Examples of changed circumstances include the listing of a new species, or a fire or other natural catastrophic event in areas prone to such events. This regulation requires that potential changed circumstances be identified in the four wind energy

HCPs along with remedial measures that would be conducted by the Applicants to address these changes.

In discussions with the Service, each of the four Applicants identified several reasonably foreseeable circumstances affecting one or all covered species or the Plan/Project Area during the Permit Term. These general foreseeable conditions that could result in changed circumstances are identified below.

- Effective bat deterrent devices become commercially available. Considerable progress has been made over the years in developing new technology to discourage or deter bats from entering the rotor swept area of turbine blades.
- New scientific information demonstrates a need for a new mitigation activity (e.g., selecting mitigation sites in areas with reduced nighttime lighting; removing certain invasive species that directly threaten bat reproductive success) that would address life history requirements for the bat in a manner not previously identified.
- Listing of species that are currently unlisted but occur within the Plan Area.
- A change in the listing status (including delisting) of a covered species through a formal status review by the Service.
- Introduction or invasion by an exotic plant or animal species that affect covered species or their habitat.

The potential for each of these circumstances is reasonably foreseeable. In some cases, additional detailed changed circumstances have been identified in the previously approved HCPs for the Auwahi Wind, Kawailoa Wind, and KWP II HCPs that remain in effect. The Applicants' strategy for addressing each of these changed circumstances is through the Adaptive Management provisions of each respective HCP as described in the project specific sections below.

If additional conservation and mitigation measures are deemed necessary to respond to changed circumstances, and such measures were not provided for in the HCP, in accordance with applicable regulations, the Service will not require any additional measures beyond those provided for in the HCP, provided the HCP is being properly implemented (50 CFR 17.22(b)(5)(ii), 17.32(b)(5)(ii); 50 CFR 222.307(g)(2)).

All changes not described above as "changed circumstances" that would result in a substantial and adverse change in the status of a covered species are considered unforeseen circumstances. In the case of an unforeseen event, the Applicant would immediately notify the Service. The Service would determine if an unforeseen circumstance has occurred. In determining whether such an event constitutes an unforeseen circumstance, the Service shall consider, but not be limited to, the following factors: the size of the current range of the affected species; percentage of range adversely affected by the HCP; percentage of range conserved by the HCP; ecological significance of that portion of the range affected by the HCP; level of knowledge about the affected species and the degree of specificity of the species' conservation program under the HCP; and whether failure to adopt additional conservation measures would appreciably reduce the likelihood of survival and recovery of the affected species in the wild.

If the Service determines that additional conservation and mitigation measures are necessary to respond to unforeseen circumstances, and the HCP is being properly implemented, the additional measures required would be, to the maximum extent practicable, as close as possible to the terms of the Applicant's HCP, and must be limited to modifications within any conserved habitat area or to adjustments within lands or waters that are already set-aside in the HCP's operating conservation program. Additional conservation and mitigation measures shall not involve the commitment of additional land or financial compensation, or restrictions on the use of land or other natural resources otherwise available for development, without the consent of the permit holder.

2.4.2 ADAPTIVE MANAGEMENT

Adaptive management is a strategy for addressing uncertainty, including changed circumstances, associated with an HCP's conservation program, particularly where it poses a significant risk to the covered species. This includes, but is not limited to, uncertainty related to the covered species status or trend; uncertainty related to the effects of a proposed covered activity on a proposed covered species; and uncertainty related to the effectiveness of an applicant's proposed minimization and mitigation measures. Through assumption-based learning and robust monitoring, adjustments can be made to the HCP's conservation program in response to what is learned. Adaptive management is essential for HCPs that were developed despite information and data gaps that pose a significant risk to a species at the time the permit is issued.

The Applicants' Adaptive Management programs for each of the four wind energy projects are described in detail within each Applicant's HCP. Due to the limited amount of biological information available on the Hawaiian hoary bat, the Applicants' adaptive management programs predominantly focus on the Hawaiian hoary bat. Refer to **Appendix G** for the status and best available scientific information on the Hawaiian hoary bat. The Applicants' adaptive management programs address the following types of uncertainty related to the Hawaiian hoary bat: uncertainty in amount of take; uncertainty in mitigation effectiveness; and uncertainty in minimization effectiveness.

2.4.3 TAKE TIERING

Tier take requests have been used to address the considerable uncertainty in estimating expected levels of Hawaiian hoary bat take. Tiers were built to capture this uncertainty, and have been used in Hawai'i for Nene (Hawaiian goose), Newell's shearwater, and Hawaiian petrel in addition to the Hawaiian hoary bat. Even as the level of uncertainty decreases based on new monitoring data and other information, applicants are still requesting tiered take to help plan for the highest estimated take levels without requiring further HCP amendments, or committing to more mitigation than may be required if take is lower. Thus, the value of using the tier system also includes phasing in the mitigation requirements, as a project's take cumulatively increases. Take tiering, along with adequate adaptive management measures, allows an applicant to effectively plan for mitigation projects when it is apparent that the next tier will be triggered. Under the ITP, the take authorization for the next tier is not in place until funding assurances for the next tier have been provided. Wind energy applicants with specific tiers of take for the Hawaiian hoary bat are identified below and each tier of take is tied to specific mitigation requirements.

2.5 COMPARISON OF ALTERNATIVES

This section compares the above alternatives with regards to the issues identified in Section 1.5 and intended achievement of project objectives (purpose and need Sections 1.1 and 1.2).

Table 2-7 compares the estimated annual take of Hawaiian hoary bats for each Alternative, including the No Action. Annual take of Hawaiian hoary bats may fluctuate between years due to hoary bat behavior and climate or facility site variability. Estimated annual take under the No Action Alternatives is based on each Project ceasing operations from dusk until dawn and thus, avoiding all future take of Hawaiian hoary bats attributable to turbine collision.

Table 2-7. Annual rate of take for the Hawaiian hoary bat, under the No action and action alternatives. Rate under the No Action Alternative assumes no nighttime operation.

	Annual Take Under the No Action and Action Alternatives		
	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3 (Increased curtailment)
Auwahi	0	6.45	4.42
Kawailoa	0	11.00 ¹	6.15 ²
KWP II	0	1.95	1.14
Pakini Nui	0	3.25	2.0

¹ The rate presented in the Draft PEIS was 13.65. The rate of 11.00 is based on Kawailoa Winds installation of bat deterrents on all 30 turbines in May-June 2019 and a take reduction of 25%.

² The rate presented in the Draft PEIS was 6.38. The rate of 6.15 is based on Kawailoa Winds installation of bat deterrents on all 30 turbines in May-June 2019 and a take reduction of 25% in addition to complete nighttime curtailment from April 15-September 15.

Table 2-8 includes a comparison of the total Covered Species anticipated take of the Action Alternatives compared to the No Action Alternative. Under the No Action Alternatives, all Applicants except for Pakini Nui would still be authorized to continue take of the Covered Species in accordance with their originally issued ITPs. These originally authorized amounts are listed under Alternative 1 – No Action.

Table 2-8. Total anticipated take of Hawaiian hoary bat, Hawaiian goose, and Hawaiian petrel under the No Action and Action Alternatives. Shaded numbers indicate take that was previously authorized under existing permits. Amounts shown in the Action alternatives include the amount previously authorized under the No Action Alternative.

	Authorized Take Under the No Action and Action Alternatives ¹		
	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3 (Increased curtailment)
Hawaiian hoary bat			
Auwahi	21	140	93
Kawailoa	60	220 ²	123 ³
KWP II	11	38	26
Pakini Nui	0	26	16
Hawaiian goose			
Auwahi	5	No change	No change
Kawailoa	0	No change	No change
KWP II	30	44	44
Pakini Nui	0	3	3
Hawaiian petrel			
Auwahi	87	No change	No change
Kawailoa	0	24	24
KWP II	43	No change	No change
Pakini Nui	0	3	3

¹Zeros in the table indicate take was neither proposed nor authorized for that species or Applicant. “No change” indicates the existing authorized take would remain in effect.

²The PEIS reported 265. Kawailoa Wind installed bat deterrents on all 30 turbines during the public comment period for the PEIS. As a result the Applicant has reduced their take request from 265 to 220 in response to a 25% reduction in take based on a conservative expected efficiency of the deterrents.

³The PEIS reported a projection of 164. Kawailoa Wind installed bat deterrents on all 30 turbines during the public comment period for the PEIS. The requested total take and take projections have been reduced by 25% in response to a conservative expected efficiency of the deterrents.

2.6 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

During the development of this PEIS, the Service considered several other alternatives in addition to the alternatives described above. These other alternatives are described in this section, along with a brief discussion of why they are not being carried forward for detailed analysis. In general, these alternatives were not selected for detailed analysis because they do not meet the Service’ purpose and need or they are beyond the scope of the PEIS.

2.6.1 REDUCED PERMIT TERM

Under an alternative with a reduced permit term, the Service would eliminate the use of tiers and shorten the permit term for all Applicants to 5-10 years. This alternative was proposed during the scoping process.

This alternative may eliminate uncertainty for take projections in later years, especially for the Hawaiian hoary bat. However, because all Applicants maintain existing power purchase agreements with the local utility company that extends to a defined time period, it is not appropriate for the Service to consider a permit term shorter than the project term. A reduced permit term would arbitrarily reduce the amount of take with no expectation that take would cease at the end of the shortened permit term. The inherent uncertainty in take projections related to wind energy facilities are best addressed through take monitoring protocols and statistical methods to estimate take (**Appendix C**). Therefore, this alternative is not being carried forward for additional evaluation.

2.6.2 DELAYED PERMIT ISSUANCE

Under a delayed permit issuance alternative, the Applicants would not be issued a permit authorizing take of the Hawaiian hoary bat until additional research studies on the Hawaiian hoary bat are completed, with the expectation that additional Hawaiian hoary bat research would lead to greater and more effective mitigation measures. This alternative was proposed during the scoping process.

This alternative would delay evaluation of the four ITP/HCP applications. The Service is required to evaluate an HCP once it is determined to be complete, in accordance with ESA Section 10(a)(2)(A). It is not appropriate or within the Service's legal authority to delay evaluation of complete HCPs due to some level of uncertainty. Instead, the Service relies on the best available scientific information at the time of evaluation in order to make permit issuance decisions.

Additionally, the Service employs adaptive management provisions, as described in Section 2.2.2, to monitor and address sources of uncertainty as part of HCP implementation. Therefore, this alternative is not being carried forward for additional evaluation.

2.6.3 ADDITIONAL COVERED SPECIES

Under this alternative, the Service would issue an ITP for three additional species: the band-rumped storm petrel (*Oceanodroma castro*), Newell's shearwater, and/or the Hawaiian hawk (*Buteo solitarius*). The Permit Term and all other terms and conditions of the four proposed HCPs would remain unchanged.

The additional covered species alternative was proposed during the scoping period. **Table 2-9** provides the listing status of these three additional species. During scoping, commenters recommended the inclusion of these species in the proposed HCPs.

The Applicants decided not to include the band-rumped storm petrel and Hawaiian hawk as covered species under their HCPs and the Service decided it was not feasible to pursue an alternative with no chance of being implemented. Additionally, the range for the band-rumped storm petrel and Hawaiian hawk are not known to extend to the four Project areas at this time (**Table 2-9**). The Service has reviewed the best available scientific information and determined there is no information to indicate likelihood of take of these two species associated with any of the individual proposed HCPs. Additionally, Applicants in coordination with the Service have reviewed similar information for the Newell's shearwater and concluded a likelihood of take may occur at the Kawailoa and KWP II facilities. For this reason, Kawailoa and KWP II facilities requested and were issued take with commensurate mitigation measures for the Newell's shearwater in original 2012 permits TE59861A-0 and TE27260A-0, respectively.

In instances where species presence and use of the project area is not documented, an evaluation of the effects of the covered activities and development of a conservation program would not be meaningful. Therefore, this alternative is not being carried forward for additional evaluation. At any time, the Applicants can apply for a major amendment to the ITP to include coverage for these species and amend their HCP to include additional conservation strategies.

Table 2-9. Information on the additional species recommended during scoping for inclusion in the proposed actions, including listing status, distribution in relation to Project, and whether or not take is authorized or requested for each species.

Species	Federal Listing Status	Observed in Project Vicinity ¹	Take Previously Authorized
Band-rumped storm petrel (<i>Oceanodroma castro</i>)	Endangered (81 FR 67786)	Auwahi – No	Auwahi – No
		Kawailoa – No	Kawailoa – No
		KWP II – No	KWP II – No
		Pakini Nui – No	Pakini Nui – No
Hawaiian hawk (<i>Buteo solitarius</i>)	Threatened (40 FR 44149)	Auwahi – No	Auwahi – No
		Kawailoa – No	Kawailoa – No
		KWP II – No	KWP II – No
		Pakini Nui – No	Pakini Nui – No
Newell's shearwater (<i>Puffinus auricularis newelli</i>)	Endangered (32 FR 4001)	Auwahi – No	Auwahi – No
		Kawailoa – Yes	Kawailoa – Yes ²
		KWP II – Yes	KWP II – Yes ²
		Pakini Nui – No	Pakini Nui – No

¹ Observations at or near the wind farm project include reported accounts or knowledge of the species passing through the wind facility general area and is based on a likelihood of occurrence.

² Due to information indicating a likelihood of occurrence of the Newell's shearwater near Kawailoa and KWP II facilities, these Applicants requested and were issued take for the Newell's shearwater in their existing permits TE59861A-0 and TE27260A-0, respectively.

2.6.4 ALTERNATIVE LOW WIND SPEED CURTAILMENT REGIMES

There are an infinite number of wind speeds that could be used as triggers for low wind speed curtailment. Several individuals provided comments during the PEIS public scoping period recommending the wind facilities increase their low wind speed curtailment cut-in speeds to 8.0 meters per second or higher. While this seems like a logical alternative to evaluate, there is no scientific information that indicates a higher cut-in speed would reduce Hawaiian hoary bat mortality. In addition, without research to predict what the reduction in take would be for curtailment at levels higher than 6.9 meters per second, we do not have the information necessary predict take associated with the higher cut-in speeds. Therefore, this Alternative was eliminated from further consideration.

2.6.5 VARIATION OF THE NO ACTION ALTERNATIVE

The No Action Alternative we are evaluating in this PEIS is based on the Service not issuing the requested ITP amendments or new permits. We assume that the Applicants would adhere to State and Federal endangered species laws and cease actions that would result in unauthorized take of listed species to the best of their ability. The Applicants would also implement measures to minimize the possibility of take during their operations and adhere to the conditions of their original ITPs for species for which they have not exceeded their authorized take. However, if the Service did not issue the requested ITP or ITP Amendments, the Applicants may continue their operations, accepting the liability for any potential unpermitted take of the covered species. All four Applicants have demonstrated a strong interest in having their facilities remain in compliance with local, state, and federal laws, including the ESA. Three of the four have existing HCPs and all four voluntarily approached the Service requesting the ITPs being considered here. Therefore, this version of the No Action Alternative is not carried forward for further consideration or comparison.

2.6.6 VARIATION OF THE INCREASED CURTAILMENT OPTION

The increased curtailment option, Alternative 3, in this PEIS was developed to analyze additional avoidance and minimization that would result in a reduction of take of the Hawaiian hoary bat at each of the facilities, but allow the Applicants to continue to produce a reduced level of power. Under Alternative 3, the Service would issue the ITPs authorizing a lower level of Hawaiian hoary bat take than what is requested by the Applicants in their new or amended HCPs. Wind facility operations and maintenance activities would be shut down at all Applicant wind turbines during nighttime hours from April 15 through September 15, when Hawaiian hoary bats are pregnant or observed to be rearing young and are most active. The cessation of operations during this timeframe would result in a minimization of the take of adult Hawaiian hoary bats and eliminate indirect take of juvenile bats. We also considered a shorter period of nighttime shutdown from June 1 through September 15 (**Appendix F**). This alternative may be expected to reduce take of Hawaiian hoary bats and reduce or eliminate indirect take of dependent young. This alternative would not be expected to avoid all take or bats or pregnant females. This alternative could likely provide additional take reduction over alternative 2, but less reduction than alternative 3. The actual reduction would depend on female bat behavior during the remaining operational lifespan of the projects and if female bats were visiting turbines during that period. This alternative would result in decreased power production compared to alternative

2, but more power production than Alternative 3. Because this alternative is simply an incremental alternative between Alternative 2 and Alternative 3 and provides less potential take reduction to Hawaiian hoary bats than Alternative 3, the alternative was not carried forward.

CHAPTER 3 - AFFECTED ENVIRONMENT

This chapter describes the elements of the natural and anthropic environments within the analysis area, which is defined as the areas encompassing each of the four wind energy facilities and their proposed mitigation sites (**Figure 2-5**) that could be affected by the proposed alternatives. Each section of this chapter will describe a different element of these environments, its current condition on the landscape, and the policy and regulatory context for management of the element, if applicable. The environmental impacts of the Action Alternatives on these current conditions are analyzed in comparison to the No Action Alternative in Chapter 4 – Environmental Consequences.

CEQ and NEPA guidance provide further direction on what elements to consider in environmental impact statements. Only those elements of the environment most likely to be impacted by the proposed action are included in this chapter (40 CFR 1508.14). Elements were chosen based on the likelihood of impact and from information gathered during the scoping process (as described in Chapter 1 and summarized in Appendix A). The following elements will be described in this chapter:

- Geology and Soils
- Hydrology and Water Resources
- Natural Hazards (Flooding and Wildfire)
- Vegetation
- Wildlife and biodiversity
- Hawaiian hoary bat
- Hawaiian petrel
- Hawaiian goose
- Cultural Resources

- Public Services and Utilities
- Agriculture

3.1 DATA SOURCES

The Service's habitat and species distribution databases are the primary sources of information used to describe the current condition of each element of the affected environment. Additional databases maintained separately by other federal, state, or local sources were used as appropriate. Previously adopted plans, policies, and regulations also are sources of data for describing each element of the affected environment. Where possible, publicly available data sources are summarized and incorporated by reference. Expert knowledge and reports from DLNR DOFAW staff and partners are another source of information used to describe existing environmental conditions.

3.2 SCOPE AND SCALE OF ANALYSIS

The analysis has been broken up into discrete sub-areas or recognized geographic districts for purposes of describing different elements of the affected environment that could be impacted by the proposed alternatives. Some elements are best described at larger scales, such as at the County level, or at island or larger landscape levels. Other elements of the affected environment are described at finer scales (e.g., at the scale of an Applicant-proposed specific mitigation area or island district where the project is located) (Table 3-1). Decisions about the appropriate scope and scale of analysis were made in consideration of the types of data available and the context and intensity of potential impacts. Each wind facility is constructed and operational, so the analysis will focus in those cases only to the resources that will be impacted by the proposed actions, and not by previous actions already analyzed. In most cases, this is limited to the wildlife, listed species, and utilities at these sites.

Table 3-1. List of wind facilities and proposed mitigation site names associated with each Applicant project and its location within recognized island districts. These place names are used throughout this chapter to describe the affected environment.

Site	Applicant	Island District Level	County Level	Island Level
Auwahi Wind Facility	Auwahi Wind	Hana	Maui	Maui
Kawailoa Wind Facility	Kawailoa Wind	Waialua	Honolulu	O'ahu
Kaheawa Wind II Facility	KWP II	Wailuku	Maui	Maui
Pakini Nui Wind Facility	Pakini Nui Wind	Ka'u	Hawai'i	Hawai'i
Waihou Mitigation Area, Duck Ponds and Pu'u Makua parcels, Kamehamenui Forest	Auwahi Wind	Hana	Maui	Maui
Hanakāpī'ai / Hanakoa Mitigation sites	Kawailoa Wind	Hanalei	Kaua'i	Kaua'i
Helemano Wilderness Area, Waimea Forest	Kawailoa Wind	Waialua	Honolulu	O'ahu
Pi'iholo Ranch or Haleakalā Ranch	KWP II	Makawao or Hana	Maui	Maui
USGS/PIERC Bat Research	KWP II	South Hilo	Hawai'i	Hawai'i
Kahuku Unit of HVNP	Pakini Nui Wind	Ka'u	Hawai'i	Hawai'i
Alpine Habitat within HVNP	Pakini Nui Wind	Ka'u	Hawai'i	Hawai'i
Pi'ihonua Mitigation Site	Pakini Nui Wind	South Hilo	Hawai'i	Hawai'i

3.3 GEOLOGY AND SOILS

3.3.1 GEOLOGY

3.3.1.1 SOUTH HILO AND KA'Ū DISTRICTS

Both of these districts are composed of fissures, lava flows, cinder and spatter cones, and faults. Hawai'i Volcanoes National Park encompasses two active rift zones: (1) Mauna Loa; and (2) Kīlauea. Kīlauea is among the world's most active volcanoes (NPS 2013). Mauna Loa and Kīlauea release basaltic lavas that are high in silica and low in sodium and potassium (NPS 2013).

3.3.1.2 MAKAWAO AND HANA DISTRICTS

The Makawao district is located on the western flank of Haleakalā Volcano on land consisting of the Kula Volcanic series, which erupted 0.98-1.5 million years ago during the Pleistocene epoch (DLNR, 2018). The Hana district mitigation sites consist primarily of basalt flows from the Hana Volcanic series (Black & Veatch 2008).

3.3.1.3 WAIALUA DISTRICT

The Waialua district on O'ahu was formed about 4 million years ago by the Wai'anae and Ko'olau volcanoes. The mitigation site is located on an elevated plateau between the two mountain ranges. (SWCA 2011b, USFWS 2011a).

3.3.1.4 HANALEI DISTRICT

The Hanalei district consists of lava from the Napali formation. Dikes are common in this area and patches of alluvium occur at the mouth of the streams (Mink and Lau 1992).

3.3.2 SOILS

3.3.2.1 SOUTH HILO DISTRICT

The Pi'ihonua Mitigation site is the only site with earthwork within the South Hilo district. Soils here include 'a'ā lava and Kahalu'u-lava flows (NRCS, accessed Nov 27, 2018).

3.3.2.2 KA'Ū DISTRICT

The Pakini Nui Wind Hawaiian hoary bat and Hawaiian petrel mitigation sites are located in the Ka'ū district of Hawai'i Island. Throughout HAVO, sparsely vegetated, homogeneous soil substrates originating from historic lava flows are typical and include volcanic ash-based soils and well-draining, fertile soils (NPS 2013).

3.3.2.3 MAKAWAO AND HANA DISTRICTS

Pi'iholo is classified as predominantly Kailua silty clay, Makawao silty clay, rock land, and rough broken land (NRCS, accessed Nov 27, 2018). Haleakalā Ranch is predominantly Puu Pa very stony medial silt loam, rock land, rock outcrop, and Waiakoa extremely stony silty clay loam eroded (NRCS, accessed Nov 27, 2018). Soils in the Waihou Mitigation Area consist of the Kaipoipoi loam in the Cornwell Spring and Kaumaea Loko parcels. Uma loamy coarse sand is found in the Duck Ponds and Pu'u Makua parcels, and very stony land and lava flows is found in the Pu'u Makua parcel (NRCS, accessed Dec 4, 2018).

3.3.2.5 WAIALUA DISTRICT

The HWA on O'ahu is predominantly classified as Rough mountainous land, with soils consisting of Helemano silty clay, Wahiawa silty clay, Paaloo silty clay, and Leilehua silty clay (NRCS, accessed Dec 6, 2018).

3.3.2.6 HANALEI DISTRICT

The Hanakāpī'ai mitigation site on Kaua'i is predominantly classified as Rock outcrop and Rough mountainous land (NRCS, accessed Dec 7, 2018).

3.4 HYDROLOGY AND WATER RESOURCES

3.4.1 SURFACE WATER

3.4.1.1 SOUTH HILO DISTRICT

The South Hilo district mitigation sites are located in the Wailoa-Wailuku-Waikaumalo watersheds containing Freshwater Forested/Shrub wetland on the eastern flank of Mauna Kea and encompassing a portion of the Hakalau Forest NWR and the Hilo Forest Reserve Kaiwiki section. The area is interspersed with numerous freshwater streams, mostly draining from mid to lower elevation levels (USFWS 2018b, accessed Nov 30, 2018).

3.4.1.2 KA'Ū DISTRICT

The Ka'ū district mitigation sites are predominantly uplands, especially in the alpine areas, but with several streams flowing downhill through mid and lower elevations (USFWS 2018b, accessed Nov. 30, 2018). Watersheds in the Ka'ū district include Hi'onamoia Gulch, Nīnole Gulch, Hīlea Gulch, Kaunāmano, Wai'ōhinu, and Kapoho (DAR 2008).

3.4.1.3 MAKAWAO AND HANA DISTRICTS

Pi'iholo is predominantly upland, however a series of mostly intermittent streams and a network of extensively modified ditches occur throughout the district (DLNR, 2018). The Hana district mitigation sites are located within the Wailea and Kanaio watersheds. A few natural springs and created ponds occur within the Waihou Mitigation Area; however, there are no wetlands or other

perennial surface water features within the mitigation site (Hawai'i Institute of Marine Biology 2006). Haleakalā Ranch is predominantly upland, with at least five main freshwater streams or drainages running through the ranch from mauka (upland) to makai (seaward). Most streams in this area are classified as intermittent by the USFWS National Wetland Inventory online database (USFWS 2018b).

3.4.1.4 WAIALUA DISTRICT

The Helemano Wilderness Area in the Waialua district on O'ahu includes upland portions of the Paukauila and Ki'iki'i watersheds, which includes the Helemano, Poamoho, and Kaukonahua (North Fork) Streams. The Paukauila-Ki'iki'i stream drainage basin is the largest drainage basin in O'ahu, supplying drinking water to communities from Pearl Harbor to the North Shore (DAR 2008).

3.4.1.5 HANALEI DISTRICT

The Hanalei district watersheds include the Waipake, Pila'a, Kulihali, Kīlauea, Kauapea, Pu'ukumu, Kalihiwai, Kalihikai East, Kalihikai Center, Kalihikai West, 'Anini, Waileia, Hanalei, Wai'oli, Waipā, Waikoko, Lumaha'i, Wainiha, Mānoa, Limahuli, Maunapulo, Hanakāpī'ai, Waiahuakua, Hanakoa, Waiolaa, Pōhakuao, Kalalau, Nākeikionā'iwi, Honopū, and the Awa'awapuhi watersheds (Hawai'i Institute of Marine Biology 2008). The Hanakāpī'ai mitigation area is within the Hanakāpī'ai watershed, which is 3.8 mi² (9.8 km²), steep, and with little embayment. It is bordered on the east by the Hanakāpī'ai stream, which has multiple tributaries draining throughout the site (USFWS 2018b).

3.4.2 GROUND WATER

3.4.2.1 SOUTH HILO AND KA'Ū DISTRICT

Rocks in the South Hilo and Ka'ū district sites are highly permeable. It is estimated that millions of gallons of water a day falls as rain over Hawai'i island, where it sinks quickly into the ground and into the basal water table. Large supplies of good quality groundwater can be found along the windward coast near Hilo, but most of the groundwater along the leeward coast is brackish (Stearns and Macdonald 1946).

3.4.2.2 MAKAWAO AND HANA DISTRICTS

The eastern portion of the Pu'u Makua mitigation area is located in the Luala'ilua aquifer subunit of the Kahikinui aquifer unit which has a sustainable yield of 11 million gallons per day (MGD) (CWRM 2008). The Luala'ilua aquifer consists of an upper unconfined aquifer and lower basal aquifer; both are suitable sources of drinking water with moderate to high vulnerability to contamination (Mink and Lau 1990). The western portion of the Waihou Mitigation Area is located in the Kamaole aquifer of the Central hydrologic unit, which has a sustainable yield of 11 MGD (CWRM 2008). The Kamehamenui Forest habitat is in the Makawao aquifer (Tetra Tech 2019a). Pi'iholo Ranch, within the Makawao district is located within the Central aquifer (Maui County 2017).

3.4.2.3 WAIALUA DISTRICT

The HWA, in the Waialua district of O'ahu sits over the Wahiawā aquifer of the Central Sector (Mink and Lau 1990). The Wahiawā aquifer contains fresh water with a low level of salinity and which is not in contact with seawater. This aquifer is considered ecologically important and is currently used for drinking (Agribusiness Development Corporation 2015).

3.4.2.4 HANALEI DISTRICT

The Hanakāpī'ai mitigation site, in the Hanalei district, is located in the Napali aquifer system, which is part of the Hanalei Aquifer Sector and is located just below Polihale Ridge. Above the ridge is the Kakaha Aquifer System, which is part of the Waimea aquifer sector. The Napali aquifer system is 34 mi² (88.1 km²). Most of the groundwater in the Napali aquifer is contained within high level dike aquifers (Mink and Lau 1992).

3.5 NATURAL HAZARDS

3.5.1 FLOODING

3.5.1.1 SOUTH HILO DISTRICT

The majority of the South Hilo district sites are located in Federal Emergency Management Agency (FEMA) flood zone X (areas determined to be outside the 0.2% annual chance floodplain) or FEMA flood zone D (undetermined flooding hazard). Flood zone D is most prominent on the upper slopes of Mauna Kea and Mauna Loa. The areas closest to the ocean have the highest risk of flooding, are predominantly labeled as flood zones A, AE, and AH and are considered Special Flood Hazard Areas (FEMA 2018).

3.5.1.2 KA'Ū DISTRICT

The Ka'ū district sites are designated as FEMA flood zone X (FEMA 2018).

3.5.1.3 MAKAWAO AND HANA DISTRICTS

The majority of the Makawao and Hana district sites are located in FEMA flood zone X (FEMA 2018), with some streambeds running through Haleakalā Ranch located in FEMA flood zone A (areas subject to inundation by the 1-percent-annual-chance flood event) (NFIP 2018).

3.5.1.4 WAIALUA DISTRICT

The HWA mitigation site is located in FEMA Flood Zone D. The HWA is not within a Tsunami or Dam Evacuation Area (NFIP 2018).

3.5.1.5 HANALEI DISTRICT

The Hanakāpī'ai mitigation site is located in FEMA flood zone X (NFIP 2018). This site is in a high rainfall area and prone to landslides (DOFAW 2011).

3.5.2 WILDFIRE

3.5.2.1 SOUTH HILO AND KA'Ū DISTRICT

Wildfire and lava-flow hazard risks were considered for the South Hilo and Ka'ū district mitigation sites. Historically, wildfires have been most prevalent near towns and populated areas (HWMO 2013) whereas fires within HVNP were relatively uncommon (NPS 2013). The potential for large or intense wildfires in high and sub-alpine elevations in these districts is low and no fires have ever been documented in the high elevations of Mauna Loa. In montane areas of Kahuku, wildfire history is not known in detail and fires may have played a role in the evolution of the montane zone in the past (NPS 2013).

Lava flow hazard is another concern for these districts. Areas of South Hilo district located on Mauna Kea are located in lava-flow hazard zones 7 and 8, with 1 being an area with highest lava-flow hazard and zone 9 being an area of lowest lava-flow hazard. Mitigation areas located on the slopes of Mauna Loa are predominantly in lava-flow hazard zones 1, 2, and 3 (Wright et al. 1992).

3.5.2.2 MAKAWAO AND HANA DISTRICTS

Fire is an increasing threat in the Makawao and Hana districts; fires are recorded between 'Ulupalakua and Kaupō gap regularly. Major fires in the Kula State Forest Reserve were recorded in 1954, 1984, and 2007. In 2007, one of the most devastating wildfires burned 2,300 ac of the Kula Forest Reserve (Tetra Tech. 2019a).

3.5.2.3 WAIALUA DISTRICT

Fire risk in the HWA in the Waialua district is considered high according to the Western O'ahu Community Wildfire Protection Plans, developed by the Hawai'i Wildfire Management Organization (Pickett and Beimler 2016).

3.5.2.4 HANALEI DISTRICT

Fire risk in the Hanakāpī'ai mitigation site in the Hanalei district is considered low due to the high rainfall in the area. However, drought can cause the fire risk to increase. People are the principal cause of wildfires in the area and have been responsible for several wildfires in the district since 2007, three of which burned over 50 ac (DOFAW 2011).

3.6 VEGETATION

3.6.1 SOUTH HILO DISTRICT

The South Hilo mitigation sites encompass a vast amount of landscapes and vegetation. Native montane forest, dominated by bogs, ferns and scrubby forest, is found at about 6000 ft. elevation in Hakalau Forest NWR, where koa (*Acacia koa*) and 'ōhi'a (*Metrosideros polymorpha*) trees form a closed-canopy forest. Higher in elevation, pastureland with alien grasses and weeds are found along with koa and 'ōhi'a and other native plants which have been planted as part of the refuge's reforestation program. At lower elevations, the forest is predominately 'ōhi'a trees with an understory of nonnative trees and shrubs, such as Christmas berry (*Schinus terebinthifolia*) and strawberry guava (*Psidium cattleianum*). Over 2,317 ac of critical habitat has been designated in the area for Kīponapona (*Phyllostegia racemosa*), including Pua 'Ākala and portions of 'Āwehi, Honoli'i, and Kapu'e streams. (USFWS 2016a). High alpine areas often have very little to no vegetation, but may be characterized by grasses, sedges, lichens and mosses (NPS 2013).

3.6.2 KA'Ū DISTRICT

Within the Ka'ū district, large forest tracts in Kahuku have been converted to grass pastures with Christmas berry, strawberry guava, kāhili ginger (*Hedychium gardnerianum*), 'ōhi'a, night cestrum (*Cestrum nocturnum*), faya tree (*Morella faya*), and blackberry (*Rubus argutus*) (SWCA 2018a). Table 1 in **Appendix A** of the Draft Pakini Nui Wind HCP (SWCA 2018a) shows a list of federally-listed endangered, rare, and uncommon species that would benefit from active restoration of lower Kahuku. Alpine areas within Ka'ū district are sparsely vegetated with small patches of stunted native shrubs consisting mostly of pūkiawe (*Leptecophylla tameiameia*) and 'ōhelo (*Vaccinium reticulatum*). Grasses, sedges, lichens, and mosses comprise the rest of the plant life. Pūkiawe, 'ōhelo and 'a'ali'i (*Dodonaea viscosa*) are the most abundant native shrubs. The most abundant native grasses are *Deschampsia nubigena*. The Mauna Loa silversword (*Argyroxiphium kauense*) is an important rare, native species found here (NPS 2013).

