Kaua‘i Island Utility Cooperative Habitat Conservation Plan

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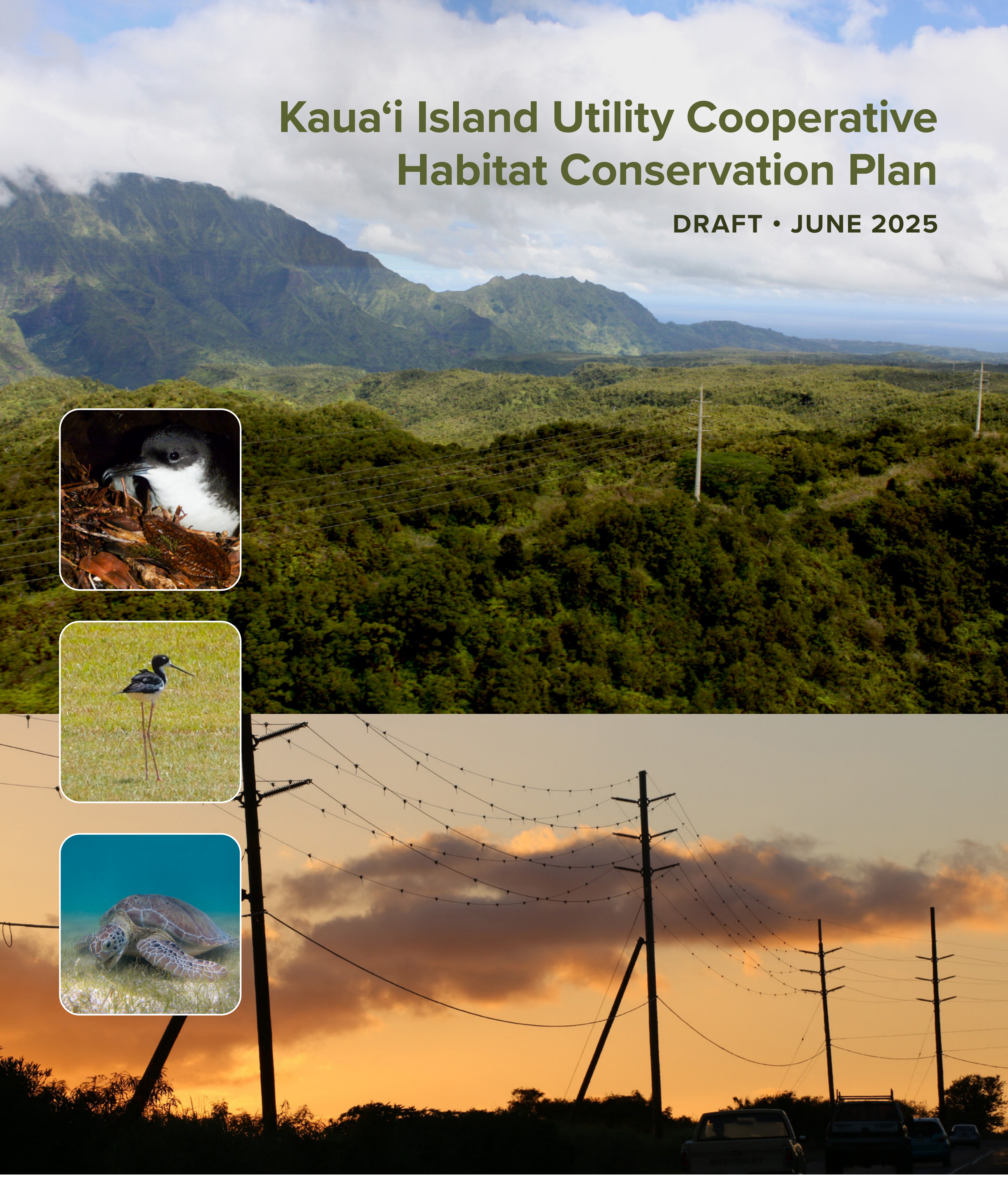

Kaua‘i Island Utility Cooperative
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KAUAʻI ISLAND UTILITY COOPERATIVE HABITAT CONSERVATION PLAN

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Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
ARC	Archipelago Research and Conservation
BA	biological assessment
BiOp	biological opinion
BLNR	Board of Land and Natural Resources
CAH	Carbon Assessment of Hawai‘i
CFR	Code of Federal Regulations
cm	centimeter
CNPDPS	Central North Pacific Distinct Population Segment
County	County of Kaua‘i
DAR	State of Hawai‘i Division of Aquatic Resources
DLNR	State of Hawai‘i Department of Land and Natural Resources
DOFAW	State of Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife
DPS	distinct population segment
EIS	environmental impact statement
EPE	Electric Power Engineers, Inc.
ESA	federal Endangered Species Act
ESRC	Endangered Species Recovery Committee
FEMA	Federal Emergency Management Agency
ft	foot
GAP	Gap Analysis Program
GPS	global positioning system
Hawai‘i PUC	Hawai‘i Public Utilities Commission
HCP	habitat conservation plan
HCP Handbook	*Habitat Conservation Planning and Incidental Take Permit Processing Handbook*
HPS	high-pressure sodium
HRS	Hawai‘i Revised Statutes
ILOC	irrevocable letter of credit
in	inch
ITL	incidental take license
ITP	incidental take permit
KESRP	Kaua‘i Endangered Seabird Recovery Project
KIUC	Kaua‘i Island Utility Cooperative
KSHCP	Kaua‘i Seabird Habitat Conservation Plan
km	kilometer
kph	kilometers per hour
LED	light-emitting diode
m	meter
MBTA	Migratory Bird Treaty Act
mi	mile

MOA	Memorandum of Agreement
mph	miles per hour
NAR	Natural Area Reserve
National Register	National Register of Historic Places
NEPA	National Environmental Policy Act
NFWF	National Fish and Wildlife Foundation
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NTBG	National Tropical Botanical Garden
NWR	National Wildlife Refuge
NWS	National Weather Service
PF	predator exclusion fencing
PG&E	Pacific Gas and Electric Company
PMRF	Pacific Missile Range Facility
REPI	Readiness and Environmental Protection Integration
Short-Term HCP	Short-Term Seabird Habitat Conservation Plan
SHPO	State Historic Preservation Officer
SOS	Save Our Shearwaters
sq km	square kilometer
sq mi	square mile
SSP	Shared Socioeconomic Pathway
State	State of Hawaiʻi
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Executive Summary

ES.1 Introduction and Background

The Kaua'i Island Utility Cooperative (KIUC) is seeking incidental take authorization from the U.S. Fish and Wildlife Service (USFWS) and the Hawai'i Board of Land and Natural Resources (BLNR) for the continued operation and maintenance of existing and new KIUC infrastructure. KIUC's application requests coverage for a period of 50 years. The authorization is needed because some of this infrastructure is known to result in incidental take of the state and federally listed species shown in Table ES-1 and referred to as *covered species*. The KIUC activities potentially resulting in take are referred to as *covered activities* and include the continued operation and maintenance of KIUC's existing and future powerlines and lights, and implementation of the conservation measures.

Table ES-1. Covered Species

English Name	Hawaiian Name	Scientific Name	Status[a] (Federal/State)
Newell's shearwater	ʻaʻo	*Puffinus newelli*	T/T
Hawaiian petrel	ʻuaʻu	*Pterodroma sandwichensis*	E/E
Band-rumped storm-petrel[b]	ʻakēʻakē	*Hydrobates castro*	E/E
Hawaiian stilt	aeʻo	*Himantopus mexicanus knudseni*	E/E
Hawaiian duck	koloa maoli	*Anas wyvilliana*	E/E
Hawaiian coot	ʻalae keʻokeʻo	*Fulica alai*	E/E
Hawaiian common gallinule	ʻalae ʻula	*Gallinula galeata sandvicensis*	E/E
Hawaiian goose	nēnē	*Branta sandvicensis*	T/E
Green sea turtle[c]	honu	*Chelonia mydas*	T/T

[a] Status:
E = Listed as endangered under the federal ESA or HRS Chapter 195D.
T = Listed as threatened under the federal ESA or HRS Chapter 195D.
[b] Hawai'i distinct population segment.
[c] Central North Pacific distinct population segment.

KIUC is seeking an incidental take permit (ITP) from USFWS under Section 10(a)(1)(B) of the federal Endangered Species Act (ESA), and an incidental take license (ITL) from BLNR under Sections 195D-4 and 195D-21 of the Hawai'i Revised Statutes (HRS). This KIUC Habitat Conservation Plan (HCP) supports the issuance of these permits.

KIUC is a public utility cooperative responsible for the production, purchase, transmission, distribution, and sale of electricity on the Island of Kaua'i (Kaua'i). To ensure reliable electrical service to Kaua'i, KIUC owns and operates a variety of electrical utility installations including fossil-fuel-fired, hydroelectric, and solar generating facilities, electric substations and switchyards, and electric transmission and distribution lines. KIUC also purchases power from several independent power producers and transmits power that it obtains from these sources through its electrical transmission system.

In May 2011, USFWS approved KIUC's Short-Term Seabird Habitat Conservation Plan (Short-Term HCP) for a period of 5 years to help develop the knowledge base for a longer permit duration. The KIUC Short-Term HCP covered three seabird species: Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), and band-rumped storm-petrel (ʻakēʻakē). After KIUC's Short-Term HCP expired in 2016, KIUC agreed with USFWS and DOFAW to continue implementing the Short-Term HCP conservation measures and reporting until a longer-term HCP could be fully developed. During the Short-Term HCP, KIUC initiated development of this HCP, which includes six additional species for which the covered activities would possibly result in take, as listed in Table ES-1. This HCP describes potential effects on the nine listed species from KIUC's covered activities over a 50-year permit term. The HCP also describes a conservation strategy to avoid, minimize, and mitigate the effects from those activities during that timeframe and provide a net conservation benefit to each species.

ES.2 Plan Area and Permit Area

The *Plan Area* is the area in which all covered activities and conservation measures will occur. Because KIUC operates an island-wide system exclusively on Kauaʻi and is proposing conservation measures in remote areas of the island, the KIUC HCP Plan Area covers the full geographic extent of Kauaʻi (see Figure ES-1). The *Permit Area* is the specific locations of all covered activities and conservation measures (i.e., the geographic area where the federal ITP and state ITL apply); these locations are described in Chapter 2, *Covered Activities*, and in Chapter 4, *Conservation Strategy*.

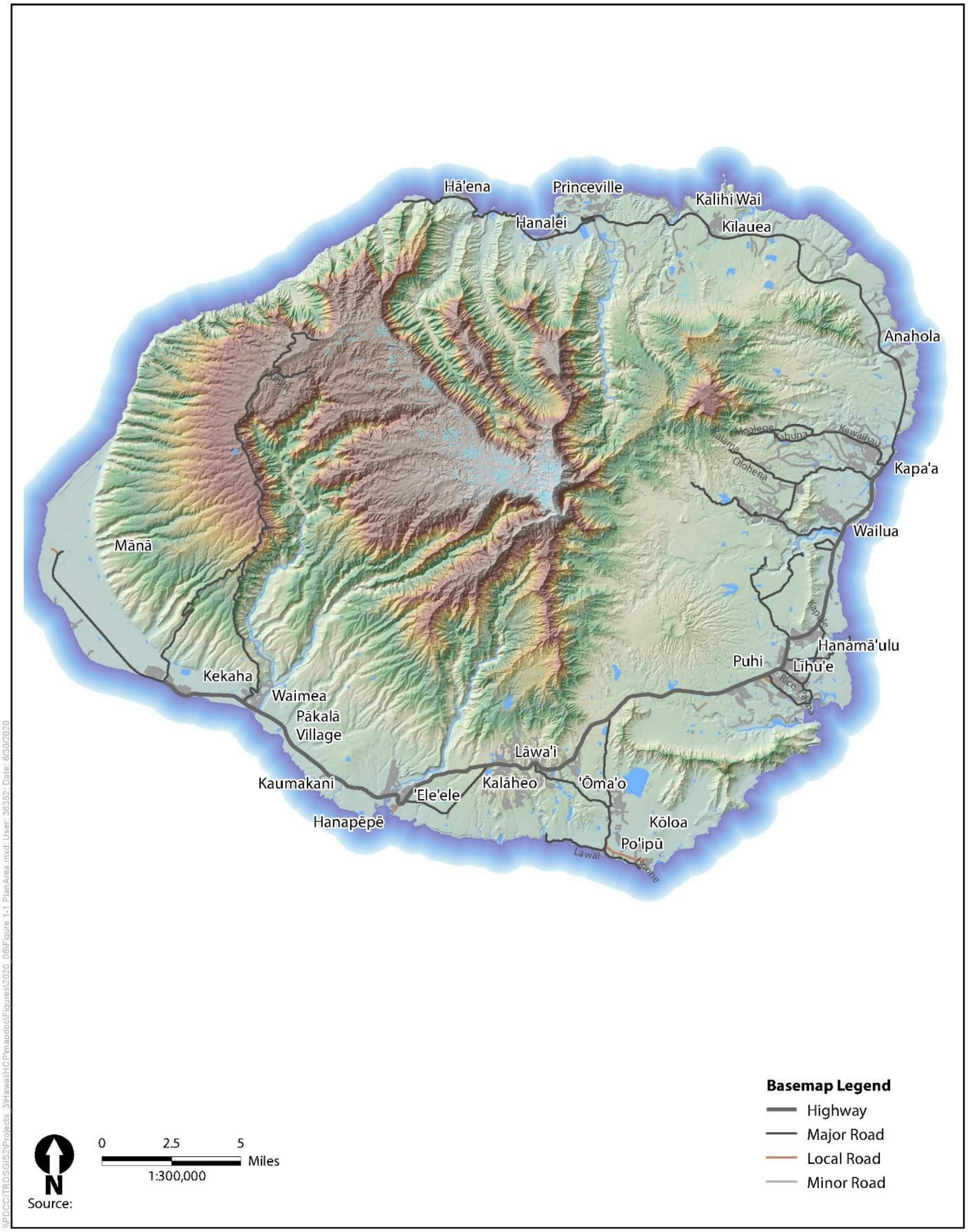

Figure ES-1. KIUC HCP Plan Area

ES.3 Covered Activities

This HCP and its permits are proposed to cover and provide incidental take authorization for KIUC activities that potentially result in take of the covered species. Covered activities must be "under the control" of the permit holder and occur within the permit term to receive coverage. Covered activities in the KIUC HCP are grouped into three broad categories: (1) powerline operations, (2) lighting operations, and (3) implementation of the HCP conservation strategy. The covered activities are summarized below; detailed descriptions of the covered activities and their selection process are provided in Chapter 2, *Covered Activities*.

- Powerline operation, modifications, and use of night lighting for repairs. This includes:
  - 171 miles (mi) (275 kilometers [km]) of existing transmission wires
  - 1,360 mi (2,189 km) of existing distribution wires
  - 70 mi (113 km) of existing communication wires
  - Up to 360 mi (580 km) of new powerlines
- Lighting operations: facility, streetlights, and nighttime lighting. This includes:
  - Facility lights at the Port Allen Generating Station and Kapaia Power Generating Station
  - 4,150 existing streetlights
  - Up to 1,754 new streetlights
  - Up to 85 hours of emergency nighttime lighting for restoration of power
- Implementation of the HCP conservation strategy, including construction and maintenance of predator exclusion fences, predator control within and outside the exclusion fences, social attraction to attract covered seabirds to new nesting colony sites, and invasive plant species control.

ES.4 Environmental Setting

Kauaʻi has a land area of approximately 550 square miles (sq mi) (1,425 square kilometers [sq km]). Roughly circular in shape, its most striking physiographic features are a high central plateau of over 5,000 feet (ft) (1,524 meters [m]) at the summits of Mt. Waiʻaleʻale (5,148 ft [1,569 m]) and Mt. Kawaikini (5,243 ft [1,598 m]). The central plateau is characterized by steep cliffs and deeply incised valleys along the northern Nā Pali Coast, the 3,600-ft-deep (1,097 m) Waimea Canyon, the broad Līhuʻe Basin on the southeastern quadrant of the island, and extensive coastal plains. Kauaʻi supports breeding populations of the covered species, as described below.

ES.4.1 Covered Seabirds

The KIUC HCP covered seabirds are Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), and the Hawaiʻi distinct population segment (DPS) of the band-rumped storm-petrel (hereafter band-rumped storm-petrel) (ʻakēʻakē). The covered seabirds spend most of their time at sea and come to land only to breed (Ainley et al. 2014; Simons 1985; Spear et al. 2007). During the breeding season (generally March through December), they nest in burrows beneath ferns and tree roots in dense forest and on steep slopes and cliffs. Adult Newell's shearwaters (ʻaʻo) and Hawaiian petrels (ʻuaʻu) forage over the sea at night and fly to and from their burrows at night or at sunset or sunrise, to forage and feed their chicks (Raine et al. 2017a). Band-rumped storm-petrels (ʻakēʻakē) have been observed feeding during the day, but likely also feed at night (Harris 1969; Kauaʻi Endangered Seabird Recovery Project 2019).

Kauaʻi supports 90 percent of the total Newell's shearwater (ʻaʻo) population (Pyle and Pyle 2009; Ainley et al. 2020) and 33 percent of the total Hawaiian petrel (ʻuaʻu) population (Raine in litt.). No band-rumped storm-petrel (ʻakēʻakē) nests have been located on Kauaʻi; however, based on auditory survey data, breeding likely occurs at several locations on Kauaʻi, primarily in the steep cliff areas of the Nā Pali Coast (Raine et al. 2017b). The majority of Newell's shearwater (ʻaʻo) known breeding areas are in the northwestern portion of Kauaʻi, and the current breeding population of Hawaiian petrel (ʻuaʻu) on Kauaʻi is confined to higher elevations in the northwest portion of the island.

For the purpose of this HCP, the portion of the total range-wide population of each covered seabird species occurring on Kauaʻi is referred to as the *Kauaʻi metapopulation*. KIUC has identified three primary regions for this metapopulation based on level of anthropogenic threats and conservation opportunities and constraints, in addition to data sources (which differ based on accessibility). These three primary regions are shown on Figure ES-2 and referenced throughout the HCP to provide context for describing relevant aspects of the covered seabirds' biology, status, and trends on Kauaʻi.

- Nā Pali Coast: Low amount of data available, low level of threats, few if any colony management opportunities (due to lack of accessibility).
- Conservation Sites: High amount of data available, moderate level of threats. These are sites KIUC is currently managing, and would continue to manage as part of this HCP.
- Remainder of the Island: Moderate amount of data available, high level of threats, few if any colony management opportunities (land ownership and accessibility) but many threat reduction opportunities (powerline strike and light attraction minimization).

The Kauaʻi metapopulations of covered seabirds face multiple anthropogenic threats. For species such as the covered seabirds with naturally low reproductive rates that rely on high adult survivorship, introduced threats that increase mortality rates such as powerline collisions and invasive predators have resulted in significant population declines. The daily movement patterns of the covered seabirds between breeding and foraging habitats and their relatively low maneuverability make them particularly susceptible to colliding with artificial structures, predominantly utility lines (Travers et al. 2019, 2020a). Their nocturnal movements, in addition to the phototropic tendencies of fledglings (i.e., tendency to be attracted to light), make them susceptible to fallout from artificial lighting (Telfer et al. 1987). All three of the covered seabird species have declined over the last few decades (Raine et al. 2017b). Figure ES-2 shows the main threats on Kauaʻi by region.

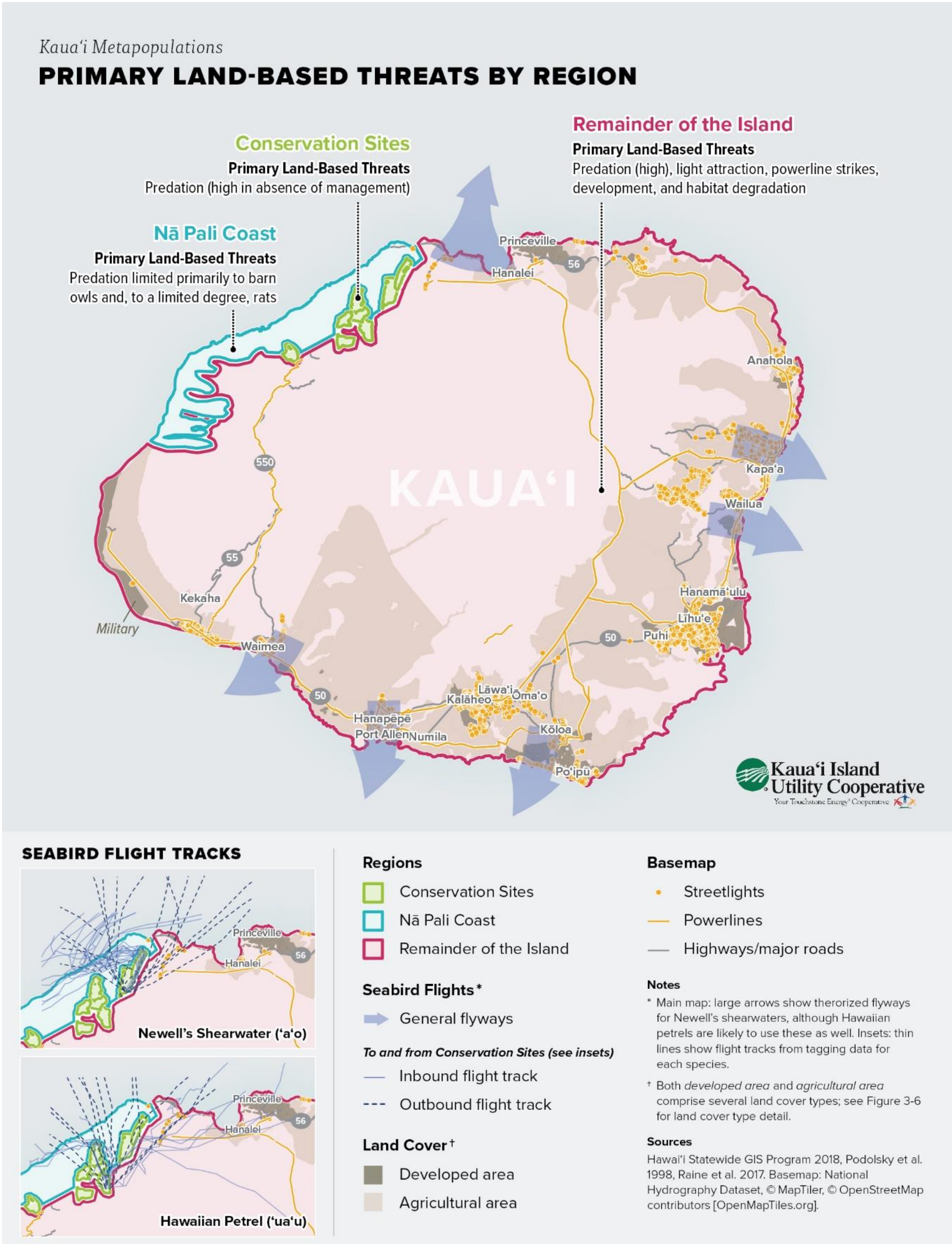

Figure ES-2. Primary Threats by Region for the Primary Covered Seabirds

From 2002 to 2011, KIUC, in coordination with USFWS and DOFAW, developed a Short-Term HCP to protect the two primary covered seabirds. For over 10 years, KIUC and its conservation partners compiled field data to learn about the distribution, populations, and behaviors of these seabirds in various locations throughout the island. This work ultimately led to the identification of monitoring and research projects to be implemented at the conservation sites. In 2011, the Short-Term HCP was approved with a 5-year permit term. After the permit term expired, KIUC continued to implement the conservation measures, conducted additional monitoring and research on listed seabirds, expanded the number of seabird conservation sites, and continued developing this HCP. Data on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) collected through the Short-Term HCP and continued conservation efforts after the Short-Term HCP expired informed the conservation measures for this HCP. See Table 3-2 in Chapter 3, *Environmental Setting*, and Appendix 1A, *Data used for Plan Development*, for more details on the conservation measures implemented and data collected since 2001.