3.6.3 MAKAWAO AND HANA DISTRICTS

At Pi'iholo, the dominant grass is kikuyu grass (*Pennisetum clandestinum*) and other grasses present are pangola grass (*Digitaria pentzii*), California grass (*Brachiaria mutica*), *Paspalum* spp., and broomsedge (*Andropogon virginicus*). The dominant legume is Spanish clover (*Desmodium incanum*) with minimal presence of trefoil (*Lotus uliginosus*). Cloverbush (*Tibouchina* spp.), fireweed (*Senecio madagascariensis*), and gorse (*Ulex europaeus*) are present but recent brush management efforts have reduced the populations of these invasive species on the ranch. Guava (*Psidium* spp.), Christmas berry and rose apple (*Syzygium jambos*) are present within the gulches (USFWS 2004a).

Vegetation at Haleakalā Ranch includes rolling grasslands, forests, and gulches. Dominant vegetation at the site includes kikuyu grass (*Pennisetum clandestinum*), lantana (*Lantana camara*), a small number of strawberry guava trees, and a few 'a'ali'i.

The Auwahi Wind Mitigation areas consists primarily of grasslands, interspersed with gulches and a few forested patches (Tetra Tech 2019a). The grasslands consist primarily of kikuyu grass and other non-native species. The Kaumaea Loko, Pu'u Makua and lower Kanehamenui Forest parcels are almost entirely pastureland with a small component planted with native trees. The Cornwell Spring parcel consists of native koa forest, non-native forest dominated by Pacific ash (*Fraxinus uhdei*) and pastureland. The Duck Ponds parcel is approximately 60% forested, dominated by Monterey pines (*Pinus radiata*), with the remaining acres in pastureland (Tetra Tech 2019a). The Waihou Mitigation Area is adjacent to the Kula Forest Reserve where critical habitat for several listed plant species has been designated including Haleakalā silversword (*Argyroxiphium sandwicense* ssp. *macrocephalum*), ko'oko'olau (*Bidens micrantha* ssp. *kalealaha*), oha wai (*Clermontia lindseyana*), *Asplenium dielerectum*, and *Geranium arboreum* (USFWS 2016a). The Kamehamenui Forest parcel is located on the north slopes of Haleakalā. It is approximately 3,400 acres and stretches from upper Kula (3,400 feet asl) to nearly the summit of Haleakalā (9,800 feet asl). Haleakalā National Park is adjacent to the parcel to the east, and the Kula Forest Reserve is adjacent to the parcel to the south. The upper elevations (>8,000 feet) are designated federal critical habitat for 10 rare plant and bird species. The lower elevations are primarily pasture lands that are well-suited for reforestation. Due to proximity, there is a potential for sensitive plant occurrences within these sites.

3.6.4 WAIALUA DISTRICT

Vegetation at the HWA mitigation site contains native and mixed forests and creates a transitory corridor contiguous with Poamoho section of the 'Ewa Forest Reserve. The native forest consists of nānū (*Gardenia mannii*), loulu (*Pritchardia bakeri* and *Pritchardia kahukuensis*), uhiuhi (*Mezoneuron kavaiensis*), kauila (*Colubrina oppositifolia*), *Bonamia menziesii*, ha'iwale (*Cyrtandra dentata*), *Chamaesyce rockii*, hāhā (*Cyanea calycina*, *C. crispa*, *C. grimesiana*, *C. humboldtiana*, and *C. koolauensis*), ānini (*Eurya sandwichensis*), hulumoa (*Exocarpos gaudichaudii*), *Hesperomannia arborescens*, kokio (*Hibiscus kokio*), 'ohe (*Joinvillea ascendens*), *Huperzia nutans*, *Phyllostegia hirsuta*, kōpiko (*Psychotria hexandra*), kaulu (*Pteralyxia macrocarpa*), 'ohe (*Polyscias gymnocarpa*), and nuku 'i'iwi (*Strongylodon ruber*) (DOFAW 2018).

3.6.5 HANALEI DISTRICT

Vegetation at the Hanakāpī'ai mitigation site is considered montane wet communities. The forest canopy is a mix of 'ōhi'a and other native trees including lapalapa (*Cheirodendron platyphyllum* subsp. *kauense*), ōlapa (*Cheirodendron trigynum*), kāwa'u (*Ilex anomala*), kōlea (*Myrsine lessertiana* and *M. alyxifolia*), and 'ohe (*Tetraplasandra* spp.). Understory tree and shrub species include kanawao (*Broussaisia arguta*), pūkiawe, na'ena'e (*Dubautia knudsenii*, *D. raillardoides* and *D. laxa*), koli'i (*Trematolobelia kauaiensis*), 'ōhelo kau lā'au (*Vaccinium calycinum*), alani (*Melicope clusiiifolia*), and mokihana (*Melicope anisata*). A total of 118 rare plant taxa have been reported from the Hono O Nā Pali Natural Area Reserve (NAR) area. The Reserve contains designated critical habitat for 69 rare plant taxa (DOFAW 2011).

3.7 WILDLIFE AND BIODIVERSITY

3.7.1 GENERAL

Due to their remote location, the Hawaiian islands have a depauperate fauna but high endemism. No native reptiles or amphibians exist and only a few native mammals colonized. However, centuries of introductions of non-native plants and animals have driven large parts of the native fauna to extinction, and the species that now make up the bulk of biodiversity at most sites are non-native. A few areas proposed for mitigation are included within the State of Hawai'i game management program as hunting areas (Hawai'i Administrative Rules Chapters 122 and 123). These sites are occupied by: feral pigs (*Sus scrofa*) and feral goats (*Capra aegagrus hircus*) on all islands; axis deer (*Axis axis*) on Maui; and black-tailed deer (*Odocoileus hemionus columbianus*) on Kaua'i. Cattle ranching also occurs at two of the sites. Other mammals likely present in all of the areas include the Polynesian rat (*Rattus exulans*), black rat (*Rattus rattus*), house mouse (*Mus musculus*), and feral cats (*Felis catus*). In addition, all sites except for those on Kaua'i include small Indian mongoose (*Herpestes javanicus auropunctatus*) populations. The Hawaiian hoary bat, or 'ōpe'ape'a, (*Lasiurus cinereus semotus*), is present at all of the sites.

3.7.2 SOUTH HILO DISTRICT

In addition to being occupied by Hawaiian geese, the habitats and vegetation within the South Hilo district are home to a number of native birds. Forest birds include the Hawai'i 'amakihi (*Chlorodrepanis virens*), 'apapane (*Himatione sanguinea*), Hawai'i 'elepaio (*Chasiempis sandwichensis*), 'ō'mao (*Myadestes obscurus*), the federally threatened 'i'iwi (*Drepanis coccinea*), and three federally endangered species: the 'akiapola'au (*Hemignathus wilsoni*), 'alawī (Hawai'i creeper; *Loxops mana*), and the Hawai'i 'akepa (*Loxops coccineus*). In addition, the federally threatened 'io (*Buteo solitarius*) utilizes these forests, while the pueo (*Asio flammeus sandwichensis*) is found in open areas (Gorresen et al. 2017). While these birds do not have any critical habitat designated, there is critical habitat for an endangered picture-wing fly (*Drosophila ochrobasis*) about 3 km southeast from the Pi'ihonua site. This species depends on *Cheirodendron* sp., *Clermontia* sp., and the fern *Marattia douglasii* to complete its life cycle (USFWS 2008).

A host of non-native birds are also present in this area, including game birds such as the Kalij pheasant (*Lophura leucomelanos*), California quail (*Callipepla californica*), Erckel's francolin (*Francolinus erckelii*), and the wild turkey (*Meleagris gallopavo*). Other common introduced birds include the Japanese white-eye (*Zosterops japonicus*), Japanese bush-warbler (*Horonis diphone*), northern cardinal (*Cardinalis cardinalis*), red-billed leiothrix (*Leiothrix lutea*), common myna (*Acridotheres tristis*), and the barn owl (*Tyto alba*) (Gorresen et al. 2017).

3.7.3 KA'Ū DISTRICT

The Kahuku Unit of HVNP is home to many of the same species as the Hilo district. Within the Hawaiian hoary bat mitigation project area, we would not expect the endangered passerines, but 'io are present along with pueo, Hawai'i 'amakihi, 'apapane, and 'ō'mao. Common non-natives include Japanese white-eye, yellow-fronted canary (*Crithagra mozambica*), saffron finch (*Sicalis*

flaveola), house finch (*Haemorhous mexicanus*), northern cardinal, common myna, and red-billed leiothrix. Game birds present in the area include Erckel's francolin and wild turkey (Judge et al. 2017). The alpine areas where Hawaiian petrel mitigation will occur is above the range for most passerine species, but another federally endangered seabird, the band-rumped storm-petrel (*Oceanodroma castro*), may be found in the area as well. Game birds may include Erckel's francolin and the chukar partridge (*Alectoris chukar*).

Critical habitat is present in the lower Kahuku unit for a picture-wing fly species, *Drosophila heteroneura*. This species is dependent on native species in the subfamily Lobelioideae (family: Campulanaceae) as a host plant for development (USFWS 2008).

3.7.4 HANALEI DISTRICT

The montane wet forest that characterizes the mitigation site at Hanakāpī'ai in the Hono o Nā Pali NAR contains an abundant richness of native fauna. Native forest birds include 'apapane, Kaua'i 'amakihi (*Chlorodrepanis stejnegeri*), 'anianiau (*Magumma parva*), Kaua'i 'elepaio (*Chasiempis sclateri*), the threatened 'i'iwi, and the endangered puaiohi (*Myadestes palmeri*), 'akikiki (*Oreomystis bairdi*), and 'akeke'e (*Loxops caeruleirostris*) (DOFAW 2011). The area is critical habitat for the latter two species (USFWS 2010a). It is also critical habitat for a picture-wing fly, *Drosophila sharpi*. This species is likely reliant on native *Cheirodendron* species as its host plant, though this is not specifically known (USFWS 2010a).

Other birds present in the area include the following: the native pueo; the federally listed Newell's shearwater (*Puffinus newelli*), band-rumped storm-petrel, and the Hawaiian petrel; the federally listed koloa (*Anas wyvilliana*); and non-native species such as the Japanese white-eye, white-rumped shama (*Copsychus malabaricus*), hwamei (*Garrulax canorus*), and the barn owl (DOFAW 2011).

3.7.5 WAIALUA DISTRICT

The HWA and Kawailoa wind facility contain a mix of native and non-native habitats. Native bird species likely to be present include the O'ahu 'amakihi (*Chlorodrepanis flava*), and the pueo, which is state-listed as endangered on O'ahu. In addition, critical habitat for the federally listed O'ahu 'elepaio (*Chasiempis ibidis*) occurs adjacent to the area (USFWS 2001), though it is not believed to be currently occupied (Vanderwerf et al. 2013). Other non-native bird species expected to occur include the Japanese white-eye, red-billed leiothrix, white-rumped shama, red-vented and red-whiskered bulbul (*Pycnonotus spp.*), and the common waxbill (*Estrilda astrild*). Further surveys of the area may include other native species, including federally listed native snails, which are known from forests upslope from this area (DOFAW 2018).

3.7.6 WAILUKU, MAKAWAO AND HANA DISTRICTS

Most of the analyzed areas on Maui consist of open pastureland with a few scattered native and non-native trees that support species of open country, such as the pueo, kolea (Pacific golden-plover; *Pluvialis fulva*), Eurasian skylark (*Alauda arvensis*), and the scaly-breasted munia (*Lonchura punctulata*). As mitigation areas are restored, we would expect native forest birds

such as the Hawai'i amakihi and the apapane to move back into these areas (Berthold et al. 2015). In addition, the endangered native Blackburn's sphinx moth (*Manduca blackburni*) is likely to be present if its host plants, non-native tree tobacco (*Nicotiana glauca*) or native 'aiea (*Nothoecstrum latifolium*), are present or replanted into these areas (USFWS 2018c). Habitat management and habitat restoration at Kamehameui Forest would be expected to enhance recovery efforts for endangered wildlife including the Hawaiian petrel, Hawaiian goose, Hawaiian hoary bat, Maui Parrotbill or kiwikiu (*Pseudonestor xanthophrys*), and the crested honeycreeper, or 'ākohekohe (*Palmeria dolei*) and provide outplanting opportunities for several critically endangered plant species including the 'ahinihina or Haleakalā silversword (*Argyoxiphium sandwicense* subsp. *macrocephalum*). These restoration areas will be important for species migration due to climate change.

3.8 HAWAIIAN HOARY BAT

*Due to the volume of information on the Hawaiian hoary bat and its importance to the analysis herein, the Service has compiled relevant information in **Appendix G** and summarized that information in this section.*

The Hawaiian hoary bat is an endangered, endemic subspecies of the hoary bat found across North and South America. The only land mammal native to Hawai'i, the bat roosts as a solitary individual or with its dependent young. The Hawaiian hoary bat was listed statewide in 1970 based on perceived habitat loss and limited knowledge of its distribution and life history requirements (USFWS 1970, 1998). There was no population estimate at the time of listing and no documentation of a population decline. However, over the past 50 years, and especially in the last 10 years, research has informed our understanding of the species distribution, life history, and threats, though tools to monitor for bats are still limited.

Methods and limitations of determining abundance and population estimates

Over the last decade, acoustic detectors have been the most widely deployed tool for bat detection (**Appendix G**) but this technology has limitations. Acoustic detectors will record a sound byte if a bat is within the detector microphones range and the bat is echolocating. Acoustic detectors cannot differentiate between the absence of a bat or presence of a bat that is not echolocating or out of the limited range and directionality of the microphone. Acoustic detectors are also not quantitative. The acoustic detectors cannot distinguish if it is one bat making multiple echolocating passes or multiple bats. A recent comparison between acoustic detectors and newer thermal video imaging shows that acoustic detectors were only detecting about 8% of the bats that the thermal imaging was capturing (Gorresen et al. (2015). Recently, Corcoran and Weller (2018) demonstrated that hoary bats on the mainland use a novel call type called "micro calls" that uses less sound energy than other bat calls and can easily go undetected with acoustic detectors. In light of this information, thermal videography is being deployed more frequently in conjunction with acoustic detectors. Thermal videography has its own limitations in the amount of area covered and, like acoustic detection, the technology is not quantitative beyond confirming the number of bats present at one time in a particular video frame.

Lack of state-wide data to provide a reliable population estimate at this time

Presently, there is no population estimate that meets scientific rigor and the reasonable statistical confidence levels necessary for the Service to conduct population viability modeling. This does not discount estimations made as a demonstration by other parties. The technology and resources that would allow for the development of a reliable statewide population estimate are recognizably not available at this time. The tools we currently have available do not directly quantify the number of bats, but the acoustic detectors can be used for assessing occupancy. Occupancy studies are long-term studies (typically 5-10 years) that can provide population trend data. To date, only one, 5-year occupancy study, conducted from 2006-2011 on a portion of Hawai'i island, has been completed (Gorresen et al. 2013; Appendix G). The results of that study suggested the bat population trend on Hawai'i island was stable to increasing at that time (Gorresen et al. 2013). A power analysis conducted with that same acoustic data gathered by Gorresen et al. (2013) suggests it could take approximately 5 to 10 years of acoustic monitoring at hundreds of sites per island to determine a population trend with a reasonable level of confidence on each island (WEST, Inc 2015). In response to this, a study was initiated on O'ahu in 2018 to look at distribution across the island and possibly determine a population trend if enough years of data can be collected.

Distribution

Despite the limitation of acoustic detection technology and radio-tracking, studies have shown the Hawaiian hoary bat to be much more widely distributed than believed at the time of listing in 1970 (USFWS 1970, 1998; USFWS 2019; see **Appendix G** for a more detailed information on bat occurrence). The Hawaiian hoary bat occurs across Kaua'i, O'ahu, Moloka'i, Maui, Lāna'i, and Hawai'i (USFWS 1998; Tetra Tech 2008; Hosten and Poland 2018; USFWS 2019), and, recently, this species has been observed visiting Kaho'olawe (KIRC 2017). While systematic acoustic monitoring does not occur throughout the islands, bat presence has been documented nearly everywhere monitoring does occur. No population estimates that meet scientific rigor and the reasonable statistical confidence levels that the Service uses exist for this subspecies, though breeding has been documented on the major islands (Appendix G). Movement of bats between the major islands is thought to be infrequent (Pinzari and Bonaccorso, pers. com 2018).

On Kaua'i, several studies have been conducted on the species' distribution (Bonaccorso and Pinzari 2011; Wolfe 2018; **Appendix G**). They found bats occur across the island in the lowlands, with some indication that they move seasonally into higher elevation areas. No specific studies have been conducted at the Hanakāpī'ai site, but bats have been observed by scientists within the Hono O Nā Pali NAR and adjacent areas (DOFAW 2011).

On O'ahu, monitoring for bats has been conducted primarily at wind facilities, military lands in the Ko'olau and Wai'anae mountain ranges, Waikīkī, Ford Island, the north shore of O'ahu, and the NWR Complex comprised of James Campbell, Kalaeloa Unit of the Pearl Harbor NWR and at the O'ahu Forest NWR (Pinzari 2014, O'ahu Army Natural Resource Program 2016, Wolfe 2018; **Appendix G**). An intensive, multi-year study is currently ongoing on O'ahu to look at year-round distribution and occupancy of the Hawaiian hoary bat across the island. Preliminary results showed bat activity at 61% of 87 randomly selected sites across all types of landscape on O'ahu (Starcevich et al. 2019). The highest rate of acoustical detection based only on the locations of the 87 detectors was in Waimea (Starcevich et al. 2019) which suggests this area

provides a resource that favors bat presence. While the HWA parcel has not had any published survey results, Hawaiian hoary bats are known from areas surrounding the parcel and are believed to utilize the subject parcel as well (DOFAW 2018). Acoustic monitoring has occurred at the Kawailoa Wind project site since 2012. Between 2012 and 2015, 72 detectors were deployed with one at each turbine on the ground (30) and at the nacelle (30), and 12 deployed near gulches in the project area. During this time, Hawaiian hoary bats were detected on 8.5% of detector nights with a seasonal peak between April and October (Tetra Tech 2016). In 2016, monitoring was reduced to four detectors (all ground-based), and Hawaiian hoary bats were detected on 12.6 and 19.4% of detector-nights in fiscal year 2017 and 2018, respectively. A similar seasonal peak between April and October was still observed (Tetra Tech 2018). The seasonal peak based on acoustic detections may be related to life history parameters.

As of 2018, the Hawaiian hoary bat is known from all islands of Maui Nui, with bats likely breeding throughout the island complex (USFWS 1998; Tetra Tech 2011, Hosten and Poland 2018; **Appendix G**). Current information indicates the species occurs seasonally on Kaho'olawe (KIRC 2017; **Appendix G**). Research on the Hawaiian hoary bat has been conducted on the south slope of Haleakalā (Todd et al. 2016), and additional research is ongoing on the west slope (H. T. Harvey 2016; Johnston et al. 2018, 2019; **Appendix G**). Monitoring of Hawaiian hoary bats has occurred at all wind facilities on Maui since beginning operations. At KWP II, bats have been detected in every month of the year with increased detection levels in the late summer-early fall months, with a high of 58% of total detector nights in September 2015 (SWCA 2018b). At Auwahi wind facility, detectors found Hawaiian hoary bats occurring throughout the year with a peak between August and October. From 2013 to 2015, detections occurred on 31% of nights (Kawailoa Wind 2014, 2015; Tetra Tech 2016, 2019b). Hawaiian hoary bats are also known from the Waihou mitigation area based on previous mitigation and research work that has been undertaken in the vicinity (Auwahi Wind 2017; USGS-PIERC 2017).

Much of the research on the Hawaiian hoary bat has been conducted on Hawai'i island (Menard 2001; Todd 2012; Gorresen et al. 2013; Bonaccorso et al. 2015; **Appendix G**). Gorresen et al. (2013) documented hoary bat occurrences over most of the island, including seasonal movements between lower elevation pupping areas and upper elevation wintering areas. Menard (2001) and Bonaccorso et al. (2015) found that hoary bats pupped in elevations typically below 3,280 ft and then moved seasonally to higher elevations in winter, presumably to take advantage of better foraging conditions. The study does not exclude the possibility of pupping at higher elevations. A pregnant female has been observed at the 5413 ft elevation, although it is unknown if she was roosting. Based on a five-year study from 2006-2011, the Hawaiian hoary bat showed a stable to increasing trend in occupancy during the breeding season on the island (Gorresen et al. 2013). Recent observations have been made of the Hawaiian hoary bat foraging in caves up to 11,800 ft above sea level on Mauna Loa (Bonaccorso et al. 2016). In addition to seasonal movements, the Hawaiian hoary bat has also been documented to move over distances up to 6.8 miles one way nightly in search of the best foraging areas (Bonaccorso et al. 2015). The Hawaiian hoary bat is likely present at all mitigation sites on Hawai'i island at some point during the year, and has been documented at the Pakini Nui Wind facility (SWCA 2018).

Life needs

Existing data indicates the Hawaiian hoary bat is a habitat generalist, and is capable of utilizing

highly fragmented habitats (Johnston et al. 2019). The physical structure of the spaces in which the Hawaiian hoary bat forages are also extremely varied, including forest gaps and clearings, forest edges along planted windrows of trees, above forest canopies, and along roads (USFWS 1998). These areas can occur in a range of habitats including undisturbed native forest, mature eucalyptus plantations having mixed understory trees and shrubs, lowland forest dominated by introduced trees, developed areas, suburban and urban areas planted with ornamental trees, grassland/pasture, river gorges, arboretums, macadamia nut orchards, and coastal bays (Gorresen et al. 2013; Bonaccorso et al. 2015; Johnston et al. 2019).

The Hawaiian hoary bat primarily feeds on nocturnal moths and beetles, which it hunts in flight across a wide array of habitat types and plant communities from sea level to at least 11,800 ft above sea level (Whitaker and Tomich 1983; Jacobs 1999; Todd 2012; Bonaccorso et al. 2015; Bonaccorso et al. 2016). Bonaccorso et al. (2015) found a mean foraging range of 570 ac \pm 178.6 ac for 28 bats though mean and median core use areas for adult bats of both sexes were 48.5 and 20.5 ac, respectively. (See Table in **Appendix G** for a breakdown of the useage and further descriptions of foraging patterns.). Core use areas are those that the adult bats frequented nightly and did not typically overlap, though forage ranges did. Core use areas ranged from 6 acres to more than 100 acres and appears to be resource availability driven. Johnston et al. (2018, 2019) found foraging areas for 20 bats in east Maui ranged from 3,000-64,000 ac with the average foraging range covering about 2,967 ac. Bats can demonstrate territoriality, but female bats can and do share roosting trees when they have young

Bats are able to utilize widely dispersed resources and move away from poor foraging conditions, such as heavy rain. Overall, bat activity and movements on the landscape are not determined by one variable, but an interaction of a complex array of environmental factors. Seasonal changes in temperature, rainfall, wind, insect abundance, and energetic costs associated with reproduction of the Hawaiian hoary bat all play important roles in its movements and habitat use (e.g. Todd 2012; Gorresen et al. 2013; Bonaccorso et al. 2015; Gorresen et al. 2015; Bonaccorso et al. 2016; Todd et al. 2016; see **Appendix G** for further discussion).

Day-roost habitat requirements for the Hawaiian hoary bat are tall (greater than five-meter [15 ft] crown height), shady trees frequently including mature native 'ōhi'a, but also including a wide variety of introduced species such as lychee (*Litchi chinensis*), various species of eucalyptus, mango (*Mangifera indica*), and numerous other tree species (Bonaccorso et al. 2015). Roost trees noted from radio-tracked bats on Maui include blue gum eucalyptus (*Eucalyptus globulus*), African tulip tree (*Spathodea campanulata*), and Monterey cypress (*Cupressus macrocarpa*) (Johnston et al. 2018) but is not limited to those species.

An estimated 1.475 million ac of forest habitat occurs across the major Hawaiian Islands (Reeves and Amidon 2018). About 50% or 700,000 ac of dry, mesic, and wet forest habitat is owned by County, State, or Federal government agencies. On O'ahu, Maui, and Hawai'i, the three islands where wind facilities are located and where almost all of the cumulative effects to the Hawaiian hoary bat are occurring, about 1,163,000 ac of forested habitat currently exists. Of that, about 630,000 ac are owned by government agencies and about 200,000 ac are currently designated as conservation lands. Additional privately-held acreage is protected by conservation easements throughout the state and is occupied by Hawaiian hoary bats.

Threats

The quantification of bat fatalities is largely limited to wind energy projects because they conduct systematic and rigorous compliance monitoring. Based on fatality monitoring, the land-based wind energy facilities are presently the greatest known source of Hawaiian hoary bat fatalities that is being quantified. As of September 2018, there have been 81 observed Hawaiian hoary bat fatalities at the six facilities that are conducting systematic monitoring. This observed fatality data, along with the EoA model calculations of unobserved take and indirect take results in a total fatality estimate of between 90 to 164 bats for the six operating wind facilities with permits (**Appendix B and C**). On the island of Maui, incidental take for all existing commercial wind projects is estimated to be no more than 11.4 bats per year. On O'ahu, incidental take for all existing O'ahu wind projects is estimated to be no more than 15.1 bats per year. On Hawai'i island incidental take for all existing Hawai'i wind projects is estimated to be no more than 2.9 bats per year. The numbers provided for the annual estimations do not represent actual observed fatalities, rather, the numbers represent what the Service is confident has not been exceeded per year because of imperfect detection (See **Appendix C** for more details). If new wind energy facilities are proposed, they would be expected to request incidental take of bats.

Other threats to bats include habitat loss, tree trimming and cutting during the time period when pups are non-volant, entanglement on barbed wire fences, pesticides and rodenticides, competition from invasive species, such as coqui frogs, and potentially predation from native and non-native owls and hawks, as well as non-native rats and cats (USFWS 1998). Bat fatalities associated with these threats are largely unquantified due to the lack of systematic monitoring tools and resources.

3.9 HAWAIIAN GOOSE

The Hawaiian goose is a medium-sized waterfowl with an overall length of approximately 25 to 27 in (Banko et al. 1999). The plumage of both sexes is similar (Banko et al. 1999). This species is adapted to a terrestrial and largely non-migratory lifestyle in the Hawaiian islands with limited freshwater habitat (Banko et al. 1999). Adaptations to a terrestrial lifestyle include increased hindlimb size, decreased forelimb size, more upright posture, and reduced webbing between the toes compared to other species of *Branta* (Banko et al. 1999; Olson and James 1991). Compared to the related Canada goose (*Branta canadensis*), Hawaiian goose wings are about 16% smaller in size and their flight is not as strong (Banko et al. 1999). Hawaiian geese are capable of inter-island and high altitude flight, but they do not migrate out of the Hawaiian archipelago (Banko et al. 1999).

The Hawaiian goose was federally listed as endangered on March 11, 1967 (32 FR 4001). No critical habitat has been designated for this species. In 2018, the Service published a proposed rule to reclassify the Hawaiian goose from endangered to threatened status (USFWS 2018d). In the proposed rule, the Service also determined that a special rule under 4(d) of the ESA was necessary and appropriate for the conservation of the Hawaiian goose. The proposed 4(d) rule would exempt certain activities from section 9 take prohibitions.

Hawaiian geese currently use shrublands, grasslands, sparsely vegetated lava flows, and human-altered habitats ranging from coastal to alpine environments (Wilson and Evans 1893; Munro 1944; Scott et al. 1986; Banko et al. 1999). In the grassy shrublands and sparsely vegetated lava flows on the islands of Hawai'i and Maui, Hawaiian geese nest, raise their young, forage, and molt (Banko et al. 1999). Some Hawaiian geese populations on these islands move seasonally from montane foraging grounds to lowland or mid-elevation nesting areas (Banko et al. 1999). On the island of Kaua'i, Hawaiian geese are primarily found using lowland habitats such as coastal wetlands at Hanalei NWR, with the exception of the Na Pali Coast (USFWS 2004b).

Hawaiian geese are currently known to occupy various habitat and vegetation community types ranging from coastal dune vegetation and nonnative grasslands (such as golf courses, pastures, and rural areas) to sparsely vegetated low- and high-elevation lava flows, mid-elevation native and nonnative shrubland, cinder deserts, native alpine grasslands and shrublands, and open and nonnative alpine shrubland-woodland community interfaces (Banko et al. 1999). 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 plants as long as they meet nutritional demands (Banko et al. 1999; Woog and Black 2001). 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 resultant higher protein content. The sites currently used by Hawaiian geese for nesting range from coastal lowland to subalpine zones and demonstrate considerable variability in features (Banko et al. 1999). However, the current distribution of Hawaiian geese nesting sites has been influenced by the location of release sites of captive-bred individuals (DOFAW 2012). Historical reports from the island of Hawai'i indicate that Hawaiian geese bred and molted primarily in the lowlands during winter months and moved upslope in the hotter and drier summer months (Henshaw 1902; Munro 1944; Banko 1988). Reproductive success is relatively low in upland habitats on the islands of Hawai'i and Maui, and higher in lowland habitat on Kaua'i (Banko et al. 1999).

Hawaiian geese have an extended breeding season, with eggs laid from August to April (Banko et al. 1999). Nesting peaks in December, and most goslings hatch from December to January (Banko et al. 1999). Hawaiian geese nest on the ground, in a shallow scrape in the dense shade of a shrub or other vegetation. A clutch typically contains three to five eggs, and incubation lasts for 29 to 32 days (Banko et al. 1999). Once hatched, the young may remain in the nest for 1 to 2 days; all hatchlings depart the nest after the last egg is hatched (Banko et al. 1999). Fledging (i.e., development of wing feathers large enough for flight) occurs at 10 to 12 weeks for captive birds, but may be later in the wild (Banko et al. 1999). During molt, adults are flightless for a period of 4 to 6 weeks and generally attain 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. After molting and fledging, around June to September, family groups frequently congregate in post-breeding flocks, often far from nesting areas. Hawaiian geese reach sexual maturity at one year of age, but usually do not form pair bonds until the second year. Females are highly philopatric (loyal to their place of birth) and nest near their natal area, while males more often disperse (Banko et al. 1999).

Hawaiian geese and one or more now extinct species of *Branta* are thought to have once been widely distributed among the main Hawaiian Islands. Fossil remains of Hawaiian geese have

been found on Maui, Moloka'i, Lāna'i, and Kaua'i (Olson and James 1991). However, Hawaiian geese fossils have not yet been found on Niihau (USFWS 2004b). On O'ahu, all fossils appear to be of a related but extinct *Branta* form (Olson and James 1991). The fossil record indicates the prehistoric (before 1778) range of Hawaiian geese was much greater than the historically observed range (Banko et al. 1999). However, it is difficult to estimate original Hawaiian geese population numbers because the species composition and even gross structure of the vegetation before Polynesian arrival is poorly understood (USFWS 2004b). By 1960, fewer than 30 Hawaiian geese remained on Hawai'i island (Smith 1952). The release of captive-bred Hawaiian geese, which began in 1960, helped save the species from extinction (USFWS 2004b). As a result of such programs, wild populations of Hawaiian geese now occur on four of the main Hawaiian Islands. As of 2017, the statewide population was 3,252 individuals with 1,104 individuals on Hawai'i, 1,482 individuals on Kaua'i, 627 individuals on Maui, and 37 individuals on Moloka'i (DOFAW 2018, unpublished).

Hawaiian geese are found regularly at the KWP II wind facility, due primarily to the presence of a former reintroduction site and the associated release pens upslope. These pens were used as a release site by the State of Hawai'i for captive-bred Hawaiian geese for a number of years, though releases no longer occur there. Birds have been seen using the KWP II site for feeding and socializing, but no nesting is known from the area, though nests have been found in the vicinity of the KWP I facility upslope (SWCA 2018b).

Hawaiian geese have the potential to occur in the area of the Pakini Nui Wind facility based on the presence of suitable foraging habitat. Over 100 nēnē have been identified using the Kahuku unit of HVNP over the past 10 years (SWCA 2018a). These birds are wide-ranging and the turbines are approximately 40 km (12.5 mi) from this known population.

From 2011 to 2016, the State of Hawai'i translocated 646 Hawaiian geese from Kaua'i to Hawai'i (598) and Maui (48) (USFWS 2018d). The birds were released at pens at Pi'ihonua on Hawai'i and Waiopae (Haleakalā Ranch) on Maui, two of the proposed mitigation sites. A similar release pen is located at Pi'iholo Ranch on Maui, another potential mitigation site, where the State of Hawai'i released captive-bred birds for several years. These pens are managed to provide protection from non-native, introduced predators, such as mongooses and feral cats. Management, habitat restoration and improvement in the Kamemaenui Forest is expected to enhance recovery of the Hawaiian goose.

3.10 HAWAIIAN PETREL

The endangered Hawaiian petrel (*Pterodroma sandwichensis*) was first listed as a federally endangered species in 1967 (USFWS 1967). This species is approximately 16 inches long (40 cm) and has a wingspan of about 3 ft. 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 feet that are pink and black.

Hawaiian petrels have a long lifespan (up to 35 years), do not reproduce until six years of age, lay one egg per year, and require significant parental investment for offspring (Simons and Hodges 1998). Petrel offspring require up to five months of care from both parents in order to

survive. Hawaiian petrels exhibit strong natal philopatry, with breeding pairs returning to the same burrow to breed each year (Bried et al. 2003). Hawaiian petrels are exclusively pelagic, spending much of their time at sea resting or foraging for squid, small fish, and crustaceans (Simons 1985). All transit over land occurs in darkness, with a peak overland passage during the year coinciding with the late incubation and chick rearing stages (Travers et al. 2015). Fledglings leaving the nest for the first time exhibit strong phototropic behavior and rely on ambient light from the moon and stars to navigate to open ocean (Telfer et al. 1987).