Monitoring data from the conservation sites over a 12-year period have demonstrated a positive abundance trend in these areas, with a high level of data confidence (Raine et al. 2024) (Figure ES-3). Available Nā Pali Coast data suggest that the abundance trends for Newell's shearwater (ʻaʻo) have been relatively flat in the last decade. For the Remainder of the Island, data since 2010 show a stable abundance trend (Figure ES-3).

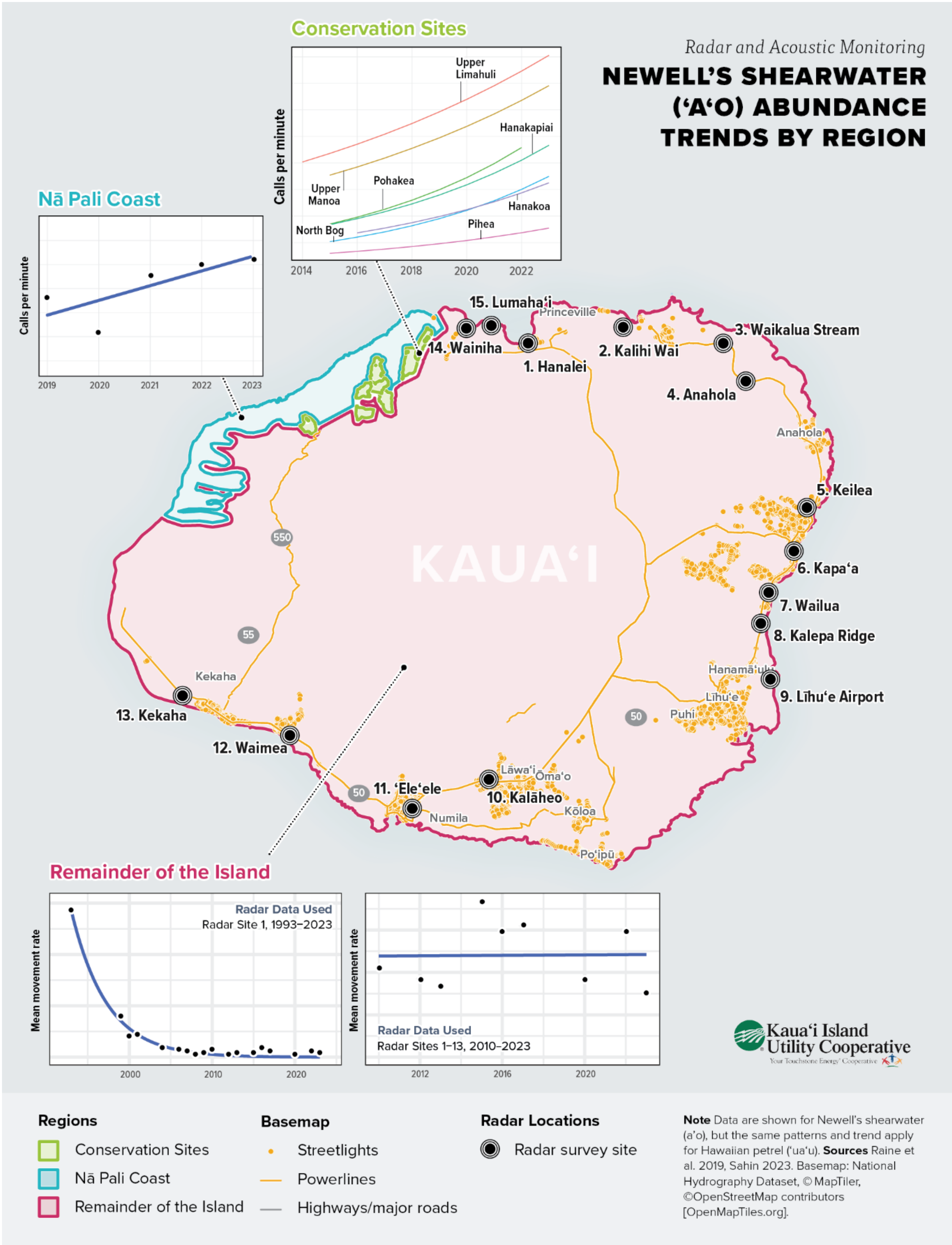

Figure ES-3. Abundance Trends for the Primary Covered Seabirds

ES.4.2 Covered Waterbirds

The KIUC HCP covered waterbirds are the Hawaiian stilt (aeʻo), Hawaiian duck (koloa maoli), Hawaiian coot (ʻalae keʻokeʻo), Hawaiian common gallinule (ʻalae ʻula), and the Hawaiian goose (nēnē). The covered waterbirds are endemic to Hawaiʻi.

Except for the Hawaiian goose (nēnē), the covered waterbird species are associated only with wetlands and open water habitat on Kauaʻi. Hawaiian geese (nēnē) use a wide variety of habitats, including highly altered landscapes such as pastures, agricultural fields, and golf courses (U.S. Fish and Wildlife Service 2004).

Long-term census data (1986–2023) indicate that the statewide populations of the covered waterbirds is stable or increasing (Gorresen et al. 2024). The most consequential threat to the covered waterbird species has been the loss of wetland habitat. Environmental contaminants such as fuel spills, water pollution, and pesticides continue to degrade habitats that support covered waterbirds, and these species are also threatened by diseases such as avian botulism. Collisions with vehicles and structures (e.g., powerlines) are also a threat to the covered waterbirds. For example, when taking off and landing, the long, low flight path of the Hawaiian goose (nēnē) makes it vulnerable to collisions with stationary structures and moving objects such as vehicles and aircraft (Banko et al. 2020; State of Hawaiʻi Division of Forestry and Wildlife 2015). The most significant threat facing the Hawaiian duck's (koloa maoli) continued existence is hybridization with feral mallards; as a result, it is now among the rarest of the world's birds (Engilis et al. 2020).

ES.4.3 Green Sea Turtle (honu)

The Hawaiian population of the green sea turtle (honu) is a threatened population segment of this species identified as the Central North Pacific DPS (81 *Federal Register* 20057) of the green sea turtle (hereafter green sea turtle) (honu). This DPS of the green sea turtle (honu) is also protected by Chapter 195D of the HRS and Section 13-124 of Hawaiʻi Administrative Rules. The range of the green sea turtle (honu) includes the Hawaiian Archipelago and Johnston Atoll.

Green sea turtles (honu) spend most of their lives in open coastline and protected bays and lagoons (Seminoff et al. 2015). On shore, green sea turtles (honu) rely on beaches characterized by intact dune structures, native vegetation, lack of artificial lighting, and normal beach temperatures for nesting (Limpus 1971; Salmon et al. 1992; Ackerman 1997; Witherington 1997; Lorne and Salmon 2007). In 2015, Parker and Balazs documented 20 nesting sites[1] around Kauaʻi. Although nesting density is low on Kauaʻi (generally zero to two nests per year), observations of nesting increased between 2015 and 2020 (State of Hawaiʻi Division of Aquatic Resources 2020).

The decline of green sea turtle (honu) is primarily attributed to development and public use of beaches, vessel strikes, attraction to artificial lights, bycatch in fishing gear, pollution, interactions with recreational and commercial vessels, beach driving, and major storm events. The species is also threated by the effects of climate change, including habitat loss and warming sea and air temperatures, including increased sand temperatures (Schroeder and Mosier 2000).

[1] Nesting data reported from Kauaʻi are speculative due to the lack of systematic surveys. Estimates may also be skewed toward high-use beaches and beaches that regularly have resting seals (as this is how green sea turtle [honu] nests have been opportunistically found).

ES.5 Conservation Strategy

The KIUC HCP conservation strategy was developed in coordination with and under guidance from USFWS and DOFAW. The HCP includes measures to avoid, minimize, and mitigate the impact of the taking on covered species from covered activities and to provide a net benefit to each species. The biological goals and objectives and conservation measures in this HCP for covered seabirds are based on over 20 years of KIUC implementing and refining the same or similar measures and the results of field monitoring to determine their effectiveness. The conservation strategy relies on (1) implementing tools and techniques to minimize effects on covered species from the covered activities, (2) managing designated areas on the landscape for the benefit of the covered seabird species and the green sea turtle (honu), and (3) contributing a net benefit to the recovery of all covered species.

ES.5.1 Conservation Framework

The conservation strategy is based on a set of biological goals and objectives for each covered species, shown in Table ES-2. A conservation strategy approach was developed for each species based on the available data and the status of the species, and is not the same for all the covered species. The biological goals state the intentions of the HCP and the biological objectives are the measurable targets by which the success of the HCP will be judged. The conservation strategy consists of six conservation measures for meeting the biological goals and objectives, described in Chapter 4, Section 4.4, *Conservation Measures.*

Table ES-2. Biological Goals and Objectives

Newell's Shearwater (ʻaʻo) (*Puffinus newelli*)
Goal 1. Provide for the survival of the Kauaʻi metapopulation of Newell's shearwater (ʻaʻo) and contribute to the species' recovery by minimizing and fully offsetting the impacts of KIUC's taking of this species over the term of the HCP to an extent that is likely to result in numbers of breeding pairs, age structure, population growth rate, and spatial distribution that is representative of a Kauaʻi viable metapopulation, thereby providing a net benefit to the species.
Objective 1.1. Substantially reduce the extent and effect of collisions of adult/subadult Newell's shearwaters (ʻaʻo) with existing and future KIUC powerlines island-wide, as measured against the pre-2020 strike estimate (Appendix 5C, *Bayesian Acoustic Strike Model*), in accordance with the location, extent, and schedule outlined in the HCP.
Objective 1.2. Minimize the adverse effects of artificial light attraction on Newell's shearwater (ʻaʻo) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.

Objective 1.3. Increase the number of Newell's shearwater ('a'o) breeding pairs and fledglings produced annually throughout the duration of the permit by managing and enhancing suitable Newell's shearwater ('a'o) breeding habitat and breeding colonies across 12 conservation sites and reducing the abundance and distribution of key seabird predators at these sites. The success of this objective will be measured by the following metrics, each of which is applied to the 12 conservation sites combined:

Metric 1. Meet the minimum target breeding pairs defined in Table 6A-3 (lists the minimum breeding pairs per year), as calculated using data from auditory surveys, acoustic surveys, and burrow monitoring.

Metric 2. Growth rate for breeding pairs annually of at least 1.0% as measured by a 5-year rolling average as inferred from data collection at the conservation sites.

Metric 3. Maintain a 5-year rolling average 87.2% reproductive success rate.

Metric 4. Eradicate terrestrial predators within predator exclusion fencing within 1 year of completing fence construction.

Metric 5. Produce at least one breeding pair within each of the four social attraction sites by year 5 after the completion of predator eradication within the fenced area at each site. Positive growth demonstrated at each site during the portion of the permit term when social attraction is occurring.

Metric 6. Ensure invasive plant and animal species do not preclude meeting the objective metrics above.

Metric 7. At least four conservation sites will be occupied annually by breeding pairs for years 1–10 and at least 9 conservation sites occupied by breeding pairs or prospecting birds for remainder of the permit term, as measured by burrow monitoring, call rates, and/or auditory surveys.

Hawaiian Petrel ('ua'u) (*Pterodroma sandwichensis*)

Goal 2. Provide for the survival of the Kaua'i metapopulation of Hawaiian petrel ('ua'u) and contribute to the species' recovery by minimizing and fully offsetting the impacts of KIUC's taking on this species over the term of the HCP to an extent that is likely to result in numbers of breeding pairs, age structure, population growth rate, and spatial distribution that is representative of a Kaua'i viable metapopulation, thereby providing a net benefit to the species.

Objective 2.1. Substantially reduce the extent and effect of collisions of adult/subadult Hawaiian petrels ('ua'u) with existing and future KIUC powerlines island-wide, as measured against the pre-2020 strike estimate (Appendix 5C, *Bayesian Acoustic Strike Model*) in accordance with the location, extent, and schedule outlined in the HCP.

Objective 2.2. Minimize the adverse effects of artificial light attraction on Hawaiian petrel ('ua'u) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.

Objective 2.3. Increase the number of Hawaiian petrel ('ua'u) breeding pairs and fledglings produced annually throughout the duration of the permit by managing and enhancing suitable Hawaiian petrel ('ua'u) breeding habitat and breeding colonies across 8 conservation sites and reducing the abundance and distribution of key seabird predators at these sites. The success of this objective will be measured by the following metrics, each of which is applied to the 8 conservation sites combined:

Metric 1. Meet the minimum target breeding pairs defined in Table 6A-4 (lists the minimum breeding pairs per year), as calculated using data from auditory surveys, acoustic surveys, and burrow monitoring.

Metric 2. Growth rate for breeding pairs annually of at least 1.0% as measured by a 5-year rolling average as inferred from data collection at the conservation sites.

Metric 3. Maintain a 5-year rolling average 78.7% reproductive success rate.

Metric 4. Ensure that invasive plant and animal species do not preclude meeting the objective metrics above.

Metric 5. At least six conservation sites will be occupied annually by breeding pairs, as measured by burrow monitoring, call rates, and/or auditory surveys.

Band-Rumped Storm-Petrel (ʻakēʻakē) (*Hydrobates castro*)
Goal 3. Contribute to the recovery of the band-rumped storm-petrel (ʻakēʻakē) by reducing threats associated with existing and future KIUC powerlines and streetlights, existing covered facility lights, and introduced predators on Kauaʻi.
Objective 3.1. Reduce the potential for band-rumped storm-petrel (ʻakēʻakē) collisions with existing and future KIUC powerlines island-wide, in accordance with the location, extent, and schedule outlined in the HCP.
Objective 3.2. Minimize the adverse effects of artificial light attraction on band-rumped storm-petrel (ʻakēʻakē) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.
Objective 3.3. Facilitate the rescue, rehabilitation, and release of band-rumped storm-petrel (ʻakēʻakē) fledglings through funding of the Save Our Shearwaters Program or other certified rehabilitation facility to offset light attraction by KIUC streetlights.
Objective 3.4. Implement predator control, including barn owl control, within the conservation sites to reduce predation of band-rumped storm-petrel (ʻakēʻakē) in areas near and within the Honopū PF conservation site (e.g., Nā Pali Coast).
Covered Waterbirds: Hawaiian Coot (ʻalae keʻokeʻo) (*Fulica alai*), Hawaiian Gallinule (ʻalae ʻula) (*Gallinula galeata sandvicensis*), Hawaiian Stilt (aeʻo) (*Himantopus mexicanus knudseni*), Hawaiian Goose (nēnē) (*Branta sandvicensis*), and Hawaiian Duck (koloa maoli) (*Anas wyvilliana*)
Goal 4. Contribute to the recovery of covered waterbird species by reducing threats associated with KIUC powerlines on Kauaʻi.
Objective 4.1. Reduce covered waterbird collisions with KIUC powerlines in Hanalei and Mānā (Kawaiʻele Waterbird Sanctuary), in accordance with the location, extent, and schedule outlined in the HCP, and relative to measured collisions in 2021.
Objective 4.2. Facilitate the rescue, rehabilitation, and release of grounded covered waterbirds through funding of the Save Our Shearwaters Program or other certified rehabilitation facility to offset collisions with KIUC powerlines.
Central North Pacific Distinct Population Segment of the Green Sea Turtle (honu) (*Chelonia mydas*)
Goal 5. Contribute to the recovery of the species by increasing the ability for green sea turtles (honu) to successfully transit Kauaʻi beaches.
Objective 5.1. Locate and shield green sea turtle (honu) nests at all locations that are visually affected by KIUC streetlights on an annual basis.
Objective 5.2. Minimize light effects to the extent practicable from existing and future KIUC streetlights onto beaches with suitable green sea turtle (honu) nesting habitat by implementing practicable minimization techniques that will reduce or eliminate these light effects.

ES.5.2 Conservation Measures

KIUC will implement or fund six conservation measures that, collectively, are expected to meet the biological goals and objectives summarized above. Below is a short summary of each conservation measure. Further details of each measure can be found in Chapter 4, Section 4.4, *Conservation Measures*.

ES.5.2.1 Conservation Measure 1. Implement Powerline Collision Minimization Projects

This conservation measure describes the actions KIUC will apply to meet the covered seabird and covered waterbird biological goals and objectives for powerline collision minimization. Powerline collision minimization is one of the most important conservation measures for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) on Kauaʻi. Seabird mortality from collisions with KIUC powerlines has significantly contributed to the decline of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) populations and continues to suppress populations of both species. Collisions occur most often with the overhead static wire due to its tall height and position above all other wires, and because it is less visible. Prior to minimization, static wires were widespread across KIUC's electric system and were present in nearly all high-collision locations. The other contributing factors for seabird powerline collision risks are the number of wires in a vertical stack, the total wire height, and the position of powerlines along ridgelines or flyways. The greater the number of wires in the vertical stack and the higher the wires, the greater the risk of seabird collision. Powerline aboveground height is highest when wires are strung from ridgeline to ridgeline across a drainage or valley. On Kauaʻi many of the powerline spans with the highest seabird collision risk are strung across mountain drainages.

Minimization actions under this conservation measure include reconfiguration of powerlines (i.e., changing the profile from vertical to horizontal and reducing the number of layers), static wire removal, and installation of bird flight diverters to substantially reduce powerline collisions. Bird flight diverters are regularly spaced reflective or light-emitting diode (LED) devices that make powerlines more visible to birds, reducing the number of collisions.

KIUC began early implementation of powerline collision minimization projects in 2020. By May 2024 island-wide minimization projects were completed on existing powerlines, with benefits being realized immediately. Minimization was implemented along a total of 127 mi (204 km) of existing powerlines with many of those miles having both static wire removal and bird flight diverter installation. Based on monitoring results and estimated strike reductions, KIUC commits to achieving a reduction in powerline collisions of at least 66.4 percent island-wide for covered seabirds and 90 percent for covered waterbirds compared to the baseline strike rate prior to initiation of the island-wide minimization projects. Figures ES-4 and ES-5 show the location of each bird flight diverter and static wire minimization project identified in Appendix 4B, *KIUC Minimization Projects,* while Figure ES-6 shows the estimated strike reduction per span in percent.

When constructing new powerlines, KIUC will minimize powerline collision risk by not installing static wires, using horizontal configuration, avoiding construction in high-collision zones to the maximum extent practicable, and employing bird flight diverters on new powerlines where applicable. These measures have the goal of achieving the greatest practicable level of reduction of potential strike risk on new lines in any given location. KIUC has estimated that strike risks on new lines will be reduced by 80 percent for seabirds and 90 percent for waterbirds with these minimization techniques on new powerlines, as compared to the baseline strike rate prior to initiation of island-wide powerline minimization.

This conservation measure applies to covered seabirds and covered waterbirds. This conservation measure is intended to support Objectives 1.1, 2.1, 3.1, and 4.1 in Table ES-2.

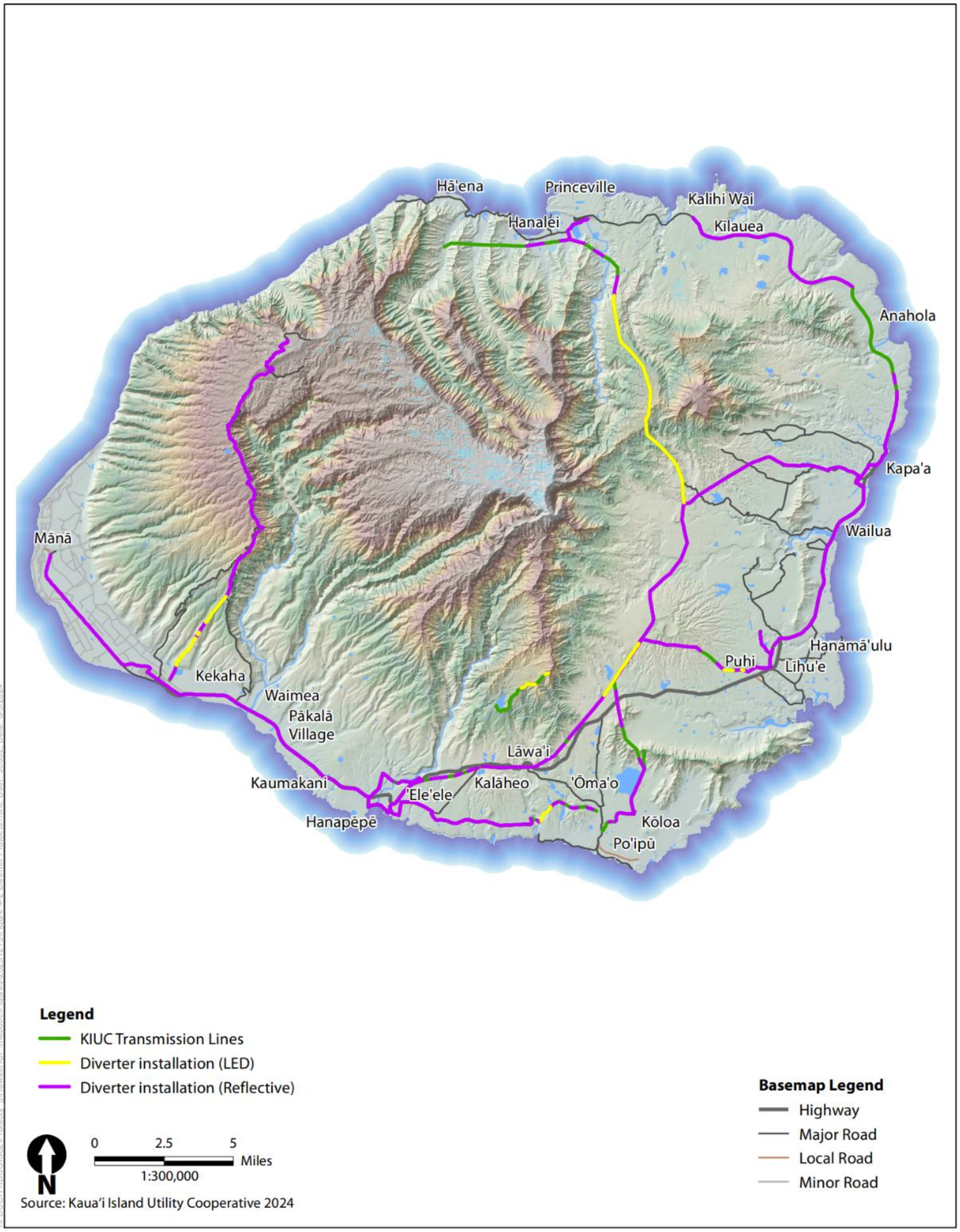

Figure ES-4. KIUC Bird Flight Diverter Minimization Project Locations

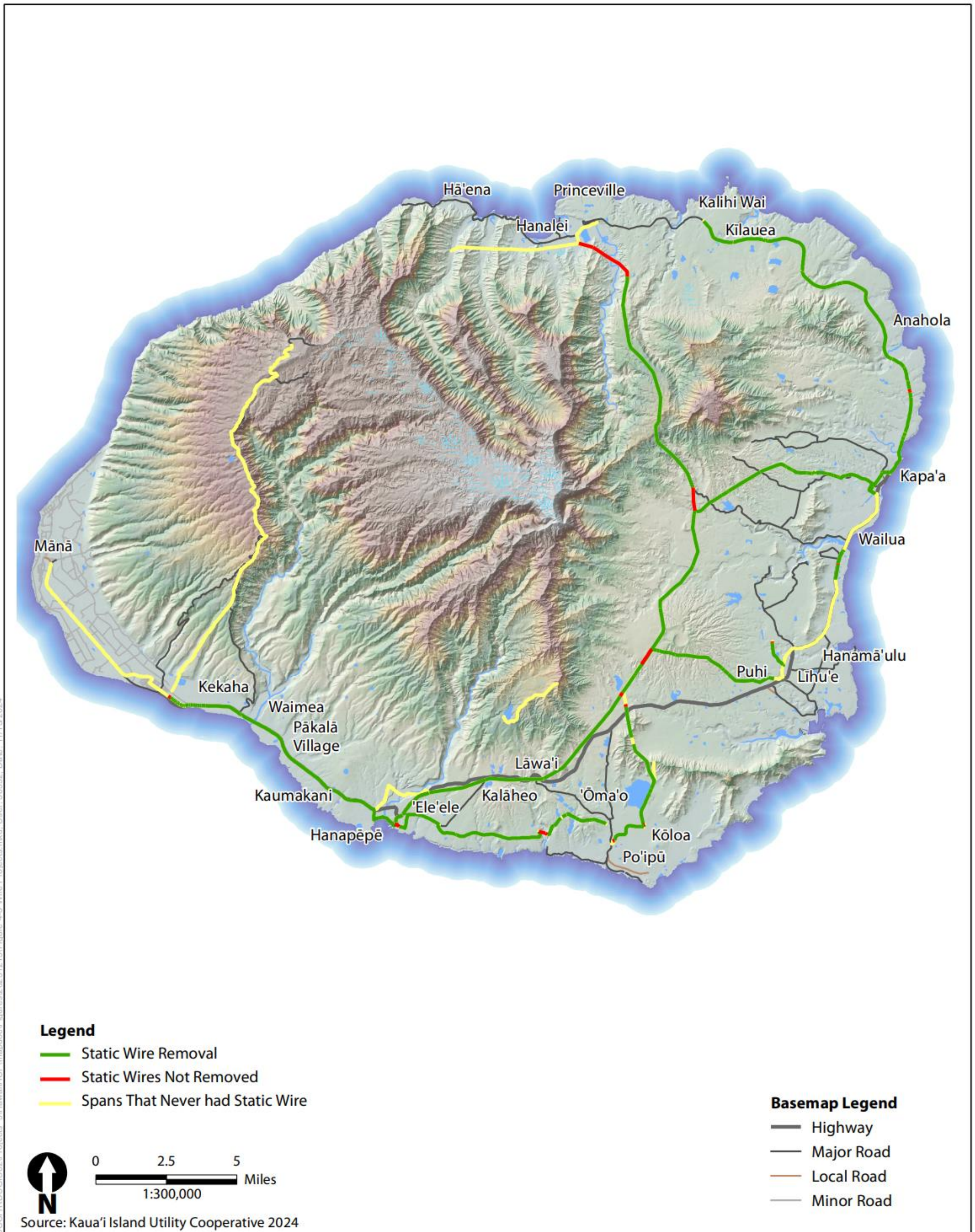

Figure ES-5. KIUC Wire Minimization Project Locations

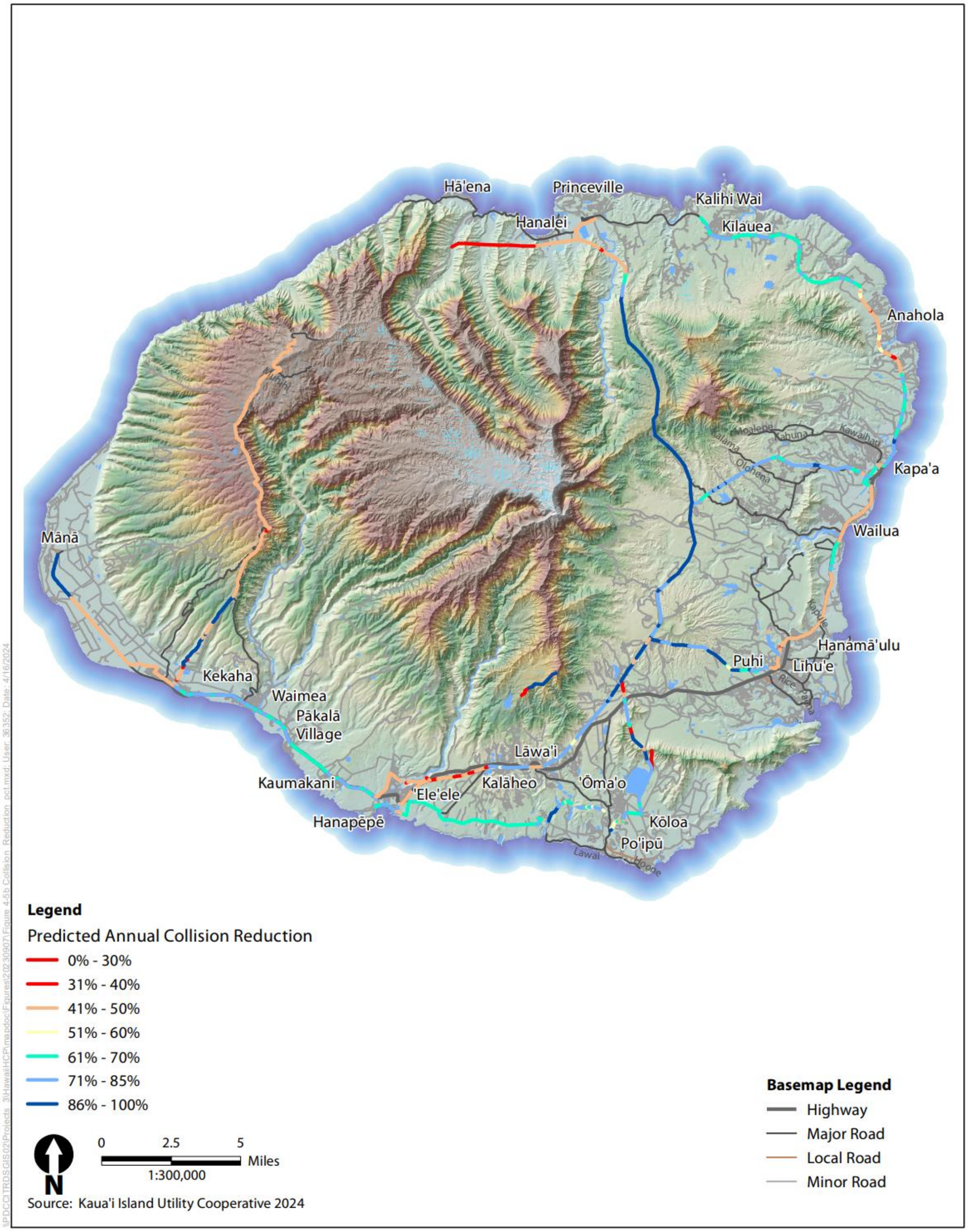

Figure ES-6. Predicted Proportional Reduction (Percent) in Annual Powerline Collisions of all Seabirds in Each Powerline Span by May 2024[2]

[2] Baseline strike rate is the estimated annual strikes per span combined prior to any minimization. It is calculated through the Bayesian model using powerline monitoring data from 2013 to 2019 (Travers et al. 2020a). See Appendix 5C, *Bayesian Acoustic Strike Model*, for details.

ES.5.2.2 Conservation Measure 2. Implement Measures to Minimize Light Attraction

Bright artificial lights attract and confuse the covered seabird fledglings, causing them to become grounded. If the light-attracted individuals that become grounded are not rescued, they are at risk of succumbing to injury or mortality due to starvation, predation, collisions with cars, or several of these threats. KIUC’s streetlights and covered facility lights are one source of artificial light in the Plan Area that can result in these effects. Under this conservation measure, KIUC will take actions to reduce and minimize this impact.

Minimization actions under this conservation measure include reducing light attraction through the installation of full-cutoff shield fixtures, and dimming exterior night lighting at facilities during the fledgling fallout season. Since 2017, all existing KIUC streetlights have full-cutoff shields to minimize light attraction, and have been converted from high-pressure sodium bulbs to more energy-efficient 3,000-kilowatt LED bulbs. In 2019, KIUC converted outdoor facility lights at Port Allen Generating Station to white LED bulbs with dimming capability to further reduce light attraction. All new streetlights during the permit term will be installed with full-cutoff shields and LED bulbs with a wattage of 3,000 kilowatts or less. In addition, predator removal will be carried out at facilities to minimize depredation of light-attracted grounded seabirds.

This conservation measure only applies to the covered seabird species because they are the only covered species group affected by light attraction away from coastal locations. This conservation measure is intended to support Objectives 1.2, 2.2, and 3.2 in Table ES-2.

ES.5.2.3 Conservation Measure 3. Provide Funding for the Save our Shearwaters Program

The Save Our Shearwaters (SOS) Program is an avian rescue and rehabilitation program that operates year-round on Kaua‘i. The initial focus of the program was on rescue and rehabilitation of Newell’s shearwater (‘a‘o) and Hawaiian petrel (‘ua‘u). The program has since been expanded to provide rescue and rehabilitation for all native bird species including all covered seabirds and covered waterbirds, as well as other, non-covered birds. Under the SOS Program, grounded seabirds, waterbirds, and other birds that are rescued by members of the public or businesses can be turned into SOS Program staff. Injured birds are assessed, rehabilitated if possible by trained staff and professional veterinary staff, and released back into the wild. All rehabilitation actions occur at an accredited animal rescue facility with extensive equipment and facilities for any necessary procedure to treat minor injuries or perform major surgery or treatment, including extended stays prior to release back into the wild.

The SOS Program has recovered and released more than 32,500 seabirds since the program was created in 1979. It is likely that all the rehabilitated seabirds would have died as a result of collision or grounding injuries, starvation, dehydration, predation, vehicle interactions, or other sources of mortality, if not retrieved, treated, and released by the SOS Program. Consequently, operation of the SOS Program plays a significant role in maintaining sustainable populations of the covered seabird species on Kaua‘i.

KIUC began funding and largely implementing the SOS Program with DOFAW in 2003. Under the HCP, KIUC will fund the SOS Program at $300,000 dollars per year[3] to support the rescue, rehabilitation, and release of the covered seabirds and waterbirds found within the SOS Program's operational area on Kauaʻi, regardless of the source of injury. KIUC will also support public outreach and education, in coordination with the SOS Program, to inform and educate the public about the risks of powerline strikes and light attraction to the covered species on Kauaʻi.

This conservation measure applies to covered seabirds and covered waterbirds. This conservation measure is intended to support Objectives 3.3 and 4.2 in Table ES-2.

ES.5.2.4 Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites

Conservation sites are specific parcels in the Plan Area where KIUC will continue to implement management actions (e.g., predator control, social attraction) to increase the reproductive success of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) breeding colonies, and to benefit band-rumped storm-petrel (ʻakēʻakē) occurring in the region. This conservation measure is the primary means of offsetting the impacts of the taking on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) and providing a net benefit for each species. KIUC commits to managing and enhancing 12 conservation sites for the KIUC HCP (Figure ES-7) to an extent that is representative of Kauaʻi viable metapopulations of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu). Details regarding the site selection process are provided in Appendix 4A, *Conservation Site Selection.* This conservation measure is intended to support Objectives 1.3, 2.3, and 3.4 in Table ES-2.

Most of the 12 conservation sites that were selected for the KIUC HCP are the same sites where KIUC has been funding and implementing predator control, seabird monitoring, and invasive plant species control for the Short-Term HCP, and in the interim period between the Short-Term HCP and commencement of this HCP. This history of over 10 years of managing conservation sites with established colonies of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) provided KIUC, USFWS, and DOFAW with a large amount of data for these species that was used to inform this HCP. These sites were selected for a number of reasons including (1) these areas have established colonies of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), in part due to a history of successful management as indicated by an increasing abundance of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) at these sites, (2) these areas have suitable habitat for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), and (3) predator populations have largely been suppressed due to years of ongoing intensive predator control. Cessation of management at these sites would put these successful colonies at risk.

[3] Starting at the first year of the permit term. Funding will increase annually to keep pace with inflation.

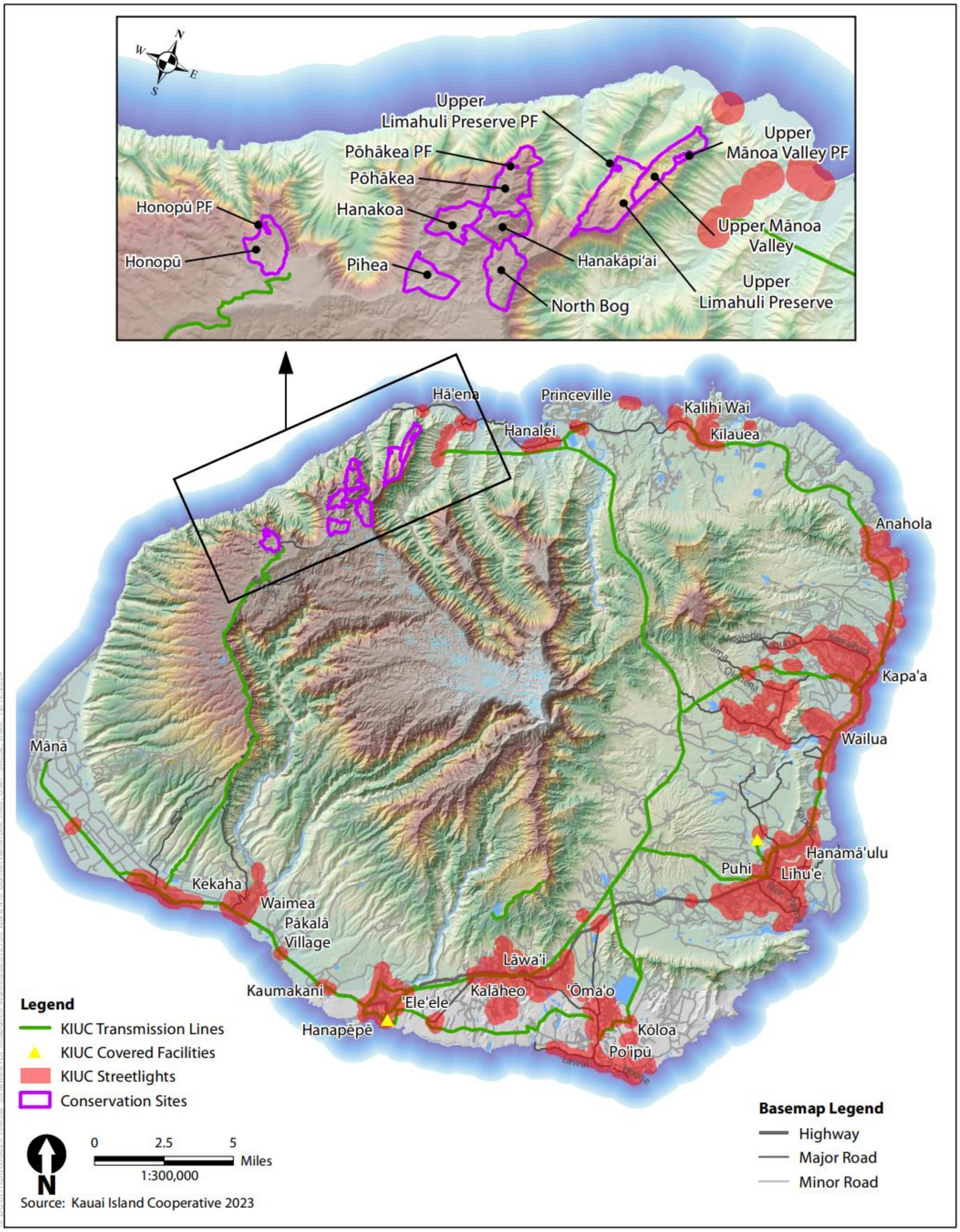

Figure ES-7. Conservation Sites

Designated conservation sites for the Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u) will continue to be managed as follows.

- Predator control measures will be implemented at all conservation sites to establish predator-free breeding habitat at four sites and substantially reduce predation at all other sites, which is critical to successfully restore productive seabird colonies (Buxton et al. 2014; Jones and Kress 2012; Young et al. 2018; Raine et al. 2020). Predator control will include removal of feral cats, rodents, ungulates, barn owl, and feral bees where signs of these species are identified. Terrestrial predator control methods include traps, bait stations, snares, hunting, and other control methods.
- Predator exclusion fencing (PF) impenetrable to most introduced terrestrial predators including feral cats, rats, pigs, and goats will be constructed and maintained. The four conservation sites where predator exclusion fences currently exist or will be constructed are: Pōhākea PF, Honopū PF, Upper Limahuli Preserve PF, and Upper Mānoa Valley PF. Existing ungulate fencing at two sites (Upper Limahuli Preserve and Honopū) will also be maintained.
- Social attraction techniques will be used to expand existing colonies and establish new colonies within the four predator exclusion fences at Pōhākea PF, Honopū PF, Upper Limahuli Preserve PF, and Upper Mānoa Valley PF. Invasive plant species management will be implemented at these sites and includes the removal of invasive plant species that affect suitable breeding habitat, and replanting of native species. Social attraction methods include the installation of artificial burrows and broadcasting calls in the restored habitat during peak breeding season (April through mid-September). Social attraction will be primarily focused on Newell's shearwater ('a'o) but will also benefit band-rumped storm-petrel ('akē'akē) at one site.
- Invasive plant species control at the other conservation sites will occur on an as-needed basis, when species documented during monitoring are determined to be spreading or are otherwise affecting suitable breeding habitat.

ES.5.2.5 Conservation Measure 5. Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program

This conservation measure is intended to support Objective 5.1 in Table ES-2. A nest detection and shielding program will be implemented to minimize and offset the effects of light attraction on green sea turtle (honu) hatchlings from KIUC streetlights near suitable nesting habitat. Nest shielding of detected green sea turtle (honu) nests will be installed on the entirety of beaches identified by KIUC and USFWS as having suitable green sea turtle (honu) nesting habitat and KIUC streetlights that have been documented as being visible from that habitat. The nest shielding will be installed at active green sea turtle (honu) nests detected via drone surveys or by a monitoring program. Light-proof fencing will be erected around the nest after approximately 45 days of incubation to shield nests from visible streetlights and to minimize the potential for vandalism.

After the green sea turtle (honu) hatchlings have emerged and entered the ocean, the fence will be removed and evidence of hatching will be reported to USFWS, DOFAW, and the State of Hawai'i Division of Aquatic Resources (DAR) within 24 hours. Unhatched eggs, deceased hatchlings, or samples of either will be sent to the National Oceanic and Atmospheric Administration by a permitted biologist for DNA analysis. Annual monitoring will occur on all beaches on Kaua'i to allow for continual updates to the nest shielding program by identifying additional beaches that may require shielding as well as removing locations where environmental conditions change and light attraction risks are removed. All staff and volunteers will be required to complete annual training provided by USFWS, DOFAW, DAR, or trainers approved by USFWS, DOFAW, and DAR, that will allow them to recognize green sea turtle (honu) tracks, signs of nesting, and hatchling activity, as well as the proper techniques for installing a temporary light shield. These measures will be implemented over the 50-year permit term unless KIUC is able to demonstrate to USFWS, DOFAW, and DAR that permanent modification of existing and future streetlights fully avoids take of green sea turtles (honu) (see Conservation Measure 6). The nest shielding program includes measures to avoid disturbing Hawaiian monk seal (ʻilio holo i ka uaua) (*Neomonachus schauinslandi*) in the rare event that an adult or mother and pup occurs close to an active green sea turtle (honu) nest that is shielded as part of this program.

ES.5.2.6 Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle (honu)

The primary means of offsetting the impacts of the taking of green sea turtle (honu) is the nest identification and nest shielding program described in Conservation Measure 5. However, there may be additional opportunities to reduce light attraction to green sea turtle (honu). This conservation measure describes how KIUC will pursue additional options with the County and State for practicably feasible minimization of streetlights that may affect green sea turtle (honu).

This conservation measure is intended to support Objective 5.2 in Table ES-2. As of 2020, KIUC and USFWS identified 29 streetlights that are visible from suitable green sea turtle (honu) nesting habitat in the Plan Area. Additional modifications of streetlights may be possible to reduce light attraction of green sea turtle (honu) hatchlings without compromising public health or safety. KIUC will work with the County and State to determine the range of available practicable minimization measures and their timeline for implementation. Light minimization techniques may include additional shielding or change in wattage. If no practicable minimization measures can be agreed upon, KIUC would not be required to implement this conservation measure further, and instead would continue to implement the shielding program required under Conservation Measure 5 throughout the life of the permit term. Annually, KIUC will survey all beaches in the Plan Area with KIUC streetlights visible from suitable green sea turtle (honu) nesting habitat. If new beach locations are identified with suitable green sea turtle (honu) habitat and visible KIUC streetlights, the same light minimization techniques agreed upon for the existing 29 streetlights will be implemented for any additional streetlights at those newly identified locations throughout the permit term.

ES.6 Effects on Covered Species

Effects on the covered species have been evaluated using a systematic, scientific analysis of the estimated adverse, beneficial, and net effects as a result of the HCP covered activities and their effects pathways. The approach to the effects analysis is not the same for all covered species and is based on available data and the status of the species. For Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), the covered species considered at greater risk of decline, there are sufficient data to develop models of abundance to inform the effects analysis. For the covered waterbirds and green sea turtle (honu), the available data do not provide sufficient information to support a similar approach, and the status of these covered species is considered stable. Therefore, other methods were used for the effects analysis for the covered waterbirds and green sea turtle (honu). This section summarizes effects by species group: covered seabirds, covered waterbirds, and green sea turtle (honu).