The Hawaiian petrel was once abundant on all islands of the southern portion of the Hawaiian Archipelago including Hawai'i, Maui, Lāna'i, Kaho'olawe, Moloka'i, O'ahu, and Kaua'i (USFWS 1983, Ainley et al. 1997, KIRC 2015). Today breeding colonies are found only in remote or high elevation areas on the islands of Hawai'i, Maui, Lāna'i, and Kaua'i. Radar studies conducted in 2002 also suggest that breeding may occur on Moloka'i (SWCA 2018b) and recent evidence for the species' presence on O'ahu has also been documented (Young et al. 2019). The known breeding habitat varies by location: on East Maui (Haleakalā) and Hawai'i Island (Mauna Loa), petrels primarily breed in subalpine habitat at high elevation, while on Kaua'i and Lāna'i they breed in lowland wet or in wet cliff habitat with dense ferns (VanZandt et al. 2014).

Pelagic surveys estimate the total Hawaiian petrel population at 19,000 birds, including juveniles and subadults (Ainley et al. 1997, Spear et al. 1995). Croxall et al. (2012) estimated a global population of the Hawaiian petrel to be 9,000 to 16,000 mature individuals. Average breeding probability for Procellariiformes is estimated at 0.82 (Griesemer and Holmes 2011).

The majority of the Hawaiian petrel global population breeds on the island of Maui within Haleakalā National Park, a location that has had the longest consistent and intensive predator control in place since the 1970s. At Haleakalā NP, 2,505 nests are known to occur, which is an increase from 700 known nests documented by Simons in 1984 (USFWS 2016b).

Hawai'i Volcanoes National Park currently encompasses the largest active Hawaiian petrel colony on the Island of Hawai'i. Within the park, the closest known colony is located on the southwest flank of Mauna Loa within the Kahuku unit, approximately 15.3 km (9.5 mi) from the Pakini Nui Wind (Swift and Burt-Toland 2009). Most of the birds nesting in this colony fly inland in the southwestern and southeastern parts of the island, but a few are expected to fly in other directions, including over Pakini Nui Wind during their flights from the nesting colonies (Day et al. 2003). A small scale satellite telemetry study conducted in the park, indicated that Hawaiian petrels from the largest colony on the island (eastern slope of Mauna Loa, 34 mi from Pakini Nui Wind) may pass by or cross the project area on flights to and from the nesting colony.

On Kaua'i, while fledgling success in the last few years has improved, the overall population has declined 78% since 1993 (Raine et al. 2017). The Kaua'i Endangered Seabird Recovery Project (KESRP) monitored 177 burrows in 2017 and 138 burrows were confirmed breeding. At least 116 Hawaiian petrel chicks fledged in 2017 (Raine et al. 2018).

No breeding colonies are known to occur on O'ahu, however a 2016 study by Young and VanderWerf detected the presence of Hawaiian petrels on the windward slope of Mt. Ka'ala at 3,600 ft elevation, over 8 mi away from Kawailoa Wind Farm (Young et al. 2019). Additionally,

a Hawaiian petrel was found recently killed on July 21, 2017 in the Kawailoa project area (Tetra Tech 2018b).

Primary threats to the Hawaiian petrel include predation by introduced predators (Hodges and Nagata 2001; Raine and Banfield 2015a, 2015b) particularly cats, rats, mongoose, feral pigs, and barn owls; as well as collisions with power lines (Cooper and Day 1998; Podolsky et al. 1998); light attraction (Reed et al. 1985; Cooper and Day 1998); and changes to breeding habitat due to introduced invasive plants (Troy et al. 2014).

Fifty-four percent of all known Hawaiian petrel deaths at Haleakalā National Park, from 1991 to 2011 have been due to introduced predators (NPS 2012). Other studies suggest another threat to seabirds is climate change and its effects to both seabird adult survivorship and recruitment (Sandvik et al. 2012) by generally affecting food availability (Oro 2014).

3.11 HISTORIC, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

Native Hawaiian ecosystems and species are an essential part of the overall cultural landscape. “In Hawaiian culture, natural and cultural resources are one and the same. Native traditions describe the formation (literally the birth) of the Hawaiian Islands and the presence of life on and around them, in the context of genealogical accounts. All forms of the natural environment, from the skies and mountain peaks, to the plateau lands, watered valleys and lava plains, and to the shoreline and ocean depths are believed to be embodiments of Hawaiian gods and deities” (Maly and Maly 2006). Protection and restoration of native habitats and species will aid in preserving native Hawaiian traditions, history and spiritual connection to the land. In a regulatory context, Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended (16 U.S.C. §40 *et seq.*), requires federal agencies to take into account the effects of their proposed actions on properties eligible for inclusion in the National Register of Historic Places. The issuance of an ITP is an undertaking subject to Section 106 of the NHPA. Historical, archaeological, cultural and natural resources have been considered.

3.11.1 SOUTH HILO DISTRICT

Preliminary searches of the National Register of Historic Places (NPS 2018) and the Office of Hawaiian Affairs (OHA) Kipuka database (OHA 2018) show no historical or cultural resources within the Pi‘ihonua mitigation site. No earthwork will be conducted throughout the rest of the South Hilo mitigation areas.

3.11.2 KA‘Ū DISTRICT

The Ka‘ū district mitigation sites include mitigation areas within HVNP and Ka Lae. The archaeological resources at HVNP cross a range of prehistoric native Hawaiian and Euro/American historic sites. An archaeological overview and assessment of the park was prepared in 2008 (Tuggle and Tomonari-Tuggle 2008). It provides guidance and recommendations for future study. The Kahuku region has contributed to the park’s database of sites and more archaeological sites are expected to be found, as only a portion of the Kahuku Unit has been systematically surveyed (NPS 2013).

3.11.3 HANA DISTRICT

Archaeological resources specific to the Hana district mitigation sites are unknown, however previous archaeological investigations in the Kahikinui area suggest that in the steep upper elevations of leeward Haleakalā, archaeological sites are exclusively temporary in nature with no permanent dwellings or associated agricultural development (Tetra Tech 2011). It is anticipated that archaeological surveys of the Hana district mitigation areas would produce few sites, likely consisting of rock shelters, cairns, ridge trails, and other temporary use sites (Tetra Tech 2011).

3.11.4 MAKAWAO DISTRICT

Preliminary searches of the National Register of Historic Places (NPS 2018) and the OHA Kipuka database (OHA 2018) show no historical or cultural resources in either mitigation site within the Makawao district.

3.11.5 WAIALUA DISTRICT

No historical resources were found during preliminary searches of the National Register of Historic Places for the Helemano Wilderness area (NPS 2018). The OHA Kipuka database lists Wahi Pana-Poamoho Ditch Tunnel and Upper Helemano Ditch Tunnel as historic sites in the area (OHA 2018).

3.11.6 HANALEI DISTRICT

The Hanakāpī'ai mitigation area is located in extremely remote, rugged, and heavily vegetated mountainous terrain. Archaeological studies for similar projects in adjacent areas have not found any sites and have concluded that there is a low likelihood of historical sites in the area (DOFAW 2011). The nearby Nā Pali coast has an abundance of pre-historic archeological sites and aesthetic values and was placed on the state and national register of historic places in 1984. However, most research on historical and cultural resources in the area have focused on the lowland and coastal areas along the Nā Pali coast. No sites have been documented in the mitigation area (DOFAW 2011).

3.11.7 HAWAIIAN HOARY BAT

The Hawaiian hoary bat, which occurs in all districts, is a Covered Species in all four of the wind projects. A description of the species, their life history and status is described in Section 3.8. However, in addition to their listed status, the Hawaiian hoary bat is also important to Hawai'i's heritage and culture, and thus is considered a cultural resource. The Hawaiian name for bat ('ōpe'ape'a) compares the animal's wing to the sails (pe'a) of a canoe and the half-leaf remaining on the taro stalk after the top half has been removed for cooking (Pukui and Elbert 1986). The 'ōpe'ape'a is also considered an 'aumākua. 'Aumākua are family or personal gods, deified ancestors who might assume the shape of [various animals]" (Pukui and Elbert, 1986). A symbolic relationship exists between 'aumākua and their associated families. Various cultural protocols are followed to steward the relationships between the family and their 'aumākua

(Kittinger et al. 2011). A family did not harm or eat the animal form their 'aumākua takes, and the 'aumākua cared for the family in various ways. 'Aumākua warns and reprimands humans in dreams, visions, and calls; guides in times of trouble; and gives inspiration or strength in times of need. 'Aumākua can be associated with families for many generations, or can be recent additions based on events that carry special cultural meaning and significance (Kittinger et al. 2011).

3.11.8 HAWAIIAN PETREL

The Hawaiian petrel has value in traditional Hawaiian culture and practice throughout the islands. Evidence of Hawaiian Petrel activity has been documented on the islands of Hawai'i, Maui, Lāna'i, Kaua'i and O'ahu, with breeding colonies found on Hawai'i, Maui, Lāna'i, Kaua'i, and possibly on Moloka'i (SWCA 2018b). The Hawaiian petrel is a Covered Species in Ka'ū and Hanalei districts. Similar to the Hawaiian hoary bat, some families consider the seabirds as their ancestors or guardians, called 'aumākua in Hawaiian language. This is particularly true of families that engage in fishing and have ties to the ocean. Native seabirds such as the Hawaiian petrel are important symbols in Hawaiian culture because they inhabit all three realms: land (because they nest in burrows), air, and sea. Seabirds were also of practical value to Native Hawaiians for feathers and food (USFWS 2016b; Boynton 2004; Xamanek Researches 1989). On land, Hawaiian Petrel chicks were harvested from their burrows as food for the Ali'i, or Royal classes and seabird feathers were used for intricate featherwork in capes and lei making. Seabirds that feed at sea and return to shore at night were used to navigate back to land from fishing or trading voyages. Hawaiians observed seabird behavior to indicate changing weather patterns (KESRP 2019).

Hawaiian proverbs also reflect the role of seabirds and finding fish: "Ka i'a 'imi i ka moana, na ka manu e ha'i mai," or "The fish sought for in the ocean, whose presence is revealed by birds" and "Pōhai ke manu maluna, he i'a ko lalo" or "When the birds circle above, there are fish below" (Pukui 1983). In modern times, seabirds continue to play a role for aku (skipjack tuna) fishermen, as the behavior of seabirds at sea tells what is happening in the ocean miles away, providing valuable information for a successful fishing trip (Boynton 2004).

3.12 PUBLIC SERVICES AND UTILITIES

According to the 2017 State of Hawai'i Data Book produced by the Department of Business, Economic Development & Tourism (DBEDT), the amount of wind energy generated and consumed in Hawai'i has steadily increased each year since 2005. The state of Hawai'i generated 9,948.8450 millions of kilowatt hour (kWh) total energy in 2016. Out of this total, 639.1270 million kWh energy generated was from wind (DBEDT 2017).

3.12.1 SOUTH HILO DISTRICT

The Pi'ihonua mitigation site is located approximately 25 mi from the city of Hilo. The city of Hilo has a police station, multiple fire stations and medical facilities. Within Ka'ū district, the closest police station is located in Nā'ālehu and the closest fire station is in the town of Ocean View. Ka'ū district health facilities are located in the town of Pahala. Hawai'i Volcanoes National Park provides a range of basic public services such as law enforcement, fire protection,

and emergency medical services. The park operations program oversees electrical, solar, water, rain catchment and sewage systems within the park (NPS 2013).

3.12.2 KA'Ū DISTRICT

The Pakini Nui Wind farm located in the Ka'ū district on the island of Hawai'i is a 20.5-MW operating wind facility with an estimated capability to provide enough power to service 18,000 homes (SWCA 2018a). The island of Hawai'i produced 1,159.57 million kWh of electricity in 2016 and out of this total, 141.8 million kWh of electricity was produced through wind (DBEDT 2017). The Hawaiian Electric Light Company (HELCO) services Hawai'i Island.

3.12.3 WAILUKU, MAKAWAO AND HANA DISTRICTS

The Maui mitigation sites are located on private land with limited public services and utilities. The closest electric plant is operated by Maui Electric Company (MECO) and is located in Mā'alaea (Tetra Tech 2011). Solid waste collection sites are located at the Central Maui Sanitary Landfill in Pu'unēnē, and the Maui Demolition and Construction Landfill in Kīhei. The County of Maui Fire Department has the primary responsibility for responding to fires. The main fire station on Maui is in Kahului, but fire stations are also located in Kula and in Makawao. The Maui Police Headquarters are in Wailuku, with the closest police station in Kīhei. The nearest hospital is the Kula Hospital, which is a critical access hospital and does not receive ambulances. Ambulances are directed to Maui Memorial Hospital in Wailuku. (Tetra Tech 2011).

The Auwahi Wind farm and KWP II both operate on Maui. Auwahi is a 21 MW (21000 kW) facility which produced 84,144 MW hours of wind energy in 2016 and 74,012 MW hours in 2017 (EIA 2018). KWP II is a 22 MW operating wind facility, which produced 80,196 MW hours in 2016 and 66,734 MW hours in 2017 (SWCA 2018b). The island of Maui produced a total 1,154.65 million kWh of electricity in 2016, and out of this, 270.04 million kWh was generated through wind (DBEDT 2017).

3.12.4 WAIALUA DISTRICT

The HWA mitigation site is located within Waialua district of O'ahu. The mitigation site is accessed through the town of Wahiawā, which has numerous public services including a police station, fire station, and hospital (SWCA 2011b, USFWS 2011).

Kawailoa Wind farm on O'ahu is a 69 MW (69,000 kW) facility (Tetra Tech 2018b). A total of 7,109.65 million kWh of electricity was produced on O'ahu in 2016, of which 227.29 million kWh were generated by wind turbines (DBEDT 2017).

3.12.5 HANALEI DISTRICT

The Hanakāpī'ai mitigation site is remote and most easily accessible by helicopter. There are no services or utilities located within the mitigation site and the nearest urban area is in Hanalei which is several miles away (DOFAW 2011).

3.13 AGRICULTURE

The Hanakāpī'ai mitigation site, the Hawaiian goose mitigation site at Pi'ihonua, and the mitigation sites within HAVO do not include any agricultural lands or resources as these areas are managed primarily for conservation.

3.13.1 WAIALUA DISTRICT

The HWA includes 1,200 ac of land that is currently zoned for agriculture. This represents about 1% of the total zoned agricultural land on O'ahu (105,500 ac), though only 40,818 ac are currently in production (Hawai'i State Department of Agriculture 2016). The portion of HWA that is zoned agriculture is a mix of ranchland, small plots of farmed land, and fallow fields. The purchase of the property will likely remove these fields from future crop production. The ranch lease is expected to be extended an additional five years until 2026 as part of the purchase (DOFAW 2018). In addition, current management plans by DOFAW do include future forestry activities on the parcel (DOFAW 2018), which would be a compatible agricultural use, as well as be consistent with the long-term protection of the area for Hawaiian hoary bats.

3.13.2 MAKAWAO AND HANA DISTRICTS

Based on the amendment request submitted by Auwahi Wind, the mitigation site at Waihou does occur primarily on land now used for cattle ranching. The ranching operations are expected to continue and the long-term easement on the site will keep it from being further developed into the future. The pens used for Hawaiian goose management on Maui cover an area of only a few acres. While this is taken out of ranch production, it constitutes a miniscule amount of the more than 108,000 ac of pastureland on Maui (Hawai'i State Department of Agriculture 2016).

CHAPTER 4 – ENVIRONMENTAL CONSEQUENCES

This chapter identifies potential impacts of each of the four Projects under the same three alternatives. The discussion is organized by elements of the Affected Environment described in Chapter 3. Each project alternative is evaluated separately for its impacts to the Affected Environment resources. The scope of the analysis in this PEIS covers the direct, indirect, and cumulative effects of the proposed incidental take, the proposed mitigation to offset that take, and the management measures proposed for implementation by the three HCP amendments and one new HCP. Because the four wind energy facilities are already constructed and in operation, the proposed action or alternatives would have no effect on wind energy facility size or project siting. No new construction or refurbishment of structures at any of the Project facilities is proposed.

Environmental consequences previously described and analyzed in NEPA documents addressing the Auwahi Wind HCP (USFWS 2012), Kawailoa HCP (USFWS 2011a), and the KWP II HCP (Planning Solutions 2010, USFWS 2011b) are incorporated into this PEIS by reference. The Pakini Nui Wind HCP is a new permit action (Section 2.1.4 for background on the Project). As detailed in Chapter 2, the alternatives are limited to evaluating different approaches to mitigating

(i.e., off-setting) or lessening the adverse effects of incidental take caused by each alternative on populations of the Hawaiian hoary bat, Hawaiian petrel, and the Hawaiian goose, as applicable depending on the project.

The Service determined that the PEIS would not need to discuss several of the Affected Environment resources in detail because there would be no or very limited potential for effects. A complete list of the resources considered, and the reasons they are excluded from detailed analysis, is provided in Section 1.6.

4.1 GEOLOGY AND SOILS

4.1.1 ALTERNATIVE 1A: AUWAHI WIND NO ACTION

The environmental effects of the existing 2012 Auwahi Wind HCP/ITP were analyzed previously under NEPA (USFWS 2012). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.1, would be Auwahi Wind implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat. The implementation of nighttime curtailment would not result in any effects to geology or soils.

4.1.2 ALTERNATIVE 1B: KAWAIOLOA WIND NO ACTION

The environmental effects of the existing 2011 Kawaihoa Wind HCP/ITP were analyzed previously under NEPA (USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.2, would be Kawaihoa Wind implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat. The implementation of nighttime curtailment would not result in any effects to geology or soils.

4.1.3 ALTERNATIVE 1C: KWP II WIND NO ACTION

The environmental effects of the existing 2011 KWP II HCP/ITP were analyzed previously under NEPA (Planning Solutions 2010, USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.3, would be KWP II implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat. The implementation of nighttime curtailment would not result in any effects to geology or soils.

4.1.4 ALTERNATIVE 1D: PAKINI NUI WIND NO ACTION

Under the No Action Alternative, Pakini Nui Wind would not be issued an ITP. Pakini Nui Wind would likely continue to conduct operations and maintenance at the wind facility as described in Section 2.1.4, including the implementation of full nighttime curtailment. The continuation of daytime facility operations and other actions by Pakini Nui Wind, which does not require an ITP, would result in no impacts to geology and soils.

4.1.5 ALTERNATIVE 2A: AUWAHI WIND PROPOSED ACTION

Under Alternative 2A, (Section 2.2.1), nighttime LWSC of turbine operations would have no effect on geology or soils.

Auwahi Wind's proposed Hawaiian hoary bat Tier 4 mitigation actions would occur on 1,752 ac of 'Ulupalakua Ranch lands. Implementation of the proposed mitigation would result in soil disturbance, including excavation and grading for the two new pond features; excavated soil would be repurposed for use around the mitigation area. Reforestation of 1,556 ac of pasture land would also result in soil disturbance, varying in extent depending on the method used for tree planting. Much of the planting may be accomplished by hand, but it is possible that heavy equipment, such as a bulldozer, could be used in some areas to facilitate efficient planting of hedgerows. Approximately 150,000 ft of ungulate fence would be constructed around the reforested areas, with some degree of soil disturbance from installation of the fence posts. Road improvements, if needed, would be consistent with current ranching operations and are not expected to require excavation or extensive grading. Little to no ground disturbance is expected for the replacement or retrofitting of water troughs, or the extension of the existing water line network to supply water to the troughs and ponds. The water line network consists of above-ground PVC pipe; therefore, no excavation is needed for extensions or repairs of the line.

Auwahi Wind's proposed Hawaiian hoary bat Tier 5 and Tier 6 mitigation actions would include similar habitat restoration actions at Kamehamenui Forest. Implementation of Auwahi Wind's Tier 5 and Tier 6 mitigation would be expected to have impacts to soils similar to those expected for Tier 4 mitigation actions as described above. Based on the results of monitoring activities to-date under the 2012 HCP, the extent of disturbance associated with the above activities is likely to be minor.

Minor soil-related impacts could occur as a result of erosion or stormwater runoff. Potential impacts will be temporary and localized and would be minimized through implementation of standard BMPs to control erosion and stormwater runoff, consistent with the measures described in the 2011 EIS (USFWS 2012). Over the long-term, reforestation is expected to stabilize soils and improve habitat quality for native species, as well as reduce the potential for water- or wind-related soil erosion. Similarly, removal of ungulates from within the fence lines will prevent soil damage and increase soil stability.

4.1.6 ALTERNATIVE 2B: KAWAILOA WIND PROPOSED ACTION

Under Alternative 2B, (Section 2.2.2) nighttime LWSC of turbine operations would have no effect on geology or soils.

Kawaiiloa Wind's proposed Hawaiian petrel mitigation activities would consist of predator control, trapping and petrel burrow monitoring at Hanakāpī'ai and Hanakoa and have some potential for soil disturbance and soil compaction due to foot traffic associated with access to the areas. However, this impact is expected to be negligible because the foot traffic is short-term, temporary, distributed over a large area, and is likely to involve only light compression of

affected soils. Acquisition of the HWA is expected to provide direct and indirect benefits to soil resources by protecting the area from development.

Hawaiian hoary bat Tier 5 and 6 mitigation may include the following habitat restoration activities: fencing and removal of ungulates, invasive vegetation removal, and planting of native forest trees. These habitat restoration activities may result in short-term soil disturbance. However, over the long term, these habitat restoration activities are expected to stabilize soils and improve habitat quality for native species, as well as reduce the potential for water- or wind-related soil erosion. Similarly, removal of ungulates from within the fence lines will prevent soil damage and increase soil stability.

4.1.7 ALTERNATIVE 2C: KWP II WIND PROPOSED ACTION

Under Alternative 2C, (Section 2.2.3) nighttime LWSC of turbine operations would have no effect on geology or soils.

The USGS research study on the island of Hawai'i, funded as mitigation for Hawaiian hoary bat impacts, may result in minor soil compaction or disturbance associated with foot or vehicle access to research sites. Predator control and fence maintenance at Pi'iholo Ranch pen or Haleakala pen on Maui have the potential for some limited soil disturbance and soil compaction due to foot traffic associated with access to the areas. However, these impacts are expected to be negligible because the foot traffic is short-term, distributed over a large area, and involves light compaction of affected soils.

4.1.8 ALTERNATIVE 2D: PAKINI NUI WIND PROPOSED ACTION

Under alternative 2D, (Section 2.2.4) nighttime LWSC of turbine operations would have no effect on geology or soils.

Pakini Nui Wind's Hawaiian hoary bat mitigation would consist of habitat improvement of approximately 1,200 ac of degraded lowland mesic-wet 'ōhi'a forest within the Kahuku Unit of HVNP in the Ka'ū district on Hawai'i Island. Habitat improvement activities, including invasive plant control, native forest tree planting and seed scarification around existing koa trees have the potential for some soil disturbance. However, this impact is expected to be temporary and localized, and over the long-term, these habitat improvements would provide direct and indirect benefits to soils.

Pakini Nui Wind's Hawaiian petrel mitigation activities include funding for fence maintenance, predator control and monitoring, and petrel burrow monitoring at an existing fenced area managed for endangered seabirds at HVNP. Site access for these activities has the potential for some soil disturbance. However, these impacts are expected to be negligible as access is occasional with the number of trips likely to be reduced by the installation of remote cameras and involves only light compression of affected soils. Pakini Nui Wind would contract with DOFAW to construct a new 7-ac Hawaiian goose breeding pen at Pi'ihonua, Hilo District on Hawai'i Island. The breeding pen would be enclosed by approximately 2,100 ft of predator-proof fence and contain two existing reservoirs. Fence construction has the potential for soil

disturbance caused by initial clearing and installation of the fence posts. In addition, fence and reservoir maintenance and repair, vegetation maintenance using lawn mowers and weed trimmers, and predator control have the potential for some minor soil disturbance, although impacts from these activities are expected to be temporary and localized and only involve minor adverse effects.

4.1.9 ALTERNATIVE 3A: AUWAHI WIND INCREASED CURTAILMENT

Under Alternative 3A, (Section 2.3.1) Auwahi Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in no effects to geology or soils.

Soil and geology impacts from the Alternative 3A mitigation activities would be similar to, but on a lesser scale, than described in Section 4.1.5 above, due to the smaller mitigation acreages needed for this alternative.

4.1.10 ALTERNATIVE 3B: KAWAIOLOA WIND INCREASED CURTAILMENT

Under Alternative 3B, (Section 2.3.2) Kawailoa Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in no effects to geology or soils.

Soil and geology impacts from the Alternative 3B Hawaiian hoary bat mitigation activities would be similar to, but on a lesser scale, than described in Section 4.1.6 above, due to the smaller mitigation acreages needed for this alternative. Impacts from Hawaiian petrel mitigation activities would be identical to those described in Section 4.1.6 above.

4.1.11 ALTERNATIVE 3C: KWP II INCREASED CURTAILMENT

Under Alternative 3C, (Section 2.3.3) KWP II would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in no effects to geology or soils.

Mitigation activities for this alternative would be the same Hawaiian hoary bat research project and predator control for Hawaiian goose as described in Section 4.1.7; therefore, the impacts to soils and geology would be identical to Alternative 2C.

4.1.12 ALTERNATIVE 3D: PAKINI NUI WIND INCREASED CURTAILMENT

Under Alternative 3D, Pakini Nui Wind would be issued an ITP to operate as described in Section 2.3.4. Pakini Nui Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in no effects to geology or soils.

Soil and geology impacts from the Alternative 3D Hawaiian hoary bat mitigation activities would be similar to, but on a lesser scale, than described in Section 4.1.8 above, due to the smaller mitigation acreages needed for this alternative. Impacts from mitigation for Hawaiian goose and Hawaiian petrel would be identical to those described in Section 4.1.8 above.

4.2 HYDROLOGY AND WATER RESOURCES

4.2.1 ALTERNATIVE 1A: AUWAHI WIND NO ACTION

The environmental effects of the existing 2012 Auwahi Wind HCP/ITP were analyzed previously under NEPA (USFWS 2012). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.1, would be Auwahi Wind implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat. The implementation of nighttime curtailment would not result in any effects to hydrology or water resources.

4.2.2 ALTERNATIVE 1B: KAWAIOLOA WIND NO ACTION

The environmental effects of the existing 2011 Kawaioloa Wind HCP/ITP were analyzed previously under NEPA (USFWS 2011a). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.2, would be Kawaioloa Wind implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat. The implementation of nighttime curtailment would not result in any effects to hydrology and water resources.

4.2.3 ALTERNATIVE 1C: KWP II NO ACTION

The environmental effects of the existing 2011 KWP II HCP/ITP were analyzed previously under NEPA (Planning Solutions 2010, USFWS 2011b). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.3, would be KWP II implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat. The implementation of nighttime curtailment would not result in any effects to hydrology and water resources.

4.2.4 ALTERNATIVE 1D: PAKINI NUI WIND NO ACTION

Under the No Action Alternative, Pakini Nui Wind would not be issued an ITP. Pakini Nui Wind would likely continue to conduct operations and maintenance at the wind facility as described in

Section 2.1.4, including the implementation of full nighttime curtailment. The continuation of daytime facility operations and other actions by Pakini Nui Wind, which does not require an ITP, would result in no impacts to hydrology and soils.

4.2.5 ALTERNATIVE 2A: AUWAHI WIND PROPOSED ACTION

Under Alternative 2A, (Section 2.2.1), nighttime LWSC of turbine operations would have no effect on hydrology and water resources.

Under the amended HCP, the restoration area for Hawaiian hoary bat mitigation is located in the Wailea watershed. Reforestation will require watering of initial plantings; however, long-term irrigation is not expected to be needed. Water for reforestation will be obtained from existing water sources used by 'Ulupalakua Ranch and this use is not expected to substantially affect groundwater based on the results of similar activities implemented and monitored under the 2012 HCP. No other mitigation activities are expected to involve water use.

There are several drainage features located within or near the mitigation area which contain water on an intermittent basis. Five small ponds, which are used by grazing cattle, occur in the Waihou Area; these ponds range in size from 40 by 50 ft up to 60 by 120 ft. Water troughs for cattle are only filled about 2 to 4 months per year. There are no wetlands or other perennial surface water features in the mitigation area. Actions proposed under the amended HCP within the 1,556 ac of pasture land that include planting native forest trees and creating hedgerows are expected to result in short-term water quality impacts due to ground disturbance. However, the trees and hedgerows would provide long-term direct and indirect benefits to surface water streams running through the pasture lands area and to the Kama'ole aquifer by improving water quality and increasing groundwater aquifer recharge.

The Kama'ole aquifer has a sustainable yield of 11 million gallons per day. The creation of two large 50,000 gallon ponds are expected to have short-term, temporary adverse impacts to nearby surface water areas from possible erosion and storm water runoff during pond construction. Following completion of pond construction, all disturbed areas will be revegetated pursuant to BMPs under the amended HCP. Neither the water troughs nor the pond features are likely to change hydrologic patterns or substantially impact groundwater within the mitigation area. Two existing groundwater springs will provide a sufficient water supply for the new ponds. One spring is located east of the mitigation area in the Kula Forest Reserve, with an existing water line to the pasture lands, and another in the Waihou Area that feeds the existing ponds and troughs. Water withdrawal for the mitigation water features represents a negligible volume from the aquifers and falls within the currently permitted water use by 'Ulupalakua Ranch. The proposed locations for the two large ponds are at least a half mile north of any surface water stream and would not be connected to existing bodies of water once completed.

Mitigation proposed for Tiers 5 and 6 would likely occur in the Kamehamehame Forest. DLNR has estimated that reforestation of the entire parcel is anticipated to increase the water collection in the Makawao aquifer from 3.4 million to 4.2 million gallons of water per day (Tetra Tech 2019a). The actions proposed by Auwahi Wind which are similar to those proposed in Tier 4 would be expected to contribute to that expected water collection gain.

4.2.6 ALTERNATIVE 2B: KAWAIOLOA WIND PROPOSED ACTION

Under Alternative 2B, (Section 2.2.2) nighttime LWSC of turbine operations would have no effect on hydrology or water resources.

Under the amended ITP/HCP, Kawailoa Wind's Hawaiian petrel mitigation activities, including predator control trapping and petrel burrow monitoring at Hanakāpī'ai and Hanakoa, are expected to have no effect to water resources, as no drilling or subsurface work would occur, and no surface water occurs in the mitigation area. The land acquisition of HWA for bats sits over the Wahiaiwā aquifer of the Central Sector (Mink and Lau, 1990). This aquifer is considered ecologically important and is currently used for drinking water (Agribusiness Development Corporation 2015). There is also a surface water ditch that traverses the property. The acquisition of the HWA is expected to provide direct and indirect benefits to the water source that traverses the property and the aquifer below the acquired parcels by protecting the area from development in perpetuity. Tier 5 and 6 mitigation may include restoration of terrestrial native vegetation and removal of invasive terrestrial and aquatic vegetation that are likely to further improve water quality and wildlife access to water sources.

4.2.7 ALTERNATIVE 2C: KWP II PROPOSED ACTION

Under Alternative 2C, (Section 2.2.3) nighttime LWSC of turbine operations would have no effect on hydrology or water resources.

Under the amended HCP, the USGS research study and the Hawaiian goose predator control at the existing Pi'iholo Ranch and at Haleakalā Ranch pens are not expected to have any impacts to hydrology or water resources.

4.2.8 ALTERNATIVE 2D: PAKINI NUI PROPOSED ACTION

Under alternative 2D, (Section 2.2.4) nighttime LWSC of turbine operations would have no effect on hydrology or water resources.

Under the proposed HCP, the restoration of 1,200 ac of degraded lowland mesic-wet 'ōhi'a forest within the Kahuku Unit of HVNP includes controlling invasive plants, planting native forest trees and seed scarification around existing koa trees to regenerate the existing koa seed bank in the Ka'ū district. Several streams flow through mid and lower elevations below the mitigation area. One-time temporary impacts to the wetlands and streams may occur during invasive vegetation control and native species planting; however, the impacts from these actions would to hydrology and water resources would be minor and temporary. The mitigation activities are expected to provide long-term direct and indirect benefits to surface water streams running through the mid and lower lands by improving water quality and increasing watershed groundwater recharge.

Under the proposed Pakini Nui Wind HCP, Hawaiian petrel mitigation activities would include predator control trapping and petrel burrow and predator monitoring at HVNP and are expected

to have no effect to water resources, as no drilling or subsurface work would occur. As mitigation for impacts to the Hawaiian goose, Pakini Nui Wind would contract with DOFAW to construct a new 7-ac breeding pen on Hawai'i Island. The new 7-acre pen would contain two existing reservoirs. The predator-proof fence would be constructed during the first year of the Hawaiian goose mitigation project. Installation of fence posts is not expected to have an impact on the hydrology because the posts will not reach the water table and there are no streams on the site. The predator-proof fence is expected to limit access of predators to the water reservoir that cannot traverse the fence. Under the proposed HCP, mitigation would also include some fence and enclosure maintenance and repair, purchase of vegetation maintenance equipment (i.e., lawn mowers and weed trimmers), and repair of the reservoir to maintain year-round water, and control of predators. The repair and maintenance of the reservoir are expected to provide long-term water resource benefits to wildlife that can access the reservoirs within the fenced area.

4.2.9 ALTERNATIVE 3A: AUWAHI WIND INCREASED CURTIALMENT

Under Alternative 3A, (Section 2.3.1) Auwahi Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in no effects to hydrology or water resources.

Hydrology or water resource impacts from the Alternative 3A mitigation activities would be similar to, but on a lesser scale, than described in Section 4.2.5 above, due to the smaller mitigation acreages needed for this alternative.

4.2.10 ALTERNATIVE 3B: KAWAILOA WIND INCREASED CURTAILMENT

Under Alternative 3B, (Section 2.3.2) Kawailoa Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in no effects to hydrology or water resources.

Hydrology or water resource impacts from the Alternative 3A Hawaiian hoary bat mitigation activities would be similar to, but on a lesser scale, than described in Section 4.2.6 above, due to the smaller mitigation acreages needed for this alternative. Impacts from Hawaiian petrel mitigation would be identical to those described in Section 4.2.6 above.

4.2.11 ALTERNATIVE 3C: KWP II INCREASED CURTAILMENT

Under Alternative 3C, (Section 2.3.3) KWP II would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in no effects to hydrology or water resources.

Mitigation activities for this alternative would be similar as described in Section 4.1.7; therefore, the impacts to hydrology and water resources would be identical to Alternative 2C.

4.2.12 ALTERNATIVE 3D: PAKINI NUI INCREASED CURTAILMENT

Under Alternative 3D, (Section 2.3.4) Pakini Nui Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in no effects to hydrology or water resources.

Hydrology or water resource impacts from the Alternative 3A Hawaiian hoary bat mitigation activities would be similar to, but on a lesser scale, than described in Section 4.2.8 above, due to the smaller mitigation acreages needed for this alternative. Impacts from mitigation for Hawaiian goose and Hawaiian petrel would be identical to Section 4.2.8.

4.3 NATURAL HAZARDS (FLOODING AND WILDFIRE)

4.3.1 ALTERNATIVE 1A: AUWAHI WIND NO ACTION

The environmental effects of the existing 2012 Auwahi Wind HCP/ITP were analyzed previously under NEPA (USFWS 2012). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.1, would be Auwahi Wind implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat.

4.3.2 ALTERNATIVE 1B: KAWAIOLOA WIND NO ACTION

The environmental effects of the existing 2011 Kawaihoa Wind HCP/ITP were analyzed previously under NEPA (USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.2, would be Kawaihoa Wind implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat.

4.3.3 ALTERNATIVE 1C: KWP II NO ACTION

The environmental effects of the existing 2011 KWP II HCP/ITP were analyzed previously under NEPA (Planning Solutions 2010, USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.3, would be KWP II implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat.

4.3.4 ALTERNATIVE 1D: PAKINI NUI NO ACTION

Under the No Action Alternative, Pakini Nui Wind would not be issued an ITP. Pakini Nui Wind would likely continue to conduct operations and maintenance at the wind facility as described in Section 2.1.4, including the implementation of full nighttime curtailment.

The continuation of daytime facility operations and other actions by Pakini Nui Wind, which does not require an ITP, would result in no impact to natural hazards.

4.3.5 ALTERNATIVE 2A: AUWAHI WIND PROPOSED ACTION

Under Alternative 2A, (Section 2.2.1), operational changes related to take avoidance and minimization would have no effect on natural hazards.

Under Auwahi Wind's proposed HCP amendment, restoration of 1,556 ac of pasture land, including planting native forest trees and creating hedgerows, is not expected to have impacts on natural hazards such as flooding or wildfire. The two proposed 50,000 gallon ponds on an additional 196 ac will be designed to facilitate aerial firefighting efforts by serving as dip tanks. The addition of these ponds will allow for helicopters to fight fires to protect the mitigation area, and also adjacent lands including Kula State Forest Reserve, Kanaio Natural Area Reserve, and the Pūu Makua/Waihou mitigation area. The two ponds are expected to provide direct benefits to wildfire prevention and control. Under Auwahi Wind's proposed HCP amendment Tier 5 and Tier 6 mitigation would include similar habitat restoration actions at Kamehamenui Forest. Under the proposed HCP amendment, implementation of Auwahi Wind's Tier 5 and Tier 6 mitigation is expected to have impacts to natural hazards such as flooding and wildfire similar to those expected for Tier 4 mitigation actions.

The extent of disturbance associated with the above activities will be relatively limited. However, minor flood or storm water runoff may be expected during establishment of out-plantings during severe storms. Potential impacts are likely to be temporary in nature and minimized through implementation of standard BMPs to control erosion and floodwater runoff, consistent with the measures described in the 2011 EIS (Tetra Tech 2011), 2012 EA (USFWS 2012) and 2012 HCP. Over the long-term, reforestation under the amended HCP is expected to stabilize soils and improve habitat quality for native species, as well as reduce the potential for water- or wind-related erosion. Similarly, removal of ungulates from within the fence lines will minimize floodwater and soil runoff and increase soil stability.

4.3.6 ALTERNATIVE 2B: KAWAIILOA WIND PROPOSED ACTION

Under Alternative 2B, operations and anticipated take of covered species at the Kawaiiloa Wind facility would be as described in Section 2.2.2. Operation of the existing wind turbines will result in no effects on natural hazards. Under the proposed HCP amendment, Kawaiiloa Wind's Hawaiian petrel mitigation activities, including predator control trapping and petrel burrow monitoring at Hanakāpī'ai and Hanakoa, are expected to have no effect on the occurrence of natural hazards such as flooding or fire. Access for mitigation and monitoring activities is temporary and infrequent and no sources of open flame, smoking or incendiary devices are

allowed. Acquisition of the HWA is not expected to have impacts on flooding or wildlife. Under the proposed HCP amendment, Tier 5 and Tier 6 mitigation may include the following habitat restoration activities: fencing and removal of ungulates; invasive vegetation removal; and planting of native forest trees. Over the long-term, these habitat restoration activities are expected to stabilize soils and improve habitat quality for native species, as well as reduce the potential for flood or storm water- or wind-related erosion. BMPs will be used to prevent and minimize the risk of natural hazards occurring such as flooding and fires. Under the amended HCP, future land acquisition is expected to have the same effects as Tier 4 mitigation actions.

4.3.7 ALTERNATIVE 2C: KWP II WIND PROPOSED ACTION

Under Alternative 2C, operations and anticipated take of covered species at the KWP II wind facility would be as described in Section 2.2.3. Operation of the existing wind turbines will result in no effects on natural hazards. The USGS research study for bat mitigation is not expected to have impacts involving the occurrence of natural hazards such as flooding or wildfire. The impacts of accessing Hawaiian hoary bat mist net sites and acoustic monitoring sites are temporary and no open flames, smoking or incendiary devices will be used. Haleakalā Ranch is predominantly upland. Maintenance within and outside the Hawaiian goose pen, outplanting of native plant species, and fuel-load reduction are expected to have beneficial impacts by minimizing the potential for impacts involving flooding or wildfire. Predator control and fence maintenance at Pi'iholo Ranch pen or Haleakalā Ranch pen on Maui to benefit the Hawaiian goose is not expected to influence the likelihood of flooding or wildfire within the affected area.

4.3.8 ALTERNATIVE 2D: PAKINI NUI PROPOSED ACTION

Under Alternative 2D, operations and anticipated take of covered species at the Pakini Nui Wind facility would be as described in Section 2.2.4. General habitat improvements from the removal of invasive vegetation and the reduction of fuel-loading, and replacement with native plants are expected to provide direct and indirect benefits by preventing the occurrence of natural hazards such as flooding or wildfire. Hawaiian petrel mitigation activities under the proposed Pakini Nui Wind HCP include funding for fence maintenance, predator control and monitoring, and petrel burrow monitoring at an existing fenced area managed for endangered seabirds at HVNP.

No impacts to wildfire risk are expected because no open flames, smoking or incendiary devices will be allowed. Construction of a new 7-ac breeding pen for the Hawaiian goose at Pi'ihonua would be enclosed by approximately 2,100 ft of predator-proof fence and contain two existing reservoirs that can be used for fighting wildfire. Fence and reservoir maintenance and repair, and vegetation maintenance using lawn mowers and weed trimmers are expected to have negligible to beneficial impacts on the natural hazards through the reduction of fuel-loading and the maintenance of water sources for firefighting.

4.3.9 ALTERNATIVE 3A: AUWAHI WIND INCREASED CURTAILMENT

Under Alternative 3A, (Section 2.3.1) Auwahi Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing

wind turbines related to take avoidance and minimization would result in no effects natural hazards.

Impacts to natural hazards from the Alternative 3A mitigation activities would be similar to, but on a lesser scale, than described in Section 4.3.5 above, due to the smaller mitigation acreages needed for this alternative.

4.3.10 ALTERNATIVE 3B: KAWAILOA WIND INCREASED CURTAILMENT

Under Alternative 3B (Section 2.3.2) Kawaiiloa Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in no effects natural hazards.

Impacts to natural hazards from the Alternative 3B Hawaiian hoary bat mitigation activities would be similar to, but on a lesser scale, than described in Section 4.3.6 above, due to the smaller mitigation acreages needed for this alternative. Impacts from Hawaiian petrel mitigation would be identical to those described in Section 4.3.6 above.

4.3.11 ALTERNATIVE 3C: KWP II INCREASED CURTAILMENT

Under Alternative 3C (Section 2.3.3) KWP II would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in no effects natural hazards.

The USGS research study being implemented for Hawaiian hoary bat mitigation, along with the predator control and fence maintenance at the Pi'iholo Ranch Hawaiian goose pen or at Haleakalā Ranch on Maui would have no effect on natural hazards.

4.3.12 ALTERNATIVE 3D: PAKINI NUI INCREASED CURTAILMENT

Under Alternative 3D (Section 2.3.4) Pakini Nui Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in no effects natural hazards.

Impacts to natural hazards from the Alternative 3D mitigation activities would be similar to, but on a lesser scale, than described in Section 4.3.8 above, due to the smaller mitigation acreages needed for this alternative. Impacts from Hawaiian petrel and Hawaiian goose mitigation would be identical to those described in Section 4.3.8 above.

4.4 VEGETATION

4.4.1 ALTERNATIVE 1A: AUWAHI WIND NO ACTION

The environmental effects of the existing 2012 Auwahi Wind HCP/ITP were analyzed previously under NEPA (USFWS 2012). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.1, would be Auwahi Wind implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat.

4.4.2 ALTERNATIVE 1B: KAWAIILOA WIND NO ACTION

The environmental effects of the existing 2011 Kawaiiloa Wind HCP/ITP were analyzed previously under NEPA (USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.2, would be Kawaiiloa Wind implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat.

4.4.3 ALTERNATIVE 1C: KWP II NO ACTION

The environmental effects of the existing 2011 KWP II HCP/ITP were analyzed previously under NEPA (Planning Solutions 2010, USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.3, would be KWP II implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat.

4.4.4 ALTERNATIVE 1D: PAKINI NUI NO ACTION

Under the No Action Alternative, Pakini Nui Wind would not be issued an ITP. Pakini Nui Wind would likely continue to conduct operations and maintenance at the wind facility as described in Section 2.1.4, including the implementation of full nighttime curtailment.

The continuation of daytime facility operations and other actions by Pakini Nui Wind, which does not require an ITP, would result in no impacts to vegetation.

4.4.5 ALTERNATIVE 2A: AUWAHI WIND PROPOSED ACTION

Under Alternative 2A, (Section 2.2.1), Project operational changes including LWSC of the wind turbines related to take avoidance and minimization would have no effect on vegetation.

Auwahi Wind's proposed Tier 4 mitigation actions would occur on 1,752 ac of 'Ulupalakua Ranch lands. The proposed mitigation activities would involve some disturbance and clearing of grassland habitat for installation of water features, as well as for reforestation and installation of ungulate fencing. Impacts to vegetation from the other mitigation activities (including road improvements and water line extensions) are expected to be minimal, and consistent with ongoing cattle ranching operations in this area. The total amount of grassland vegetation that will

be temporarily or permanently impacted represents a small fraction of the overall mitigation area and surrounding habitat. The species that will be affected are primarily non-native species associated with the degraded grassland habitat. No forest vegetation will be removed as part of these activities. Because the Waihou Mitigation Area is adjacent to designated critical habitat for several plant species, there is a potential for listed plant species to occur in the area affected by mitigation actions. However, there is a low likelihood of impacts to listed plant species due to ongoing vegetation monitoring that would detect listed species and take appropriate action to avoid or minimize adverse impacts to these plants. Standard BMPs for invasive plant management will be implemented to minimize adverse impacts to vegetation communities across the mitigation area. Gear-cleaning procedures for equipment and vehicles will be enforced to reduce the potential for introduction of invasive plant seeds and propagules, as well as arthropods such as exotic ants. Targeted use of herbicides will be carried out as needed to control certain invasive species, if needed.

Long-term benefits to vegetation in the mitigation area are expected through reforestation of hedgerows with fast-growing tree species. It is possible that non-native, non-invasive, trees and understory species could be included in the reforestation effort; however, native species suitable for Hawaiian hoary bats will be used to the extent practicable. Ungulate fencing is also likely to provide benefits by reducing grazing, browsing, and trampling of native vegetation by ungulates, thus promoting the long-term success of the reforested areas. The legal protection applied to the mitigation area will also provide benefits by prohibiting reduction in forest cover below 20% within the Pasture lands. Furthermore, installation of dip tanks as part of the pond features will help to provide protection for vegetation in future cases of wildfire. Through natural and assisted forest regeneration and ongoing legal protection, benefits to vegetation associated with the mitigation measures are anticipated beyond the permit term of the HCP. Auwahi Wind's proposed Tier 5 and Tier 6 mitigation actions include similar habitat protection and restoration actions as described above and occur in two additional areas encompassing 690 ac and 508 ac, respectively in the Kamehamehenui Forest. Implementation of Auwahi Wind's Tier 5 and Tier 6 mitigation actions is expected to have vegetation impacts similar to those caused by Tier 4 mitigation actions.

4.4.6 ALTERNATIVE 2B: KAWAIOLOA WIND PROPOSED ACTION

Under Alternative 2B, (Section 2.2.2), Project operational changes including LWSC of the wind turbines related to take avoidance and minimization would have no effect on vegetation.

Kawaioloa Wind's Hawaiian petrel mitigation activities, including predator control trapping and petrel burrow monitoring at Hanakāpī'ai and Hanakoa, Kaua'i, have some potential for disturbance to native vegetation associated with access to these areas. However, this is expected to be negligible as impacts are short-term, temporary, and distributed over a large area. Because of the predominance of native vegetation, designated critical habitat, and the occurrence sensitive plant species, there is the potential for impacts to sensitive plant species and their habitats at the Kaua'i mitigation sites. However, there is a low likelihood of impacts to sensitive plant species because access is likely to be confined to existing trails and knowledgeable field staff that would be able to identify species and take appropriate action to avoid or minimize adverse impacts.

Acquisition of the HWA is expected to provide direct and indirect benefits to vegetation resources by protecting the area from development. Tier 5 mitigation may include the following habitat restoration activities on 1,725 ac on O'ahu: fencing and removal of ungulates; invasive vegetation removal; and planting of native forest trees. These habitat restoration activities may result in short-term vegetation disturbance, and in areas where native forest is the predominant vegetation cover, have the potential to impact native species and their habitats. However, over the long-term, these habitat restoration activities are expected to increase native vegetation cover, reduce ungulate damage to vegetation, reduce the threat of catastrophic wildfire, as well as improve habitat quality for rare plant species. Should Tier 6 take levels be reached, mitigation would include similar habitat protection and restoration actions and occur 1,319 ac on O'ahu. Implementation of Kawaihoa Wind's Tier 5 and Tier 6 mitigation, would be expected to have similar impacts on vegetation resources.

4.4.7 ALTERNATIVE 2C: KWP II WIND PROPOSED ACTION

Under Alternative 2C, (Section 2.2.3), Project operational changes including LWSC of the wind turbines related to take avoidance and minimization would have no effect on vegetation.

The USGS research study being implemented for Hawaiian hoary bat mitigation would have no impact on vegetation. Predator control and fence maintenance at the Pi'iholo Ranch Hawaiian goose pen or at Haleakalā Ranch on Maui are not expected to impact vegetation resources.

4.4.8 ALTERNATIVE 2D: PAKINI NUI PROPOSED ACTION

Under Alternative 2D, (Section 2.2.4), Project operational changes including LWSC of the wind turbines related to take avoidance and minimization would have no effect on vegetation.

Pakini Nui Wind's Hawaiian hoary bat mitigation consists of habitat improvement of approximately 1,200 ac of degraded lowland mesic-wet 'ōhi'a forest within the Kahuku Unit of HVNP in the Ka'ū district on Hawai'i Island. Habitat improvement activities, including invasive plant control, native forest tree planting and seed scarification around existing koa trees have the potential for some vegetation disturbance. However, vegetation disturbance in lowland areas is expected to be temporary and localized, and over the long-term, these habitat improvements would be expected to increase native vegetation cover, reduce competition with invasive plant species, improve habitat quality for rare plant species, as well as increase overall native forest recovery and resilience. There is the potential for the occurrence of sensitive plant species within lowland forest (bat) and alpine (petrel) mitigation sites; however, the likelihood of these species being impacted is low. Lowland mitigation sites are in degraded habitat, while high elevation sites are sparsely vegetated with access confined to fence lines and existing trails. In addition, hired field staff would have the ability to identify sensitive species and take appropriate action to avoid or minimize adverse impacts to such plants.

Construction of the 7-ac Hawaiian goose breeding pen at Pi'ihonua, Hilo District, Hawai'i Island has the potential for some vegetation disturbance from initial clearing and installation of the fence posts. However, these impacts to vegetation are expected to be temporary and confined to the width of the predator-proof fence line. In addition, fence and reservoir maintenance and

repair, vegetation maintenance using lawn mowers and weed trimmers, and predator control also have the potential for some vegetation disturbance, although impacts from these activities are expected to be negligible because the area encompassing the breeding pen is composed primarily of non-native pasture grasses and scattered native plant resources.

4.4.9 ALTERNATIVE 3A: AUWAHI WIND INCREASED CURTAILMENT

Under Alternative 3A, (Section 2.3.1) Auwahi Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in no effects to vegetation.

Vegetation impacts from the Alternative 3A mitigation activities would be similar to, but on a lesser scale, than described in Section 4.4.5 above, due to the smaller mitigation acreages needed for this alternative.

4.4.10 ALTERNATIVE 3B: KAWAILOA WIND INCREASED CURTAILMENT

Under Alternative 3B, operations and mitigation management activities conducted at the Kawaiiloa Wind facility would be as described in Section 2.3.2. Impacts on vegetation would be expected to be similar to those under Alternative 2B for the Hawaiian petrel mitigation. However, impacts to vegetation resulting from the Hawaiian hoary bat mitigation would be less than under Alternative 2B due to the smaller mitigation acreages proposed under Alternative 3B.

4.4.11 ALTERNATIVE 3C: KWP II INCREASED CURTAILMENT

Under Alternative 3C, operations and mitigation management activities conducted at the KWP II wind facility would be as described in Section 2.3.3. Impacts on vegetation would be expected to be similar to those described in Alternative 2C.

4.4.12 ALTERNATIVE 3D: PAKINI NUI INCREASED CURTAILMENT

Alternative 3D, operations and mitigation management activities conducted at the Pakini Nui Wind facility would be as described in Section 2.3.4. Impacts on vegetation from Hawaiian goose and Hawaiian petrel mitigation would be expected to be similar to those described in Alternative 3D. However, impacts to vegetation resulting from Hawaiian hoary bat mitigation would be less than under Alternative 2D due to the smaller bat mitigation acreages proposed under Alternative 3D.

4.5 WILDLIFE AND BIODIVERSITY

This section describes the potential effects of the alternatives on wildlife and other biodiversity resources in the affected area. The impacts to the Covered Species (the Hawaiian hoary bat, Hawaiian petrel, and the Hawaiian goose) are described separate Sections. Wildlife and other biodiversity resources in the affected environment are described in Section 3.7.

4.5.1 ALTERNATIVE 1A: AUWAHI WIND NO ACTION

The environmental effects of the existing 2012 Auwahi Wind HCP/ITP were analyzed previously under NEPA (USFWS 2012). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.1, would be Auwahi Wind implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat.

Impacts observed and expected include the fatalities of invasive and endemic avian wildlife species as a result of collision with turbines during daytime operation. Scavenger control at the turbine sites to improve carcass retention for fatality monitoring would be expected to temporarily reduce the presence of mammalian scavengers at the project. Scavenger control is expected to benefit fatality monitoring by improving the probability of finding a fatality. Removal of tree tobacco below the height of three feet and along roadway edges at the site is not expected to have adverse impacts to the Blackburn's sphinx moth because removal precludes moths from egg-laying or feeding at sites that would place the eggs, caterpillars, or pupae in peril of being hit by vehicles. Auwahi Wind's out-plantings of 'aiea at the mitigation site are expected to benefit the moth.

Under the No Action Alternative, Auwahi Wind would continue to implement its 2012-approved HCP including Hawaiian petrel mitigation activities involving predator control and trapping near the summit of Haleakalā. These activities are likely to benefit ground-dwelling seabirds and other avian species by reducing numbers of predatory species, such as feral cats. Auwahi Wind's ongoing Hawaiian hoary bat habitat restoration work, including invasive vegetation removal and out-planting of native tree species, under their 2012 HCP is expected to result in beneficial impacts to native forest birds, such as the Hawai'i 'amakihi and the 'apapane, which may move back into these areas (Berthold et al. 2015), as well as increase the biodiversity within affected areas. Mitigation actions are not expected to have impacts on avian species such as the pueo, kolea, Eurasian skylark, and the scaly-breasted munia.

4.5.2 ALTERNATIVE 1B: KAWAIILOA WIND NO ACTION

The environmental effects of the existing 2011 Kawaiiloa Wind HCP/ITP were analyzed previously under NEPA (USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.2, would be Kawaiiloa Wind implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat.

Impacts observed and expected include the fatalities of invasive and endemic avian wildlife species as a result of collision with turbines during daytime operation. Scavenger control at the turbine site to improve carcass retention for fatality monitoring would be expected to temporarily reduce the presence of mammalian scavengers at the project. Scavenger control is expected to benefit fatality monitoring by improving the probability of finding a fatality so as to better understand impacts on wildlife and help to ensure that anticipated take limits are not being exceeded.

Kawailoa Wind's mitigation activities under its 2011 HCP/ITP as detailed in section 2.1.2, will continue within the 150-ac 'Uko'a wetland, including manual removal of invasive aquatic vegetation and predator removal, and maintenance of a 40-ac ungulate exclusion fence, until the approved tiers of mitigation are completed. Non-native predator removal is expected to benefit native water birds and other ground-dwelling or nesting birds at the site by reducing the rate and threat of predation. Construction of the predator fence is expected to have beneficial effects by preventing feral pig access to the fenced portion of the water source in the mitigation area. The removal of invasive aquatic vegetation is expected to benefit wildlife by opening up water access to native avian species including the pueo and waterbirds. Removal of invasive vegetation may have temporary impacts on biodiversity to species dependent on the invasive vegetation, but habitat restoration is expected to improve biodiversity. Kawailoa's contribution to the land acquisition of the Waimea Native Forest and the protection of this land into perpetuity is expected to have benefits to native and nonnative wildlife in the habitat. The three Hawaiian hoary bat research projects funded by Kawailoa Wind are not expected to have impacts on wildlife or other biodiversity.

4.5.3 ALTERNATIVE 1C: KWP II NO ACTION

The environmental effects of the existing 2011 KWP II HCP/ITP were analyzed previously under NEPA (Planning Solutions 2010, USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.3, would be KWP II implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat.

Impacts observed and expected include the fatalities of invasive and endemic avian wildlife species as a result of collision with turbines during daytime operation. Scavenger control at the turbine site to improve carcass retention for fatality monitoring would be expected to temporarily reduce the presence of mammalian scavengers at the project. Scavenger control is expected to benefit fatality monitoring by improving carcass retention. This results in improved probability of finding a fatality.

KWP II's ongoing mitigation activities under its 2011 HCP/ITP, as detailed in section 2.1.3, are expected to continue. Fence maintenance and out-planting of native plants at Makamaka'ole are expected to provide direct and indirect benefits to wildlife that may nest inside the predator-free enclosure. The protection of seabird nesting burrows from predators is expected to have benefits to biodiversity by providing predator-free nesting habitat for various species of seabirds including Bulwer's petrel and others. The Hawaiian hoary bat habitat restoration work at Kahikinui that began in 2014 is expected to continue to provide direct and indirect benefits to the bat and other native species. As mitigation areas are restored, we would expect native forest birds such as the Hawai'i amakihi and the apapane to move into these areas (Berthold et al. 2015). Biodiversity of species that depend solely on the invasive species that are removed may be temporarily reduced by the removal of such vegetation, but the habitat restoration is expected to improve future biodiversity associated with native forest plant species.

4.5.4 ALTERNATIVE 1D: PAKINI NUI NO ACTION

Under the No Action Alternative, Pakini Nui Wind would not be issued an ITP. Pakini Nui Wind would likely continue to conduct operations and maintenance at the wind facility as described in Section 2.1.4, including the implementation of full nighttime curtailment.

The continuation of daytime facility operations and other actions by Pakini Nui Wind, which does not require an ITP, may result in localized noise, lighting, and human or vehicle activity which could displace or disturb wildlife species that rely on passive listening to forage. Most of these activities would be intermittent and of short duration, with the exception of turbine operation. Turbine operation would cause detrimental effects to avian species that are active during the day while the rotors are spinning. Detrimental effect could also occur at night due to collision with the rotors when they are idle.

4.5.5 ALTERNATIVE 2A: AUWAHI WIND PROPOSED ACTION

Under Alternative 2A, (Section 2.2.1), operational changes related to take avoidance and minimization would have no effect on wildlife and biodiversity at the wind turbine sites.

The restoration of 1,556 ac of pasture land, including the planting of native forest trees to create fenced hedgerows and installation of water features, vegetation clearing, excavation, and use of construction equipment may cause a temporary disturbance to wildlife in the project's pasture land. These activities could result in short-term impacts to wildlife due to habitat disturbance and noise from vehicles and equipment. Impacts to these species are anticipated to be negligible because the area has been previously disturbed, and all activities will occur in areas that are subject to ongoing ranching activities. To prevent ungulates from damaging the planted trees and to maintain long-term habitat suitability, fencing will be installed around the reforested areas, utilizing existing fences where available. Best management practices to avoid and minimize impacts to wildlife will be implemented, that are consistent with the HCP, EA, and EIS for the existing permit (Tetra Tech 2011, Tetra Tech 2012, USFWS 2012). New water reservoirs could attract mosquitos, which carry avian malaria, but are not anticipated to significantly increase the presence of mosquitos beyond current conditions, given the existing ponds in the Waihou Area and surrounding lands. Existing ponds contain aquatic insects that prey on mosquito larvae and these predatory species are expected to colonize the new water features. Water troughs will be equipped for wildlife egress to prevent wildlife from drowning. Obstructions such as vegetation and fencing will be removed to provide unabated flight approaches to avian wildlife for drinking access. Biodiversity is expected to increase as a result of the introduction of native trees in the pasture land under Auwahi Wind's amended HCP.

Management, restoration, and improvement actions in the pastureland of Kamehamenui Forest for Tiers 5 and 6 are expected to have similar impacts as those described for the 'Ulupalakua project in the previous paragraph. Outplanting of native forest trees, vegetation clearing, excavation, and use of construction equipment may cause a temporary disturbance to wildlife in the project's pasture land. These activities could result in short-term impacts to wildlife due to habitat disturbance and noise from vehicles and equipment. Impacts to these species are anticipated to be negligible. Out-planting of native tree species will help build the vertical

vegetative structure and canopy cover. A heterogeneous vegetative structure provides shelter for insect species that are the prey for Hawaiian hoary bats (Jantzen 2012, H.T. Harvey 2019) and avian species. Creation of water features will also likely increase biodiversity. New water reservoirs could attract mosquitos, which carry avian malaria, but are not anticipated to significantly increase the presence of mosquitos beyond current conditions at this lower elevation pastureland. Removal of invasive plant and animal species is expected to cause a decrease in biodiversity of invasive wildlife such as ungulates and invasive vegetation in the mitigation area. Removal of ungulates is expected to improve habitat quality and heterogeneity of native plant species. Replacement of the invasive vegetation through natural recruitment and outplanting of native plants is expected to provide long-term benefits to wildlife and biodiversity by providing native shelter and food resources.

4.5.6 ALTERNATIVE 2B: KAWAILOA WIND PROPOSED ACTION

Under Alternative 2B, operations and anticipated take of Covered Species at the Kawaiiloa Wind facility would be as described in Section 2.2.2. Impacts to wildlife and biodiversity at the turbine site would be expected to be higher under this alternative than as described in Section 4.5.2 because of increased night-time operations.

Kawaiiloa Wind's Hawaiian petrel mitigation activities under the amended HCP, including predator control trapping at Hanakāpī'ai and Hanakoa, are expected to have beneficial effects to ground-nesting seabirds by temporarily reducing the numbers of cats and other predators that reduce seabird survival. Biodiversity of ground nesting seabirds on the mitigation area is expected to increase accordingly. Acquisition of the HWA is expected to provide direct benefits to endemic species such as Hawaiian short-eared owl and O'ahu 'amakihi and introduced species by protecting the area from development and destruction of habitat. Indirect benefits include a buffer zone that is created by the protection of habitat from development for the federally listed O'ahu 'elepaio that occurs in adjacent habitat (USFWS 2001). HWA may contribute to the expansion of 'elepaio habitat. Future land acquisition and restoration actions proposed in Tiers 5 and 6 would be expected to have similar beneficial effects as Tier 4 mitigation activities to O'ahu wildlife species.

4.5.7 ALTERNATIVE 2C: KWP II WIND PROPOSED ACTION

Under Alternative 2C, operations and anticipated take of covered species at the KWP II wind facility would be as described in Section 2.2.3. Impacts to wildlife and biodiversity at the turbine site would be expected to be the same as described in Section 4.5.3 during daytime operations and additional impacts would be expected to species flying at night that may collide with moving turbine blades. The USGS research study for bat mitigation involving the use of mist nets is not expected to have direct negative impacts on wildlife other than bats. Nontarget nocturnal flying species such as barn owls may be incidentally captured in the mist net. Standard operating procedures are in place to safely remove, treat if necessary, and release all captured species. Dietary studies of bat guano to better understand the diet of Hawaiian hoary bats may have indirect negligible impacts on localized insect populations in the future. Control of non-native predators in and around Hawaiian goose pens at Haleakalā Ranch and Pi'iholo Ranch is expected to benefit native species, including the goose, in the vicinity of the pens. The maintenance of the

predator-free area and fence will have benefits to other wildlife that nest within the protected area.

4.5.8 ALTERNATIVE 2D: PAKINI NUI PROPOSED ACTION

Under Alternative 2D, operations and anticipated take of Covered Species at the Pakini Nui Wind facility would be as described in Section 2.2.4. Impacts to wildlife and biodiversity at the turbine site would be expected to be the same as described in Section 4.5.4 during daytime operations.

Under the proposed action the conservation program in the HCP includes habitat improvement activities for the Hawaiian hoary bat, including invasive plant control, native forest tree-planting and seed scarification around existing koa trees. These activities have the potential for some temporary disturbance to wildlife in the immediate work area, but over the long-term, the habitat restoration is expected to beneficially affect the hoary bat, biodiversity in general and specifically the Hawaiian hawk, Hawaiian short-eared owl, Hawaiian thrush, Hawai'i 'amakihi, and the 'apapane as well as non-natives avian species. Game birds such as Erckel's francolin and wild turkey may also benefit from the improved habitat. Removal of invasive non-native vegetation is likely to beneficially affect native species and ecosystem function. Hawaiian petrel mitigation activities under the HCP include funding for fence maintenance, predator control, and monitoring to protect endangered seabirds at HVNP. Predator control is expected to have beneficial effects on seabirds and other ground-nesting species nesting in the vicinity of the area subject to predator control activities. Predator control and a predator-proof fence are expected to provide similar benefits to the Hawaiian goose at the new 7-ac breeding pen at Pi'ihonua that Pakini Nui Wind will fund DOFAW to construct. Construction could cause localized and temporary disturbance to wildlife in the form of noise and disturbance from construction and maintenance activities related to construction equipment, lawn mowers, weed trimming, and fence construction in the vicinity of the pen or the existing reservoirs. BMPs will be implemented during construction and maintenance activities to avoid and minimize impacts which are expected to be temporary and short in duration. Fencing around the two reservoirs is likely to benefit the Hawaiian goose and other native wildlife species in and around the ponds by excluding non-native wild pigs, deer, and goats that are otherwise very likely to destroy and degrade habitat in this area.

4.5.9 ALTERNATIVE 3A: AUWAHI WIND INCREASED CURTAILMENT

Under Alternative 3A, (Section 2.3.1) Auwahi Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in similar impacts to wildlife and biodiversity as described for Alternative 2A in Section 4.5.5.

Impacts to wildlife and biodiversity from the Alternative 3A mitigation activities would be similar to, but on a lesser scale, than described in Section 4.5.5 above, due to the smaller mitigation acreages needed for this alternative.

4.5.10 ALTERNATIVE 3B: KAWAIILOA WIND INCREASED CURTAILMENT

Under Alternative 3B, (Section 2.3.2) Kawaiiloa Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in similar impacts to wildlife and biodiversity as described for Alternative 2B in Section 4.5.6.

Impacts to wildlife and biodiversity from the Alternative 3B Hawaiian hoary bat mitigation activities would be similar to, but on a lesser scale, than described in Section 4.5.6 above, due to the smaller mitigation acreages needed for this alternative. Impacts from Hawaiian petrel mitigation would be identical to those described in Section 4.5.6 above.

4.5.11 ALTERNATIVE 3C: KWP II INCREASED CURTAILMENT

Under Alternative 3A, (Section 2.3.3) KWP II would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in similar impacts to wildlife and biodiversity as described for Alternative 2A in Section 4.5.7.

Impacts to wildlife and biodiversity from the Hawaiian hoary bat USGS research project would have no impacts to wildlife and biodiversity. Impacts from Hawaiian goose mitigation would be identical to those described in Section 4.5.7 above.