ES.6.1 Effects on Covered Seabirds

KIUC activities result in four sources of take of covered seabirds: collisions with powerlines, light attraction from streetlights, light attraction from facility lights and nighttime construction lighting, and management at the conservation sites. The covered seabirds collide with powerlines owned and operated by KIUC along their flight paths between the ocean feeding areas and montane breeding habitats (Travers et al. 2020a). KIUC operates streetlights, lights at its covered facilities, and night lighting for emergency restoration of power, all of which are sources of artificial lighting that attract the covered seabirds (primarily fledglings). Covered seabirds attracted by artificial lighting become disoriented and may become grounded, an event referred to as fallout (Imber 1975; Telfer et al. 1985). Conservation site management, primarily predator trapping, may also result in take of covered seabirds. The following sections summarize methods and results for estimating the level of take from each covered activity, the effects of take on the covered seabirds, the beneficial effects of the conservation strategy, and the net effects considering both the adverse effects of take and the beneficial effects of the conservation strategy.

ES.6.1.1 Population Dynamics Model—Two Scenarios

KIUC developed custom population dynamics models using the best available data for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) on Kauaʻi for the following specific uses in the HCP:

- To model the plausible bounds of Kauaʻi metapopulation trends based on available data.
- Estimate the annual level of take.
- Evaluate the benefits of powerline strike minimization on the covered seabirds.
- Quantify the benefits of the seabird breeding colonies at the conservation sites.
- To determine the net effects (i.e., adverse and beneficial effects combined) of the HCP covered activities and conservation measures on the Kauaʻi metapopulations of the two seabird species, and to quantify and estimate the timing of the net benefits provided by the HCP.
- To provide metrics against which to track Kauaʻi metapopulation abundance trends during HCP implementation.

A population dynamics model was not developed for band-rumped storm-petrel (ʻakēʻakē) because of the lack of data on this species.

For Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), two hypothetical abundance trend scenarios were modeled to estimate the plausible bounds of abundance trends within the confines of the available data.

- *Worse-case trend* population dynamics model scenario (or worse-case trend scenario) assumes the population trend at model initiation is in rapid decline in areas outside the conservation sites. This approach is intended to estimate the lower plausible bound of abundance trends outside the conservation sites.

- *Stable trend* population dynamics model scenario (or stable trend scenario) assumes the initial population trend outside of the conservation sites is relatively stable, as explained below. This approach is intended to estimate the upper plausible bound of abundance trends outside the conservation sites.

Appendix 5D, *Population Dynamics Model for Newell’s Shearwater (‘a‘o) on Kaua‘i*, describes the model and results for Newell’s shearwater (‘a‘o) for the two scenarios. Appendix 5E, *Population Dynamics Model for Hawaiian Petrel (‘ua‘u) on Kaua‘i* describes the model and results for Hawaiian petrel (‘ua‘u) for the two scenarios. The modeling framework allows each subpopulation to have its own set of vital rate values and therefore different trends in abundance through time. The vital rates for each subpopulation were also modeled to change through time as management efforts continue to be implemented and increase their benefits to the species, corresponding to the timeline of these measures described in Chapter 4, *Conservation Strategy*. For the two model scenarios for each species, island-based estimates of abundance for each subpopulation were used to initialize population trajectories, which were then projected forward in time through the 50-year permit term.

The modeled outcomes under each scenario (worse case and stable trend) provide important reference points for understanding the effects of the covered activities (powerline collisions and light attraction from streetlights and facility lights) on the covered seabirds, and the island-wide benefits of the minimization measures and the HCP conservation sites. The modeled scenarios for these two abundance trends can be viewed as plausible bounds of what may occur given different suites of assumptions and based on the best available data. Future abundance trends are likely to fall within the range of these two scenarios.

The worse-case scenario assumes a declining population at model initiation based on the estimated trend at one radar site (Hanalei) that showed the greatest decline since 1993 (Figure ES-8). The stable trend scenario assumes a stable population at model initiation based on radar data from 2010 through 2022 collected by the Kaua‘i Endangered Seabird Recovery Project. Two other datasets corroborate this stable trend: (1) powerline strike data collected by KIUC from 2013 through 2019 showing no significant trend in annual collisions, and (2) data from the SOS Program since 2012 on collected and rescued seabirds that also shows no significant trend. See Appendix 5D, *Population Dynamics Model for Newell’s Shearwater (‘a‘o) on Kaua‘i*, and Appendix 5E, *Population Dynamics Model for Hawaiian Petrel (‘ua‘u) on Kaua‘i*, for details on the two model scenarios.

This HCP demonstrates that the conservation strategy will fully offset KIUC’s impacts on Newell’s shearwater (‘a‘o) and Hawaiian petrel (‘ua‘u), and provide a net benefit for the species under both modeled scenarios. Most importantly, modeling demonstrates that the HCP conservation strategy will fully offset effects and provide a net benefit even under the worse-case scenario. This means that these standards will be met for any scenario that falls within the range of the two plausible bounds modeled through the worse-case scenario and the stable trend scenario.

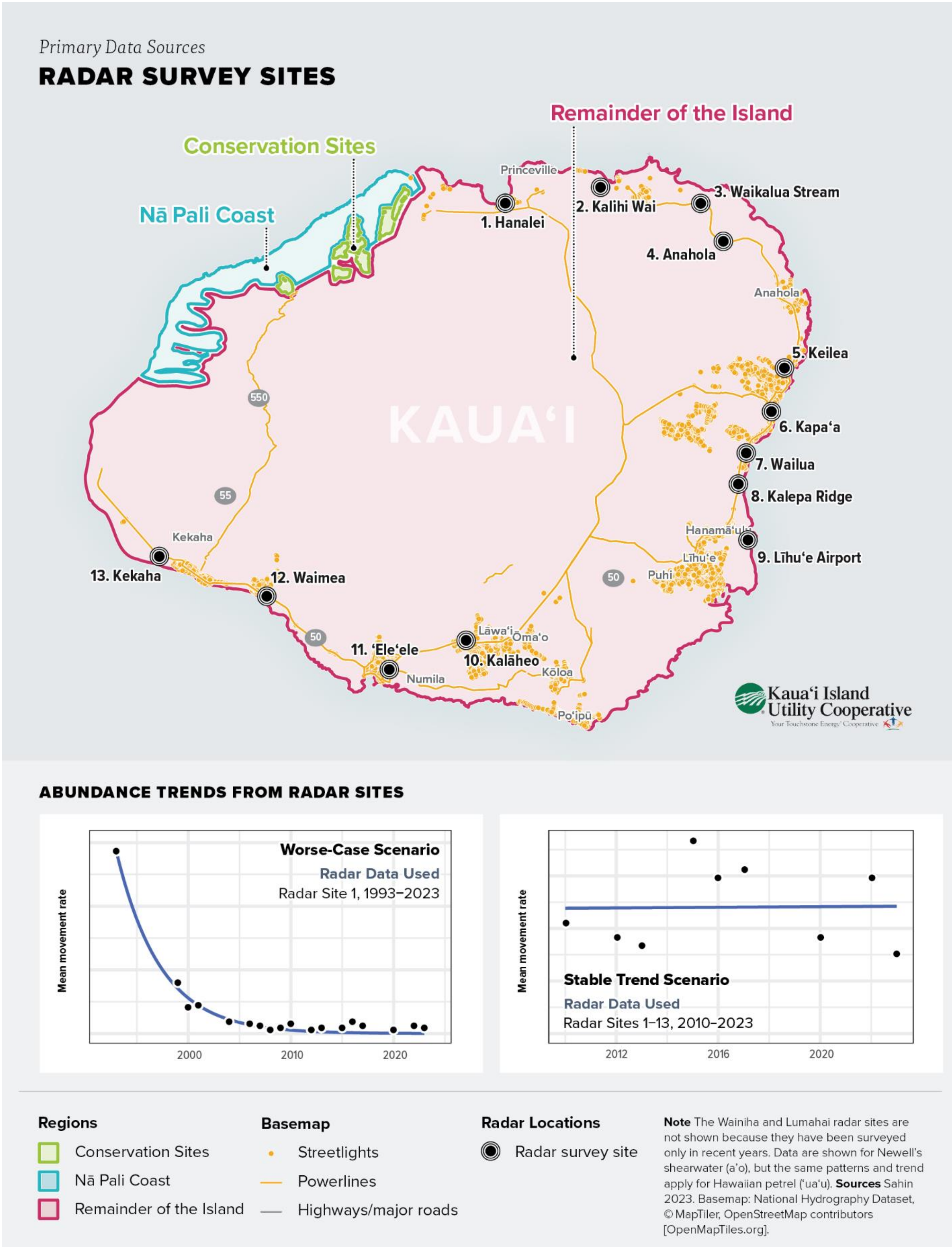

Figure ES-8. Radar Data Used for Abundance Trends Scenarios for Covered Seabirds

ES.6.1.2 Take Analysis: Methods

Powerlines

To quantify take of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) from powerlines, KIUC used acoustic monitors that record bird collisions at key locations, the data from which was fitted to a Bayesian model as described in Appendix 5C, *Bayesian Acoustic Strike Model*. While acoustic monitoring provides data on the number of birds colliding with lines, these data cannot provide information on the species colliding with the powerlines or the proportion of those collisions that result in injuries or mortality (Travers et al. 2021). Travers et al. (2021) therefore used observations of seabird powerline collisions to estimate the proportion of collisions by species and the post-collision outcomes (no observed injury, injury, and mortality). These estimated ratios for species, no observed injury, injury, and mortality are applied to the modeled strike rate. Through powerline minimization measures, KIUC has reduced annual strike estimates. The estimated take for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) is based on an assumed 66.4 percent reduction of covered seabird strikes as compared to strike rates before minimization. KIUC projected annual collisions over time as a function of changing abundance and powerline strike minimization (see Appendix 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*, and Appendix 5E, *Population Dynamics Model for Hawaiian Petrel (ʻuaʻu) on Kauaʻi*, for a detailed description of this step).

To estimate indirect take of eggs and chicks as a result of powerline collisions, KIUC assumed every breeding adult injury or mortality resulted in the loss of an egg or chick that breeding season. KIUC assumed 20 percent of powerline collisions consisted of breeding adults.

The requested take of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) is based on the stable trend scenario of the population dynamics model. This approach provides a take estimate consistent with powerline monitoring data since 2013 and with the radar data trends since 2010. It also avoids underestimating take of the covered species during HCP implementation and therefore reduces the risk of an HCP amendment early in implementation (see Chapter 5, Section 5.3.1.1, *Use of Population Dynamics Models*, for further explanation).

There have been no direct observations of band-rumped storm-petrel (ʻakēʻakē) colliding with powerlines (Travers et al. 2021) in over 10 years of powerline monitoring, and a realistic collision estimate cannot be determined. For this reason, take for this species was estimated independent of the population dynamics model.

Streetlights

To calculate take of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) from streetlights, KIUC assigned fallout documented by the SOS Program to streetlights based on the proportional contribution of those lights to the lightscape of Kauaʻi. The proportional assessment was developed using remotely sensed radiance (brightness) data collected by a sensor on the Suomi National Polar-Orbiting Partnership Satellite (Cao et al. 2020). The process used to estimate fledgling fallout due to streetlights is described in Appendix 5B, *Light Attraction Modeling for Covered Seabirds*. For the covered facilities, take was estimated using the average number of downed birds detected at each facility as documented in KIUC monitoring logs (Kauaʻi Island Utility Cooperative 2024) and the SOS database. The population dynamics model assumes 100 percent of Newell's shearwater (ʻaʻo) and

Hawaiian petrel (ʻuaʻu) fallout results in mortality even though a number of these species grounded by fallout are rescued, released, and rehabilitated each year.

Impacts on band-rumped storm-petrel (ʻakēʻakē) from light attraction are difficult to estimate. Fallout data for this species are limited, perhaps in part because it is a very small and cryptic seabird that is difficult to find once grounded. Take estimates for this species were created using the very limited data available.

Conservation Program

To estimate the take of covered seabirds as a result of management at the conservation sites, KIUC estimated annual rates of injuries and mortalities based on data from 2015 through 2024 at all of KIUC's conservation sites and projected these same historic rates forward for the 50-year permit term.

ES.6.1.3 Take Analysis: Results

Table ES-3 provides the requested take amount by unit of take for Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), and band-rumped storm-petrel (ʻakēʻakē). KIUC requests all forms of take (no observed injury, injury, mortality, indirect take of eggs and chicks) as outlined by the requested unit of take in Chapter 5, *Effects*. Take will be measured by unit of take during implementation. The rate of no observed injury, mortality, and indirect take of eggs and chicks cannot be measured and will be assumed constant unless future data indicate otherwise. Chapter 5, *Effects*, provides the estimated breakdown for each species in terms of no observed injury, injury, mortality, and indirect take of eggs and chicks that was incorporated into the population dynamics model. The following sections summarize effects on each of the covered seabirds.

Table ES-3. Covered Seabirds and Requested Take and Estimated Amount by Source of Take

	Type of Take	Unit of Take	Average Annual Take by Unit of Take	Requested Take by Unit of Take (50 years)	Percent of Total Take for the Species
Newell's shearwater ('a'o)	Existing powerlines	Powerline strikes	6,207	310,375	94%
	New powerlines	Powerline strikes	278	13,897	4%
	Existing streetlights	Fallout	70	3,479	1%
	New streetlights	Fallout	21	1,066	<1%
	Facilities	Fallout	14	676	<1%
	Conservation program	Conservation site management	5	272	<1%
	Total		**6,595**	**329,765**	**100%**
Hawaiian petrel ('ua'u)	Existing powerlines	Powerline strikes	2,357	117,853	95%
	New powerlines	Powerline strikes	101	5,073	4%
	Existing streetlights	Fallout	4	208	<1%
	New streetlights	Fallout	1	62	<1%
	Facilities	Fallout	<1	16	<1%
	Conservation Program	Conservation site management	15	755	<1%
	Total		**2,479**	**123,967**	**100%**
Band-rumped storm-petrel ('akē'akē),	Existing powerlines	Powerline strikes	<1	18	23%
	New powerlines	Powerline strikes	<1	7	9%
	Existing streetlights	Fallout	<1	36	53%
	New streetlights	Fallout	<1	10	15%
	Facilities	Fallout	0	0	0%
	Conservation Program	Conservation site management	0	0	0%
	Total		**1**	**71**	**100%**

ES.6.1.4 Effects Assessment

As required under the federal and state ESAs, this HCP evaluates the *impacts* of the taking on each covered seabird species' long-term survival and likelihood of recovery. This HCP also assesses the benefits of the conservation measures described in Chapter 4, *Conservation Strategy,* and evaluates these benefits in combination with the impacts of the taking to ascertain the net effects of the HCP on each species. For this purpose, a set of hypothetical comparisons were modeled through the population dynamics model for Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u) to isolate selected variables. Table ES-4, and Figures ES-9 through ES-12 provide the modeled outcomes for each comparison under the stable trend and worse-case scenarios. The following sections summarize how the hypothetical modeled outcomes from each comparison were used to assess adverse, beneficial, and net effects on the species.

Table ES-4. Comparisons Used for Effects Analysis for Newell's Shearwater (ʻaʻo) and Hawaiian Petrel (ʻuaʻu)

Comparison Name	Description	Purposes of Comparison in Effects Analysis
HCP (blue line in figures below)	HCP as proposed, with proposed take and proposed measures to offset take and provide net benefit.	• Assess Benefits of Conservation by comparing with *Proposed Take with Minimization Only* (i.e., comparing modeled outcomes with and without measures to offset take and result in net benefit to species). • Assess Net Effects of the HCP (effects of proposed take and conservation) by comparing with modeled outcomes under *No-Take* (i.e., comparing modeled outcomes with the HCP vs. hypothetical scenario in which there is no take and no conservation).
Proposed Take after Minimization Only (grey line in figures below)	Includes proposed minimized take but excludes measures to offset take or provide net benefit.	• Assess Benefits of Conservation by comparing to *HCP*. • Assess Benefits of Powerline Minimization by comparing with modeled abundance trends under *Take with No Minimization or Conservation* (i.e., comparing modeled outcomes with and without powerline minimization). • Assess Impact of the Take Prior to Mitigation by comparing with modeled abundance trends under *No-Take* (i.e., comparing modeled outcomes with and without take, absent measures to offset take).
Take with no Minimization or Conservation (red line in figures below)	Includes take but excludes the HCP's measures to minimize take, offset take, or provide net benefits to the species.	• Assess Benefits of Powerline Minimization by comparing with modeled abundance trends under *Proposed Take with Minimization Only*.
No Take/ No HCP (purple line in figures below)	Hypothetical situation in which all KIUC powerlines are removed and all KIUC streetlights and covered facility lights are turned off permanently. Excludes all measures to offset take or result in net benefit to the species.	• Assess Net Effects of the HCP (Proposed Take and Conservation). Compare to *HCP.* • Assess Impact of the Take Prior to Mitigation. Compare to *Proposed Take with Minimization Only*.

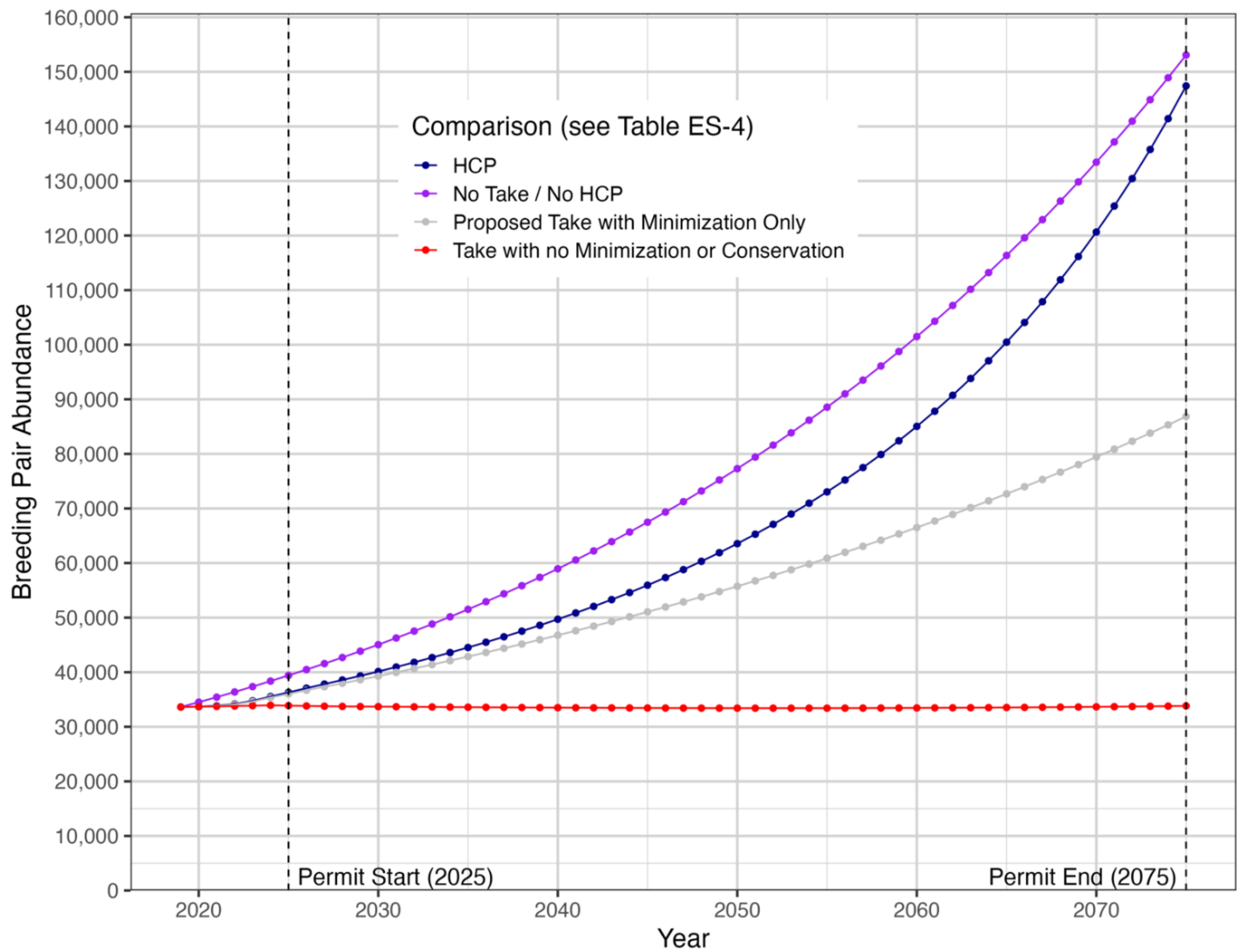

Figure ES-9. Newell's shearwater (ʻaʻo) Modeled Outcome Comparisons on Kauaʻi, Stable Trend Scenario

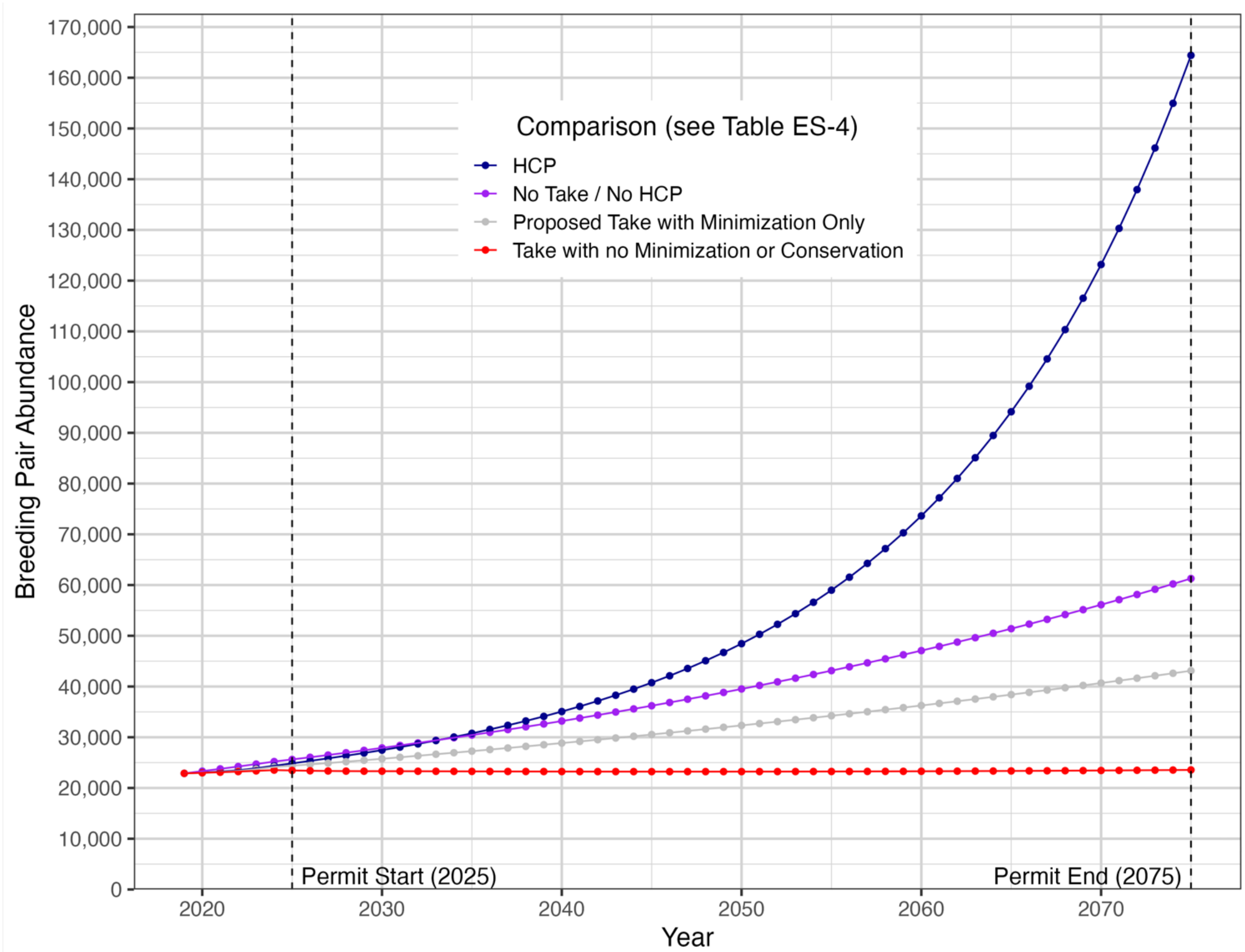

Figure ES-10. Hawaiian petrel (ʻuaʻu) Modeled Outcome Comparisons on Kauaʻi, Stable Trend Scenario

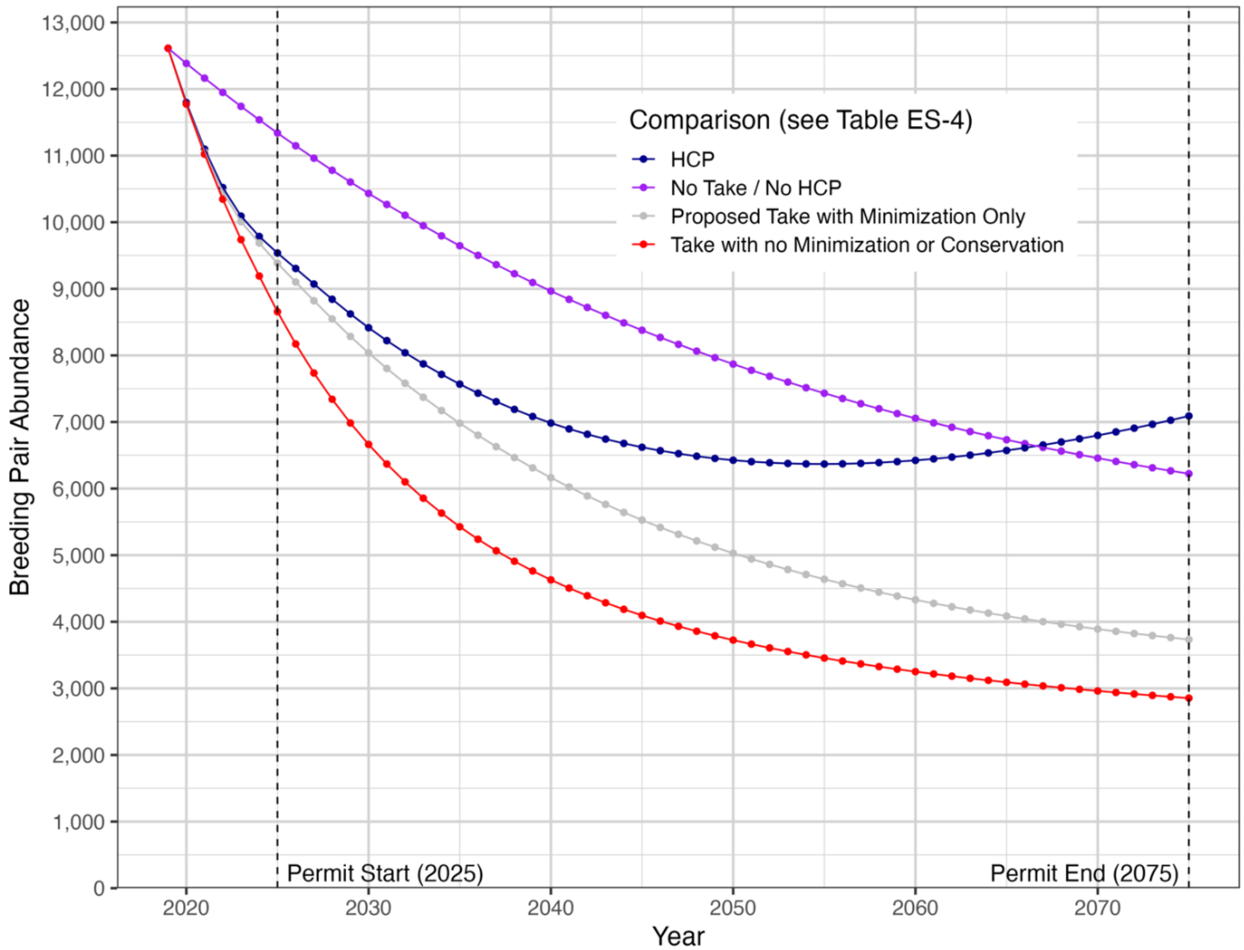

Figure ES-11. Newell's shearwater (ʻaʻo) Modeled Outcome Comparisons on Kauaʻi, Worse-Case Scenario

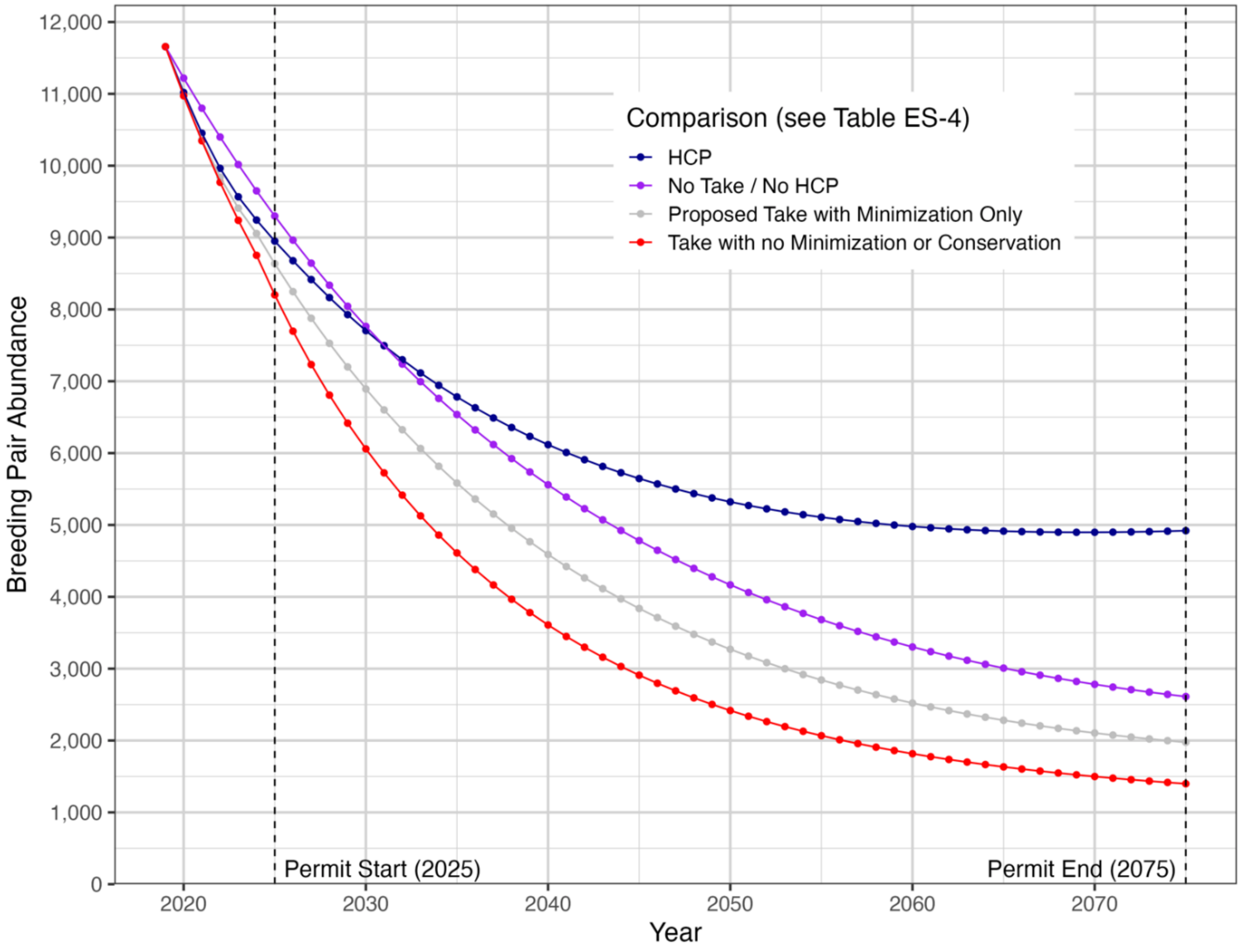

Figure ES-12. Hawaiian petrel (ʻuaʻu) Modeled Outcome Comparisons on Kauaʻi, Worse-Case Scenario

Impact of the Taking

Newell's Shearwater (ʻaʻo) and Hawaiian Petrel (ʻuaʻu)

To evaluate the impacts of the taking on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), KIUC compared hypothetical modeled outcomes with no take (purple lines on Figures ES-9 through ES-12) against the modeled outcomes with the proposed take (grey lines on Figures ES-9 though ES-12). These comparisons were made under each scenario, as described below.

Stable Trend Scenario

Under the stable trend scenario for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), as shown by the purple lines on Figures ES-9 and ES-10, under the hypothetical outcomes with no KIUC take and no KIUC conservation measures during the permit term, the Kauaʻi metapopulation would increase substantially over the 50-year permit term. As shown by the grey line on Figures ES-9 and ES-10, even with minimization, ongoing take of Newell's shearwaters (ʻaʻo) and Hawaiian petrel (ʻuaʻu) as a result of KIUC covered activities could have an appreciable negative effect on the Kauaʻi metapopulations of these species by slowing species recovery over the 50-year analysis period, in the absence of mitigation measures to offset these effects.

Worse-Case Scenario

Under the worse-case scenario for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), as shown by the purple lines on Figures ES-11 and ES-12, in the hypothetical absence of KIUC take or KIUC conservation during the permit term, the Kauaʻi metapopulation would continue to decline. This assessment shows that under the worse-case scenario, the effects of predation and other threats to the species are substantial even without the adverse effects of KIUC's covered activities. As shown by the grey line on Figures ES-11 and ES-12 even with minimization, the continued loss of Newell's shearwaters (ʻaʻo) and Hawaiian petrel (ʻuaʻu) as a result of KIUC covered activities could have an appreciable negative effect on the Kauaʻi metapopulations of these species in the absence of mitigation measures to offset these effects.

Band-Rumped Storm-Petrel (ʻakēʻakē)

The take request for band-rumped storm-petrels (ʻakēʻakē) is 71 individuals over the 50-year permit term (an average of approximately 1.4 birds per year). The worldwide population size of the band-rumped storm-petrel (ʻakēʻakē) is uncertain, but has been estimated to be around 150,000 birds (Appendix 3A, Species Accounts). The Hawaiʻi DPS of the band-rumped storm-petrel (ʻakēʻakē) represents a small, remnant population, and Kauaʻi breeding pairs were estimated to be 171–221 in 2002, while in the mid-2010s there were an estimated 250 breeding pairs. Given what is known about this species and KIUC's impact on the species, the take request is not likely to have an appreciable effect on the survival and recovery of the Hawaiʻi DPS of band-rumped storm-petrel (ʻakēʻakē).

Beneficial and Net Effects

Newell's Shearwater (ʻaʻo) and Hawaiian Petrel (ʻuaʻu)

To evaluate the beneficial effects of powerline minimization on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), KIUC compared hypothetical modeled outcomes with unminimized take (red lines in Figures ES-9 through ES-12) against modeled outcomes with the proposed (minimized) take (grey lines in Figures ES-9 through ES-12). To evaluate the beneficial effects of the conservation strategy (minimization and mitigation) on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), KIUC compared the hypothetical modeled outcomes with proposed take and no measures to offset take (grey lines in Figures ES-9 through ES-12) with modeled outcomes under full implementation of the HCP (dark blue lines in Figures ES-9 through ES-12). To evaluate the net effects of the HCP, considering the minimized take and the measures to offset that take, KIUC compared the hypothetical modeled outcome of no take (purple lines in Figures ES-9 through ES-12) against modeled outcomes with full implementation of the HCP (dark blue lines in Figures ES-9 through ES-12).

Stable Trend Scenario

As shown by comparing the red and grey lines on Figures ES-9 and ES-10, the proposed minimization measures result in substantial metapopulation increases for both species under the stable trend scenario. Measures to offset take substantially improve modeled outcomes. As shown by comparing the red and dark blue lines on Figures ES-9 and ES-10, the metapopulation sizes at the end of the 50-year permit term are substantially greater for both species under the HCP than under the hypothetical outcome for unminimized take, demonstrating the beneficial effects of the conservation strategy. For the stable trend scenario, the population growth rate with the HCP (dark blue lines in Figures ES-9 and ES-10) exceeds the population growth rate without the HCP (purple lines in Figures ES-9 and ES-10) for both species.

Worse-Case Scenario

As shown by comparing the red and grey lines on Figures ES-11 and ES-12, the proposed minimization measures result in substantially reduced levels of metapopulation decline for both species under the worse-case scenario. In the absence of conservation measures to offset impacts, however, the metapopulations continue to decline for both species.

Proposed conservation measures will reverse downward metapopulation trends under the worse-case scenario. As shown by comparing the red and dark blue lines on Figures ES-11 and ES-12, the metapopulation sizes at the end of the 50-year permit term are substantially greater for both species under the HCP scenario than under the unminimized take scenario, demonstrating the beneficial effects of the conservation strategy.

Under the worse-case scenario, the HCP results in a net benefit to the Kauaʻi metapopulation for both Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) by the end of the permit term. Comparing the purple line with the dark blue line on Figures ES-11 and ES-12, this net benefit is realized by approximately 2056 for Newell's shearwater (ʻaʻo) and 2032 for Hawaiian petrel (ʻuaʻu).

In summary, even under the worse-case scenario the HCP fully offsets the impacts of the taking and provides a net benefit to Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) by resulting in the following:

1. Reversing the decline of the Kauaʻi metapopulation (under the worse-case scenario) and creating a consistently growing metapopulation.
2. Increasing metapopulation abundance for at least 18 years of the permit term.
3. The Kauaʻi metapopulation does not fall below the threshold of 2,500 breeding pairs set by USFWS and DOFAW as the minimum viable metapopulation size, at any time during the permit term.
4. By the end of the permit term, the Kauaʻi metapopulation is growing steadily, greatly increasing metapopulation viability. Metapopulation viability is discussed in more detail in Chapter 5, Section 5.3.2.4, *Beneficial Effects and Net Effects*, in the subsection titled *Metapopulation Viability*.

Band-Rumped Storm-Petrel (ʻakēʻakē)

KIUC's funding of the SOS Program is expected to minimize and partially offset effects of powerline strikes and streetlights for band-rumped storm-petrel (ʻakēʻakē). Based on SOS data from 2009 through 2024, an estimated 31 band-rumped storm-petrels (ʻakēʻakē) will be rescued and released over the 50-year permit term, minimizing, and partially offsetting the take of 71 band-rumped storm-petrels (ʻakēʻakē) from KIUC covered activities conservatively estimated for this species over the permit term (see Chapter 5, Section 5.3.4, *Requested Take and Effects on Band-Rumped Storm-Petrel (ʻakēʻakē)*, for more details). The species is also likely to benefit from predator control at the Honopū conservation site because of its proximity to the Nā Pali Coast, where most band-rumped storm-petrels (ʻakēʻakē) are thought to occur on Kauaʻi. Another benefit to this species takes place at the Honopū PF site, where social attraction for this species is implemented. Barn owl control at all conservation sites is likely to benefit band-rumped storm-petrel (ʻakēʻakē) by reducing presence of barn owls and risk of predation from these wide-ranging predators. KIUC expects funding of the SOS Program, in addition to the conservation measures for the other two covered seabird species, are sufficient to offset the impact of the taking on band-rumped storm-petrel ('akē'akē). Considering both the take associated with KIUC activities and the effects of SOS recoveries and regional predator control, the KIUC HCP will have a net benefit to band-rumped storm-petrels ('akē'akē) on Kaua'i.

ES.6.2 Effects on Covered Waterbirds

The covered waterbirds are susceptible to powerline strikes but not susceptible to light attraction, so the analysis focuses on estimating the effects of powerline strikes. For two of the waterbird species, Hawaiian goose (nēnē) and Hawaiian duck (koloa maoli), there is also a risk of take from conservation site management which is included in the analysis for those two species.

ES.6.2.1 Take Analysis: Methods and Results

The effects analysis for covered waterbirds is based on powerline monitoring data and an assessment provided by Marc Travers and André Raine in 2020, updated to include data through the end of 2024 (in litt.). A combination of acoustic data of recorded strikes and observations of waterbird behavior around powerlines were used to estimate powerline collisions for three of the covered waterbirds: Hawaiian stilt (ae'o), Hawaiian duck (koloa maoli), and Hawaiian goose (nēnē). Observational and acoustic data were not available for Hawaiian common gallinule ('alae 'ula) or Hawaiian coot ('alae ke'oke'o), so strike estimates were developed for these species using grounded birds detected from 2011 through 2024. The resulting take estimates for the 50-year permit term are summarized in Table ES-5. KIUC requests take of the covered waterbirds associated with 37 percent of all KIUC powerline collisions along powerline spans in Mānā (spans 1–113) and Hanalei (spans 462–478 and 1297–1328) during the permit term.

To estimate the take of covered waterbirds as a result of management at the conservation sites, KIUC evaluated conservation site data from 2015 through 2024 and determined the species at risk to be Hawaiian goose (nēnē) and Hawaiian duck (koloa maoli). Based on this same data, KIUC estimates that take will be limited to 10 individuals for each species over the 50-year permit term, or less than one individual per year.

Table ES-5. Summary of Take Request on Covered Waterbirds from Powerline Strikes and Conservation Site Management

Covered Species	Estimated Annual Take	50-Year Take Request[a]	50-Year Projected SOS Rehabilitation[a]
Hawaiian stilt (ae'o)	1	53	85
Hawaiian duck (koloa maoli)	10	490	638
Hawaiian coot ('alae ke'oke'o)	2	107	173
Hawaiian common gallinule ('alae 'ula)	2	107	135
Hawaiian goose (nēnē)[f]	25	1,236	1,558

[a] See Table 5-13a, Table 5-13b, and their footnotes for explanations as to how these numbers were calculated.

ES.6.2.2 Effects Assessment

KIUC's funding of the SOS Program's rescue and recovery efforts for the covered waterbirds will minimize take from powerline strikes and conservation site management. In addition, KIUC's funding for the SOS Program is expected to fully offset take and provide a net benefit through the rescue, recovery, and release of waterbirds back into the wild that are affected by factors unrelated to KIUC's covered activities (e.g., disease, dog attacks, vehicle collisions). Rescuing, treating, and releasing covered waterbirds in this situation contributes to the species recovery by increasing their survival and reproduction. The final column in Table ES-5 provides the projected 50-year total of recoveries based on the annual average number of individuals of each covered waterbird species recovered or released from the SOS Program from 2012 through 2024 (the period representing consistent waterbird data collection). As shown in Table ES-5, the number of recoveries exceeds the number of take for all the covered waterbird species by 28–322 individuals (26–62 percent). As long-term trends (1986–2023) indicate that these species are stable or increasing on Kaua'i despite ongoing loss resulting from powerline collisions during this same time period, the proposed take is not expected to adversely affect the survival or recovery of the species on Kaua'i. In addition, KIUC's funding of SOS recoveries is expected to provide a net benefit for each of the covered waterbird species, as described above.

ES.6.3 Effects on Green Sea Turtle (honu)

Adverse effects of lights on green sea turtle (honu) hatchlings are well documented throughout the species' range, where hatchlings become disoriented by lights and die from dehydration, predation, or vehicle collisions. Green sea turtles (honu) have been documented to be vulnerable to these effects from KIUC streetlights located in close proximity to suitable green sea turtle (honu) nesting habitat.

ES.6.3.1 Take Analysis: Methods and Results

KIUC, in coordination with USFWS, conducted a field evaluation in 2020 to assess the extent to which KIUC streetlights might affect green sea turtles (honu), and to evaluate which beaches have suitable habitat and KIUC streetlights that are visible from the beach. Seven beaches were determined to have streetlights that were visible from potentially suitable green sea turtle (honu) nesting habitat at the time of the evaluation.

Based on a low average annual nesting density of green sea turtles (honu) at all Kaua'i beaches and presumed efficacy of the minimization measures described in Chapter 4, Section 4.4, Conservation Measures, KIUC assumes that with the monitoring and minimization measures, most take resulting from KIUC streetlights will be avoided. KIUC requests take of 50 green sea turtle (honu) nests over the 50-year permit term, which is equivalent to an average of one nest every year. Take of any type (disorientation, injury, or mortality) of any hatchlings in a nest will count as take of that nest. This requested take accounts for the possibility of green sea turtle (honu) nests going undetected by monitors and therefore not being shielded from a KIUC streetlight. Alternatively, shielding may be ineffective at some nest sites due to incorrect placement or vandalism, in which case hatchlings may be affected by KIUC streetlights. The take estimates for the 50-year permit term are provided in Table ES-6.

Table ES-6. Summary of Take Request of Green Sea Turtle (honu) Nests from Light Attraction

Covered Species	50-Year Take Request	50-Year Mitigation
Green sea turtle (honu)	50 nests	Shielding of ~3 times more nests than would be affected by KIUC streetlights

ES.6.3.2 Effects Assessment

The estimated number of female green sea turtles (honu) that nest in the Plan Area is only 0.39 percent of the total breeding females estimated for the entire Central North Pacific DPS of green sea turtle (honu) (Seminoff et al. 2015). Of 20 nesting sites documented on Kauaʻi, all but two were described as having intermittent or indeterminate use (Parker and Balazs 2015). The loss of up to 50 nests over a 50-year period resulting from KIUC streetlights, where most or all of the take is expected to consist of small fraction of the hatchlings in each nest, is not expected to adversely affect the population or appreciably reduce the likelihood of the species' survival and recovery in the wild.