4.5.12 ALTERNATIVE 3D: PAKINI NUI INCREASED CURTAILMENT

Under Alternative 3D, (Section 2.3.4) Pakini Nui Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would result in similar impacts to wildlife and biodiversity as described for Alternative 2A in Section 4.5.8.

Impacts to wildlife and biodiversity from the Alternative 3D Hawaiian hoary bat mitigation activities would be similar to, but on a lesser scale, than described in Section 4.5.8 above, due to the smaller mitigation acreages needed for this alternative. Impacts from Hawaiian goose and Hawaiian petrel mitigation would be identical to those described in Section 4.5.8 above.

4.6 HAWAIIAN HOARY BAT

This section describes the potential effects of each alternative on the Hawaiian hoary bat. Due to the lack of a State-wide or island-by-island population estimate that meets scientific rigor and the reasonable statistical confidence levels. This does not discount estimations made as a demonstration by the Applicants. The technology and resources that would allow for the development of a reliable statewide population estimate are recognizably not available at this time. For the covered species, each HCP has approached their analysis of effects slightly

differently. This difference in analyses between the HCPs is reasonable and appropriate based on the information available. The Service has reviewed each HCP's analyses, but has conducted our own analysis of effects based on the information included in Section 3.8, **Appendix G** and in our files.

4.6.1 ALTERNATIVE 1A: AUWAHI WIND NO ACTION

Under Alternative 1A, operations and anticipated take of the Hawaiian hoary bat at the Auwahi Wind facility would be as described in Section 2.1.1. Take of Hawaiian hoary bats in exceedance of 21 over the existing term (through 2037) would not be authorized and mitigation for fatalities in excess of the anticipated take would not be assured. Auwahi Wind has already exceeded their permitted Hawaiian hoary bat take. Under the No Action alternative, the Service expects Auwahi Wind would modify their WTG operational regime to ensure no further bat take occurs. Failure to do so would result in a violation of the take prohibitions under section 9 of the ESA and may result in enforcement actions. Restricting operations of the turbines to only daytime hours is likely to avoid additional take of the Hawaiian hoary bat.

Under Auwahi Wind's current ITP and HCP Hawaiian petrel mitigation activities, including predator control and trapping and burrow monitoring near the summit of Haleakalā, is not expected to impact Hawaiian hoary bats because bats are not expected to be in the affected area. Hawaiian hoary bat habitat restoration work initiated under the 2012 ITP/HCP includes invasive vegetation removal and outplanting of native trees that are likely to temporarily disturb bats in the immediate area through noise and vegetation disturbance, but these impacts would be short-term and negligible. The habitat created by the removal of invasive vegetation and the outplanting of native tree species is expected to result in long-term beneficial impacts to the Hawaiian hoary bat by providing roosting habitat that includes native species with which the bat evolved.

4.6.2 ALTERNATIVE 1B: KAWAIOLOA WIND NO ACTION

Under Alternative 1B, operations and anticipated take of Hawaiian hoary bats at the Kawaiiloa Wind facility would be as described in Section 2.1.2. Take of Hawaiian hoary bats in exceedance of 60 would not be authorized and mitigation for bat fatalities in excess of the anticipated take would not be assured. Kawaiiloa Wind has already exceeded their permitted Hawaiian hoary bat take. Under the No Action Alternative, the Service expects Kawaiiloa Wind to modify their WTG operational regime to ensure no further take of bats occurs. Failure to do so would result in a violation of the take prohibitions described in section 9 of the ESA and may result in enforcement actions. Restricting turbine operations to only daytime hours is likely to avoid additional take of the Hawaiian hoary bat.

Mitigation activities conducted under the 2011 ITP/HCP within the 150-ac 'Uko'a wetland, including manual removal of invasive aquatic vegetation, predator removal, and maintenance of a 40-ac ungulate exclusion fence, are expected to provide direct and indirect beneficial effects to the bat by providing access to open water for drinking and additional foraging resources and opportunities. Maintenance activities, fence repair, and predator control are expected to cause temporary disturbance of bats in the form of noise and minor habitat disturbance. These impacts

are expected to be short-term in nature and infrequent. Land acquisition under the 2011 Kawaiiloa HCP is likely to contribute to the acquisition of the Waimea Native Forest and the protection of this land into perpetuity. Such effects are expected to provide benefits to bats by supporting roosting and foraging and protection of the habitat from development. The three Hawaiian hoary bat research projects funded under the 2011 Kawaiiloa HCP are expected to provide beneficial impacts to bats by furthering our understanding of bat diet, habitat usage, and distribution on O'ahu, and of genetic diversity and the sex of bat fatalities throughout the islands. Monitoring activities associated with placing and retrieving acoustic detectors, changing batteries, and memory cards may cause a temporary disturbance to bats in the form of noise and motion, but these impacts are likely to be short-term and negligible.

4.6.3 ALTERNATIVE 1C: KWP II NO ACTION

The environmental effects of the existing 2011 KWP II HCP/ITP were analyzed previously under NEPA (Planning Solutions 2010, USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued.

Take of Hawaiian hoary bats in exceedance of 11 would not be authorized and mitigation for fatalities in excess of the anticipated take would not be assured. KWP II has already exceeded their permitted Hawaiian hoary bat take. Under the No Action alternative, the Service expects KWP II to modify their WTG operational regime to ensure no further take of bats occurs. Failure to do so would result in a violation of the take prohibitions under section 9 of the ESA and may result in enforcement actions. Restricting turbine operations to only daytime hours is likely to avoid additional take of the Hawaiian hoary bat.

Mitigation activities for the Hawaiian hoary bat under KWP II ITP/HCP, including reforestation and fence maintenance, are expected to have beneficial effects on the bat by increasing roosting habitat containing native species with which the bat evolved.

4.6.4 ALTERNATIVE 1D: PAKINI NUI NO ACTION

Under Alternative 1D, operations at the Pakini Nui Wind facility would be as described in Section 2.1.4. Pakini Nui Wind does not currently have authorization to take the Hawaiian hoary bat. Under the No Action Alternative, the Service expects Pakini Nui Wind to modify their WTG operational regime to ensure no further bat take occurs. Failure to do so would result in a violation of the take prohibitions under section 9 of the ESA and may result in enforcement actions. Since Pakini Nui Wind would not have an approved HCP or ITP under this alternative, no conservation and mitigation activities would be expected to occur to offset any take impacts to the bat. The Pakini Nui Wind turbine site does not support any bat roosting or pupping habitat due to a lack of trees. Localized noise, lighting, and human or vehicle activity associated with continued operation and maintenance of the wind facility may displace or disturb foraging bats. Most of this activity would be intermittent, of short duration, and have negligible effects on the bat because alternative foraging areas are available adjacent to the areas subject to those activities.

4.6.5 ALTERNATIVE 2A: AUWAHI WIND PROPOSED ACTION

Under Alternative 2A, operations, anticipated take and associated minimization and mitigation activities at Auwahi Wind would be as described in Section 2.2.1.

Under Alternative 2A, Auwahi Wind would be anticipated to take up to 119 Hawaiian hoary bats, through February 23, 2037. The Service uses a standardized approach to project a take estimate for individual projects based on site-specific factors, as described in **Appendix C**. Take occurs from the death of the individual, the loss of dependent young, and the loss of future generations that may have been produced.

In order to account for the immediate loss and future loss, indirect take is assessed to the females taken during the breeding season taking into account the estimated survival rate of dependent young. The bat population on Maui or statewide is not known; however, acoustic detections indicate the Hawaiian hoary bat is well distributed throughout Maui and statewide (Johnston et al. 2018; Wolfe 2018; Starcevich 2019; **Appendix G**). It is certain that the entire population of bats on Maui would not be directly extirpated by the operation of Auwahi Wind farm on Maui because not every bat will pass through the Project and not every bat that does fly across or through the wind farm would result in a fatality. While bats are highly mobile and have been known to travel up to 12 mi in a night, the bats do focus their activity where the resources are available and spend the majority of their time in their core use area. The bats that utilize the turbine area for foraging would be at higher risk of fatality than bats that do not frequent the Project. A local effect on a bat subpopulation may be expected if core use areas overlaps with the turbine sites because of the higher probability of turbine encounter during nightly usage. Fatalities of individuals from that subpopulation would be expected to cause a localized decrease in that local population. This local effect on that subpopulation could impact the species by reducing the local subpopulation below a threshold that could cause genetic diversity to decline. There is an absence of published information specific to the Hawaiian hoary bat that shows the potential annual take at a wind project site would lead to a permanent decline in genetic diversity island-wide or statewide. The Hawaiian hoary bat is recognized as one species statewide. Genetic diversity is present in the Hawaiian hoary bat population. See **Appendix G** for further discussion on bat genetics, clades, and hybridization between clades. High mobility of adult bats provides an adaptive ability to sustain genetic diversity through the opportunity to breed with individuals throughout the island (**Appendix G**). This mobility could be expected to minimize any effect of genetic loss that would be associated with a potential localized subpopulation decrease. Acoustic detections have not shown a decline at the wind site since operations began, suggesting use has not decreased over the last 6 years (Auwahi Wind 2012, 2013, 2014, 2015, 2016, 2017, 2018). Lost future productivity of an adult bat would also be expected under this alternative. Bats may live up to 10 years, though it is unknown if they breed each year or how many years they may produce young. The loss of an adult bat would be expected to result in the additional loss of future generations on that island. The indirect loss of dependent pups is included in the amount of take and is mitigated for regardless of whether the adult female had dependent young. Mitigation efforts are focused on the same island that the impacts to the bat population (adults and dependent young) would occur and would be expected to provide a beneficial effect on the resident population on the island to reduce the impact of the loss.

To replace the take, Auwahi Wind would conduct the minimization and mitigation measures as described in Section 2.2.1. Tier 4 Hawaiian hoary bat mitigation would protect into perpetuity approximately 1,752 ac of 'Ulupalakua Ranch lands on leeward Haleakalā. Specific mitigation actions include creating forested linear landscape hedgerows comprised of koa with 'a'ali'i understory that can be used for foraging and night roosting habitat and function as travel corridors. In addition, installation of ponds to provide year round water and aquatic insect resource for the Hawaiian hoary bat are proposed. The project and land will be protected through a legal and permanent conservation easement. These actions are not expected to appreciably reduce the functional foraging value that exists in the pastureland because large tracts will remain between the hedgerows which are expected to provide additive foraging value for the bats. The protection and mitigation actions are expected to augment the connectivity between nearby State Forest Reserves (Kula and Kanaio) and other conservation areas that currently provide bat habitat adjacent to the project area. The habitat improvement would be expected to provide foraging sufficient to support a minimum of 85 bats if we assume bats use an average of 20.3 ac for their core use area. The additive value of the hedgerows is expected to provide added foraging resources into perpetuity (many bats generations to come) and has specific success criteria and adaptive management triggers to assess the usage of the site prior to improvement and at incremental periods for the duration of the project. The usage period of the hedgerows is not constrained by the length of the permit. The mitigation is expected to provide resources not previously present into perpetuity as a condition of the conservation easement. The size of a foraging range and core use area used by the bat varies based on a variety of factors including prey availability and abundance. The 20.3 median was used as a surrogate for determining a reasonable size. The main factor is the prey abundance and added foraging resources that will be measured, not per se, a designated acreage. Long-term monitoring will be conducted to assess bat activity and determine the effectiveness of the mitigation. If mitigation is not meeting the success criteria, adaptive management will be used to ensure mitigation will offset bat incidental take. These restoration, management, and monitoring activities could result in short-term impacts to bats due to habitat disturbance and noise from vehicles and equipment. Impacts to bats are anticipated to be negligible because the area has been previously disturbed, and all activities will occur in areas that are subject to ongoing ranching activities. Best management practices (BMPs) to avoid and minimize impacts to bats will be implemented, consistent with the HCP amendment. New water reservoirs could attract insects on which the bats forage. Bats are expected to benefit from the additional ponds because bats have been observed utilizing other pond areas in the adjacent Waihou and Duck Pond areas. Existing ponds contain aquatic insects that may be expected to establish in the new water features. The adult life stages of these insects may be expected to provide prey for bats. Water troughs will be equipped for wildlife egress to prevent bats from drowning. Water troughs will be drained on a rotating basis to minimize mosquito development. This may result in bats shifting their use of the water resource to a different filled trough nearby. The impacts from this are expected to be minimal given the mobility of the bats and the distance between troughs. Tier 4's water features are expected to begin providing benefits within one year of implementation. The hedgerows are expected to require 7-10 years to attain and create the edge effect and support arthropods that contribute to the bats' diet. Although there would be some delay in the effectiveness of Tier 4 mitigation, the land will be protected from development into perpetuity and the added landscape features are expected to provide benefits for at least 50 years, based on longevity of koa.

To avoid a lag in implementation, planning for Tier 5 and Tier 6 mitigation would be triggered if 75% of the take in the previous tier is reached. Tier 5 mitigation would focus on management, restoration, and improvement of 690 ac land in the Kamehamenui Forest on Maui that would be protected into perpetuity. The specific mitigation area selection would be based on the best science available for the Hawaiian hoary bat at the time, and will seek to improve and provide additive value for bat foraging, roosting, and/or breeding. If, at the time of planning for Tier 5, a Kamehamenui Forest parcel is not available or suitable, another area will be selected based on the selection criteria and considerations provided in **Appendix B**. The project would be required to meet the success criteria in order to mitigate the incidental take. Restoration and management actions could include removal of ungulates and invasive vegetation removal, planting of native forest trees to improve heterogeneity and vertical structure, and installation of water features. Restoration, management, improvements, and monitoring activities may result in short-term impacts to bats due to habitat disturbance and noise from vehicles and equipment. As with Tier 4, BMPs would be implemented to avoid and minimize impacts to bats during mitigation activities. The overall impact of the restoration would be expected to benefit bats and provide additive resource value that will sustain bat generations into perpetuity.

In the event Tier 6 is reached, mitigation would focus on restoration and management of at least 508 ac at Kamehamenui Forest to mitigate the take of up to 25 bats. If, at the time of planning for Tier 6, a Kamehamenui Forest parcel is not available or suitable, another area will be selected based on the selection criteria and considerations provided in **Appendix B**. Restoration actions and Maui-based site selection would be based on the best science available at the time. Impacts to bats are expected to be similar to those described for Tier 4 and 5 mitigation actions. BMPs will be implemented to avoid and minimize disturbance to bats. Should Tier 5 or 6 be triggered late in the term of the permit, funding assurances will ensure that the mitigation meets the success criteria determined at the time of the mitigation implementation even if the mitigation activities extend beyond the expiration date of the permit.

4.6.6 ALTERNATIVE 2B: KAWAIILOA WIND PROPOSED ACTION

Under Alternative 2B, operations, anticipated take, and associated minimization and mitigation activities at Kawaiiloa Wind would be as described in Section 2.2.2. Under Alternative 2B, Kawaiiloa Wind would be authorized to take up to 220 Hawaiian hoary bats, through December 7, 2031. The Service uses a standardized approach to project a take estimate for individual projects based on site specific factors, as described in **Appendix C**. The take of a bat during the breeding season may result in the indirect loss or take of a dependent offspring. The bat population on O'ahu or throughout the state is not known, however, acoustical detections indicate the Hawaiian hoary bat is more widespread throughout O'ahu (Wolfe 2018; Starceovich et al. 2019) and the state (**Appendix G**) than believed at the time of listing. It is certain that the state-wide population of bats would not be directly extirpated by the operation of Kawaiiloa Wind farm on O'ahu because not every bat will fly across or through the Project and not every bat that may pass through the turbine site would result in a fatality. While bats are highly mobile and have been known to travel up to 12 mi in a night, the bats tend to focus their activity where the resources are available and spend the majority of their time in their core use area. The bats that utilize the turbine area for foraging would have a higher risk of fatality than bats that do not use that area. A local effect on a bat subpopulation could be expected if core use areas overlap with

the turbine sites because of the higher probability of turbine encounter during nightly usage. Fatalities of individuals from that subpopulation would be expected to cause a localized decrease in that local population. This local effect on that subpopulation could impact the species by reducing the local subpopulation below a threshold that could cause genetic diversity to decline. There is an absence of published information specific to the Hawaiian hoary bat that shows the potential annual take at the wind project site would lead to a permanent decline in genetic diversity island-wide or statewide. The Hawaiian hoary bat is recognized as one species statewide. Genetic diversity is present in the Hawaiian hoary bat population but there is no indication that the local population that utilizes the wind project site differs from the population islandwide. See **Appendix G** for further discussion on bat genetics, clades, and hybridization between clades. High mobility of adult bats provides an adaptive ability to sustain genetic diversity through the opportunity to breed with individuals throughout the island (**Appendix G**). This mobility could be expected to minimize the effect of genetic loss that would be associated with a potential localized subpopulation decrease. Though anecdotal only, acoustic detections have not shown a decline at the wind site since beginning operation suggesting use has not decreased over the last 6 years (Kawailoa Wind 2013, 2014, 2015; Tetra Tech 2016, 2017, 2018). Lost future productivity of an adult bat may also occur under this alternative. Bats may live up to 10 years, though it is unknown if they breed each year or how many years they may produce young. The loss of an adult bat would be expected to result in the additional loss of future generations on that island. The indirect loss of dependent pups is included in the amount of take and is mitigated for regardless of whether the adult female had dependent young. Mitigation efforts are focused on the same island that the impacts to the bat population (adults and dependent young) would occur and would be expected to provide a beneficial effect on the resident population on the island to reduce the impact of the loss.

An island wide study currently underway has initially indicated that the highest rate of acoustical detection, based on 87 acoustic detectors randomly deployed around the island of O'ahu, was in Waimea Valley (Starcevich et al. 2019). High detection rates were also noted at other areas along the north shore and on the western side of the island near Waianae. Though the results of the acoustic study preliminary, it suggests the Waimea area provides a resource that favors bat presence, or at least detection. Bats are capable of flying 12 miles in one night if resources are sparse. It is reasonable to assume that Kawailoa Wind is within a bat's flight distance to the Waimea Valley, a substantial portion of the Waianae Mountain Range, a portion of the Koolau Mountain Range, and most of north and central Oahu. The close proximity of an area that has high bat detections to a wind farm does not, in itself, prove a higher risk of collision. The risk of collision is based on the frequency in which a bat flies through the turbine rotor zone. That risk is greatest if the bats foraging range includes the wind farm. Bats may fly through the wind farm to get to an offsite resource, such as Waimea Valley. Likewise, areas that provide rich resources would be expected to support larger bat numbers and may actually result in the bats not having to fly as far to meet their nutritional needs and thus not flying through a nearby area such as the wind farm.

Tier 4 mitigation to mitigate the take of up to 55 bats consists of land acquisition of the HWA. The distance between Kawailoa Wind farm and HWA is within the possible flight range of a bat given a 12 mile range. Flight distance can be associated with prey abundance and environmental factors. Land acquisition to protect and preserve land on O'ahu known to be occupied by bats

has a high likelihood of contributing to the recovery of the species given the high level of development pressure across the island. The HWA includes non-forested fallow agricultural areas that are suitable for restoration and the mix of forested lands, fallow agricultural lands, and a water resource is expected to provide foraging and roosting habitat for the Hawaiian hoary bat. Creation of protected foraging areas is expected support a greater number of bats through improved productivity and reduced foraging range because of resource availability. The area also provides connectivity with adjacent conservation areas occupied by bats. Hawaiian hoary bats are estimated to live an average of 4 to 10 years and are thought to begin breeding the year following becoming volant (DOFAW 2015; Bonaccorso 2016). The benefits associated with the protected foraging areas are expected to last for multiple bat generations.

To avoid a lag in implementation, planning for Tier 5 and Tier 6 mitigation will be triggered when 75% of the take in the previous tier is reached. In the event that Tier 5 is reached, the mitigation proposed for this tier would be expected to replace the adult and dependent young in advance of the take to avoid impacts on productivity and future generations. Tier 5 would mitigate the anticipated take of up to 85 bats. The Tier 5 mitigation would focus on land protection or preservation of habitat through easement or acquisition and habitat restoration and land management on O'ahu. The project would be selected based on the best science available for the Hawaiian hoary bat at the time that is known to improve and provide additive value for bat foraging, roosting, productivity, and/or breeding. The project would be required to meet the success criteria in order to mitigate the incidental take. The size of a Tier 5 mitigation project would be based on a minimum of 20.3 ac per bat (at least 1,725 ac), or the amount of acreage determined by the wildlife agencies to be the most appropriate at the time. Restoration and management actions could include fencing and removal of ungulates, invasive vegetation removal and planting of native forest trees, and installation or improvement of water features. Forests are threatened with degradation through non-native weed species such as strawberry guava which spread rapidly and have not been documented to be utilized by the Hawaiian hoary bat. Non-native ungulates cause damage to mature trees and decrease or destroy the regeneration of mature forest suitable for bat roosting by their browsing on terminal shoots and damage to the cambial layer of the tree through rubbing. Restoration, management, and monitoring activities may result in short-term impacts to Hawaiian hoary bats due to habitat disturbance and noise from vehicles and equipment, but the long-term impacts of invasive species removal or other approved mitigation activities are expected to benefit the bat for multiple generations. No vegetation above 15 ft tall that could provide roosting would be removed during the pupping season to avoid effects on dependent young. The overall impact of the native outplanting and restoration is expected to benefit bats and provide additive resource value that will sustain bat generations and productivity into perpetuity. In the event Tier 6 is reached, mitigation would focus on restoration and management of at least 20.3 ac per bat (at least 1,319 ac), or the amount of acreage determined by the wildlife agencies to be best at the time, to determine the size and characteristics of the parcel or restoration actions to mitigate the take of up to 65 bats. Similar to Tier 5, restoration actions on an O'ahu-based site would be based on the best science available at the time. Impacts to bats are expected to be similar to those described for Tier 5 mitigation actions. Should Tier 5 or 6 be triggered late in the term of the permit, funding assurances will ensure the mitigation meets the success criteria determined at the time of the mitigation implementation even if it extends beyond the expiration date of the permit. Removal of threats,

creation of suitable habitat, and providing additive benefit to bats above what already exists is expected to provide benefits to the Hawaiian hoary bat.

Kawailoa Wind's Hawaiian petrel mitigation activities, including predator control trapping at Hanakāpī'ai and Hanakoa, is expected to have negligible impacts to bats because bats are not known to use the sites.

4.6.7 ALTERNATIVE 2C: KWP II WIND PROPOSED ACTION

Under Alternative 2C, operation, anticipated take, and associated minimization and mitigation activities at KWP II would be as described in Section 2.2.3. KWP II would be authorized to take up to 27 Hawaiian hoary bats through January 2, 2032. The Service uses a standardized approach to project a take estimate for individual projects based on site-specific factors, as described in Appendix C. The take of a bat during the breeding season may result in the indirect loss or take of a dependent offspring. In order to account for the immediate loss and future loss, indirect take is assessed to the females taken during the breeding season taking into account the estimated survival rate of dependent young. The bat population on Maui or statewide is not known.

Acoustical detections indicate the Hawaiian hoary bat is well distributed throughout Maui and statewide (Johnston et al. 2018; Wolfe 2018; Starcevich 2019; **Appendix G**). It is certain that the entire population of bats on Maui would not be directly extirpated by the operation of KWP II on Maui because not every bat would be expected to fly across or through the wind farm and not every bat that does fly through the wind farm would result in a fatality. While bats are highly mobile and have been known to travel up to 12 mi in a night, the bats tend to focus their activity where the resources are available and spend the majority of their time in their core use area. The bats that utilize the turbine area for foraging would be at higher risk of fatality than bats that do not use that area. A local effect on the bat subpopulation might be expected if core use areas overlap with the turbine sites because of the slightly higher probability of turbine encounter during nightly usage. Fatalities from this local sub-population would be expected to cause a localized decrease in that subpopulation. This local effect on the subpopulation could impact the species, either by reducing genetic diversity or by reducing the local subpopulation below a threshold that would cause that population to decline. There is no published information available to the Service to suggest this local effect would lead to a decline in genetic diversity. Statewide, the Hawaiian hoary bat is recognized as one population with genetic diversity. See **Appendix G** for further discussion on the genetics, clades and clade hybridization. Mobility of the bats provides an adaptive ability to sustain genetic diversity, at least within an island, minimizing any effect of localized subpopulation decrease. Though anecdotal, acoustic detection has not declined at KWP II since operations began, suggesting use by the bats has not decreased over the last 6 years (KWP II 2013, 2014, 2015, 2016, and 2017). Lost future productivity of an adult bat would also be expected under this alternative. Bats may live up to 10 years, though it is unknown if they breed each year or how many years they may produce young. The loss of an adult bat would be expected to result in the additional loss of future generations on that island. The indirect loss of dependent pups is included in the amount of take for which mitigation is provided regardless of whether the adult female had dependent young.

The ESRC Hawaiian Hoary Bat Guidance (DOFAW 2015) determined that it was appropriate to allocate a mitigation credit of one Hawaiian hoary bat for each \$50,000 of funding that is included in a proposed or amended HCP and assured through a letter of credit or other financial assurances acceptable to the USFWS and DOFAW. The research component of the mitigation program is intended to reduce uncertainty in mitigation effectiveness and inform more consistent, scientifically justifiable and quantifiable mitigation practices for Hawaiian hoary bats in the future. The USGS research project funded by KWP II to mitigate for 19 bats was reviewed and selected at the direction of the ESRC and its advisory bat subcommittee comprised of bat biologists. The research is expected to provide beneficial impacts to the bats by furthering understanding of the bat diet, roosting habitat selection, movement, and distribution throughout the island of Hawai'i. This research, while not directly providing a resource that improves bat productivity or survival, provides indirect support for identification and long-term improvement of bat habitat and furthering our understanding of bat needs and habitat use to the benefit of future bat generations. The activities associated with conducting the research activities include bat capture through mist-netting, handling of the bats, collection of genetic and fecal samples, measurement, tagging, and tracking of the bat, and are expected to cause temporary, non-lethal harassment to the bat. The qualified biologists conducting the research possess a USFWS Recovery permit and adhere to strict capture, handling, sampling, and release guidelines for the protection of the bat and to assure no lasting harm to the bat occurs. The impacts to the bat in the form of discomfort are expected to be short-term and the benefits of these research actions are expected to be long-term in the form of knowledge gained through the sampling and tracking of the bats.

To avoid a lag in implementation, planning for Tier 4 mitigation would be triggered when 75% of the take in the current tier is reached. In the event that Tier 4 is reached, the mitigation would be expected to replace the adults and dependent young in advance of the take to avoid impacts to productivity and future generations. Tier 4 would mitigate take of up to eight bats. The Tier 4 mitigation would focus on land acquisition on Maui that is not already in conservation, where bats are present, and where the land parcel is in danger of being developed or compromised with regard to bat use. The approximate acreage per bat would be 60-80 ac or 480-640 ac for eight bats. Acreage is based on the quality of the habitat provided for the bats. The specific parcel would be determined when funding and planning for Tier 4 take is triggered. Prior to any planned land purchase, bat detectors would be deployed to ensure that bats are present on or near the parcel. At least 10 bat detectors would be deployed throughout the parcel for at least three months. Bat detection would have to occur on at least three detectors during the assessment period. The bat monitoring may be expected to cause short-term, infrequent disturbance to bats in the form of disturbance during deployment and retrieval of detectors and the changing or cards or batteries. The expected impacts of land acquisition for bat use is expected to benefit the bats by providing resources for multiple future generations.

KWP's mitigation actions for the Hawaiian goose include continuing to fund predator control and fence maintenance at the Pi'iholo Ranch pen, Haleakalā Ranch pen on Maui. These actions are expected to have negligible impacts to the bat. While predator exclusion or reduction may benefit the bat if roosting within the protected area, no studies have documented such effects associated with Hawaiian goose pens.

4.6.8 ALTERNATIVE 2D: PAKINI NUI PROPOSED ACTION

Under Alternative 2D, operations, anticipated take and associated minimization and mitigation activities at Pakini Nui Wind would be as described in Section 2.2.4. As with the no action alternative, localized noise, lighting, and human or vehicle activity associated with current operation and maintenance tasks could displace or disturb bats using passive listening to forage. Most of this activity would be intermittent and of short duration, with the exception of turbine operation.

Pakini Nui Wind would be anticipated to take up to 26 Hawaiian hoary bats, over a period of 10 years. The Service uses a standardized approach to project a take estimate for individual projects based on site-specific factors, as described in Appendix C. The take of a bat during the breeding season may result in the indirect loss or take of a dependent offspring. In order to account for the immediate loss and future loss, indirect take is assessed to the females taken during the breeding season taking into account the estimated survival rate of dependent young. The bat population on Hawai'i island or statewide is not known. Acoustical detections indicate the Hawaiian hoary bat is well distributed throughout the island of Hawai'i and statewide (Pinzari et al. 2014; Wolfe 2018; Starceovich et al. 2019; **Appendix G**). The population on Hawai'i island has been reported to be stable to increasing (Goressen et al. 2013) It is certain that the entire population of bats on Hawai'i island would not be directly extirpated by the operation of Pakini Nui Wind because not every bat would fly across or through the Project and result in a fatality. While bats are highly mobile and have been known to travel up to 12 mi in a night, bats focus much of their activity where resources are available and spend the majority of their time in their core use area. The local bat subpopulation that utilizes the turbine area for foraging would be at higher risk of fatality than bats that do not frequent the Project. A local effect on a bat subpopulation would be expected if a bats core use area overlaps with the turbine sites because of the higher probability of turbine encounter during nightly usage. Fatalities of individuals from that subpopulation would be expected to cause a localized decrease in that local population. This local effect on that subpopulation could impact the species by reducing the local subpopulation below a threshold that could cause genetic diversity to decline. There is an absence of published information specific to the Hawaiian hoary bat that shows the potential annual take at a wind project site would lead to a permanent decline in genetic diversity island-wide or statewide. The Hawaiian hoary bat is recognized as one species statewide. Genetic diversity is present in the Hawaiian hoary bat population. See **Appendix G** for further discussion on bat genetics, clades, and hybridization between clades. High mobility of adult bats provides an adaptive ability to sustain genetic diversity through the opportunity to breed with individuals throughout the island (**Appendix G**). This mobility would be expected to minimize any effect of genetic loss that would be associated with a potential localized subpopulation decrease. Lost future productivity of an adult bat would also be expected under this alternative. Bats may live up to 10 years, though it is unknown if they breed each year or how many years they may produce young. The loss of an adult bat would be expected to result in the additional loss of future generations on that island. The indirect loss of dependent pups is included in the amount of take and is mitigated for regardless of whether the adult female had dependent young. Mitigation efforts are focused on the same island that the impacts to the bat population (adults and dependent young) would occur and would be expected to provide a beneficial effect on the resident population on the island to reduce the impact of the loss.

The requested bat take would be mitigated by restoring a 1,200 ac contiguous area of forest within the Kahuku section of HVNP that would be permanently protected by the NPS. The size of the restoration project equates to about 46.2 ac per bat. The project would consist of native plant establishment and seed dispersal, invasive species control, long-term maintenance, and invasive species monitoring. The upward adjustment in acreage from 20.3 ac to 46 ac is made to account for the mitigation occurring on federal lands which are already protected into perpetuity from the threat of future development. The forest restoration mitigation project area is within the year-round known range of the Hawaiian hoary bat and is proposed on lands for which there is currently no management plan nor is there funding for habitat restoration. Much of the Kahuku lowland forest (<4,500 ft elevation) is badly degraded by decades of land clearing and destruction by cattle, mouflon sheep, and pigs. Large forest tracts have been converted to alien grass pastures and are invaded by Christmas berry, strawberry guava, and k̄hili ginger which are not documented hosts of Hawaiian hoary bats. HVNP staff have constructed boundary fences to exclude feral pigs and cattle. The methods used by the NPS to achieve the proposed restoration are reliable and proven in the Kahuku section. Habitat improvement activities for the bat at HVNP will include invasive plant control, native forest tree planting, and seed scarification around existing koa trees and are expected to provide additive value for the bat in an otherwise limited landscape. Based on an NPS trial, overall increased native biodiversity of the vegetation is expected to boost bat forage biodiversity and availability within the first few years after planting. Long-term roosting and potential pupping resources are expected to begin establishing after six years when koa seedlings are expected to reach over 15 ft or more in height (personal communication, Sierra McDaniel, HVNP, June 13, 2018). As such, roosting habitat within the entire forest restoration mitigation project area is expected to be fully established within 14 years after starting the mitigation effort. Due to the design, the improved functionality and resources of the forest restoration mitigation project area is expected to continue for the lifespan of each successful tree, which in some cases could be hundreds of years. Forest restoration activities could result in short-term disturbances from worker and vehicle noise, as well as surface disturbance associated with seedling planting. The outplanting is expected to provide a new foraging area and added biodiversity of bats' potential prey species. The forest restoration mitigation project area, which is adjacent to the Ka'ū Forest Reserve, provides habitat for a number of rare, threatened, and endangered species, in addition to the Hawaiian hoary bat and Hawaiian goose. Adaptive management triggers are in place if monitoring indicates the success criteria are not being met or new information indicates a change in success criteria is necessary (Section 6.2.5 in the Pakini Nui Wind HCP), to assure the Applicant would meet the mitigation obligation. For these reasons, no adverse impacts to the Hawaiian hoary bat population would be anticipated from the proposed mitigation.

Pakini Nui Wind's Hawaiian petrel mitigation activities include fence maintenance and predator control and monitoring to protect endangered seabirds at HVNP and are not expected to impact Hawaiian hoary bats because the bats are not known to utilize the site. Pakini Nui Wind will contract with DOFAW to construct a new predator-free 7-ac breeding pen at Pi'ihonua for the Hawaiian goose. Construction could cause localized and temporary disturbance in the form of noise and disturbance from construction and maintenance activities related to construction equipment, lawn mowers, weed trimming, and fence construction to Hawaiian hoary bats in the vicinity of the pen or that use the existing reservoirs. Best management practices will be utilized

during construction and maintenance to avoid and minimize impacts which are expected to be temporary and short in duration. Long-term impacts of the Hawaiian goose pen to the Hawaiian hoary bat are considered negligible.

4.6.9 ALTERNATIVE 3A: AUWAHI WIND INCREASED CURTAILMENT

Under Alternative 3A, (Section 2.3.1) Auwahi Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would reduce the expected take under Alternative 3A to an additional 94 bats (60 bats in Tier 4 and 34 bats in Tier 5) through the permit term ending February 23, 2037.

The net effect from the reduction of take associated with the implementation of this alternative, even with a reduction in beneficial effects due to a proportional reduction in the required mitigation, would result in less overall impact than alternative 2A. There would be an expected decrease in renewable energy production that would need to be met by another source during the nighttime operational shutdown.

4.6.10 ALTERNATIVE 3B: KAWAIILOA WIND INCREASED CURTAILMENT

Under Alternative 3B (Section 2.3.2) Kawaiiloa Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would reduce the expected take under Alternative 3B to an additional 140 bats (55 bats in Tier 4 and 85 bats in Tier 5) through the permit term ending December 7, 2031.

The net effect from the reduction of take associated with the implementation of this alternative, even with a reduction in beneficial effects due to a proportional reduction in the required mitigation, would result in less overall impact than alternative 2B. There would be an expected decrease in renewable energy production that would need to be met by another source during the nighttime operational shutdown. Impacts from Hawaiian petrel mitigation would be identical to those described in Section 4.6.6 above.

4.6.11 ALTERNATIVE 3C: KWP II INCREASED CURTAILMENT

Under Alternative 3C (Section 2.3.3) KWP II would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would reduce the expected take under Alternative 3C to an additional 15 bats for Tier 3 through the permit term ending January 2, 2032.

The net effect from the reduction of take associated with the implementation of this alternative, even with a reduction in beneficial effects due to a proportional reduction in the required

mitigation, would result in less overall impact than alternative 2C. There would be an expected decrease in renewable energy production that would need to be met by another source during the nighttime operational shutdown. Impacts from Hawaiian goose mitigation would be identical to those described in Section 6.6.7 above.

4.6.12 ALTERNATIVE 3D: PAKINI NUI INCREASED CURTAILMENT

Under Alternative 3D (2.3.4) Pakini Nui Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. This operational change of the existing wind turbines related to take avoidance and minimization would reduce the expected take under Alternative 3D to an additional 16 bats through the 10-year permit term ending 2029.

The net effect from the reduction of take associated with the implementation of this alternative, even with a reduction in beneficial effects due to a proportional reduction in the required mitigation, would result in less overall impact than alternative 2D. There would be an expected decrease in renewable energy production that would need to be met by another source during the nighttime operational shutdown. Impacts from Hawaiian goose and Hawaiian petrel mitigation would be identical to those described in Section 6.6.8 above.

4.7 HAWAIIAN PETREL

This section describes the potential effects of the alternatives on the Hawaiian petrel in the analysis area. Hawaiian petrel resources in the affected environment are described in Section 3.10.

4.7.1 ALTERNATIVE 1A: AUWAHI WIND NO ACTION

The environmental effects of the existing 2012 Auwahi Wind HCP/ITP were analyzed previously under NEPA (USFWS 2012). Under Alternative 1A, a major amendment to the ITP would not be issued. The previously authorized take of 87 Hawaiian petrels in Auwahi's existing ITP would not change.

Turbines that operate during the day, as well as those curtailed at night, pose a risk of injury from collision for the Hawaiian petrel. Collision with stationary objects such as power lines and buildings is well documented, but sufficient information to estimate a collision risk does not exist. The potential for Hawaiian petrel collision impacts with stationary wind turbine blades to occur is less than when the turbine is operational; therefore, the impacts to the Hawaiian petrel would likely be less than the previously authorized take limit.

4.7.2 ALTERNATIVE 1B: KAWAILOA WIND NO ACTION

The environmental effects of the existing 2011 Kawaiiloa Wind HCP/ITP were analyzed previously under NEPA (USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. Kawaiiloa did not have authorized take of the Hawaiian petrel in their original ITP.

Turbines that operate during the day, as well as those curtailed at night, pose a risk of injury from collision for the Hawaiian petrel. Collision with stationary objects such as power lines and buildings is well documented, but sufficient information to estimate a collision risk does not exist. The potential for Hawaiian petrel collision impacts with stationary wind turbine blades to occur is minor.

4.7.3 ALTERNATIVE 1C: KWP II NO ACTION

The environmental effects of the existing 2011 KWP II HCP/ITP were analyzed previously under NEPA (Planning Solutions 2010, USFWS 2011b). Under the No Action Alternative, a major amendment to the ITP would not be issued. The previously authorized take of 43 Hawaiian petrels in KWP II's existing ITP would not change.

Turbines that operate during the day, as well as those curtailed at night, pose a risk of injury from collision for the Hawaiian petrel. Collision with stationary objects such as power lines and buildings is well documented, but sufficient information to estimate a collision risk does not exist. The potential for Hawaiian petrel collision impacts with stationary wind turbine blades to occur is less than when the turbine is operational; therefore, the impacts to the Hawaiian petrel would likely be less than the previously authorized take limit.

4.7.4 ALTERNATIVE 1D: PAKINI NUI NO ACTION

Under the No Action Alternative, Pakini Nui Wind would not be issued an ITP. Pakini Nui Wind would likely continue to conduct operations and maintenance at the wind facility as described in Section 2.1.4, including the implementation of full nighttime curtailment.

Turbines that operate during the day, as well as those curtailed at night, pose a risk of injury from collision for the Hawaiian petrel. Collision with stationary objects such as power lines and buildings is well documented, but sufficient information to estimate a collision risk does not exist. The potential for Hawaiian petrel collision impacts with stationary wind turbine blades to occur is minor.

4.7.5 ALTERNATIVE 2A: AUWAHI WIND PROPOSED ACTION

Under Alternative 2A, (Section 2.2.1), the previously authorized take of up to 87 Hawaiian petrels in Auwahi's existing ITP would not change and was previously analyzed. Auwahi would implement the LWSC as described in their HCP Amendment. No additional take of petrels beyond that already authorized and analyzed would be expected. There would be no new effects to Hawaiian petrels from this alternative.

The proposed bat mitigation projects under Alternative 2A for Tiers 4-6 as described in Section 2.2.1 are expected to have no impact to the Hawaiian petrel because the petrel is not expected to utilize the mitigation sites or be impacted by actions planned.

4.7.6 ALTERNATIVE 2B: KAWAIILOA WIND PROPOSED ACTION

Under Alternative 2B (Section 2.2.2) Kawaiiloa Wind would modify operations by implementing LWSC and bat deterrent technology as described in their amended HCP. The take of up to 24 Hawaiian petrels, including direct and indirect losses, is anticipated to occur over a 20-year period. Kawaiiloa has requested take of 24 Hawaiian petrel in their ITP amendment request.

Kawaiiloa's Hawaiian petrel mitigation activities, including predator control trapping and petrel burrow monitoring at Hanakāpī'ai and Hanakoa, is expected to provide benefits to the breeding colony by reducing predation, and thereby increasing survival and fledging success. The proposed bat mitigation projects under Alternative 2B for Tiers 4-6 as described in Section 2.2.2 are expected to have no impact to the Hawaiian petrel because the petrel is not expected to utilize the mitigation sites or be impacted by actions planned.

4.7.7 ALTERNATIVE 2C: KWP II WIND PROPOSED ACTION

Under Alternative 2C (Section 2.2.3), the previously authorized take of 43 Hawaiian petrels in KWP II's existing ITP would not change and was previously analyzed. KWP II would implement the LWSC as described in their HCP Amendment. No additional take of petrels beyond that already authorized and analyzed would be expected. There would be no new effects to Hawaiian petrels from this alternative.

4.7.8 ALTERNATIVE 2D: PAKINI NUI PROPOSED ACTION

Under Alternative 2D (Section 2.2.4), Pakini Nui Wind would modify operations by implementing LWSC as described in their amended HCP. The take of up to 3 Hawaiian petrels, including direct and indirect losses, is anticipated to occur over a 10-year period. The potential for this impact to the petrel to occur is extremely low, but cannot be discounted. Pakini Nui has requested take of three Hawaiian petrel in their ITP request.

Pakini Nui Wind's Hawaiian petrel mitigation activities include fence maintenance and predator control and monitoring to protect endangered seabirds. These mitigation actions would provide direct and indirect benefits to the Hawaiian petrel population by reducing or eliminating predators and increasing breeding success. The construction of a new predator-free 7-ac breeding pen at Pi'ihonua for the Hawaiian goose is not expected to impact the Hawaiian petrel because the petrels are not expected to use the site. The proposed bat mitigation proposed under Alternative 2D as described in Section 2.2.4 is expected to have no impacts to the Hawaiian petrel because the petrel is not expected to utilize the mitigation sites or be impacted by actions planned.

4.7.9 ALTERNATIVE 3A: AUWAHI WIND INCREASED CURTAILMENT

Under Alternative 3A (Section 2.3.1), the previously authorized take of 87 Hawaiian petrels in Auwahi's existing ITP would not change and was previously analyzed. Auwahi would implement the LWSC as described in their HCP Amendment. No additional take of petrels

beyond that already authorized and analyzed would be expected. There would be no new effects to Hawaiian petrels from this alternative.

The bat mitigation described in Alternative 3A are expected to have no impact to the Hawaiian petrel because the petrel is not expected to utilize the mitigation sites or be impacted by actions planned.

4.7.10 ALTERNATIVE 3B: KAWAILOA WIND INCREASED CURTAILMENT

Under Alternative 3B (Section 2.3.2) Kawaiiloa Wind would modify operations by implementing LWSC as described in their amended HCP. Kawaiiloa has requested take of 24 Hawaiian petrel in their ITP amendment request.

Although turbine operation would cease during night time hours during the Hawaiian hoary bat breeding season, take of Hawaiian petrels may occur outside of this period. Additionally, Hawaiian petrels may collide with stationary objects such as the turbine monopoles and slowly rotating or stationary blades, meteorological towers, and cranes (USFWS 2016b). We expect the risk to a petrel would be reduced in the rotor sweep region if the blades were stationary, but it would be dependent on the position of the blade at the time the petrel flew through, which would be variable. Under this alternative, the Service expects that the likelihood of take from collision with non-operational project infrastructure would be a rare event. There is not sufficient information to quantify the reduction in take; however, it would likely be the same or less than described in Alternative 2B.

Kawaiiloa's Hawaiian petrel mitigation activities, including predator control trapping and petrel burrow monitoring at Hanakāpī'ai and Hanakoa, would provide benefits to the colony in general by reducing predation and increasing fledgling success. The proposed bat mitigation projects Alternative 3B for Tiers 4 and 5 are expected to have no impact to the Hawaiian petrel because the petrel is not expected to utilize the mitigation sites or be impacted by actions planned.

4.7.11 ALTERNATIVE 3C: KWP II INCREASED CURTAILMENT

Under Alternative 3C (Section 2.3.3) the previously authorized take of up to 43 Hawaiian petrels on their existing ITP would not change and was previously analyzed. KWP II would implement the LWSC as described in their HCP Amendment. No additional take of petrels beyond that already authorized and analyzed would be expected. There would be no new effects to Hawaiian petrels from this alternative.

KWP II's mitigation for the bat and Hawaiian goose is not expected to have any impact to the Hawaiian petrel, because the bat mitigation is research and the petrel is not expected to utilize the Hawaiian goose mitigation sites or be impacted by actions planned.

4.7.12 ALTERNATIVE 3D: PAKINI NUI INCREASED CURTAILMENT

Under Alternative 3D (Section 2.3.4), Pakini Nui Wind would modify operations by implementing LWSC as described in their amended HCP. Kawaiiloa has requested take of three

Hawaiian petrel in their ITP request. The potential for this impact to the petrel to occur is extremely low, but cannot be discounted.

Although turbine operation would cease during night time hours during the Hawaiian hoary bat breeding season, take of Hawaiian petrels may occur outside of this period. Additionally, Hawaiian petrels may collide with stationary objects such as the turbine monopoles and slowly rotating or stationary blades, meteorological towers, and cranes (USFWS 2016b). We expect the risk to a petrel would be reduced in the rotor sweep region if the blades were stationary, but it would be dependent on the position of the blade at the time the petrel flew through, which would be variable. Under this alternative, the Service expects that the likelihood of take from collision with non-operational project infrastructure would be a rare event. There is not sufficient information to quantify the reduction in take; however, it would likely be the same or less than described in Alternative 2D.

Pakini Nui Wind's Hawaiian petrel mitigation activities include fence maintenance and predator control and monitoring to protect endangered seabirds at HVNP and are expected to mitigate the take of Hawaiian petrels. The construction of a new predator-free 7-ac breeding pen at Pi'ihonua for the Hawaiian goose is not expected to impact the Hawaiian petrel because the petrels are not expected to use the site. The proposed bat mitigation is expected to have no impact to the Hawaiian petrel because the petrel is not expected to utilize the mitigation sites or be impacted by actions planned.

4.8 HAWAIIAN GOOSE

4.8.1 ALTERNATIVE 1A: AUWAHI WIND NO ACTION

The environmental effects of the existing 2012 Auwahi Wind HCP/ITP were analyzed previously under NEPA (USFWS 2012). Under the No Action Alternative, a major amendment to the ITP would not be issued. The previously authorized take of five Hawaiian geese in Auwahi's existing ITP would not change.

The implementation of nighttime curtailment under the No Action Alternative would not result in any additional effects to the Hawaiian goose.

4.8.2 ALTERNATIVE 1B: KAWAILOA WIND NO ACTION

The environmental effects of the existing 2011 Kawaihoa Wind HCP/ITP were previously analyzed under NEPA (USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. Take of the Hawaiian goose was not authorized in Kawaihoa's original ITP.

The implementation of nighttime curtailment would not result in any effects to the Hawaiian goose.

4.8.3 ALTERNATIVE 1C: KWP II NO ACTION

The environmental effects of the existing 2011 KWP II HCP/ITP were analyzed previously under NEPA (Planning Solutions 2010, USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. The existing KWP II ITP authorizes take of up to 30 Hawaiian geese. KWP II would continue to conduct daytime operations and maintenance at the wind facility, as described in Section 2.1.3, until they reach their maximum anticipated take amount of Hawaiian geese.

The implementation of nighttime curtailment would not result in any changes to the previously analyzed effects to the Hawaiian goose.

4.8.4 ALTERNATIVE 1D: PAKINI NUI NO ACTION

Under the No Action Alternative, Pakini Nui Wind would not be issued an ITP. Pakini Nui Wind would likely continue to conduct operations and maintenance at the wind facility as described in Section 2.1.4, including the implementation of full nighttime curtailment. Operations of the turbines during the daytime hours would be expected to pose a risk of collision and fatality to Hawaiian geese. Any take would be a violation of the ESA section 9 prohibitions and subject the project to possible enforcement action.

4.8.5 ALTERNATIVE 2A: AUWAHI WIND PROPOSED ACTION

Under Alternative 2A, (Section 2.2.1), operational changes related to take avoidance and minimization would have no effect on the previously authorized take of five Hawaiian geese in their existing ITP. Auwahi Wind is not requesting an increase in take of the Hawaiian goose; therefore, no additional impacts would be expected.

The proposed bat mitigation projects under Alternative 2A for Tiers 4-6 as described in Section 2.2.1 are expected to have minor beneficial impacts to the Hawaiian goose because of the creation of ponds which may be periodically used by the Hawaiian goose as water sources and nest sites.

4.8.6 ALTERNATIVE 2B: KAWAILOA WIND PROPOSED ACTION

Under Alternative 2B (Section 2.2.2), Kawaiiloa Wind is not requesting an incidental take of the Hawaiian goose; therefore, no impacts would be expected.

The proposed bat mitigation would likely have no impacts to the Hawaiian goose on the island of O'ahu because the known population is less than two individuals, which are located at, or in the vicinity of James Campbell NWR.

4.8.7 ALTERNATIVE 2C: KWP II WIND PROPOSED ACTION

Under Alternative 2B, (Section 2.2.3) KWP II's is requesting to increase their take of the Hawaiian goose from 30 to 44 individuals. This change will have minor impacts to the Hawaiian

goose population in the immediate area of the KWP II facility, but the effect would be negligible to the population on Maui or throughout Hawai'i.

KWP II's mitigation actions for the Hawaiian goose include predator control and fence maintenance at the Pi'iholo Ranch pen, Haleakalā Ranch pen on Maui and is expected to provide benefits to the Hawaiian goose in the form of increased productivity above baseline. The USGS Hawaiian hoary bat research project is not expected to impact the Hawaiian goose.

4.8.8 ALTERNATIVE 2D: PAKINI NUI PROPOSED ACTION

Under Alternative 2D, operations and anticipated take at Pakini Nui would be as described in Section 2.2.4. The construction of a new predator-free 7-ac breeding pen at Pi'ihonua for the Hawaiian goose is expected to provide benefits to the Hawaiian goose. Adaptive management triggers are in place if monitoring indicates the success criteria are not being met or new information indicates a change in success criteria is necessary (Section 6.4.3 in the Pakini Nui HCP), to assure the Project would meet the mitigation obligation. For these reasons, no adverse impacts to the Hawaiian goose population would be anticipated from the proposed mitigation.

The proposed bat mitigation includes restoration activities and removal of invasive species and is expected to have short-term impacts on the Hawaiian goose in the form of localized noise and disturbance. HVNP will use standard operating procedures and BMPs to avoid and minimize impact to Hawaiian geese in the area if present when restoration activities are underway. Long-term impacts of the restoration are expected to be negligible to beneficial to the Hawaiian goose if they use the area.

4.8.9 ALTERNATIVE 3A: AUWAHI WIND INCREASED CURTAILMENT

Under Alternative 3A, (Section 2.3.1) Auwahi Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. Auwahi Wind is not requesting an increase in take of the Hawaiian geese above the five authorized in their original ITP; therefore, no additional impacts would be expected.

The bat mitigation described in Section 2.3.4 is expected to have negligible to minor beneficial impacts to the Hawaiian goose because of the creation of ponds which may be used by the Hawaiian goose as water sources.

4.8.10 ALTERNATIVE 3B: KAWAIILOA WIND INCREASED CURTAILMENT

Under Alternative 3B, (Section 2.3.2) Kawaiiloa Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. Kawaiiloa does not have, nor are they requesting, take authorization for the Hawaiian goose; therefore, there would be no impacts to the Hawaiian goose.

The Hawaiian hoary bat and Hawaiian petrel mitigation associated with Alternative 3B are expected to have no impacts to Hawaiian goose because geese are not known to use the mitigation sites.

4.8.11 ALTERNATIVE 3C: KWP II INCREASED CURTAILMENT

Under Alternative 3C, (Section 2.3.3) KWP II would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. Under this alternative, KWP II would be requesting to increase their take of the Hawaiian goose from 30 to 44 individuals. This change in operation will have minor impacts to the Hawaiian goose population in the immediate area of the KWP II facility, but the effect would be negligible to the population on Maui or throughout Hawai'i.

KWP II's mitigation actions for the Hawaiian goose includes predator control and fence maintenance at the Pi'iholo Ranch pen, Haleakalā Ranch pen on Maui and is expected to provide benefits to the Hawaiian goose in the form of increased productivity above baseline. The Hawaiian hoary bat USGS research mitigation project is expected to have no impacts to the Hawaiian goose.

4.8.12 ALTERNATIVE 3D: PAKINI NUI INCREASED CURTAILMENT

Under Alternative 3D, (Section 2.3.4.2) Pakini Nui Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. The construction of a new predator-free 7-ac breeding pen at Pi'ihonua for the Hawaiian goose is expected to provide benefits to the Hawaiian goose similar to those described in Section 4.8.8.

The proposed bat and petrel mitigation includes restoration activities and removal of invasive species at HVNP, which may serve as feeding or nesting habitat for the Hawaiian goose. If they utilize the mitigation area, the proposed management would provide minor benefits, similar to but slightly less than described in Section 4.8.8, to the Hawaiian goose.

4.9 CULTURAL RESOURCES

4.9.1 ALTERNATIVE 1A: AUWAHI WIND NO ACTION

The environmental effects of the existing 2012 Auwahi Wind HCP/ITP were analyzed previously under NEPA (USFWS 2012). Under Alternative 1A, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.1, would be Auwahi Wind implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat. The implementation of nighttime curtailment would not result in any effects to cultural resources.

4.9.2 ALTERNATIVE 1B: KAWAIILOA WIND NO ACTION

The environmental effects of the existing 2011 Kawaiiloa Wind HCP/ITP were analyzed previously under NEPA (USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.2, would be Kawaiiloa Wind implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat. The implementation of nighttime curtailment would not result in any effects to cultural resources.

4.9.3 ALTERNATIVE 1C: KWP II NO ACTION

The environmental effects of the existing 2011 KWP II HCP/ITP were analyzed previously under NEPA (Planning Solutions 2010, USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.3, would be KWP II implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat. The implementation of nighttime curtailment would not result in any effects to cultural resources.

4.9.4 ALTERNATIVE 1D: PAKINI NUI NO ACTION

Under the No Action Alternative, Pakini Nui Wind would not be issued an ITP. Pakini Nui Wind would likely continue to conduct operations and maintenance at the wind facility as described in Section 2.1.4, including the implementation of full nighttime curtailment.

The continuation of daytime facility operations and other actions by Pakini Nui Wind, which does not require an ITP, would result in no impact to cultural resources.

4.9.5 ALTERNATIVE 2A: AUWAHI WIND PROPOSED ACTION

Under Alternative 2A, operations and anticipated take at Auwahi Wind would be as described in Section 2.2.1. An archaeological resource investigation specific to the Mitigation Area has not been conducted; however, previous archeological investigations in the Kahikinui District suggest that archaeological sites in the upper elevations of Leeward Haleakalā are temporary in nature with no permanent dwellings or associated agricultural development (Kirch et al. 2004; Dixon et al. 1999). Most sites, including primary and temporary habitations, agricultural features, heiau and other sites with ritual functions, boundary markers, shelters, surface midden, burials, and other permanent features appear to be concentrated below 3,000 ft in elevation (Kirch et al. 2004; Dixon et al. 1999), but some types of temporary sites may occur above 6,000 ft in elevation if the topography is gentle (Soehren 1963 as cited in DOFAW 2004; NSF 2010). Based on this information, it is anticipated that archaeological resources within the mitigation area (3,500 to 5,500 ft above sea level) are limited, and likely consist of rock shelters, cairns, ridge trails, and other temporary use sites.

An archaeological investigation will be conducted prior to commencing any ground disturbing activities associated with the proposed mitigation, and consultation with the SHPD is currently underway. Any historical, cultural, and archeological resources that are identified will be

avoided to the extent possible through micrositing and other BMPs. Contractor requirements will include precautionary measures related to the inadvertent discovery of cultural remains, such as stopping work in the immediate area of the discovery and immediately notifying the SHPD. With these measures, mitigation activities are not expected to significantly impact archeological or cultural resources.

Under this alternative, there is expected to be an impact to those who consider Hawaiian hoary bats to have special cultural significance as ‘aumākua (family or personal gods, deified ancestors who might assume the shape of a bat). It is unknown how many individuals may identify ‘ōpe‘ape‘a as their ‘aumākua across the Hawaiian Islands. Such spiritual beliefs and values are personal and immeasurable; therefore the effects to this type of cultural value cannot be quantified. Minimization and mitigation measures proposed under the amendment would be expected to result in long-term beneficial impacts to Hawaiian hoary bats on the island of Maui.

4.9.6 ALTERNATIVE 2B: KAWAIOLOA WIND PROPOSED ACTION

Under Alternative 2B, operations and anticipated take at Kawailoa Wind would be as described in Section 2.2.2. The land acquisition of HWA proposed under Tier 4 bat mitigation would not impact archeological resources. Construction of fences that may occur as part of Tier 5 and/or Tier 6 Hawaiian hoary bat mitigation has the potential to impact archeological resources. However, an archaeological investigation will be conducted prior to commencing any ground disturbing activities associated with the proposed mitigation, and consultation with the SHPD is currently underway. Any historical, cultural, and archeological resources that are identified will be avoided to the extent possible through micrositing and other BMPs. Contractor requirements will include precautionary measures related to the inadvertent discovery of cultural remains, such as stopping work in the immediate area of the discovery and immediately notifying the SHPD. With these measures, mitigation activities are not expected to significantly impact archeological or cultural resources.

Under this alternative, there is expected to be an impact to persons who consider Hawaiian hoary bats and Hawaiian petrels to have special cultural significance as ‘aumākua (family or personal gods, deified ancestors who might assume the shape of a bat). It is unknown how many individuals may identify the ‘ōpe‘ape‘a or ‘ua‘u as their ‘aumākua across the Hawaiian Islands. Such spiritual beliefs and values are personal and immeasurable; therefore the effects to this type of cultural value cannot be quantified. Minimization and mitigation measures proposed under the amendment would be expected to result in long-term beneficial impacts to Hawaiian hoary bats on the island of Oahu and Hawaiian petrels.

4.9.7 ALTERNATIVE 2C: KWP II WIND PROPOSED ACTION

Under Alternative 2C, operations and anticipated take at KWP II would be as described in Section 2.2.3. Construction of fences has the potential to impact archeological resources. Preliminary searches of the National Register of Historic Places (NPS 2018) and the OHA Kipuka database (OHA 2018) show no historical or cultural resources in either mitigation site within the Makawao district. Archaeological resources specific to the Hana district mitigation sites are unknown, however previous archaeological investigations in the Kahikinui area suggest

that in the steep upper elevations of leeward Haleakalā, archaeological sites are exclusively temporary in nature with no permanent dwellings or associated agricultural development (Tetra Tech 2011). It is anticipated that archaeological surveys of the Hana district mitigation areas would produce few sites, likely consisting of rock shelters, cairns, ridge trails, and other temporary use sites (Tetra Tech 2011). A detailed archaeological investigation will be conducted prior to commencing any ground disturbing activities associated with the proposed mitigation, and consultation with the SHPD is currently underway. Any historical, cultural, and archeological resources that are identified will be avoided to the extent possible through micrositing and other BMPs. Contractor requirements will include precautionary measures related to the inadvertent discovery of cultural remains, such as stopping work in the immediate area of the discovery and immediately notifying the SHPD. With these measures, mitigation activities are not expected to significantly impact archeological or cultural resources.

Under this alternative, there is expected to be an impact to persons who consider Hawaiian hoary bats to have special cultural significance as ‘aumākua (family or personal gods, deified ancestors who might assume the shape of a bat). It is unknown how many individuals may identify ‘ōpe‘ape‘a as their ‘aumākua across the Hawaiian Islands. Such spiritual beliefs and values are personal and immeasurable; therefore the effects to this type of cultural value cannot be quantified. Minimization and mitigation measures proposed under the amendment would be expected to result in long-term beneficial impacts to Hawaiian hoary bats on the island of Oahu.

4.9.8 ALTERNATIVE 2D: PAKINI NUI PROPOSED ACTION

Under Alternative 2D, operations and anticipated take at Pakini Nui Wind would be as described in Section 2.2.4. Preliminary searches of the National Register of Historic Places (NPS 2018) and the Office of Hawaiian Affairs (OHA) Kipuka database (OHA 2018) show no historical or cultural resources within the Pi‘ihonua mitigation site. No earthwork will be conducted throughout the rest of the South Hilo mitigation areas. A detailed archaeological resource investigation specific to the Pi‘ihonua mitigation area for the Hawaiian goose has not yet been conducted. Prior to fence construction, an archaeological investigation will be conducted prior to commencing any ground disturbing activities associated with the proposed mitigation, and consultation with the SHPD will be conducted as needed. Any historical, cultural, and archeological resources that are identified will be avoided to the extent possible through micrositing and other BMPs. Contractor requirements will include precautionary measures related to the inadvertent discovery of cultural remains, such as stopping work in the immediate area of the discovery and immediately notifying the SHPD. With these measures, mitigation activities are not expected to significantly impact archeological or cultural resources.

Under this alternative, there is expected to be an impact to those who consider Hawaiian hoary bats and Hawaiian petrels to have special cultural significance as ‘aumākua (family or personal gods, deified ancestors who might assume the shape of a bat). It is unknown how many individuals may identify ‘ōpe‘ape‘a or ‘ua‘u as their ‘aumākua across the Hawaiian Islands. Such spiritual beliefs and values are personal and immeasurable; therefore the effects to this type of cultural value cannot be quantified. Minimization and mitigation measures proposed under the amendment would be expected to result in long-term beneficial impacts to Hawaiian hoary bats and Hawaiian petrel on the island of Hawai‘i.

4.9.9 ALTERNATIVE 3A: AUWAHI WIND INCREASED CURTAILMENT

Under Alternative 3A, (Section 2.3.1) Auwahi Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. Impacts to cultural resources would be similar to those described in section 4.9.5, although impacts to those that identify 'ōpe'ape'a as their 'aumākua may be incrementally lessened by the reduced take level associated with this alternative.

Impacts to cultural resources from the Alternative 3A mitigation activities would be similar to, but on a lesser scale, than described in Section 4.9.5 above, due to the smaller mitigation acreages needed for this alternative.

4.9.10 ALTERNATIVE 3B: KAWAIOLOA WIND INCREASED CURTAILMENT

Under Alternative 3B, (Section 2.3.2) Kawailoa Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. Impacts to cultural resources would be similar to those described in section 4.9.6, although impacts to those that identify 'ōpe'ape'a or 'ua'u as their 'aumākua may be incrementally lessened by the reduced take level associated with this alternative.

Impacts to cultural resources from the Alternative 3B mitigation activities would be similar to, but on a lesser scale, than described in Section 4.9.6 above, and smaller mitigation acreages needed under this alternative.

4.9.11 ALTERNATIVE 3C: KWP II INCREASED CURTAILMENT

Under Alternative 3C, (Section 2.3.3) KWP II would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. Impacts to cultural resources would be similar to those described in section 4.9.7, although impacts to those that identify 'ōpe'ape'a as their 'aumākua may be incrementally lessened by the reduced take level associated with this alternative.

Impacts to cultural resources from the Alternative 3C mitigation activities would be similar to, but on a lesser scale, than described in Section 4.9.7 above, due to the smaller mitigation acreages needed for this alternative.

4.9.12 ALTERNATIVE 3D: PAKINI NUI INCREASED CURTAILMENT

Under Alternative 3D, (Section 2.3.4) Pakini Nui Wind would cease turbine operations at night during the period from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP. Impacts to cultural resources would be similar to those described in section 4.9.8, although impacts to those that identify 'ōpe'ape'a or

‘ua‘u as their ‘aumākua may be incrementally lessened by the reduced take level associated with this alternative.

Impacts to cultural resources from the Alternative 3D mitigation activities would be similar to, but on a lesser scale, than described in Section 4.9.8 above, due to the smaller mitigation acreages needed for this alternative.

4.10 PUBLIC SERVICES AND UTILITIES

This section describes the potential effects of the alternatives on public services and utilities. Public services and utilities in the affected environment are described in Section 3.12.

4.10.1 ALTERNATIVE 1A: AUWAHI WIND NO ACTION

The environmental effects of the existing 2012 Auwahi Wind HCP/ITP were analyzed previously under NEPA (USFWS 2012). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.1, would be Auwahi Wind implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat.

Year-round nighttime shutdown of turbines would have the potential to reduce the amount of wind energy generated by approximately 50% of current production capacity (**Table 2-6**). This is an estimate only and is relative to their current operating regime that includes day operation and night operation with LWSC. The loss of this portion of renewable energy would need to be made up by some additional source of energy production to meet island-wide energy demand.

4.10.2 ALTERNATIVE 1B: KAWAILOA WIND NO ACTION

The environmental effects of the existing 2011 Kawaihoa Wind HCP/ITP were analyzed previously under NEPA (USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as described in Section 2.1.2, would be Kawaihoa Wind implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat.

Year-round nighttime shutdown of turbines would have the potential to reduce the amount of wind energy generated by approximately 50% of current production capacity (**Table 2-6**). This is an estimate only and is relative to their current operating regime that includes day operation and night operation with LWSC. The loss of this portion of renewable energy would need to be made up by some additional source of energy production to meet island-wide energy demand.

4.10.3 ALTERNATIVE 1C: KWP II NO ACTION

The environmental effects of the existing 2011 KWP II HCP/ITP were analyzed previously under NEPA (Planning Solutions 2010, USFWS 2011). Under the No Action Alternative, a major amendment to the ITP would not be issued. The only change to existing operation, as

described in Section 2.1.3, would be KWP II implementing full nighttime curtailment in order to avoid impacts to the Hawaiian hoary bat.

Year-round nighttime shutdown of turbines would have the potential to reduce the amount of wind energy generated by approximately 50% of current production capacity (**Table 2-6**). This is an estimate only and is relative to their current operating regime that includes day operation and night operation with LWSC. The loss of this portion of renewable energy would need to be made up by some additional source of energy production to meet island-wide energy demand.

4.10.4 ALTERNATIVE 1D: PAKINI NUI NO ACTION

Under the No Action Alternative, Pakini Nui Wind would not be issued an ITP. Pakini Nui Wind would likely continue to conduct operations and maintenance at the wind facility as described in Section 2.1.4, including the implementation of full nighttime curtailment.

Year-round nighttime shutdown of turbines would have the potential to reduce the amount of wind energy generated by approximately 50% of current production capacity (**Table 2-6**). This is an estimate only and is relative to their current operating regime that includes day operation and night operation with LWSC. The loss of this portion of renewable energy would need to be made up by some additional source of energy production to meet island-wide energy demand.