The green sea turtle (honu) monitoring and minimization measures will not only minimize take resulting from KIUC streetlights (possibly to zero) but is also expected to shield nests exposed to other (non-KIUC) light sources. On five of the seven beaches identified in KIUC's 2020 streetlight assessment, most of the light is from sources other than KIUC streetlights, including residential buildings, commercial buildings (e.g., restaurants, resorts, shopping centers), and beach infrastructure (e.g., restrooms, parking lot lighting, walking path lighting). As described in Chapter 5, *Effects*, KIUC's nest shielding program will shield any nests on approximately 4.4 mi (7.1 km) of beaches. Of these 4.4 mi (7.1 km), 3.9 mi (6.3 km; 74 percent) of beaches have the potential for light attraction from non-KIUC sources. Assuming an even distribution of nests on these beaches, this will result in the shielding of approximately three times more green sea turtle (honu) nests affected by non-KIUC light sources than those affected by KIUC light sources. As such, the take of hatchlings in up to 50 nests over 50 years is expected to be fully offset through the reduction of take from non-KIUC light sources. The nest shielding program is also expected to provide a net conservation benefit to green sea turtle (honu) because over the 50-year permit term KIUC will be shielding approximately three times more nests than would be affected by their own streetlights.

ES.7 Monitoring and Adaptive Management

Chapter 6, *Monitoring and Adaptive Management Program*, of the KIUC HCP describes the monitoring and adaptive management program. The purposes of this program are as follows:

- To ensure that KIUC remains in compliance with the HCP, the federal ITP, and the state ITL.
- To ensure that take of the covered species does not exceed the maximum limits set by the federal ITP and state ITL.
- To evaluate the effectiveness of the conservation measures (Chapter 4, *Conservation Strategy*) on an ongoing basis and identify when adaptive management must be applied to improve their effectiveness.

For compliance monitoring KIUC has included in Chapter 6, *Monitoring and Adaptive Management Program*, a compliance schedule and adaptive management triggers and responses for all relevant compliance monitoring actions (see Table 6-2 in Chapter 6). Compliance monitoring and adaptive management will allow KIUC to document that all the requirements of the HCP are being met and will allow USFWS and DOFAW[4] to determine, using the success metrics in Table 6-2, whether the HCP is on track both in terms of scope and schedule.

[4] And DAR, when green sea turtle (honu) is involved.

The take monitoring under the KIUC HCP compares the actual take that occurs during implementation to ensure KIUC does not exceed the 50-year take limit authorized by the federal ITP and state ITL. Table 6-3 describes triggers for adaptive management responses if take levels are higher than expected based on 5-year rolling averages of take during HCP implementation.

Chapter 6, *Monitoring and Adaptive Management Program*, of the KIUC HCP also includes monitoring and adaptive management triggers and responses to ensure the effectiveness of the HCP's conservation measures. DOFAW, USFWS, the Endangered Species Recovery Committee (ESRC), and DAR (specific to the green sea turtle [honu]) will participate in the review of annual reports and make recommendations for adaptive management decisions. KIUC will have discretion over day-to-day adjustments to the conservation strategy that do not rise to the level of adaptive management as detailed in Chapter 6. Table 6-3 of the HCP includes monitoring strategies, metrics of success, adaptive management triggers, and adaptive management responses for all the HCP's conservation measures.

ES.8 Plan Implementation

Chapter 7, *Plan Implementation*, of the KIUC HCP describes how KIUC will implement the HCP. The chapter describes the following topics.

- Implementation responsibilities of KIUC, USFWS, and DOFAW (Section 7.2, *Implementation Responsibilities*).
- Regulatory assurances requested for this HCP under the federal ESA and HRS (Section 7.3, *Regulatory Assurances*).
- Estimated costs of HCP implementation (Section 7.4, *Costs of KIUC HCP Implementation*) and funding assurances (Section 7.5, *Funding Assurances*).
- The process to revise or amend the HCP during implementation (Section 7.6, *Revisions and Amendments*).
- Requirements for annual reporting to USFWS and DOFAW (Section 7.7, *Reporting*).

ES.8.1 Implementation Responsibilities

KIUC is responsible for implementing the conservation strategy as described in the HCP. USFWS, DOFAW, ESRC, and DAR (specific to the green sea turtle [honu]) will have the responsibility during HCP implementation for reviewing annual reports submitted by KIUC for completeness and compliance; determining whether KIUC is making progress towards achieving the biological goals and objectives and implementing all applicable requirements of the HCP; and making recommendations to KIUC regarding adaptive management changes according to the adaptive management process described in Chapter 6, *Monitoring and Adaptive Management Program*. DOFAW will be responsible for providing HCP Annual Reports submitted by KIUC to the ESRC for their review and recommendations for adaptive management, considering recommendations from the ESRC regarding adaptive management or other changes to the HCP to improve its effectiveness, and coordinating with USFWS and KIUC regarding these recommendations.

ES.8.2 Regulatory Assurances

No Surprises assurances are provided by the federal ESA through the "No Surprises" rule (50 Code of Federal Regulations [CFR] Section 17.22.32). This rule provides assurances to ITP holders that USFWS will not require the commitment of additional land, water, or financial compensation; or additional restrictions on the use of land, water, or other natural resources beyond the level otherwise agreed to in the HCP without the consent of the permittee. The HRS provides for regulatory "incentives" in Section 195D-23 that are similar to the regulatory assurances provided by the federal ESA. The State cannot, in order to protect a threatened or endangered species, "impose additional requirements or conditions, or modify any existing requirements or conditions to mitigate or compensate for changes in the conditions or circumstances of any species or ecosystem, natural community, or habitat covered by the [HCP]." Allowable exceptions are described in Chapter 7, Section 7.3, *Regulatory Assurances.*

Consistent with the No Surprises regulations, the KIUC HCP identifies and analyzes reasonably foreseeable changed circumstances that could affect a species or geographic area during its term (50 CFR Section 17.3). Changed circumstances addressed in the HCP include effects of severe weather, natural hazards, and climate change, new invasive species, disease outbreaks in the covered species, vandalism, and population declines due to issues at sea. Should one or more of the changed circumstances described in the HCP occur, KIUC is required to implement the measures specified in Section 7.3.3, *Changed Circumstances Addressed by this HCP*, to respond to the changes. KIUC is not required to implement remedial actions for any unforeseen circumstances, which are also defined in the same section.

ES.8.3 Costs and Funding

The cost to implement the KIUC HCP is summarized in Table ES-7.

Table ES-7. Summary of Estimated Costs to Implement the KIUC HCP

Cost categories	Average annual cost	50-year total HCP cost (2025–2075)[a]	Percentage of 50-year total HCP cost
Plan Administration	$435,685	$21,784,266	5.1%
Powerline Collision Minimization	$2,048,769	$102,438,469	23.8%
Save Our Shearwaters Program	$300,000	$15,000,000	3.5%
Manage and Enhance Conservation Sites	$2,442,480	$122,123,979	28.3%
Green Sea Turtle (honu) Nest Detection and Shielding Program	$166,913	$8,345,650	1.9%
Infrastructure Monitoring and Minimization Program	$1,169,795	$58,489,770	13.6%
Seabird Colony Monitoring Program	$1,088,034	$54,401,693	12.6%
State Compliance Monitoring	$52,708	$2,635,405	0.6%
Changed Circumstances	$433,510	$21,675,483	5.0%
Adaptive Management	$318,974	$15,948,699	3.7%
Contingency	$163,795	$8,189,736	1.9%
Total	**$8,620,663**	**$431,033,150**	**100.0%**

[a] Costs are expressed in 2024 dollars.

KIUC has the financial capacity and commits to fully fund all costs to implement the KIUC HCP. A summary of the estimated cost to implement the HCP is in Table ES-7. To ensure funding for adaptive management and for remedial measures should they be needed to address changed circumstances, KIUC will secure a letter of credit in an amount sufficient to fund a reasonable proportion of expected adaptive management or remedial actions in any one year, as described in Chapter 7, Section 7.5, *Funding Assurances*. Costs for implementation of the KIUC HCP are part of KIUC's operational costs, which will be passed on to all KIUC ratepayers. KIUC's costs for implementation of the KIUC HCP are anticipated to be fully covered by its revenues received, electricity rates charged, and debt financing.

KIUC has demonstrated its ability to fund HCP implementation since 2011. Since 2016, KIUC has continued to implement many of the same conservation measures in the Short-Term HCP that are now part of this HCP. In addition, KIUC has implemented many powerline collision minimization projects during both the Short-Term HCP and afterwards, as early implementation actions for this HCP. This track record of funding many of the same conservation actions since 2016 provides assurances to USFWS and DOFAW that KIUC will be able to fully fund HCP implementation.

ES.8.4 Revisions and Amendments

There are two types of changes that may be made to the HCP: minor modifications or major amendments. Minor modifications are changes to the HCP provided for under the operating conservation program, including adaptive management changes and responses to changed circumstances. Minor modifications also include changes that do not increase the levels of authorized incidental take or do not materially modify the scope or nature of effects on the covered species from activities or actions covered by the federal ITP and state ITL. USFWS and DOFAW will confirm receipt of any modification request and will notify KIUC acknowledging the minor modification or determining if such modification request constitutes a major amendment.

Major amendments are changes in the HCP that may affect the impact analysis or conservation strategy. Amendments to the HCP and either the federal ITP or state ITL follow the same formal application and review process as the original HCP and permits, including National Environmental Policy Act/Hawai‘i Environmental Protection Act[5] review, *Federal Register* notices, an internal Section 7 consultation by USFWS, and review and recommendation by the ESRC and action by the BLNR.

ES.8.5 Reporting

KIUC will prepare an annual report for each year of the 50-year permit term of the KIUC HCP. The annual reports will summarize implementation activities in the previous calendar year (January 1 to December 31) as well as cumulatively over the permit term. KIUC will submit each annual report following the reporting year in order to comply with the reporting deadline established by the Hawai‘i ESA.[6]

Following each calendar year, KIUC's contractors will submit to KIUC technical reports that summarize their activities in the previous calendar year. Once all of the technical reports are

[5] HRS Chapter 343.

[6] HRS Section 195D-21(f) requires HCP permittees to submit an annual report within 90 days of each fiscal year ending June 30.

available (usually in the spring of each year), KIUC will prepare an annual report and submit it to USFWS and DOFAW by a target date of July 1 of each year, but no later than September 28 as required by the Hawaiʻi ESA. The information required in each annual report is provided in Section 7.7.1, *Annual Reporting*.

KIUC is also responsible for reporting specific situations that may arise outside of the annual reporting cycle, and to coordinate with USFWS and DOFAW regarding this information. These reporting and coordination requirements are described in Section 7.7.2, *Other Reporting and Coordination*.

Chapter 1
Introduction and Background

Chapter 1 Highlights

Chapter Purpose: This chapter introduces the applicant and provides background for the HCP, the scope of the HCP, the regulatory basis for the HCP, and the process of developing this HCP. This chapter also introduces the organization of the document.

Context: This chapter establishes the context for the entire HCP.

Major Conclusions:	See the following for more information:
• **Applicant.** KIUC, the applicant, is a not-for-profit, cooperative association that provides electrical service on Kauaʻi.	
• **Background.** Various seabirds, waterbirds, and the green sea turtle listed under the federal Endangered Species Act (ESA) and Hawaiʻi ESA are known to collide with powerlines or be attracted to or disoriented by lights. This HCP is necessary for KIUC to operate their electrical system, streetlights, and facility lights in compliance with the federal ESA and Hawaiʻi ESA.	Section 1.1
• **Related HCPs.** In 2011, USFWS approved KIUC's *Short-Term Seabird Habitat Conservation Plan* for 5 years.	Section 1.2
• **Scope of the KIUC HCP.** The *Plan Area* is the Island of Kauaʻi. The *Permit Area* is where the federal permit and state license apply. Nine species are proposed for coverage in this HCP, called *covered species*. *Covered activities* include the continued and future operation and modification of KIUC's powerlines, the operation of all KIUC-owned streetlights, and lights at two KIUC facilities. The conservation measures are also covered activities. KIUC is applying for a federal permit and state license for 50-year terms.	Section 1.3, Figure 1-1, Table 1-1
• **Regulatory Context.** Section 9 of the federal ESA prohibits the take of endangered or threatened wildlife species without authorization. Section 10 of the federal ESA establishes a process for non-federal entities to obtain authorization to incidentally take federal ESA-listed species with an approved HCP. KIUC is applying to USFWS for this authorization. Hawaiʻi Revised Statutes Chapter 195D is the state's ESA, which also requires an HCP for an incidental take license. KIUC is applying to the Hawaiʻi Department of Land and Natural Resources, Division of Forestry and Wildlife for this license.	Sections 1.1.2 and 1.4
• **HCP Process.** The process for obtaining federal and state incidental take authorization has three phases: (1) the HCP development phase; (2) the permit application processing phase; and (3) the implementation phase, after permit issuance.	Section 1.5
• **Organization of the HCP.** The HCP consists of 10 chapters and 22 appendices. Subsequent chapters present the *Covered Activities, Environmental Setting, Conservation Strategy, Effects, Monitoring and Adaptive Management, Plan Implementation, Alternatives to Take, References,* and *Glossary of Terms*.	Section 1.6
• **Data Sources:** State and federal regulations, laws, and statutes pertaining to endangered or threatened species.	

1.1 Overview and Background

1.1.1 Applicant: Kauaʻi Island Utility Cooperative

The Kauaʻi Island Utility Cooperative (KIUC) is a not-for-profit, tax-exempt cooperative association governed by a publicly elected nine-member Board of Directors.[1] As a public utility responsible for the production, purchase, transmission, distribution, and sale of electricity on the Island of Kauaʻi (Kauaʻi), KIUC is regulated by the State of Hawaiʻi (State) Public Utility Commission, and is required by law to provide and ensure the availability of electrical service on Kauaʻi. KIUC is entirely owned by its members, which total approximately 34,000 ratepayers.

To ensure reliable electrical service to Kauaʻi, KIUC owns and operates a variety of electrical utility installations. These installations include fossil-fuel-fired, hydroelectric, and solar generating facilities, electric substations and switchyards, and electric transmission and distribution lines. KIUC also purchases power from several independent power producers and transmits power that it obtains from these sources through its electrical transmission system.

1.1.2 Need for the KIUC Habitat Conservation Plan

KIUCʻs electrical transmission and distribution system is largely above ground and consists of wires supported by poles or towers that extend from 25 to more than 100 feet above ground. Three species of seabirds listed under the federal Endangered Species Act (federal ESA) are known to collide with these powerlines. Such collisions often result in injury or mortality of the affected birds. In addition to powerline collisions, lights at KIUC facilities and KIUC streetlights are known to attract and/or disorient listed seabirds, particularly fledglings making their first flights to sea. Birds that become disoriented by these lights can exhaust themselves by flying around the lighted areas before eventually landing on the ground (commonly referred to as *fallout*). Due to their physiology, these birds have difficulty regaining flight, so without intervention, they either succumb to starvation or dehydration, or are killed by invasive predators or vehicles.

The take of species (see Chapter 10, *Glossary of Terms*) protected by the federal ESA and its state law equivalent, Hawaiʻi Revised Statutes (HRS) Chapter 195D, incidental to otherwise lawful activities, is prohibited unless authorized via an incidental take permit (federal ITP) issued by the U.S. Fish and Wildlife Service (USFWS) and an incidental take license (state ITL) issued by the State of Hawaiʻi Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) (hereafter DOFAW), respectively. This permit and license are referred to collectively as the *permits*. Applications for a federal ITP and state ITL are supported by a habitat conservation plan (HCP) that describes, among other things, the anticipated effects of the proposed taking on listed species; how those effects on the affected species will be avoided, minimized, and mitigated; and how the HCP will be funded.

In May 2011, USFWS approved KIUC's *Short-Term Seabird Habitat Conservation Plan* (Short-Term HCP) for a period of 5 years. The Short-Term HCP addresses the following federal and state-listed seabirds which are known to be adversely affected by KIUC facilities.

- Newell's shearwater (ʻaʻo) (*Puffinus newelli*)

[1] KIUC was formed as a cooperative pursuant to the provisions of Chapter 421C of the Hawaiʻi Revised Statutes.

- Hawaiian petrel ('ua'u) (*Pterodroma sandwichensis*)
- Hawai'i distinct population segment of the band-rumped storm-petrel (hereafter band-rumped storm-petrel) ('akē'akē) (*Hydrobates castro*)

Before the Short-Term HCP was prepared, relatively little was known about the distribution, population, and behaviors of the three listed seabirds on Kaua'i, or the extent of the effects of KIUC's facilities and operations on these species. Thus, a central purpose of the Short-Term HCP was to have KIUC, in concert with multiple conservation partners, implement a suite of specific monitoring and research projects, and use the resulting new information to inform the development and implementation of a subsequent HCP that would have a longer permit duration. A summary of each data type collected, other available data, and how they are used in the HCP can be found in Appendix 1A, *Data Used for Plan Development*.

At the time the take authorization for the Short-Term HCP was issued to KIUC in 2011, USFWS expected that KIUC would receive longer-term take coverage under the *Kaua'i Seabird Habitat Conservation Plan* (KSHCP; Section 1.2.1, *Kaua'i Seabird Habitat Conservation Plan*). However, by 2015, monitoring data suggested that KIUC's annual take would exceed the capacity of the KSHCP, prompting a decision by DOFAW that KIUC needed to prepare a separate long-term HCP covering only KIUC's facilities and operations that result in take of the three listed seabirds.

1.2 Relationship to Other Habitat Conservation Plans on Kaua'i

1.2.1 Kaua'i Seabird Habitat Conservation Plan

DOFAW and USFWS approved the KSHCP in 2020 and issued federal ITPs and state ITLs to the qualifying applicants. The KSHCP covers the effects of artificial nighttime lighting on the Newell's shearwater ('a'o), Hawaiian petrel ('ua'u), band-rumped storm-petrel ('akē'akē), and the Central North Pacific distinct population segment of the green sea turtle (hereafter green sea turtle) (honu) (*Chelonia mydas*). Take of listed species due to light attraction on Kaua'i is an island-wide issue that adversely affects the above covered species and is collectively caused by many different entities (hotels and resorts, businesses, and government agencies). The duration of the KSHCP permits is 30 years and the geographic scope of the HCP is the entire island of Kaua'i.

The structure of the KSHCP enables multiple parties on Kaua'i to each hold their own federal ITP and state ITL for light attraction effects on the covered species at their particular facility under the coordinated framework of the KSHCP. This framework takes advantage of economies of scale and enables a pooling of funding resources to collectively implement mitigation activities to achieve the conservation goals of the KSHCP. The inclusion of eight entities[2] in the KSHCP involved the development of Participant Inclusion Plans that were approved by DOFAW and USFWS.

[2] These entities include NCL (Bahamas Ltd.), The Princeville Resort Kaua'i, Kaua'i Marriott Resort, Kaua'i Coffee Company, LLC, Sheraton Kaua'i Resort (Starwood Resorts), County of Kaua'i, Hawai'i Department of Transportation, and Alexander & Baldwin, Inc. The permit issued to Alexander and Baldwin, Inc. also covers their 11 subsidiaries and affiliates.

The KSHCP overlaps with the KIUC HCP in geographic scope and in coverage of the same three seabird species. Each of these plans addresses anticipated take of seabirds and sea turtles resulting from light attraction and includes conservation/mitigation measures to offset those impacts. The plans will be implemented separately.

1.2.2 Kauaʻi Lagoons Habitat Conservation Plan

Kauaʻi Lagoons LLC received approval from USFWS and DOFAW for the Kauaʻi Lagoons HCP in 2012. This HCP covers short-term construction and long-term resort and golf course operations at the approximately 600-acre Kauaʻi Lagoons Resort[3] in Līhuʻe. The Kauaʻi Lagoons HCP covers activities including new facility construction, general property operation and maintenance (including facility lighting), and public access and usage (e.g., driving, biking). The associated state ITL and federal ITP provide take authorization for Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), band-rumped storm-petrel (ʻakēʻakē), Hawaiian stilt (aeʻo) (*Himantopus mexicanus knudseni*), Hawaiian coot (ʻalae keʻokeʻo) (*Fulica alai*), Hawaiian common gallinule (ʻalae ʻula) (*Gallinula galeata sandvicensis*), Hawaiian duck (koloa maoli) (*Anas wyvilliana*), and Hawaiian goose (nēnē) (*Branta sandvicensis*). The duration of the Kauaʻi Lagoons HCP is 30 years and the geographic scope is restricted to the resort property.

Although the Kauaʻi Lagoons HCP and the KIUC HCP provide take coverage for the same seabird and waterbird species and include light attraction of listed seabirds as a covered activity, there is no overlap in the location of KIUC streetlights and Kauaʻi Lagoon lights.

1.3 Scope of the KIUC HCP

1.3.1 Plan Area and Permit Area

The *Plan Area* is the area in which all covered activities and conservation measures will occur. Because KIUC operates an island-wide system exclusively on Kauaʻi and is proposing conservation measures in remote areas of the island, the KIUC HCP Plan Area covers the full geographic extent of Kauaʻi (see Figure 1-1). The *Permit Area* is the specific locations of all covered activities and conservation measures (i.e., the geographic area where the ITP applies); these locations are described in Chapter 2, *Covered Activities*, and in Chapter 4, *Conservation Strategy*.

[3] In 2015, the name of Kauaʻi Lagoons Resort was changed to Hōkūala Resort. In 2019–2020, the Hōkūala Community Association requested a minor amendment to change the name of the Kauaʻi Lagoons Habitat Conservation Plan to Hōkūala Habitat Conservation Plan. The minor amendment is pending further consideration by USFWS.