4.10.5 ALTERNATIVE 2A: AUWAHI WIND PROPOSED ACTION

Under Alternative 2A, operations and anticipated take at Auwahi Wind would be as described in Section 2.2.1. Implementation of year-round nighttime low wind speed curtailment with higher cut-in speeds August through October, would have the potential to reduce the amount of wind energy generated by Auwahi Wind up to 20% of current production capacity (**Table 2-6**). This estimate would vary depending on wind speed and is strictly based on the relative amount of non-operation time when the turbines would be curtailed due to wind speeds below the cut-in speed. The loss of this portion of renewable energy would need to be made up by some additional source of energy production to meet island-wide energy demand.

4.10.6 ALTERNATIVE 2B: KAWAILOA WIND PROPOSED ACTION

Under Alternative 2B, operations and anticipated take at Kawaiiloa Wind would be as described in Section 2.2.2. Implementation of increased cut-in speeds for year-round nighttime curtailment would have the potential to reduce the amount of wind energy generated by Kawaiiloa Wind up to approximately 20% of current production capacity (**Table 2-6**). This estimate would vary depending on wind speed and is strictly based on the relative amount of non-operation time when the turbines would be curtailed due to wind speeds below the cut-in speed. The loss of this portion of renewable energy would need to be made up by some additional source of energy production to meet island-wide energy demand.

4.10.7 ALTERNATIVE 2C: KWP II WIND PROPOSED ACTION

Under Alternative 2C, operations and authorized take at KWP II would be as described in Section 2.2.3. Implementation of seasonal nighttime low wind speed curtailment, with the possibility to extend the duration of the initial period commensurate with take, would have the potential to reduce the amount of wind energy generated by KWP II Wind up to approximately 20% of current production capacity (**Table 2-6**). This estimate would vary depending on wind speed and is strictly based on the relative amount of non-operation time when the turbines would be curtailed due to wind speeds below the cut-in speed. The loss of this portion of renewable energy would need to be made up by some additional source of energy production to meet island-wide energy demand.

4.10.8 ALTERNATIVE 2D: PAKINI NUI PROPOSED ACTION

Under Alternative 2D, operations and anticipated take at Pakini Nui Wind would be as described in Section 2.2.4. Implementation of year-round low wind speed curtailment during morning and evening hours would have the potential to reduce the amount of wind energy generated by Pakini Nui Wind up to approximately 20% of current production capacity (**Table 2-6**). This estimate would vary depending on wind speed and is strictly based on the relative amount of non-operation time when the turbines would be curtailed due to wind speeds below the cut-in speed. The loss of this portion of renewable energy would need to be made up by some additional source of energy production to meet island-wide energy demand.

4.10.9 ALTERNATIVE 3A: AUWAHI WIND INCREASED CURTAILMENT

Under Alternative 3A, operations and anticipated take at Auwahi Wind would be as described in Section 2.3.1. Implementation of nighttime shutdown of turbine operations from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP, would have the potential to reduce the amount of wind energy produced up to approximately 32% of current production capacity (**Table 2-6**). This estimate would vary depending on wind speed and is strictly based on the relative amount of non-operation time when the turbines would be curtailed due to wind speeds below the cut-in speed. The loss of this portion of renewable energy would need to be made up by some additional source of energy production to meet island-wide energy demand.

4.10.10 ALTERNATIVE 3B: KAWAILOA WIND INCREASED CURTAILMENT

Under Alternative 3B, operations and anticipated take at Kawaihoa Wind would be as described in Section 2.3.2. Implementation of nighttime shutdown of turbine operations from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP, would have the potential to reduce the amount of wind energy produced up to approximately 32% of current production capacity (**Table 2-6**). This estimate would vary depending on wind speed and is strictly based on the relative amount of non-operation time when the turbines would be curtailed due to wind speeds below the cut-in speed.

The loss of this portion of renewable energy would need to be made up by some additional source of energy production to meet island-wide energy demand.

4.10.11 ALTERNATIVE 3C: KWP II INCREASED CURTAILMENT

Under Alternative 3C, operations and anticipated take at KWP II would be as described in Section 2.3.3. Implementation of nighttime shutdown of turbine operations from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP, would have the potential to reduce the amount of wind energy produced up to approximately 32% of current production capacity (**Table 2-6**). This estimate would vary depending on wind speed and is strictly based on the relative amount of non-operation time when the turbines would be curtailed due to wind speeds below the cut-in speed. The loss of this portion of renewable energy would need to be made up by some additional source of energy production to meet island-wide energy demand.

4.10.12 ALTERNATIVE 3D: PAKINI NUI INCREASED CURTAILMENT

Under Alternative 3D, operations and anticipated take at Pakini Nui Wind would be as described in Section 2.3.4. Implementation of nighttime shutdown of turbine operations from April 15 through September 15 and implement intermittent LWSC during the rest of the year, as described in the Applicant's HCP, would have the potential to reduce the amount of wind energy produced up to approximately 32% of current production capacity (**Table 2-6**). This estimate would vary depending on wind speed and is strictly based on the relative amount of non-operation time when the turbines would be curtailed due to wind speeds below the cut-in speed. The loss of this portion of renewable energy would need to be made up by some additional source of energy production to meet island-wide energy demand.

4.11 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Pursuant to NEPA regulations (40 CFR 1502.16), an EIS must disclose the irreversible and irretrievable commitment of resources associated with the Projects should they be implemented. An irreversible commitment of resources applies primarily to the loss of nonrenewable resources and resources that are renewable only over a long period of time as a result of the Projects (40 CFR 1508.1 1). Nonrenewable resources generally include biological habitat, agricultural land, mineral deposits, water, cultural resources, and fossil fuels. Irretrievable commitments apply to loss of production or use of renewable resources. These opportunities are forgone for the period of the proposed action, during which the resource cannot be used. Resources that are committed irreversibly or irretrievably are those that cannot be recovered if the Projects are implemented. Irreversible and irretrievable commitment of resources associated with the projects including historical, archaeological, and cultural resources was addressed previously and is incorporated here by reference (Planning Solutions 2010, USFWS 2011b, Tetra Tech 2012).

The four projects are constructed and operating. None of the alternatives would be expected to result in the irreversible loss of natural resources, such as water resources, soils, or agricultural or timber land and mitigation actions under Alternatives 2 and 3. Mitigation actions would provide benefit to soils and water resources through soil stabilization and watershed habitat

improvement. While the use of some amount of resources, such as fossil fuels and other materials (e.g., turbine replacement parts) would be required for each Projects' operation and maintenance activities, the irreversible and irretrievable commitment of these resources under all three alternatives would be similar. As project components wear out, they could also be recycled. During decommissioning, the project components would be salvaged and reused and the wind farm site would be returned to its original condition to the extent possible.

The only certain way to eliminate the potential for Hawaiian hoary bat take at wind facilities is by completely shutting down the turbines at night. Hawaiian geese can be active during the day or night, so the only way to ensure no take is to completely stop the operation of the wind turbines. There is no way to completely prevent the potential take of the Hawaiian petrel without stopping operation altogether and removing the existing turbines because that have been known to fly into tall stationary objects.

Alternative 1, followed by Alternative 3, would require the most use of fossil fuels (diesel or coal) or other energy development to offset the loss of renewable power during nighttime shutdown of the projects to avoid or reduce potential take of nocturnally active species. Issuance of the ITP under Alternative 2 would be expected to require the least amount of fossil fuel use because the facilities would be able to operate on nights with winds above the curtailment speed.

Issuance of the ITP/ITL and implementation of the associated HCP for all four wind projects would authorize limited incidental take of the Covered Species. Impacts would occur over the term of the permit. Operation of the Projects would impact species of wildlife that are considered culturally important. The incidental take of Covered Species would comprise an irreversible, environmental change associated with implementation of either action alternative through the loss of an avian or bat individual or 'aumākua considered to have cultural significance. Avoidance, minimization, and mitigation measures outlined in each of the HCPs would reduce the impacts on biological resources to below a level of population significance. Implementation of the conservation strategies and mitigation actions under the alternatives would also require the minor use of resources, such as fossil fuels for vehicles and equipment operation. Overall, however, implementation of those strategies and actions would result in a net benefit to the Covered Species by preserving and enhancing the Hawaiian hoary bat habitat and foraging resources for perpetuity, minimizing potential for predation of the Hawaiian goose and Hawaiian petrel, and improving species' productivity.

4.12 UNAVOIDABLE ADVERSE EFFECTS

As described in Sections 4.1 through 4.10, the potential impacts associated with Alternatives 2 and 3 are anticipated to be minor and generally beneficial compared to the No Action Alternative, for the majority of Affected Environment resources evaluated, with the exception of the potential adverse impacts on the endangered Hawaiian hoary bat, discussed in Section 4.6, and the loss of cultural resources with regard to the animal species that have the potential to be taken (Section 4.9). As described in Chapter 2, Alternatives 1, 2, and 3 all require the implementation of conservation strategies that would ensure permanent adverse effects from the potential take of the Covered Species is avoided (Alternative 1), or minimized and mitigated

(Alternatives 2 and 3) consistent with ESA Section 10(a)(2)(B) issuance criteria. Therefore, the potential unavoidable adverse effects would be limited.

4.13 SHORT TERM USE VERSUS LONG TERM PRODUCTIVITY

NEPA (40 CFR 1502.16) requires that an EIS include a discussion of the relationship between short-term uses of the human environment and the maintenance and enhancement of long-term productivity. Short-term trade-offs include impacts to soil, hydrology, vegetation, wildlife, and agricultural resources at each of the four Projects and mitigation sites and are related to construction of the project and implementation of the proposed mitigation. The four Projects in this PEIS are already constructed and operating. Long-term impacts of each of the four Projects would primarily be beneficial. Operation of the Projects would provide a source of electrical energy generated from an abundant, clean, local, and infinitely renewable energy source. Generation and integration of wind energy into the electric grid reduces fossil fuel consumption, thereby reducing greenhouse gas and carbon dioxide emissions, particulate-related health effects, and other forms of pollution associated with coal or diesel fuel electric generation. The use of a local renewable resource provides greater security in maintaining an energy supply and reduces state expenditures on imported fossil fuels.

Under the No Action Alternative, the Projects would be non-operational at nighttime to avoid take of the Hawaiian hoary bats. This would result in long term loss of renewable energy productivity by up to 50% and the need for increased use of alternative fuels for energy production to replace the loss. Under Alternatives 1, 2, and 3, operations and maintenance activities would result in the same short-term uses of the environment. Alternative 2 would result in additional short-term uses, and Alternative 3 in slightly less uses, associated with implementation of conservation strategies and mitigation actions on conservation lands. Long-term uses of the environment would include conservation lands that would result in restored habitat and enhanced long-term species productivity.

CHAPTER 5 – CUMULATIVE EFFECTS

Cumulative effects under NEPA are those effects that result from incremental action(s) when added to other past, present and reasonably foreseeable future actions (40 C.F.R. §1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Cumulative effects are very difficult to predict at an island-wide or state-wide scale. Naturally-occurring events, such as impacts associated with hurricanes or volcanic eruptions are not factored into the cumulative effects analysis. Past, present, and foreseeable future projects considered in this analysis include, but are not limited to, those subject to: ESA section 10 ITPs and their associated HCPs; ESA section 10 recovery permits and their associated SHAs; ESA section 7 BOs and their accompanying Incidental Take Statements; and Federal, State, and local conservation projects (**Appendix I**).

Based on the findings presented in Chapter 4, the impacts caused by operation of the four wind facilities, under any of the three alternatives considered, would minimally add to the cumulative effects on most of the environmental resources described in Chapter 3. A table summarizing the impact of each alternative, including the cumulative effects of adding that impact to other past,

present, and reasonably foreseeable future actions affecting cultural resources, public utilities and services, and the three listed species, is presented in **Appendix H**. Most of the impacts to resources, such as soils, are not associated with specific past, present, or future actions, therefore it is not possible to assess cumulative effects relative to these resources. Affected environmental resources that would be impacted by any of the three alternatives considered herein that may have measurable cumulative effects are cultural resources, public utilities and services, and the three listed species. Therefore, our cumulative effects analysis is limited to consideration of cultural resources (inclusive of Hawaiian hoary bats and Hawaiian petrels as 'aumākua), public utilities and services, Hawaiian hoary bat, Hawaiian goose, and Hawaiian petrel (**Appendix H, Table H-5**).

Changes in land-use and effects associated with the introduction of non-native plants and animals have altered habitat conditions across the islands. Prior to the arrival of Polynesians to the islands, vegetation on the lower valley slopes (below 400 m elevation) consisted of native forest (Kirch 1982). The valley forest was cleared by Polynesian settlers, mostly aided by fire, and converted to agricultural fields to feed the growing population. This shift to agricultural practices created and maintained open grasslands below 440 m elevation (Kirch 1982). By the time Captain James Cook arrived in 1778, the estimated indigenous population in the Hawaiian Islands was about 300,000. However, due to the influx of European and American explorers, by 1920 the indigenous Hawaiian population was estimated to be 24,000.

The introduction of non-native species to the Hawaiian islands began with the arrival of the Polynesians. Prior to their arrival, plants and animals that made it to Hawaii without the assistance of humans had 70 million years of relative isolation to develop in association with the islands volcanic activity. Most of Hawaii's native species are found nowhere else in the world. Native species evolved in the absence of major predators, sharp-hooved ungulates, toxic or thorny plants, and even the mosquito. Since they did not evolve to compete with or coexist with introduced species, many natives have not survived (Hawaii Invasive Species Council 2019). Of the estimated 5,000 species that currently occur throughout the Hawaiian islands, about 1,300 are non-native vascular plants (Bishop Museum 2019). Nearly all of Hawaii's fruit-eating animals are extinct and most of the seed dispersers are non-native birds.

Sugarcane was first planted in Hawaii in the early to mid 1800s. Early in the 20th century, Hawaiian plantation owners began large-scale sugarcane operations to make up for a worldwide sugar shortage due to a hurricane that devastated the Puerto Rican sugarcane industry in 1899. During the peak of Hawaii's agricultural production in 1980 there were 14 sugarcane and 4 pineapple plantations, along with more than 500 small independent growers, farming more than 300,000 acres of land. By 1982, approximately one third of the land area acreage in Hawaii was farmland. As the sugarcane industry began its decline, residential and commercial development for the tourism industry took its place and between 1982 and 2012 about 50,000 acres of agricultural land and 26,000 acres of forested land were converted to developed lands (Farmland Information Center 2019).

Existing and foreseeable future projects considered in our cumulative analyses for the Hawaiian hoary bat, Hawaiian goose, and Hawaiian petrel, and the anticipated impacts (negative, beneficial, negligible, or neutral) are shown in **Appendix I, Table I-2**. It is difficult to quantify

how the effects of past actions, such as the introduction of non-native species or changes in land use practices, have affected the Covered Species. Therefore, our evaluation of cumulative effects focuses on the known threats to the species and attempts to quantify the changes to those threats. For the purposes of this cumulative effects analysis, the temporal extent considered is the operational life of the known and foreseeable future projects (approximately 20 years). The spatial extent of the cumulative effects analysis for cultural resources and public utilities and services are the islands on which each wind farms operation and mitigation activities would occur. The spatial extent of the cumulative effects analysis for the three listed species is the known range of each species.

5.1 CULTURAL RESOURCES

Existing and foreseeable future actions may contribute to the loss of 'aumākua. For the purposes of this analysis, the Service assumes that those sources are the same as those that contribute to the loss of the associate species, which is detailed in **Appendix I, Table I-2**.

5.1.1 CULTURAL RESOURCES - ALTERNATIVE 1: NO ACTION

Under this alternative, the four wind projects would not be expected to impact archeological or cultural resources and would therefore not contribute to the cumulative impacts to archeological or cultural resources associated with other projects or actions.

It is unknown how many individuals may identify 'ōpe'ape'a or 'ua'u as their 'aumākua across the Hawaiian Islands. Such spiritual beliefs and values are personal and immeasurable; therefore the effects to this type of cultural value cannot be quantified.

5.1.2 CULTURAL RESOURCES - ALTERNATIVE 2: PROPOSED ACTION

Under this alternative, the four wind project HCPs are not expected to impact archeological resources. Archaeological investigations will be conducted prior to commencing any ground disturbing activities associated with the proposed mitigation actions. Consultation with the SHPD is currently underway. Any historical, cultural, and archeological resources that are identified will be avoided through micro-siting and other BMPs. Contractor requirements will include precautionary measures related to the inadvertent discovery of cultural remains, such as stopping work in the immediate area of the discovery and immediately notifying the SHPD. With these measures, mitigation activities are not expected to cause or contribute to cumulative effects to archeological resources.

There is expected to be a cumulative impact to those who consider Hawaiian hoary bats, 'ōpe'ape'a, and Hawaiian petrels, 'ua'u, as having special cultural significance as 'aumākua. Under this alternative, loss of up to 332 'ōpe'ape'a and 27 'ua'u, some proportion of which may be considered as 'aumākua, could occur over the next 15 years. These impacts would be in addition to the anticipated take of 'ōpe'ape'a and 'ua'u at these and other existing projects, future wind projects if they were to operate at night, and from other sources that contribute to the fatality of 'ōpe'ape'a and 'ua'u if recognized as an 'aumākua. It is unknown how many individuals may identify 'ōpe'ape'a or 'ua'u as their 'aumākua across the Hawaiian Islands. Such

spiritual beliefs and values are personal and immeasurable; therefore the effects to this type of cultural value cannot be quantified. Minimization and mitigation measures proposed under the proposed HCPs would be expected to result in long-term beneficial impacts to Hawaiian hoary bats and Hawaiian petrels. Other ongoing and future non-wind projects and threats to 'aumākua occur throughout Hawai'i. This alternative would be expected to have the greatest cumulative impact on 'ōpe'ape'a and 'ua'u as 'aumākua.

5.1.3 CULTURAL RESOURCES - ALTERNATIVE 3: INCREASED CURTAILMENT

Under this alternative, the four wind projects are not expected to have impacts on archeological resources. Archaeological investigations will be conducted prior to commencing any ground disturbing activities associated with the proposed mitigation actions. Consultation with the SHPD is currently underway. Any historical, cultural, and archeological resources that are identified will be avoided through micrositing and other BMPs. Contractor requirements will include precautionary measures related to the inadvertent discovery of cultural remains, such as stopping work in the immediate area of the discovery and immediately notifying the SHPD. With these measures, mitigation activities are not expected to contribute to the cumulative effects to archeological resources.

There is expected to be a cumulative impact to those who consider Hawaiian hoary bats, 'ōpe'ape'a, and Hawaiian petrels, 'ua'u, as having special cultural significance as 'aumākua. Under this alternative, loss of up to 248 'ōpe'ape'a and 27 'ua'u, some proportion of which may be considered to be 'aumākua, could occur over the next 15 years. These impacts would be in addition to the anticipated take of 'ōpe'ape'a and 'ua'u at these and other projects and at future wind projects if they were to operate at night. It is unknown how many individuals may identify 'ōpe'ape'a or 'ua'u as their 'aumākua across the Hawaiian Islands. Such spiritual beliefs and values are personal and immeasurable; therefore, the effects to this type of cultural value cannot be quantified. Minimization and mitigation measures proposed under the proposed HCPs would be expected to result in long-term beneficial impacts to Hawaiian hoary bats and Hawaiian petrels. Other ongoing and future non-wind projects and threats to 'aumākua occur throughout Hawai'i.

5.2 PUBLIC UTILITIES AND SERVICES

Electrical power is supplied utilizing production from both firm and non-firm generation sources. Firm generation sources include coal, oil, biofuel, biofuel/diesel, waste-to-energy, and geothermal. Non-firm generation sources include wind, solar, hydro, and customer-sited solar programs. In the State of Hawai'i, firm and non-firm generation sources other than wind accounted for approximately 93% of all energy produced in 2016 (DBEDT 2017).

The Hawai'i Clean Energy Initiative (HRS 196-10.5) and Renewable Portfolio Standards (HRS 269-92) specifies that the State of Hawai'i will establish a renewable portfolio standard of 100% of net electricity sales from renewable sources by 2045. In 2018, renewable energy production capacity from non-firm sources, including the four Projects being evaluated in this EIS, accounted for approximately 30% of the total capacity (3,215 MW) available to the HECO on O'ahu, Maui, and Hawai'i Island (HECO 2019).

In 2018, HECO issued a renewable energy request for proposals seeking to develop an additional 220 MW, 60 MW, and 20 MW of renewable energy generation on O'ahu, Maui, and Hawai'i Island, respectively (HECO 2018). As of January 2019, HECO listed projects in development (**Appendix I Table I-1**) that could add an additional 334 MW, 79.2 MW, and 82.5 MW of renewable energy generation on O'ahu, Maui, and Hawai'i Island, respectively (HECO 2019). It would be anticipated that additional renewable energy generation will become available in the future, but the timing, approval, construction, and operation of such projects is uncertain.

In May 2018, the 38 MW Puna Geothermal Venture (PGV) plant in Pahoia, Hawai'i island, was shut down as a result of damage caused by the eruption of the nearby Kīlauea Volcano. PGV had provided approximately 20 to 30% of Hawai'i Island's energy needs over the last decade (PGV 2018). The PGV plant remains offline due to damage at the plant and to utility lines and poles connecting the plant to the grid, however, the company estimates restarting operation by the end of 2019 (PGV 2018, Star Advertiser 2019).

5.2.1 PUBLIC UTILITIES AND SERVICES - ALTERNATIVE 1: NO ACTION

Under this alternative the production of renewable wind-generated energy supplied by these four Projects could be reduced by up to 50% (**Table 2-6**), however, there is no way to determine what percentage of overall Hawaii-wide energy use this represents, or what percentage of Hawaii-generated renewables this represents. This alternative would have short-term impacts on achieving island-wide energy needs since utility companies have the ability to transition to fossil fuels as needed. However, cumulatively, the loss of this renewable energy generation would result in significant, long-term effects to the ability for the State of Hawai'i to meet their renewable energy goal. Although new renewable energy projects could be developed, it would likely take several years of planning, compliance, and construction before such projects would contribute to renewable energy production. Solar energy potentially could be developed with reduced planning and compliance needs, but would only be able to offset the daytime loss of wind energy production.

5.2.2 PUBLIC UTILITIES AND SERVICES - ALTERNATIVE 2: PROPOSED ACTION

Under this alternative the production of renewable wind-generated energy supplied by the four wind projects could be reduced by up to 20%, however, there is no way to determine what percentage of overall Hawaii-wide energy use this represents, or what percentage of Hawaii-generated renewables this represents. This alternative would have short-term impacts on achieving island-wide energy needs since utility companies have the ability to transition to fossil fuels as needed. The loss of this renewable energy generation would result in minor, short-term effects to the State of Hawai'i's ability to meet their renewable energy goal.

5.2.3 PUBLIC UTILITIES AND SERVICES - ALTERNATIVE 3: INCREASED CURTAILMENT

Under this alternative the production of renewable wind-generated energy supplied by the four wind projects could be reduced by up to 40%, however, there is no way to determine what

percentage of overall Hawaii-wide energy use this represents, or what percentage of Hawaii-generated renewables this represents. This alternative would have short-term impacts on achieving island-wide energy needs since utility companies have the ability to transition to fossil fuels as needed. The loss of this renewable energy generation would result in moderate, long-term effects to the State of Hawai'i's ability to meet their renewable energy goal. Although new renewable energy projects could be developed, it would likely take several years of planning, compliance, and construction before such projects would contribute to renewable energy production. Solar energy potentially could be developed with reduced planning and compliance needs, but would only be able to offset the daytime loss of wind energy production.

5.3 HAWAIIAN HOARY BAT

The temporal scope of this cumulative effects analysis is the operational life of the known and future wind energy Projects (approximately 20 years) (**Appendix I, Table I-2**). The spatial extent of this cumulative effects analysis is statewide across the bat's range as described in the Hawaiian hoary Bat Recovery Plan (USFWS 1998). Assuming very little movement between islands, this analysis also considers the total anticipated bat take per island. The cumulative effects analysis for the Hawaiian hoary bat is lengthier than for the other two covered species due to various sources of uncertainty and knowledge gaps. Past, present, and foreseeable future projects considered in this analysis include, but are not limited to, those subject to: ESA section 10 ITPs and their associated HCPs; ESA section 10 recovery permits and their associated SHAs; ESA section 7 biological opinions (BOs) and their accompanying Incidental Take Statements; and Federal, State, and local conservation projects (**Appendix I**).

Tree-trimming and harvesting activities are not necessarily incompatible with bat habitat needs (Patriquin & Barclay 2003, Johnson & Strickland 2003), although they have the potential to impact juvenile bats which may be unable to fly away from an occupied tree when it is cut or disturbed. The Service recommends that harvesting or trimming of woody plants more than 15 ft tall should not be conducted between June 1 and September 15. It is not known how many bat fatalities attributed to tree trimming and harvesting occurs on private lands State-wide. Based on the majority of Federal and State projects adhering to the Service's recommendations to avoid the bat pupping period, these impacts are likely minor and are not expected to contribute significantly to cumulative effects on the bat.

Bat mortality caused by individuals becoming snagged on barbed wire has been documented. Annual mortality estimates range from 0 to 0.8 Hawaiian hoary bats per 100 kilometers of barbed wire (Zimpfer and Bonaccorso 2010). Most barbed wire fences are not systematically monitored and the bat fatalities due to snagging may be quickly taken by predators or scavengers. In addition, the surrounding landscape may affect the risk of bat collisions with a barbed wire fence. Although observed bat fatalities are uncommon, the extent of the impact of barbed wire fences is largely unknown. The Service recommends removal or replacement of barbed wire with smooth wire when providing technical assistance and in all formal and informal consultations. Barbed wire usage is expected to decrease State-wide, but the amount of remaining barbed wire in use State-wide is unknown. Based on the low estimates of mortality related to bat impalement on barbed-wire fences and the decrease in barbed wire use, this impact is not expected to contribute significantly to cumulative effects to this species.

Competition for food resources is also a consideration. Coqui frogs, *Eleutherodactylus coqui*, introduced to the State of Hawai'i in the late 1980s (Woolbright et al. 2006) are widely established on Hawai'i island, and are found in smaller areas on Maui, O'ahu, and Kaua'i islands (Hawai'i Invasive Species Council 2018; Appendix G). The highest densities of frogs are found at elevations lower than 2,200 ft above sea level (20,000 –40,000 individuals/2.47 ac) (Beard et al. 2009), but the frogs are now spreading to mid-elevation forests and have the ability to thrive and successfully overwinter at higher elevations in Hawai'i (Kraus and Campbell 2002, Hawai'i Invasive Species Council 2018). The spread to higher elevations poses increased threat to insect resources that overlap with the Hawaiian hoary bat. At this time, coqui frog may pose a minor threat to Hawaiian hoary bat prey resources, but the threat may be expected to increase in the future if the frog persists and expands in range.

Climate change may exacerbate the impacts of coqui frogs on the bat by allowing an expansion of their numbers into higher elevation areas, where they would compete with the Hawaiian hoary bat by changing the composition of the insect fauna available to forage (USFWS 2019). Other impacts from climate change to the bat are unknown. Warmer temperatures may allow an expansion of pupping habitat into higher elevation areas, but may also result in a reduction in available prey availability. These impacts may be partially mitigated by the ability of the Hawaiian hoary bat to range widely in search of resources.

Unquantifiable threats to the Hawaiian hoary bat include the incidental introduction and establishment of non-native and invasive species that have likely reduced bat roosting habitat, foraging habitat, and/or prey availability (USFWS 2011, 2019; **Appendix G**). Resort or housing developments, farming, road construction, and pesticides are expected to persist into the future and have the potential to result in further habitat loss or alteration. Wildfires can cause direct loss of adult bats and dependent young that are unable to escape a forest fire. Historically, conversion of native forests to large-scale agriculture or the expansion of human development has resulted in an appreciable reduction in Hawaiian hoary bat roosting, potential foraging habitat, and possible changes in insect prey populations (USFWS 1998). An estimated 1.475 million ac of forest currently occurs across the major Hawaiian Islands (Reeves and Amidon 2018), although portions of the forest have been degraded or fragmented over time. The high mobility of the bat provides capability to utilize fragmented landscapes. On O'ahu, Maui, and Hawai'i, the three islands where wind facilities are located and where almost all of the cumulative effects to the Hawaiian hoary bat are occurring, about 1.1 million ac of forest currently exists.

Collisions

Another direct impact to Hawaiian hoary bats is through collisions with man-made objects. Bats colliding with fishing line, vehicles or vehicle antennas, though rarely reported, have been documented. The impacts from these sources is largely unquantified because of the lack of systematic monitoring and reporting. Based on the incidents reported, the impact is expected to be minor.

Rotating wind turbine blades pose a known risk of collision if bats are present. Low wind speed curtailment is implemented by all of the projects to avoid and minimize collision risks to bats (See **Appendix D** for additional description, limitation, and benefits). The area under wind

turbines is systematically monitored and fatality rate can be estimated through modeling. There is uncertainty associated with predicting how many fatalities will occur in the future. The incidental take requests presented in this PEIS have been informed by fatality monitoring results from all wind facilities with ITPs in Hawai'i and reflect a refinement in take estimation and accountability for observed as well as unobserved take that was not previously taken into account with earlier ITPs.

The incidental take of Hawaiian hoary bats has been higher than anticipated under the projects' approved HCPs, in part, because risk to bats associated with wind energy development in Hawai'i was largely unknown and underestimated at the time the ITPs were issued. The amount of projected bat incidental take in the future includes observed and unobserved fatalities in addition to fatalities of dependent young (indirect take). Advancements have been made in how bat fatality rates are estimated to appropriately account for imperfect detection and unobserved fatalities that may have occurred (See **Appendix C** for a full description). The Service has adopted a conservative (on the side of the species) standard for estimating bat take and has rigorous compliance monitoring standards. The probability of detecting a bat fatality is informed by measured factors and variables. These include project-specific searcher efficiency, carcass retention times, the interval time between searches, the probability that if a bat carcass is missed it will be found on a subsequent search, the size and terrain of the searchable area, the portion of bat fatalities expected to occur in the actual searched area based on density dependent ballistics, turbine height, wind direction, and the number of turbines.

It is important to understand that each project has its own set of numerical values for each of the factors because of their unique site and monitoring characteristics. When the currently approved HCPs for Auwahi, Kawaihoa and KWPII were prepared, post-construction bat mortality monitoring data from Hawai'i wind farms was limited. Estimates of bat take were based on the best available monitoring data from one operating wind farm in Hawai'i and general comparisons of bat acoustic activity between sites, which underestimated collision risk for bats. Advancements in acoustic monitoring and thermal imaging have shown that prior occupancy studies significantly under-reported habitat use and distribution of the Hawaiian hoary bat. The EoA software (ver. 2.0.6), used as a standard by PIFWO to project future bat take and calculate current take levels, incorporates project-specific inputs from the all project-specific monitoring efforts, resulting in reduced uncertainty and more accurate project-specific take estimates and projections. For these reasons, the three HCP Amendments and the new HCP more accurately estimate the range of Hawaiian hoary bat take over the remaining years of Project operation.

Renewable Energy Mandate and Future Wind Projects

The Hawaiian Electric Companies issued a renewable energy request for proposals seeking to develop an additional 60 MW of renewable energy on Maui (HECO 2018). It is not known if a similar request will be initiated in the future, but the start of operations of a new project in the next 5 years is unlikely given that no projects were identified in 2018. The Hawai'i Clean Energy Initiative (HRS 196-10.5) and Renewable Portfolio Standards (HRS 269-92) specifies that the State of Hawai'i will establish a renewable portfolio standard of 100% of net electricity sales from renewable sources by 2045. It is anticipated that new wind projects will be proposed in the future, but the timing, approval, construction, and operation of such projects is uncertain.

However, it is also expected that future wind energy projects that would pose a risk to Hawaiian hoary bats would offset anticipated take impacts through an approved HCP.

In addition to the take that has already been authorized within the State of Hawai'i, several proposed wind facilities may be expected to request take in the future and were included in the analysis (**Appendix I, Table I-2**). On Hawai'i island, there are two other commercial-scale wind facilities besides Pakini Nui Wind that are in operation and are in the process of developing or finalizing HCPs and seeking incidental take permits for bats. The Lalamilo project has requested a total of 6 bats for its 20 year operational period, and Hawi Wind, which has been in operation for about 20 years and does not have an approved monitoring plan or ITP, is developing an HCP and seeking an ITP. The amount of unauthorized take attributable to this facility is uncertain. On Maui, there are two wind projects that may seek MECO approval and power purchase agreements in the future, but the Service does not have the operating regime or draft HCPs for either of these projects. On O'ahu, there is one proposed wind energy project, Palehua Wind, but the operating regime and draft HCP has not been received by the Service.

Future Minimization and Avoidance

The take projections and anticipated take per island (**Appendix I Table I-2**) do not take into account deterrent technology or actions that could be developed and would be deployed in the future to reduce incidental take at any of the projects. Because of the tiering of take, there is incentive for projects to implement take reduction measures to reduce take that has not occurred in a future tier. The future development of bat deterrents is not considered in this analysis because we do not yet know the efficiency of the technology for lowering the fatalities of Hawaiian hoary bats. The Service conducted our analysis of the cumulative impacts using the assumption that little to no reduction in anticipated take would occur through future application of new deterrent technologies, so as to avoid underestimating the impacts of take. Testing of the deterrent technology on the mainland has shown promise, especially for reducing hoary bat fatalities. The wind industry in Hawai'i has invested in deterrents and is testing the deterrents in Hawai'i. Should results be similar to those observed on the mainland, the number of fatalities may be reduced by 20-100% once these deterrents are implemented.