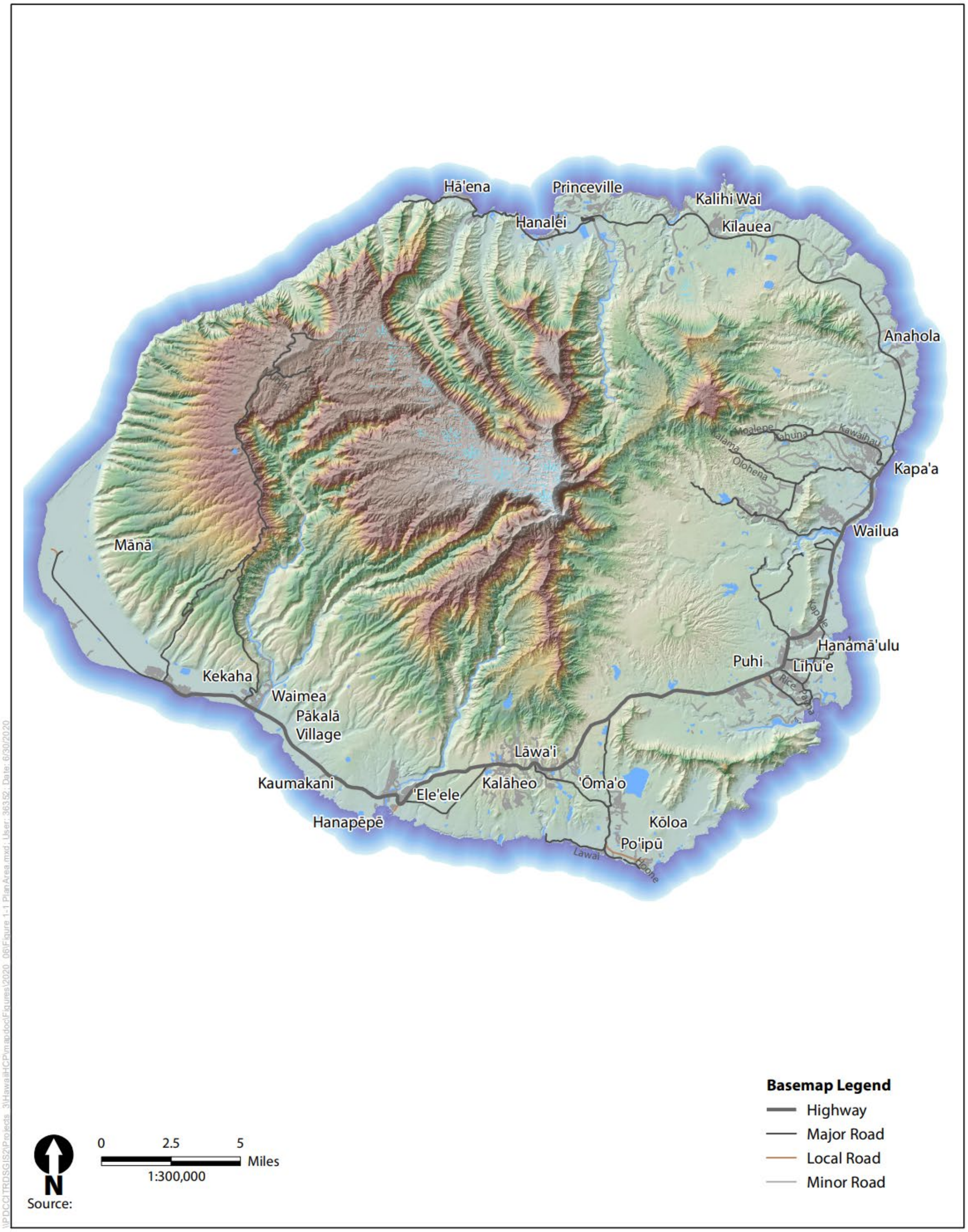

Figure 1-1. KIUC HCP Plan Area

1.3.2 Covered Species

Nine species are covered in this HCP and are referred to as *covered species* (Table 1-1). The covered species were selected based on their listing status and potential for the covered activities to result in take as defined by the federal ESA and state HRS Chapter 195D. Appendix 1B, *Evaluation of Species Considered for Coverage*, describes the evaluation process and rationale by which KIUC selected the covered species.

Table 1-1. Covered Species

English Name	Hawaiian Name	Scientific Name	Status[a] (Federal/State)
Newell’s shearwater	‘a‘o	*Puffinus newelli*	T/T
Hawaiian petrel	‘ua‘u	*Pterodroma sandwichensis*	E/E
Band-rumped storm-petrel[b]	‘akē‘akē	*Hydrobates castro*	E/E
Hawaiian stilt[c]	ae‘o	*Himantopus mexicanus knudseni*	E/E
Hawaiian duck	koloa maoli	*Anas wyvilliana*	E/E
Hawaiian coot	‘alae ke‘oke‘o	*Fulica alai*	E/E
Hawaiian common gallinule	‘alae ‘ula	*Gallinula galeata sandvicensis*	E/E
Hawaiian goose	nēnē	*Branta sandvicensis*	T/E
Green sea turtle[d]	honu	*Chelonia mydas*	T/T

[a] Status:
E = Listed as endangered under the federal ESA or HRS Chapter 195D.
T = Listed as threatened under the federal ESA or HRS Chapter 195D.
[b] Hawai‘i distinct population segment.
[c] Proposed for downlisting to threatened by USFWS in 2021. Final rule is still pending.
[d] Central North Pacific Region distinct population segment.

1.3.3 Covered Activities

Covered activities are those projects or ongoing activities that are reasonably certain to take the covered species and for which KIUC is requesting take authorization. Covered activities include the continued operation and modification of many of KIUC’s existing facilities; the operation and modification of certain future KIUC facilities; and implementation of the conservation measures described in this HCP. Covered activities are described in detail in Chapter 2, *Covered Activities*.

1.3.4 Permit Term

The *permit term* represents the period over which KIUC is authorized to incidentally take the covered species in conjunction with implementing the HCP for both the federal ITP and state ITL. All conservation actions outlined in the HCP must also be completed within the permit term to offset the impacts of the taking on the covered species by covered activities. KIUC is requesting take authorization from USFWS and DOFAW for 50 years. Accordingly, all assessments made in this HCP are based on a 50-year permit term.

This permit term was determined by KIUC as a reasonable timeframe to justify the significant investment in preparing and implementing this HCP. This period provides sufficient regulatory assurances to justify this investment and provides KIUC with the certainty it needs to continue to provide cost-effective electricity to its members on Kaua'i. This permit term also provides enough time in which to implement the conservation strategy and conduct long-term biological monitoring to determine its effectiveness in offsetting the impacts of the taking of the covered species caused by covered activities. As discussed in Chapter 7, *Plan Implementation*, prior to the expiration of the KIUC HCP and the take authorizations, KIUC may apply to renew or extend the federal ITP and the state ITL in accordance with applicable laws existing at that time.

1.4 Regulatory Context

1.4.1 Federal Endangered Species Act

The federal ESA provides for the conservation of endangered or threatened species and the ecosystems on which they depend. Section 9 of the federal ESA prohibits the take of endangered or threatened wildlife species without a special exemption. Under the federal ESA, the term *take* means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect listed species or to attempt to engage in any such conduct (16 United States Code [U.S.C.] 1532; 50 Code of Federal Regulations [CFR] 17.3). *Harm* includes significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns including, but not limited to, breeding, feeding, or sheltering (50 CFR 17.3). *Harass* is defined as intentional or negligent acts or omissions that create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt essential behavioral patterns including, but not limited to, breeding, feeding, or sheltering (50 CFR 17.3).

1.4.1.1 Federal Section 7 Process

Section 7 of the federal ESA requires all federal agencies to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. To that end, proposed federal actions that may affect listed species or critical habitat trigger formal consultation with USFWS, unless a may affect, not likely to adversely affect determination is warranted. The proposed issuance of a federal ITP for this HCP is a federal action that triggers a formal ESA Section 7 consultation. Consultation begins when the federal agency submits a written request for initiation to USFWS, along with a biological assessment (BA) of its proposed action and when USFWS accepts that BA as complete. If USFWS concurs with the finding in the BA that the action is not likely to adversely affect a listed species or critical habitat, the action may be conducted without further review under the federal ESA. If not, formal consultation is conducted. The outcome of formal consultation is USFWS issuance of a biological opinion (BiOp) describing how the proposed federal agency action is likely to affect the listed species and its critical habitat, and whether the action complies with the federal ESA Section 7 mandate to avoid jeopardy and destruction/adverse modification of critical habitat. For this HCP, USFWS will consult internally (with itself) to comply with Section 7 of the federal ESA.

If the BiOp concludes the proposed federal action is likely to jeopardize the continued existence of a listed species or adversely modify its critical habitat, the BiOp will include *reasonable and prudent alternatives* to avoid those outcomes. If the BiOp concludes that the proposed federal action would take a listed species but would not jeopardize its continued existence or destroy or adversely modify critical habitat, the BiOp will include an incidental take statement exempting anticipated take.

Incidental take "refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity" (50 CFR 402.02). The incidental take statement accompanying the BiOp specifies the following: the form and the amount or extent of anticipated take, reasonable and prudent measures and terms and conditions to minimize the impacts of the taking on the listed species, and monitoring and reporting requirements.

1.4.1.2 Federal Section 10 Process

Section 10(a) of the federal ESA establishes a process for non-federal entities to obtain authorization to incidentally take ESA-listed species. Private landowners, corporations, state agencies, local agencies, and other non-federal entities may apply for a Section 10(a)(1)(B) federal ITP for take of federally listed fish and wildlife species "that is incidental to, but not the purpose of, otherwise lawful activities." Submission of an HCP is required for all ESA Section 10 federal ITP applications. A detailed description of the HCP process is presented in the *Habitat Conservation Planning and Incidental Take Permit Processing Handbook* (HCP Handbook) (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016).

1.4.2 Hawaiʻi Revised Statutes, Chapter 195D

HRS Chapter 195D is the state's legislation corresponding to the federal ESA. Chapter 195D contains the state's policy to proactively ensure that the survival of indigenous aquatic life, wildlife, and plants and their habitat are perpetuated. Section 195D-4 provides that any species listed as endangered or threatened pursuant to the federal ESA is automatically deemed to be an endangered or threatened species by the state.

Section 195D-3 expressly prohibits any person to take, possess, transport, transplant, export, process, sell, offer for sale, or ship any threatened or endangered species, except as permitted by rules adopted by the Board of Land and Natural Resources (BLNR). It is also unlawful to violate any rule pertaining to the conservation of listed species or to violate the terms of, or fail to fulfill the obligations imposed and agreed to under, any license issued under any authorized habitat conservation plan or safe harbor agreement.

Under the HRS, *take* of aquatic life and wildlife is defined similarly to the federal ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect endangered or threatened species. Hawaiʻi law further defines take as to cut, collect, uproot, destroy, injure, or possess endangered or threatened species of aquatic life or land plants. Any attempt to engage in any such conduct is also prohibited.

HRS Section 195D-4(g) allows for issuance of a license as part of an HCP. The state requirements for an HCP are similar to those of the federal ESA Section 10, with several important differences. The state HRS Section 195D-4(g) requires that an HCP "increase the likelihood that the [covered] species will survive and recover" and that the cumulative impacts of the covered activities provide "net environmental benefits."

After consultation with the Endangered Species Recovery Committee (ESRC), the BLNR may issue a take authorization in the form of a temporary license as part of an HCP to allow take otherwise prohibited if the take is incidental to, and not the purpose of, carrying out an otherwise lawful activity. The role of the ESRC (Section 195D-25) is to serve as a consultant to the BLNR on matters relating to endangered, threatened, proposed, and candidate species. The ESRC is comprised of biological experts, representatives of relevant federal and state agencies (e.g., USFWS, U.S. Geological Survey, DOFAW), and other appropriate governmental and non-governmental members. The ESRC reviews all HCP permit applications and makes recommendations to the BLNR on whether they should be approved, amended, or rejected. The ESRC also reviews all existing HCPs and state ITLs annually to ensure compliance and makes recommendations for any necessary changes to existing HCPs.

1.5 Habitat Conservation Plan Process

The process for obtaining federal and state incidental take authorization has three phases: (1) the HCP development phase; (2) the permit application processing phase; and (3) if a permit is issued, the post-issuance/implementation phase.

1.5.1 HCP Development Phase

During the HCP development phase, the applicant prepares an HCP that includes a description of covered activities, covered species, the conservation program that would be implemented to avoid, minimize, and mitigate the impacts of anticipated taking of listed species, and funding assurances for implementation of the HCP. Consistent with Section 10 of the federal ESA and implementing regulations, and associated USFWS guidance, an HCP submitted in support of a federal ITP application includes, without limitation, the following information:

- A complete description of the activity(ies) for which take will be authorized.
- A determination of the type and potential amount of take of the covered species caused by covered activities, and specification of the impacts on the covered species likely to result from such taking.
- Steps and measures that the applicant will implement to avoid, minimize, and mitigate such impacts, to the maximum extent practicable.
- Assurances that adequate funding will be made available to implement the avoidance, minimization, and mitigation measures proposed under the HCP.
- Procedures and funding to deal with changed circumstances.
- Alternative actions to such taking that were considered, and the reasons why such alternatives are not being utilized.
- A discussion of the biological goals and objectives of the HCP.
- A monitoring plan.
- An adaptive management plan.
- Any additional measures that USFWS determines are necessary and appropriate for the HCP.

Pursuant to HRS Section 195D-21(a), HCPs submitted in support of a state ITL must provide the following information.

- The geographic area encompassed by the HCP.
- The ecosystems, natural communities, or habitat types within the Plan Area that are the focus of the HCP.
- The endangered, threatened, proposed, and candidate species known or reasonably expected to occur in the ecosystems, natural communities, or habitat types in the Plan Area.
- The activities contemplated to be undertaken with sufficient detail to allow DOFAW to evaluate the impact of the activities on the ecosystems, natural communities, or habitat types within the Plan Area.
- The measures to be undertaken to protect, maintain, restore, or enhance those ecosystems, natural communities, or habitat types within the Plan Area.
- A schedule for implementation of the proposed measures and actions contained in the HCP.
- An adequate funding source to ensure that the proposed measures and actions contained in the HCP are undertaken in accordance with the schedule.

The HCP development phase concludes, and USFWS's permit processing phase begins when the applicant submits a complete permit application package to USFWS. HRS Section 195D-4(i) directs DOFAW to work cooperatively with federal agencies to concurrently process federal ITP and state ITL applications pursuant to the federal ESA on a consolidated basis to the extent feasible to minimize procedural burdens upon the applicant.

1.5.2 National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires federal agencies to analyze the environmental impacts of their discretionary decisions and ensure that environmental information is available to agency officials before decisions are made and before actions are taken. The NEPA process helps federal agencies make informed decisions with respect to the environmental consequences of their actions and ensures that measures to protect, restore, and enhance the environment are included, as necessary, as a component of their actions. NEPA also ensures public scrutiny during project planning and decision-making.

Depending on the scope and potential effects of the HCP, the federal agency usually prepares one of three environmental documents: (1) a categorical exclusion; (2) an environmental assessment; or (3) an environmental impact statement (EIS). USFWS has determined the proposed action of issuing an ITP to KIUC has the potential to significantly affect the quality of the human environment, and is preparing an EIS to assist in evaluating the ITP application.

Although the federal ESA and NEPA requirements overlap considerably, the scope of NEPA goes beyond that of the federal ESA by considering impacts of a federal action not only on fish, wildlife, and plant resources but also on other resources such as water quality, air quality, and cultural resources.

1.5.3 Hawai‘i State Environmental Review Law

The State of Hawai‘i Office of Planning and Sustainable Development facilitates the state's environmental review process pursuant to HRS Chapter 343 and its implementing regulations (Hawai‘i Administrative Rules 11-200.1), also commonly known as the Hawai‘i Environmental Protection Act. The office announces the availability of environmental assessments and EISs for public review and comment, as well as summaries of proposed actions and details of upcoming EIS public scoping meetings in its semi-monthly publication, *The Environmental Notice*. The office is responsible for environmental oversight and review and assists throughout the environmental review process.

1.5.4 Permit Processing Phase

Once KIUC submits a draft HCP and a complete federal ITP application, USFWS will publish a Notice of Availability of the draft HCP and draft EIS documents in the *Federal Register* and accept public comment on those documents for a minimum of 30 days.

The public comment period and consultation process are important feedback mechanisms during HCP development and can inform other measures the Secretary of the Interior may require as being necessary or appropriate for purposes of the plan pursuant to the authority for such measures under ESA Section 10(a)(2)(A)(iv).

In addition to the above, after a complete application has been received, USFWS initiates an internal ESA Section 7 consultation process addressing the effects of the HCP and the federal ITP action on listed species and critical habitat (Section 1.4.1.1, *Federal Section 7 Process*). The culmination of the consultation process is USFWS' issuance of a BiOp.

When the NEPA document and BiOp are completed, USFWS prepares a Record of Decision and findings documents and decides whether it will issue, issue with conditions, or deny the federal ITP. These findings include, without limitation, whether the HCP meets the requirements for issuance of a Section 10 permit as listed below.

- The taking will be incidental to 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 HCP will be provided.
- The HCP includes provisions to address any changed or unforeseen circumstances.
- The taking will not appreciably reduce the likelihood of survival and recovery of the listed species in the wild.
- The applicant will ensure that other measures required by USFWS as being necessary or appropriate will be met.
- USFWS has received assurances that the applicant will implement the HCP.

The State of Hawai‘i's BLNR approval process for an HCP and issuance of the state ITL occurs in parallel with the federal process. DLNR reviews the HCP for consistency with state regulations on the take of listed species and the Office of Planning and Sustainable Development publishes a Notice of Availability of the draft HCP in its bulletin *The Environmental Notice* for a 60-day minimum public comment period.[4] DOFAW would also hold a public meeting on Kauaʻi. During this time, DLNR requests the ESRC meet to review and provide comments on the draft HCP and conduct a site visit, and reviews any revisions to the draft HCP resulting from ESRC and public comment and USFWS consultation. Based on its review, the ESRC would provide a recommendation to approve, approve with conditions, or deny the HCP/ITL application to BLNR. BLNR then considers the ESRC and staff recommendation, accepts public testimony, and votes to recommend approval or denial of the HCP/ITL application. A two-thirds majority vote (five of seven members of BLNR) is required for approval of the HCP and issuance of the state ITL.

On January 23, 2023, the first public draft KIUC HCP was published by DLNR through the Office of Conservation and Coastal Lands, Environmental Review Program for a 60-day public comment period overseen by the state. The same first public draft HCP was also reviewed by the ESRC in compliance with HRS 343 and Chapter 195D and in support of KIUC's application for an ITL under the Hawaiʻi ESA.

During this public comment period, DOFAW held the following public meetings to solicit further comments and provide an opportunity for KIUC and their consultants to answer questions.

- February 28, 2023: The ESRC conducted a site visit on Kauaʻi with KIUC and interested members of the public. A site visit orientation and presentation was given by KIUC in a conference room at the Līhuʻe Airport, prior to the site visit.
- March 1, 2023: The ESRC held a review meeting of the draft HCP at the Līhuʻe Public Library. KIUC presented an overview of the HCP and answered questions from the ESRC.
- March 27, 2023. DOFAW held a public meeting on the draft HCP at the Līhuʻe Public Library to solicit public comments.
- June 22 and 23, 2023: Virtual meeting with the ESRC for continued presentations and discussion of the draft KIUC HCP, including the proposed conservation strategy for covered seabirds.

During and after the public review period, DOFAW received written comments from ESRC members, DLNR, and five organizations or individuals. KIUC has reviewed the written comments and all questions and comments from the ESRC, DLNR, non-governmental organizations and the public. This second public draft HCP incorporates the comments received on the first public draft HCP published in January 2023, as well as continued collaboration and comments from USFWS and DOFAW.

1.5.5 Implementation Phase

If the federal ITP and state ITL are issued, the applicant (now a permittee) will implement the HCP as described in the final HCP, the federal ITP, and state ITL. The applicant will prepare regular monitoring reports and will coordinate with USFWS as specified in the HCP and federal ITP. USFWS will monitor and review the permittee's compliance with the HCP and federal ITP, including the progress towards achieving the HCP's biological goals and objectives, over the entire permit term. In addition, the ESRC will review the HCP and state ITL on an annual basis to ensure compliance with

[4] At DLNR's discretion, the state public comment period can be initiated as soon as the public draft HCP is complete, prior to the federal comment period.

all agreed upon activities and make recommendations for any necessary changes on the basis of available monitoring reports and scientific and other reliable data.

1.5.6 Migratory Bird Treaty Act

The federal Migratory Bird Treaty Act of 1918, as amended (MBTA) (16 U.S.C. 703–712) implements treaties and conventions between the United States and Canada, Japan, Mexico, and Russia for the protection of migratory birds. The MBTA prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species and their parts, nests, and eggs without prior authorization by the Department of the Interior U.S. Fish and Wildlife Service. Taking is defined under the MBTA separately from the federal ESA. The species protected by the MBTA is primarily based on bird families and species included in the four international treaties. The list of migratory bird species protected is in CFR Title 50 Section 10.13. All the covered bird species identified in Table 1-1 are protected by the MBTA and federal ESA. Other migratory birds not covered by the HCP and that may be affected by the covered activities are discussed in the NEPA document for this HCP. KIUC has prepared an Avian Protection Plan to further discuss conservation measures for and potential impacts on all MBTA species, including those listed under the federal ESA, but not a covered species under the HCP that may be affected by KIUC activities and projects.

1.5.7 National and State Historic Preservation Acts

The National Historic Preservation Act (NHPA) of 1966 (16 U.S.C. 470) established a comprehensive program to preserve the historical and cultural foundations of the nation as a living part of community life. Prior to implementing an *undertaking* (e.g., issuing a federal permit), Section 106 of the NHPA requires federal agencies to assess and determine whether the undertaking has the potential to affect historic properties that are on the National Register of Historic Places (National Register) or that are eligible for listing on the National Register, and to afford the Advisory Council on Historic Preservation and the State Historic Preservation Officer (SHPO) a reasonable opportunity to comment on any undertaking that may adversely affect such properties. NHPA Section 101(d)(6)(A) allows properties of traditional religious and cultural importance to a tribe or Native Hawaiian organization to be determined eligible for inclusion on the National Register if they meet the listing criteria. The Section 106 process normally involves step-by-step procedures that are described in detail in the implementing regulations (36 CFR Part 800) and are summarized generally below.

- Establish if the proposed federal action constitutes an undertaking as defined in the NHPA; the USFWS has determined that ITP issuance is an undertaking for NHPA purposes.
- Delineate the Area of Potential Effect.
- Identify and evaluate historic properties in consultation with the SHPO and interested parties.
- Assess the effects of the undertaking on properties that are eligible for inclusion on the National Register.
- Where potential adverse effects to historic properties are present, consult with the SHPO, other agencies, and consulting parties to assess the effects and, if appropriate address them in accordance with the requirements of applicable laws.

HRS Chapter 6E establishes a comprehensive program of historic preservation to promote the use and conservation of historic properties for the education, inspiration, pleasure, and enrichment of state citizens. HRS Section 6E-8 requires that before any agency or officer of the state or its political subdivisions commences any project that may affect an historic property, aviation artifact, or a burial site, the agency or officer must advise DLNR and allow the department an opportunity for review of the effect of the proposed project and obtain its written concurrence before commencing. KIUC must comply with the requirements of this law and its regulations as it implements the avoidance, minimization, and mitigation measures that are part of the KIUC HCP.

1.6 Organization of the KIUC HCP

The HCP consists of the following chapters and technical appendices.

- Chapter 1, *Introduction and Background*, provides an overview of KIUC as the applicant, KIUC's purpose and need for the HCP, and the regulatory framework within which the HCP is being prepared.
- Chapter 2, *Covered Activities*, describes KIUC's existing and future activities that are covered by the HCP.
- Chapter 3, *Environmental Setting*, describes the existing conditions of the Plan Area relevant to the HCP.
- Chapter 4, *Conservation Strategy*, summarizes the conservation strategy and describes the specific conservation actions to be implemented to fully offset the impacts of the taking of covered species by covered activities, and to contribute to the recovery of the covered species.
- Chapter 5, *Effects*, presents the impacts of the covered activities on each of the covered species.
- Chapter 6, *Monitoring and Adaptive Management Program*, discusses the monitoring requirements and adaptive management procedures associated with implementation of conservation actions and reserve management.
- Chapter 7, *Plan Implementation*, discusses how the HCP is to be implemented and funded over time, including timeframes and success criteria. The chapter also describes the changed circumstances foreseen by the plan and how KIUC will address them if they occur.
- Chapter 8, *Alternatives to Take*, presents the required analysis of alternatives considered that would reduce take of the covered species but were rejected by KIUC and why they were rejected.
- Chapter 9, *References*, lists the documents and sources cited and relied upon in preparing this HCP.
- Chapter 10, *Glossary of Terms*, provides definitions for technical terms used in the HCP.
- Appendix 1A, *Data Used for Plan Development,* presents detail for each data type used to inform development of this HCP.
- Appendix 1B, *Evaluation of Species Considered for Coverage*, lists the special-status species that were considered for coverage under this HCP, their legal status, their coverage under the HCP (covered or noncovered status), and the rationale for coverage. Attachments to this appendix provide additional detail on Hawaiian hoary bat (ʻōpeʻapeʻa) (*Lasiurus cinereus semotus*) and

listed plant species, including avoidance and minimization measures that must be implemented during the 50-year HCP permit term.