Mitigation

The approved HCPs listed in **Appendix I, Table I-2** include mitigation actions that are expected to help offset the anticipated incidental take impacts to Covered Species. These actions include: 1) reforestation and restoration of foraging and roosting habitats, installation of water features, and removal of invasive species that degrade water sources, roosting, and foraging habitat of the bats; 2) conducting high priority research to inform and improve management for the benefit of bats; and/or 3) acquisition of suitable habitat and protection of that land for perpetuity. The required measures of success for reforestation or restoration activities are objective and based on best science to appropriately gauge progress toward habitat improvements. All pending and approved ITPs and associated HCPs must include monitoring to document impacts to the Hawaiian hoary bat and the effectiveness of mitigation actions in addition to adaptive management. This combination of monitoring and adaptive management allows the Applicants, USFWS, and DOFAW to track compliance with the ITP, ITL and HCP, respond to conditions that indicate take or mitigation is not meeting the success criteria, and take corrective actions to ensure mitigation needs are met. Accordingly, project-related take impacts associated with these

HCPs will be avoided, minimized, and mitigated, using the best available scientific practices and adaptive management, to the extent that offsets the impacts of incidental take of this species.

Basis for reforestation and restoration mitigation

Permitted projects with HCPs or BOs that have provided mitigation, and potential projects in the foreseeable future with impacts to bats are shown in **Appendix I, Table I-2**. Projects with a "+" shown in the Hawaiian hoary bat column have already or are expected to mitigate for the projected take over the duration of the project to avoid and minimize impacts to the bat population. The Hawaiian Hoary Bat Recovery Plan, while dated, identifies degradation and loss of habitat as a major contributing factor to the presumed decline of the Hawaiian hoary bat (USFWS 1998). A five year study of bat occupancy on the island of Hawai'i indicates that while bats occur from sea level to the highest volcanic peaks on the island, with a fairly high occupancy throughout almost all regions, there is a significant association between occupancy and the prevalence of mature forest cover (Gorresen et al. 2013).

All land-based actions have an acreage associated with them, but the acreage is not be used as a sole determinate for the mitigation value of a project. The core use information is provided only as a reference point for how many bats would reasonably be expected to be supported once the actual mitigation actions are added. The amount of acreage needed to support a bat is dependent upon on the amount of resources available within that acreage and what aspect of the bat's life is being supported, e.g. foraging, day roosting, or night roosting. The raw data provided by Bonaccorso et al. (2015) provides a snapshot in time between August and October. The core use areas of some bats were quite small (around 6 ac) while others were over 100 ac. Johnston et al. (2019) tracked bats that had foraging ranges in the thousands of acres. It is important to understand that these foraging ranges and core use areas are polygons. It does not mean that the bat is utilizing every acre or resource within that polygon. It means the bat is somewhere within the polygon while it was being tracked. The polygon in some ways represents the limitation of the tracking technology. If a bat were to forage in a straight line to and from the roost every night the acreage would be quite small. In the case of a Projects mitigation, the additive value of all of the actions are the basis for valuing the mitigation, not just the acreage. The size of a foraging range and core use area used by the bat varies based on a variety of factors including prey availability and abundance. In the case of a restoration project designed to provide increased foraging opportunities, the overriding factor is the prey abundance and added foraging resources that will be measured, not per se, a designated acreage. Somewhat akin to resource equivalency analysis modeling used for the endangered Indiana bat, the acreage estimated as a core use area of bats (Bonaccorso et al. 2015) was multiplied by the number of bats that are expected to be taken. The 20.3 median of the core use area was used as a surrogate for determining a reasonable size because half of the observations were below and half were above this amount. Smaller or larger areas could also be used. The total was used as a surrogate for the amount of habitat acreage needed that, when enhanced, restored or protected, could be expected to provide sufficient bat resources to mitigation for the impacts of incidental take.

In addition to acreage criteria, mitigation sites were selected because the management actions that were part of the mitigation would create or restore a suitable habitat and provide new foraging resources for bats that would extend into the future. Actions include outplanting of native tree species, invasive plant removal, and enhancement of water resources that increase roosting and foraging opportunities. While bats have been reported to use non-native and

invasive plant species as roosting sites, invasive plant species can negatively affect hydrology, soil erosion, native species diversity, changes in prey composition, and canopy characteristics which impact a wide range of native species in addition to bats. Tools to measure the direct impacts of land-based mitigation actions on bat productivity or survival are largely based on acoustical detections and knowledge gained from radio tracking, and more recently, thermal imaging and insect composition. Surrogate measurements of success include improved canopy density, outplanting success, and amount of area cleared of invasive species. The impacts provided by the land-based mitigation of the existing projects is expected to benefit the bat population.

Basis for Hawaiian hoary bat research

As described previously, although research is an uncommon form of compensatory mitigation under section 10 of the ESA, the Service identified that research which informed on-the-ground management actions and life history parameters necessary to recover Hawaiian hoary bats was one of the highest priorities for the species and an appropriate form of compensatory mitigation in this case. Concurrent with the several land-based mitigation projects for bats, researchers have increased the understanding of aspects Hawaiian hoary bat distribution, habitat use, prey consumption, and occupancy (Gorresen et al. 2013, 2015; Pinzari et al. 2012, 2014; Bonaccorso et al. 2015, 2016; Todd et al. 2016; H.T. Harvey 2019; USFWS 2019; Starcevich et al. 2019, **Appendix G**). The Hawaiian Hoary Bat Recovery Plan, Hawaiian Hoary Bat Five-Year Status Review (USFWS 2011c), and the ESRC Hawaiian Hoary Bat Guidance document, identify research on Hawaiian hoary bat biology, population, and limiting factors as priorities for the species (USFWS 1998, 2011c, DOFAW 2015). The need for bat research was identified decades ago, but has largely gone unsupported due to limited funding and higher priorities. These and other research findings are used to inform the land-based mitigation actions to further benefit the bats and aid in identifying appropriate mitigation sites to support foraging, pupping, and roosting needs. The baseline information from those surveys indicated detection probabilities, mean pulses/night, percentage of nights with feeding activity, and acoustic detections are greater in recovering forest areas than in unrestored shrublands (Todd et al. 2016). These results show that more detections are occurring in the restoration areas than had previously occurred prior to restoration. However, there is no monitoring technique or technology available to determine whether the increase in detections is a direct result of an increase in bat production/reproductive success within the restoration areas.

Basis for land acquisition and protection

The biological objective of habitat protection and preservation as mitigation is to protect and preserve, in perpetuity, bat roosting and/ or foraging habitat that would otherwise be threatened with degradation or development. The environment a bat utilizes daily and throughout its life is varied. Removal of suitable tree habitats for roosting, breeding or foraging, reduction or modification of prey base, introduction of a new threat or disturbance, or loss of other resources necessary for bat population growth and stability are all forms of habitat losses. Such losses can be attributed to a variety of sources including encroachment by development, agriculture, or invasive species that degrade or reduce a resource necessary to the bat. The result of the losses is a reduced carrying capacity of the island for the Hawaiian hoary bat. The acquisition, protection, and preservation of land that provides life services to the Hawaiian hoary bat contributes to

sustaining and growing the carrying capacity. Land selected for acquisition and preservation for perpetuity provides long-term suitability for the Hawaiian hoary bat.

Summary

Information obtained by recent and ongoing research projects is helping us to better understand how bats are using certain habitats, what the general distribution of bats is across specific areas, and on how to supplement their needs. The mobility of the Hawaiian hoary bat contributes to the resiliency of the species and may be expected to lessen the impacts of localized threats and contribute to its continued existence and recovery. Impacts from ongoing past, present and reasonably foreseeable future actions and other sources as described above, would likely result in major, if not significant, cumulative effects to the Hawaiian hoary bat if adequate minimization and mitigation measures (as described above) were not implemented. Habitat conservation and restoration, along with other mitigation actions, are likely to provide conservation benefits to the Hawaiian hoary bat by protecting foraging and roosting habitats, and enable the affected bat populations to remain stable, if not slightly increase.

5.3.1 HAWAIIAN HOARY BAT - ALTERNATIVE 1: NO ACTION

Impacts from wind projects, when combined with other ongoing past, present and reasonably foreseeable future actions would result in significant effects to the Hawaiian hoary bat if not for the minimization and mitigation measures associated with the HCPs, as discussed above, and given the 1.4 million acres of forested habitats remaining State-wide. Due to the potential for bat take from any new wind facility, all future wind projects would need to obtain an HCP and permit prior to the start of operations. Under approved HCPs, habitat conservation and restoration, along with other mitigation actions, are likely to provide conservation benefits to the Hawaiian hoary bat by protecting foraging and roosting habitats, and enabling the bat populations to remain stable, if not slightly increase. Information obtained by recent and ongoing research projects is helping us to better understand how bats are using certain habitats, what the general distribution of bats is across specific areas, and on how to supplement their needs to increase their use of certain habitat types. This information will further inform effective minimization and mitigation measures under approved HCPs. The mobility of the Hawaiian hoary bat also contributes to the resiliency of the species and may be expected to lessen the impacts of localized threats and contribute to its continued existence and recovery.

Under the No Action Alternative, a new ITP or amendment would not be issued for any of the four Projects and their associated HCPs would not be implemented. As such, the Projects would not contribute to the cumulative effects on the Hawaiian hoary bat because no adverse impacts would be expected to occur in the absence of nighttime turbine operation.

5.3.2 HAWAIIAN HOARY BAT - ALTERNATIVE 2: PROPOSED ACTION

Under Alternative 2, each of the four Projects would be anticipated to take the Hawaiian hoary bat up to the amount shown in Section 2.2. Low wind speed curtailment would be deployed at all projects.

The combined new take of bats for all four projects, if approved, would be up to 332 Hawaiian hoary bats (160 [O'ahu]; 146 [Maui]; 26 [Hawai'i]) over the next 15 years. This would be in addition to the existing approved take of up to 245 bats that has already occurred or may occur in the future. The requested take amounts would be the maximum expected to occur if no new avoidance and minimization measures were to be implemented. The numbers do not mean that the amount of take will absolutely occur. Take could be less, but there is uncertainty in the effectiveness that future avoidance and deterrent technologies may have. The take includes the loss of the adult as well as the loss of the dependent pups that would be assumed to exist if a female is taken during the breeding season. Under each of the four HCPs, adaptive management provisions are in place to avoid exceeding the requested amount of take.

The presence of wind farms operating at night pose a risk to bats on the islands of O'ahu, Maui, and Hawai'i. The absence of commercial wind facilities on Kaua'i, Lāna'i, and Moloka'i, suggest that bat populations on those islands do not face the same level of risk. It is reasonably certain that the entire population of bats Statewide would not be directly extirpated by the operation of the wind farms on the islands of O'ahu, Maui and Hawai'i because not every bat on is likely to fly through the wind project sites and be killed. Interisland movement is limited.

Hawaiian hoary bats are highly mobile, capable of using fragmented habitats, and are more widespread than previously thought. Acoustic monitoring at wind facilities has not shown a decrease in bat activity. While bats are highly mobile and have been known to travel up to 12 mi in a night, the bats tend to focus their activity in areas where food and sheltering resources are available and spend the majority of their time in their core use area. A local effect on the bat population is possible if the core use area overlaps with the turbine sites because of the slightly higher probability of turbine encounter during nightly usage. This local effect on population could impact the species, either by reducing genetic diversity or by reducing the local population below a threshold that, with the contribution of other mortality factors, would cause the population to decline. Mobility of the bats provides an adaptive ability to sustain gene flow, at least on an island. Lost future productivity of an adult bat may also occur. Bats may live up to 10 years, though it is unknown if they breed each year and for how many years they may produce young. The loss of an adult bat would also foreclose future additional recruitment by its progeny into future generations of the bat on that island. Under the four HCPs, mitigation actions are focused on the same island on which take impacts occur and are expected to provide beneficial effects on the resident island population to offset the impacts of the taking for the reasons discussed below.

The four wind projects would mitigate their impacts of the taking by a combination of land-acquisition to protect Hawaiian hoary bat habitat into perpetuity, restoration and enhancement of roosting and foraging habitat, creation of foraging and roosting habitats, and research that focuses on the bats distribution, diet, and habitat use that will benefit future bat management actions. Mitigation actions are focused on the island on which the take is occurring to minimize any potential reductions in genetic diversity. Under this alternative, mitigation for the four projects would include a combined total of at least 9,095 ac (4,466 ac [O'ahu]; 3,429 ac [Maui]; 1,200 ac [Hawai'i]) of bat habitat restoration, creation, and protection. These actions are expected to reduce the impacts on the bat population of O'ahu, Maui, and Hawai'i, and to avoid a significant adverse effect on the bat population statewide as a whole. The ongoing and

proposed research projects and bat monitoring are expected to benefit the bats through informing more refined, efficient management and conservation approaches that increase the likelihood of recovery of the species in the wild.

Future wind and non-wind projects may be expected to contribute to bat fatalities if the projects operate at night and there are no technologies available to completely avoid collisions. Future wind projects would be expected to mitigate the impacts of the take through land and research based actions. The effects of those actions are expected to provide a benefit to the species on the island on which the take occurs and improve the understanding of how to effectively conserve and recover the Hawaiian hoary bat. Under this alternative, bat fatalities would be expected to occur but mitigation would also be expected to offset the impacts of the taking on the bat.

Other sources that contribute to Hawaiian hoary bat mortality or limit its productivity were described in the introduction of Section 5.3 and have adverse effects on the bat. These include bat fatalities associated with barbed wire, removal of trees that harbor non-volant bat pups during the pupping season, predation, and wildfire. BMPs provided in the HCPs for the four projects in this PEIS and existing projects (**Table I-2**) minimize such effects through avoidance and minimization measures that include removal of barbed wire at the projects, prevention of the introduction of invasive species, and scavenger and predator control. The implementation of these measures avoids additive adverse effects from these sources and may provide a slight benefit to the bat in the form of predator removal.

For the reasons discussed above, no significant cumulative effects to the Hawaiian hoary bat are expected to occur with implementation of Alternative 2 given the likely benefits of the habitat conservation and restoration actions proposed by the Applicants to mitigate/offset the impacts of their anticipated take of bats along with their commitment to implement take avoidance and minimization measures.

5.3.3 HAWAIIAN HOARY BAT - ALTERNATIVE 3: INCREASED CURTAILMENT

Under this alternative, the turbines would cease operation dusk to dawn from April 15 through September 15 for the remaining years of the permit. This would be expected to reduce the potential take of Hawaiian hoary bat to no more than 248 (123 [O'ahu]; 109 [Maui]; 16 [Hawai'i]) over the next 15 years. This would be in addition to the existing approved take of up to 245 bats that has already occurred or could occur over the next 20 years. The requested take amounts would be the maximum expected to occur if no new avoidance and minimization measures were to be implemented. The numbers do not mean that the amount of take will absolutely occur. Take could be less, but there is uncertainty in the effectiveness that future avoidance and deterrent technologies may have.

The take requested under this alternative would be expected to result in fewer fatalities of individuals than Alternative 2. The non-operation of the turbines at night for 5 months would avoid the killing of adult bats from April 15 through September 15. In addition, it would avoid the indirect loss of dependent pups. A local effect on the bat population might be expected if the core use area of the bat from September 16 through April 14 overlaps with the turbine sites because of the slightly higher probability of turbine encounter during nightly usage. Mobility of

the bats provides an adaptive ability to sustain genetic diversity, at least within an island. Avoidance of take during the breeding season may also have fewer impacts to genetic diversity because dependent young would not be at risk of indirect take. The negative impacts from this alternative on individual bats would be expected to be less than those expected in Alternative 2 because fewer bats, in general, are taken from April through September.

Commensurate with the expected reduction in take proposed in this alternative, the land-based mitigation would be 4,458 ac (1,278 ac [O'ahu]; 2,442 ac [Maui]; 738 ac [Hawai'i]) of bat habitat restoration, creation, and protection. In addition, the proposed research project would be reduced slightly in scope.

Mitigation action under the four HCPs would occur on the same island on which bat take would occur, and similar beneficial impacts are likely to occur as those described for Alternative 2 (Section 5.3.2) but with less acreage involved. Cumulative impacts from other sources would also be similar to those described under Alternative 2.

5.4 HAWAIIAN GOOSE

The temporal scope of this analysis is the operational life of the known and future Projects (approximately 20 years) (Appendix I, Table I-2). The spatial extent of this cumulative effects analysis is statewide across the range of the Hawaiian goose as described in the Draft Revised Hawaiian Goose Recovery Plan (USFWS 2004). Incidental take for Hawaiian geese has been authorized for projects occurring across the State through ITPs with HCPs under section 10 and through ESA section 7 consultations resulting in a BOs and ITS (**Appendix I Table I-2**). Statewide, incidental take of 133 Hawaiian geese is permitted or pending approval. Past, present, and foreseeable future projects considered in this analysis include, but are not limited to, those subject to: ESA section 10 ITPs and their associated HCPs; ESA section 10 recovery permits and their associated SHAs; ESA section 7 biological opinions (BOs) and their accompanying Incidental Take Statements; and Federal, State, and local conservation projects (Appendix I).

Implementation of recovery actions for the Hawaiian goose has significantly reduced the risk of extinction for the species. Once on the brink of extinction, the captive propagation and release program successfully increased the number of individuals and re-established populations throughout the species' range on the islands of Hawai'i, Kaua'i, Maui, and Moloka'i. In the years between 1960 and 2008, some 2,800 captive-bred nene were released into areas of their former range at more than 20 sites throughout the main Hawaiian Islands. In addition, 646 nene were relocated from Kaua'i to Hawai'i (598) and Maui (48) between 2011 and 2016. The species continues to be conservation-reliant and is dependent on long-term management commitments to active predator control and habitat management (Reed et al. 2012). Ongoing habitat management and predator control actions on state, federal, and private lands across the species range (**Appendix I Table I-2**) are expected to have beneficial impacts.

Operation of wind farms pose a threat to the Hawaiian goose due to the risk of collisions with WTG towers or turbine blades, or strikes by turbine blades at wind farm facilities. On Maui, there are three facilities with a total of 40 WTGs in operation [KWP I (20 WTGs), KWP II (14 WTGs) in western Maui, and Auwahi Wind (8 WTGs) in southeastern Maui]. All three Maui

facilities have approved HCPs and have received Federal ITPs and State ITLs authorizing the total combined take of 95 Hawaiian geese during the 20-year period of operation for each project. The HCPs include the following mitigation measures to offset the impacts of anticipated take on the Hawaiian goose: (1) establish an additional population of 75 Hawaiian geese at an off-site location (Haleakala Ranch); (2) conduct predator control and habitat enhancement at the additional population site; (3) conduct on-site habitat restoration; (4) conduct on-site monitoring of Hawaiian geese; and (5) fund Hawaiian goose conservation actions at Haleakala National Park (DOFAW 2016, *in litt.*).

Over 12.5 years, from January 2006 to June 2018, KWP I estimated take of 64 full-grown Hawaiian geese (KWP I 2008b, 2009, 2010, 2011, 2013, 2014, 2015, 2016, 2017 and 2018). In the six years from July 2012 through June 2018, KWP II estimated take of 14 Hawaiian geese (KWP II 2013, 2014, 2015, 2016, 2017 and 2018). From 2005 to 2011, two Hawaiian geese fatalities have been documented at Pi'iholo Ranch, while 48 Hawaiian geese have been released at this site. From 2011 through 2017, 46 fledglings have been produced at the Haleakala Ranch pen as part of Hawaiian goose mitigation for KWP I (KWP I 2012, 2013, 2014, 2015, 2016 and 2017). Take has also been anticipated for this species at the Auwahi Wind facility, but as of FY 2017 no Hawaiian geese have been observed injured or killed (Auwahi 2017).

On Hawai'i Island, two facilities with a total of 30 WTGs are in operation [Hawi (16 WTGs) and Pakini Nui Wind (14 WTGs)]; however, there are no reports of Hawaiian geese being killed at these facilities (Michael Azeka, Hawi Wind; SWCA 2018a). Based on the proximity of these facilities to areas used by Hawaiian geese, there is the potential for collisions. Pakini Nui Wind's draft HCP requests authorization for take of three Hawaiian geese over the 10-year term ITP/ITL (SWCA 2018). Pakini Nui Wind's proposed mitigation measures include funding to: (1) construct a 7 ac breeding pen with a predator-proof fence; (2) conduct predator control; and (3) maintain predator-proof fence and existing reservoir.

On O'ahu, a total of 42 WTGs are in operation at Kawailoa Wind Power (30 WTGs) and Kahuku Wind Power (12 WTGs), and an additional 9 to 10 WTGs are proposed at the Na Pua Makani project in the Kahuku area. Na Pua Makani has an ITP for take of six Hawaiian geese due to the proximity of the proposed wind energy project to James Campbell NWR, where the single breeding pair of Hawaiian geese have been observed. In early 2019, the breeding female died of unknown causes. Discussions are ongoing regarding the possibility of relocating the single male Hawaiian goose to another island (A. Marshall 2019, pers.comm.). Based on this information, no effects to the Hawaiian goose from wind energy facilities on O'ahu are expected at this time. However, should a breeding population of the Hawaiian goose become established in the future, these wind farm facilities could have impacts.

In 2012, Tower Kaua'i Lagoons Land, LLC (Kaua'i Lagoons) (formerly known as Kaua'i Lagoons, LLC) was issued an ITP and ITL authorizing take of 17 Hawaiian geese incidental to construction and operation of a resort and golf course in Lihu'e, Kaua'i (Kaua'i Lagoons 2012). Measures to minimize and mitigate the impacts of the taking include the following: (1) habitat management; (2) predator control; (3) monitoring; (4) assistance with translocation and population management; and (5) outreach and education. To date, incidental take of two Hawaiian geese has been reported, leaving the remaining authorized take of 15 birds (Kaua'i

Lagoons 2018). Kaua'i Lagoons has provided \$85,000 to support the translocation and population management of 646 Hawaiian geese to Maui and Hawai'i Island, and continues to conduct on-site habitat management, predator control, and endangered species outreach and education.

By their attraction to mowed grass and human food, Hawaiian geese may become tame and unafraid of human activity, making them vulnerable to the impacts other harmful human activities. Activities that may negatively impact the Hawaiian goose include use of pesticides, golf ball strikes, vehicle collisions, artificial and natural hazards, entanglement, and disturbance from certain recreational activities (USFWS 2018). These threats may be widespread throughout its range, and can result in direct and indirect injury and mortality, reduced reproductive success, and reduced distribution of the Hawaiian goose.

The Draft Revised Recovery Plan sets forth a general recovery strategy for the Hawaiian goose (USFWS 2004). In order for Hawaiian goose populations to survive they should be provided with generally predator-free breeding areas and sufficient food resources. Human-caused disturbance and mortality should be minimized, and genetic and behavioral diversity maximized. The recovery goal stated in the Draft Revised Recovery Plan is to conserve the Hawaiian goose by facilitating its use of a mix of natural and human-altered habitats in such a way that the life-history needs of the species are met and the populations become self-sustaining.

In 2018, the Service published a proposed rule to reclassify the Hawaiian goose from endangered to threatened status (USFWS 2018d). In the proposed rule, the Service also determined that a special rule under 4(d) of the ESA was necessary and appropriate for the conservation of the Hawaiian goose. In the proposed 4(d) rule, certain activities that could result in "take" otherwise prohibited under the ESA, would no longer be prohibited.

The Service recognizes there are cumulative effects from sources that are unmitigated, such as vehicle collisions, golf ball strikes, entanglement, human disturbance, and wind facilities operating without an ITP, as described above. The mitigation contained in each of the project HCPs is expected, at a minimum, to fully offset the Hawaiian geese that are incidentally taken. The Service expects that fully offsetting mitigation or mitigation to the maximum extent practicable would also be included in any future permits granted.

The Hawaiian goose is listed as endangered and continues to be impacted by habitat loss and predation. However, the Hawaiian goose is now more abundant, largely due to the captive propagation program and the increased capacity of conservation agencies and partners to manage habitat and control predators on larger spatial scales. The proposed reclassification would not significantly change the protection afforded this species under section 9 of the ESA; other than the specific activities included in the proposed 4(d) rule, the regulatory protections of the ESA would remain in place. Currently, substantial self-sustaining populations exist and are well distributed in multiple localities on Kaua'i, Maui, and Hawai'i Island (USFWS 2018), totaling 3,252 individuals (DLNR 2018, in lit.). With ongoing management, these populations are expected to continue to be self-sustaining without additional releases of captive-bred birds.

5.4.1 HAWAIIAN GOOSE -ALTERNATIVE 1: NO ACTION

Under this alternative, take of Hawaiian geese could still occur as a result of collisions with WTG towers or stationary turbine blades, or strikes by turbine blades during daytime operations at Auwahi, KWP II, and Pakini Nui Wind. However, the amount of take expected to occur over the life of the three projects would be expected to be slightly less than projected for Alternatives 2 and 3 because the turbines would not operate at night.

Under this alternative, mitigation actions already completed by Auwahi and KWP II are expected to offset the anticipated take under existing their respective ITPs/ITLs (see Sections 4.8.1 and 4.8.3). If unauthorized take of an nene were to occur at any of the wind HCP facilities they would halt operations; therefore, in combination with the cumulative effects discussed above, significant impacts are not expected on the Maui (627), Hawai'i Island (1,104), or statewide population (3,252).

5.4.2 HAWAIIAN GOOSE -ALTERNATIVE 2: PROPOSED ACTION

Under this alternative, the proposed mitigation measures at Pakini Nui Wind and KWP II are expected, at a minimum, to fully offset the estimated incidental take, and contribute to the species' recovery by providing a net conservation benefit, as required by State law. The beneficial impacts of the proposed mitigation actions in combination with the cumulative effects discussed above are not expected to have significant impacts on Maui, Hawai'i Island, or statewide Hawaiian goose populations.

5.4.3 HAWAIIAN GOOSE -ALTERNATIVE 3: INCREASED CURTAILMENT

Under Alternative 3, the beneficial impacts would be expected to be similar to those described for Alternative 2. The number of fatalities might be expected to be slightly less because the turbines would not be operating at night from April 15 through September 15, though, like described under Alternative 1, the risk of collision with a stationary blade would still exist. Under this alternative, the beneficial impacts of the proposed mitigation actions in combination with the cumulative effects discussed above are not expected to have significant impacts on Maui, Hawai'i Island, or statewide Hawaiian goose population.

5.5 HAWAIIAN PETREL

The temporal scope of this analysis is the operational life of the known and future Projects (approximately 20 years) (**Appendix I, Table I-2**). The spatial extent of this cumulative effects analysis is across the Hawaiian petrels range as described in the Hawaiian Petrel Recovery Plan (USFWS 1983) and on the islands of O'ahu and Hawai'i where the requested take of petrels is proposed.

Incidental take of the Hawaiian petrel has been authorized for projects throughout its range through ITPs with HCPs under section 10 and through ESA section 7 consultations (**Appendix I Table I-2**). Projects that have ITPs accompanied by approved HCPs authorizing take for

Hawaiian petrel are mitigating for take and are obligated to meet that requirement through providing island-specific and potentially, species level benefits to the seabird population.

Past and present adverse impacts on the Hawaiian petrels across its range include predation by introduced predators (Hodges and Nagata 2001; Raine and Banfield 2015a, 2015b) particularly cats, rats, mongoose, feral pigs, and barn owls; collisions with power lines (Cooper and Day 1998; Podolsky et al. 1998); light attraction (Reed et al. 1985; Cooper and Day 1998); and changes to breeding habitat due to introduced invasive plants (Troy et al. 2014). While at sea, the species is exposed to other human-associated threats, including plastics, which the petrels may ingest, oil spills, and interactions with fishery activities. Climate change may also contribute to seabird adult survivorship and recruitment (Sandvik et al. 2012) by generally affecting food availability (Oro 2014).

Operation of wind farms pose a threat to the Hawaiian petrel due to the risk of collisions with wind turbine monopoles or turbine blades. On Maui, there are three facilities with a total of 40 WTGs in operation. All three Maui facilities have approved HCPs and have received Federal ITPs and State ITLs authorizing the total combined take of up to 143 adult Hawaiian petrels and 37 chicks during the 20-year period of operation for each project. The actual take at these facilities has been far below that projected. The cumulative take to date of those three projects is no more than 21 (including adults and indirect take) based on 8 observed fatalities. The anticipated take is being fully offset through predator control, predator fence construction, and predator fence maintenance activities throughout Maui Nui as previously described in the approved HCPs and Project annual reports.

There are also unmitigated impacts on the Hawaiian petrel from unshielded lighting and predation occurring at non-wind project sources (**Appendix I, Table I-2**). Advances in surveying, monitoring, and modeling, have shown the magnitude of the powerline collision threat, especially on Kaua'i, has been underestimated in the past. Efforts are ongoing to avoid, minimize, and mitigate the adverse effect on the Hawaiian petrel colonies on Kaua'i.

5.5.1 HAWAIIAN PETREL -ALTERNATIVE 1: NO ACTION

Under this alternative, Kawaihoa Wind (O'ahu) and Pakini Nui Wind (Hawai'i) would not be issued a major amendment of their 2011 ITP to include Hawaiian petrels as a covered species. Turbines that are curtailed at night may pose a reduced risk of collision to Hawaiian petrel when compared to rotating turbine blades, though collision with stationary objects such as power lines and buildings does occur. The loss of an adult could result in the loss of dependent young in addition to the adult as well as lost future productivity of that bird and its young. No benefits would be expected under this alternative to offset the fatality of Hawaiian petrels. The impacts of take on O'ahu or Hawai'i might be expected to result in loss of Hawaiian petrel but the loss may be expected to be less than under Alternative 2 or 3.

The survival and recovery condition of the Hawaiian petrel will need to include representation throughout Hawai'i, Maui, Kaua'i, and Lāna'i islands to ensure adequate genetic diversity to sustain the evolutionary adaptive potential for the species (Willi et al. 2006). Hawaiian petrel fatalities for all of the wind projects listed in **Appendix I, Table I-2** has been lower than

estimated. The loss of petrels under the issued ITP's are being fully mitigated ahead of the actual take, resulting in increased colony productivity that, but for the mitigation actions, would not have occurred (KWP I 2018; KWP II 2018; Kahuku Wind Power 2018; Auwahi Wind, LLC and Tetra Tech 2018). The mitigation actions are expected to result in a significant benefit to the species.

5.5.2 HAWAIIAN PETREL -ALTERNATIVE 2: PROPOSED ACTION

Under Alternative 2, two of the four projects would be anticipated to take of the Hawaiian petrel up to the amount shown in Section 2.2. The combined take of the two projects seeking coverage for Hawaiian petrel, if approved, would be up to 27 Hawaiian petrel (up to 24 on O'ahu, up to 3 on Hawai'i). This would be in addition to the existing approved take for other approved projects discussed in Section 5.5. The requested take amounts would be the maximum expected to occur if no new avoidance and minimization measures were to be implemented. The numbers do not mean that the amount of take will absolutely occur. The take includes the loss of the adult as well as the loss of dependent young that would be assumed to exist if a female or male is taken during the breeding season. The loss, without replacement, would not be expected to have significant adverse impacts on the statewide Hawaiian petrel population. Predator control and fence maintenance actions proposed as mitigation would be expected to fully offset the potential loss of adults and dependent juveniles on O'ahu and Hawai'i through protection of known colonies on Hawai'i and Kaua'i and provide a benefit statewide to the Hawaiian petrel population.

The Service also evaluated the cumulative take of Hawaiian petrels by island. Under this alternative, the Pakini Nui Wind (Hawai'i) wind project would be anticipated take of up to three petrels over the period of 10 years. The proposed mitigation for the requested take of three Hawaiian petrel would entail predator control and fence maintenance at a newly fenced site within HVNP which currently encompasses the largest active Hawaiian petrel colony on the Island of Hawai'i. Adaptive management triggers are in place in the HCP if monitoring indicates the success criteria are not being met or new information indicates a change in success criteria is necessary to assure the mitigation obligation is met. This mitigation would be expected to provide benefits to the entire Hawaiian petrel subpopulation at HVNP. For this reason, no significant adverse impact to the Hawaiian subpopulation of the petrel on the island of Hawai'i or the statewide population are anticipated from the Pakini Nui Wind Project.

On O'ahu, take of up to 24 Hawaiian petrels anticipated under the Kawailoa Wind ITP/ITL amendment would contribute to adverse effects to this species through the loss of adults and potential dependent young. At this time, there is no known breeding colony on O'ahu. The mitigation for the requested take of 19 adults and 5 chicks for this Project would involve contributing to Hawaiian petrel management at known breeding colonies on Kaua'i to mitigate the impacts of Project-caused fatalities. The predator control efforts on Kaua'i are expected to provide benefits to the existing colony of petrels that would not occur but for the mitigation. The Service expects the benefits of predator control on Kaua'i to benefit the local petrel subpopulation.

For the above reasons, no significant adverse cumulative impacts to the population of Hawaiian petrels across the state are anticipated from this Project.

Sources of other Hawaiian petrel mortality as described in the introduction to Section 5.5 also contribute to cumulative adverse effects on the petrel. Cumulative impacts on the Hawaiian petrels across all the islands are caused by predation, light attraction, changes to breeding habitat due to introduced invasive plants, and at-sea threats, including ingestion of plastics, oil spills, and interaction with fishing activities. While the benefits of predator control proposed by the wind power project HCPs would reduce predators within the mitigation areas and within unquantified buffer zones around these sites, the benefits would not be expected to reduce threats and effects from other human-associated threats which include new wind energy without petrel coverage for take, plastics (which the petrels may ingest), oil spills, and interactions with fishery activity. Climate change may also contribute to reduced adult seabird survivorship and recruitment by adversely affecting food availability. However, the benefits likely to occur from the proposed mitigation actions under the wind power HCPs are not likely to contribute to exacerbating the adverse cumulative effects described above.

5.5.3 HAWAIIAN PETREL -ALTERNATIVE 3: INCREASED CURTAILMENT

Under Alternative 3, the beneficial impacts would be expected to be similar to those described for Alternative 2. The number of fatalities might be expected to be slightly less because the turbines would not be operating at night from April 15 through September 15, though, like described under Alternative 1, the risk of a Hawaiian petrel collision with a stationary blade would still exist. Under this alternative the Service would not expect wind project-related cumulative impacts to the Hawaiian petrel population.

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