- Appendix 3A, *Species Accounts*, presents detailed ecological accounts of all covered species, including modeling results of habitat distribution, that were developed for selected species.
- Appendix 4A, *Conservation Site Selection*, presents the methods and results for habitat suitability analyses and population distribution modeling that were conducted to inform the conservation site selection process.
- Appendix 4B, *KIUC Minimization Projects*, presents a spreadsheet of all KIUC's completed powerline flight diverters, static wire removal, and undergrounding projects.
- Appendix 4C, *Protocols for Seabird Trap Interactions at Conservation Sites*, presents the protocols and procedures for situations where birds are caught in predator control traps or otherwise expected to have been impacted by other HCP-related actions.
- Appendix 4D, *Best Management Practices for Invasive Plant Species Control*, presents the invasive plant species control methods that are currently employed (and will continue to be employed during HCP implementation) within the conservation sites.
- Appendix 4E, *Review of New Powerlines and Streetlights in Northwestern Kauaʻi*, describes the process to ensure that potential future KIUC infrastructure in a specifically defined area of northwestern Kauaʻi will not inhibit the ability of the HCP to achieve the biological goals and objectives.
- Appendix 4F, *Land Agreement with National Tropical Botanical Garden for Upper Limahuli Preserve Conservation Sites*, a copy of the signed agreement that gives KIUC access to these conservation sites for the entire permit term for the purpose of conducting HCP-related activities[5].
- Appendix 4G, *Land Agreement with Ric Berry for Upper Mānoa Valley Conservation Sites*, a copy of the signed agreement that gives KIUC access to these conservation sites for the entire permit term for the purpose of conducting HCP-related activities.
- Appendix 4H, *State Lands Access Package*, includes a letter from DLNR outlining the process for KIUC to obtain access to the conservation sites on state-owned land and permission to conduct HCP activities at those sites. Additionally, the package includes a template non-exclusive easement and standard permit terms and conditions.
- Appendix 4I, *Conservation Easement for Upper Mānoa Valley and Upper Mānoa Valley PF Conservation Sites*, a copy of the signed conservation easement that ensures protection of these sites regardless of changes in land ownership through the term of the HCP.

[5] Unforeseen issues developed in April 2025 between National Tropical Botanical Garden and KIUC regarding the Land Agreement with National Tropical Botanical Garden for the Upper Limahuli Preserve conservation sites. KIUC has initiated a dispute resolution process to resolve these issues. If the dispute resolution process results in Upper Limahuli Preserve not being used as an HCP conservation site, KIUC will coordinate with USFWS and DOFAW to find an alternative site or sites, minimization, mitigation, or a combination of these actions to make up for the site being withdrawn from the HCP.

- Appendix 5A, *Variables Influencing Powerline Strikes*, presents the methods and results for estimating take of the covered seabird species caused by light attraction due to KIUC streetlights and lights at KIUC facilities on Kauaʻi.
- Appendix 5B, *Light Attraction Modeling for Covered Seabirds*, presents the methods and results for estimating take of the covered seabird species caused by light attraction due to KIUC streetlights and lights at KIUC facilities on Kauaʻi.
- Appendix 5C, *Bayesian Acoustic Strike Model*, outlines the methods and results for estimating pre-HCP annual collisions with existing powerlines.
- Appendix 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*, presents the methods and results for the effect of KIUC's minimization and conservation actions on the Kauaʻi metapopulations of Newell's shearwater (ʻaʻo).
- Appendix 5E, *Population Dynamics Model for Hawaiian Petrel (ʻuaʻu) on Kauaʻi*, presents the methods and results for the effect of KIUC's minimization and conservation actions on the Kauaʻi metapopulations of Hawaiian petrel (ʻuaʻu).
- Appendix 6A, *Adaptive Management Comparison Tables*, presents tables showing the estimated number of powerline collisions and breeding pairs for the Kauaʻi metapopulations of Newell's Shearwater (ʻaʻo) and Hawaiian Petrel (ʻuaʻu) during the permit term. KIUC will compare monitoring data to these tables during implementation.
- Appendix 6B, *KIUC Site Monitoring Protocols and Procedures for Protected Seabirds*, described the monitoring protocols and procedures that will be employed to locate and rescue grounded seabirds at KIUC covered facilities and at construction sites with night lighting.
- Appendix 7A, *Cost Model,* describes the cost model used to estimate HCP costs described in Chapter 7.
- Appendix 7B, *KIUC Funding Assurances: Supporting Information*, provides additional information on KIUC's finances to support the funding assurances described in Chapter 7.
- Appendix 7C, *Summary of Supplementary Climate Projections*, provides technical details on the assumptions and results of climate forecast models summarized in Chapter 7 regarding the expected changes in frequency and intensity of extreme weather events.

Chapter 2
Covered Activities

Chapter 2 Highlights

Chapter Purpose: This chapter describes activities for which KIUC is seeking incidental take coverage under the federal Endangered Species Act (ESA) and Hawaiʻi ESA for impacts on the nine covered species. The covered activities are described in three broad categories: (1) powerline operations, (2) lighting operations, and (3) implementation of the conservation strategy. KIUC's facilities that are not covered by this HCP are also described.

Context: KIUC selected the covered activities based on a set of criteria, including what is under its control and what is reasonably likely to result in take of the covered species.

Major Conclusions:	**See the following for more information:**
• **Powerline Operations.** KIUC owns and operates overhead electrical wires (powerlines) on the Island of Kauaʻi. As part of its routine operation in providing electrical service, KIUC installs and maintains several types and configurations of overhead powerlines that are known to cause take of the seabird and waterbird covered species. Therefore, operation of these powerlines requires coverage by the federal incidental take permit and the state incidental take license. The types of overhead powerlines include: (1) transmission, (2) distribution, and (3) communication wires. KIUC's current overhead powerline system is estimated to include 171.3 miles (275.7 kilometers) of existing transmission wires, 1,360 miles (2,189 kilometers) of existing distribution wires, and 70 miles (112.7 kilometers) of communication wires. KIUC also forecasts installing up to 360 miles (579 kilometers) of new powerlines during the 50 years of the HCP. Operation of the existing powerlines and up to 360 miles (579 kilometers) of new powerlines are covered under this HCP.	Section 2.1, Figure 2-1, Figure 2-2a Section 2.2
• **Lighting Operations.** KIUC owns and operates two power generating stations at Port Allen and Kapaia where facility lights have been known to attract the covered seabirds, causing disorientation and grounding. KIUC also utilizes nighttime lighting to repair or replace powerlines in order to restore power during outages. In addition, KIUC operates approximately 4,150 light-emitting diode streetlights throughout the island that may cause disorientation of the covered seabirds. In limited locations, green sea turtle (honu) hatchlings may also be disoriented by streetlights. KIUC forecasts operating up to an additional 1,754 streetlights during the 50-year permit term. Operation of these three lighting sources (facility lights, nighttime lighting for power restoration, and existing and future streetlights) are covered activities under this HCP.	Section 2.3, Section 4.5 Section 2.4
• **Implementation of the Conservation Strategy.** Certain activities related to implementation of the HCP conservation strategy at the proposed conservation sites may result in limited incidental take of the covered seabirds and is also a covered activity.	
• **Activities Not Covered.** Ten categories of KIUC's operational activities or structures were determined by KIUC to not require coverage in this HCP because they are not likely to result in take of the covered species.	
Data Sources: The description of covered activities comes primarily from KIUC.	

This chapter describes existing and future activities for which KIUC is seeking incidental take coverage under Section 10 of the federal Endangered Species Act (federal ESA). These activities are collectively referred to as *covered activities*. Pursuant to Section 10(a)(1)(B) of the federal ESA, the Secretary can consider authorizing "any taking otherwise prohibited by section 9(a)(1)(B) if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity." Take is authorized through execution of a federal incidental take permit (ITP) that meets the requirements of Section 10(a)(2)(B) of the federal ESA, including submission of a habitat conservation plan (HCP) that meets the requirements of the federal ESA.

The Hawai'i Revised Statutes (HRS) in Section 195D-4 have a similar provision that allows "after consultation with the endangered species recovery committee, the Hawai'i State Board of Land and Natural Resources may issue a temporary license as a part of a habitat conservation plan to allow a take otherwise prohibited by subsection (e) if the take is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity."

The U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service jointly developed the *Habitat Conservation Planning and Incidental Take Permit Processing Handbook* (HCP Handbook) (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016). The HCP Handbook assists the agencies in evaluating the adequacy of proposed HCPs and in providing technical assistance to ITP applicants during HCP development. Consistent with the HCP Handbook, covered activities have the following attributes.

- **Incidental take:** The activity resulting in take is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.
- **Control or authority:** The covered activity must be under the direct control of KIUC as a project or activity it implements directly, implements through contracts or leases, or controls through a regulatory framework (e.g., under a federal or state permit or other authorization).
- **Location:** The covered activity must occur within the geographic area of the KIUC HCP Plan Area (see Chapter 1, Section 1.3.1, *Plan Area and Permit Area*).
- **Timing:** The covered activity must occur during the proposed permit term (50 years; see Chapter 1, Section 1.3.4, *Permit Term*).
- **Impact:** The covered activity must be reasonably certain to cause incidental take of one or more covered species (see Chapter 1, Section 1.3.2, *Covered Species*).
- **Project Definition:** The location, footprint, frequency, and types of impacts resulting from the activity can be defined well enough that direct and indirect impacts on covered species can be evaluated and conservation measures can be developed.

The covered activities that meet all these criteria are described in three broad categories: (1) powerline operations, (2) lighting operations, and (3) implementation of the HCP conservation strategy. These categories are described in the following subsections as they relate to operation and modification of existing and future KIUC infrastructure. KIUC is seeking take coverage under federal and state permits for all covered activities described in this chapter.

The final section of this chapter lists KIUC infrastructure operations and modification activities not covered by the HCP because it was determined they do not meet one or more of the criteria listed above.

The covered activities described in this chapter are intended to be as inclusive as possible of KIUC activities currently occurring or expected to occur in the Permit Area and that are reasonably certain to cause incidental take of the covered species. Any activities identified in the future that, in either or both USFWS or State of Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife's (DOFAW) view may not clearly fall within the scope of covered activities described in this chapter or in any federal ITP or state incidental take license (ITL) issued to KIUC by USFWS or DOFAW, respectively. Terms and conditions will be evaluated on a case-by-case basis, by USFWS and DOFAW to determine whether take is covered under their respective permits, or whether a new permit or permit amendment request is required. Factors the agencies may consider in this assessment include, but are not limited to, the following.

- The activity is under the direct control or authority of KIUC.
- The activity increases the probability that the biological goals and objectives of the HCP (Chapter 4, *Conservation Strategy*) cannot be met.
- The activity changes the types of impacts evaluated in Chapter 5, *Effects*, including, without limitation, the estimated take or impact of taking of any covered species.
- Adequate take coverage under the federal and state permits remains available for the covered activities originally described in the KIUC HCP.
- The activity is otherwise legal, requires an HCP amendment under then applicable law, or requires additional regulatory compliance including, without limitation, supplemental National Environmental Policy Act/Hawai'i Environmental Policy Act.

If, after permit issuance, USFWS or DOFAW determines that a specific KIUC activity is reasonably certain to cause take of the covered species and is under KIUC's control but it is not included within the descriptions of covered activities in this chapter, then KIUC will not receive take coverage for the activity under USFWS's or DOFAW's respective permits. In this event KIUC may, at its discretion, apply for an amendment to either the federal ITP or state ITL, or both, in accordance with processes set out in then-applicable law.

2.1 Powerline Operations

KIUC owns and operates overhead electric powerlines on the Island of Kaua'i (Figure 2-1). The wire sizes and pole heights vary widely for each type of line depending on site-specific physical circumstances present along the powerline corridor (e.g., topography). Moreover, line configuration may switch from one type to another (and often back again) within distances of as little as a few hundred feet (ft). This changeability makes it impossible to map the differences on a system-wide scale. All KIUC wires on Kaua'i are considered operational when the wires are in place (i.e., when they are in the bird's flight path) but they do not need to be electrified.

2.1.1 Types of KIUC Overhead Wires

KIUC overhead wires with the potential to cause take of the covered species fall into one of the following three categories: (1) transmission wires, (2) distribution wires, and (3) communication wires (Figure 2-2a). KIUC is seeking coverage for all existing and future KIUC overhead wires falling into one of these three categories and all existing and future KIUC supporting structures holding these overhead wires. Supporting structures for the purposes of this HCP include only poles, towers, lattice structures, and H-frames[1] (hereafter referred to as support structures).

- **Transmission Wires**. KIUC owns and operates 171.3 circuit-miles[2] (mi) (275.7 kilometers [km]) of transmission lines. Transmission wires are typically raised between 59 ft (18 meters [m]) and 79 ft (24 m) above the ground, with the tallest lines more than 100 ft (34 m) above the ground (Figures 2-2a and 2-2b). As of the end of 2022, there are roughly 1,616 KIUC-owned support structures that support the transmission wires that can range in height from 30 to 110 ft (48.3 to 177 m). The transmission circuits are protected from lightning strikes by a wire mounted above the conductor wire, known as an overhead shield wire, span wire, or earth wire. The static wire, if present, is typically the highest wire and, because it is a smaller and lighter wire, it sags less than the conductor wires. The majority of static wire on KIUC's system has been removed as part of KIUC's island wide minimization plan. As of 2024, there are approximately 5.3 mi (8.5 km) of static wire remaining on the system, the majority of which (3.0 mi [4.8 km]) is located north of and on the very southern part of the powerline trail.

  A single transmission circuit is typically comprised of three conductor wires (three phases) that can be on one or both sides of the pole and can switch back and forth. These wires are nearly always bare aluminum; often two circuits are mounted on a single pole. This configuration is common on the west side of Kaua'i. However, on the east and north sides of Kaua'i, transmission lines often include double circuits with six wires on alternate sides of the pole (Travers et al. 2019). Transmission wires can be arranged in three different types of arrays.

  - Vertical arrays, where the conductor wires are immediately above one another on the pole (Figure 2-2a).
  - Triangular arrays, where conductor cables are mounted on either side of the pole.
  - Horizontal arrays, where the lines are mounted on horizontal crossarms or post-type insulators, which is rare for transmission wires but more common for distribution wires.

- **Distribution Wires**. KIUC owns and operates 1,360 circuit-mi (2,189 km) of distribution lines (as of 2020). Distribution wires built on the same pole as transmission wires are always mounted underneath the transmission wires (termed an *under-build*; Figure 2-2a). Where transmission wires are not present, distribution wires are mounted on support structures that are 30 to 50 ft (12 to 15 m) tall (Figure 2-2a), often with under-build service circuits mounted below the distribution wires.

  Distribution circuits can range from two to four wires (i.e., one to three conductors and a neutral wire), depending on the requirements in the area. Distribution wires can be placed closer together than transmission wires because they carry a lower voltage. As with transmission lines, the distribution wires are arranged in a variety of ways and a variety of heights depending upon each pole's site-specific circumstances; it is common for distribution wires to be vertically spaced on alternating sides of the pole (Travers et al. 2019). Moreover, distribution circuits frequently change from one configuration to another over a short distance. In some instances, distribution wires owned by other public agencies or private entities are located on the same

[1] Poles and towers are columns or posts that are differentiated based on the type of material: poles are wood, and towers are steel. Lattice structures and H-frame structures are also currently part of the grid system and can both be made of either wood or steel (Kaua'i Island Utility Cooperative 2020).

[2] A circuit-mile is defined as 1 mile of either a set of alternating current three-phase conductors in an overhead or underground alternating current circuit, or one pole of a direct current circuit. Data from end of year 2022 report.

pole with KIUC distribution wires. Distribution wires are covered primarily due to waterbird risks, and not all distribution wires are expected to result in impacts on any of the covered species (e.g., those in residential neighborhoods). Some distribution spans have been identified as having collision risks for covered seabirds.

- **Communication Wires.** KIUC owns and operates approximately 70 circuit-mi (113 km) of communication lines. KIUC's communication wires are typically only present where transmission lines are also present but are not present in all transmission line locations. The communication wire, if present, is typically mounted below the transmission and distribution wires and is therefore typically the nearest wire to the ground (Figures 2-2a and 2-2b). Because the communication wire consists of fragile fiber-optic cable, it is protected by a black plastic buffer tube. The buffer tubes may be different diameters depending on the length of the wire. In some cases, the communication wire is combined with the static wire and located as the top line in an array. These overhead fiber and static combined lines are being removed as part of KIUC's minimization plan and being replaced with a fiber cable mounted below the distribution layer.
- **Support Structures**. There are roughly a combined total of 26,000 KIUC-owned support structures that support KIUC-owned and -operated overhead transmission wires, distribution wires, and communication wires.

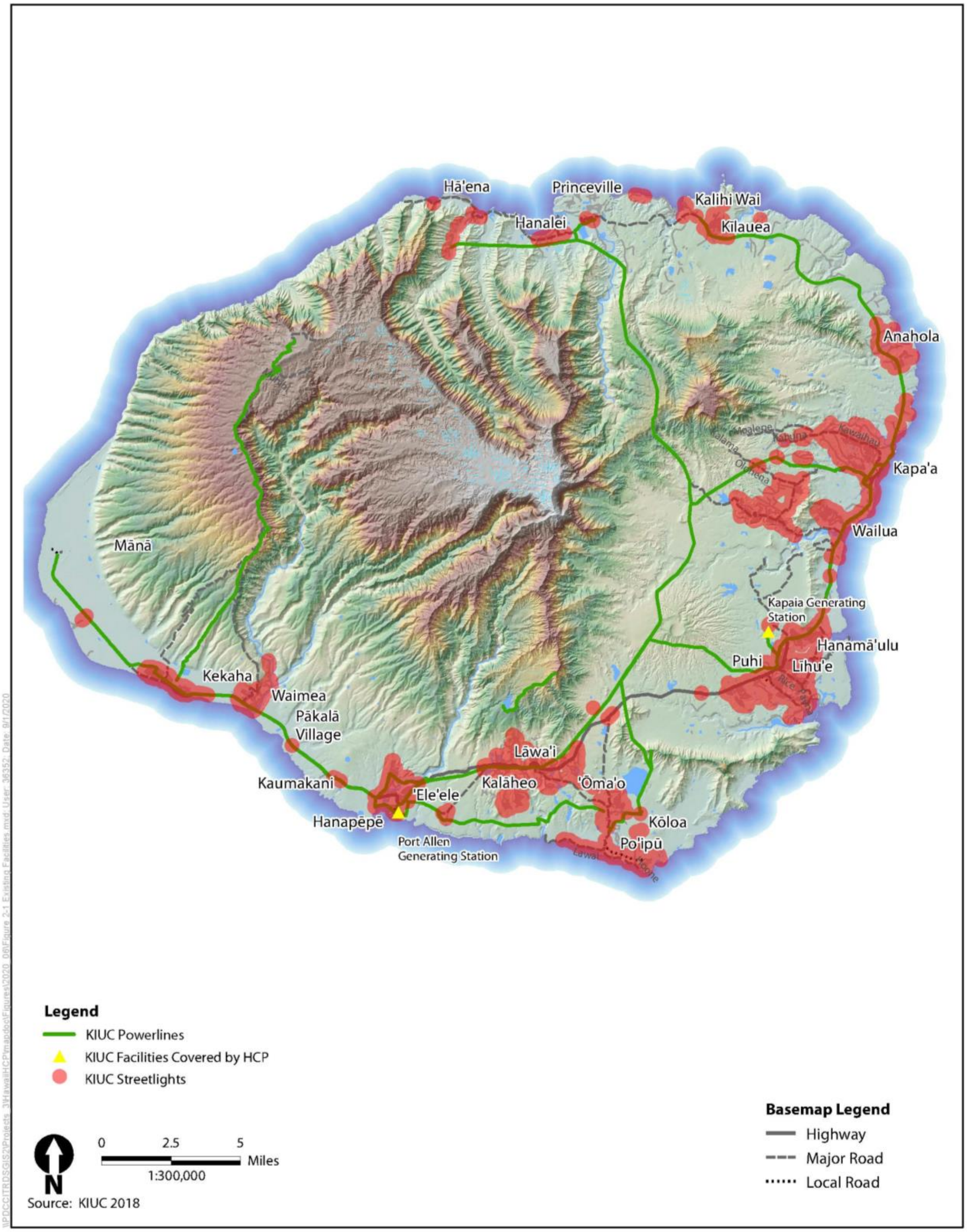

Figure 2-1. Covered Activities: Existing Facilities

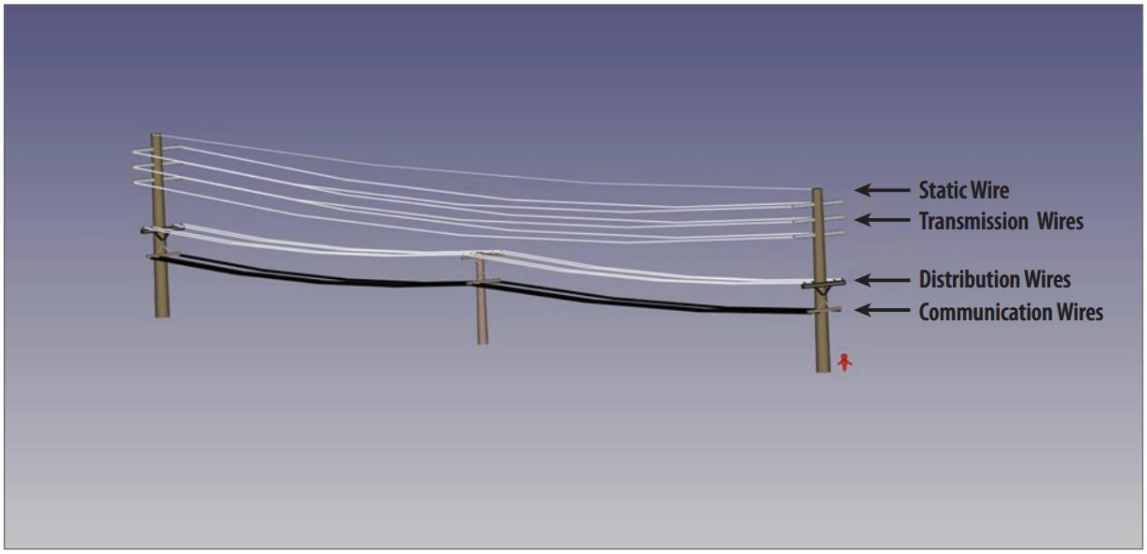

FIGURE 2-2a. Types of wires covered in the KIUC HCP, shown in a vertical array.

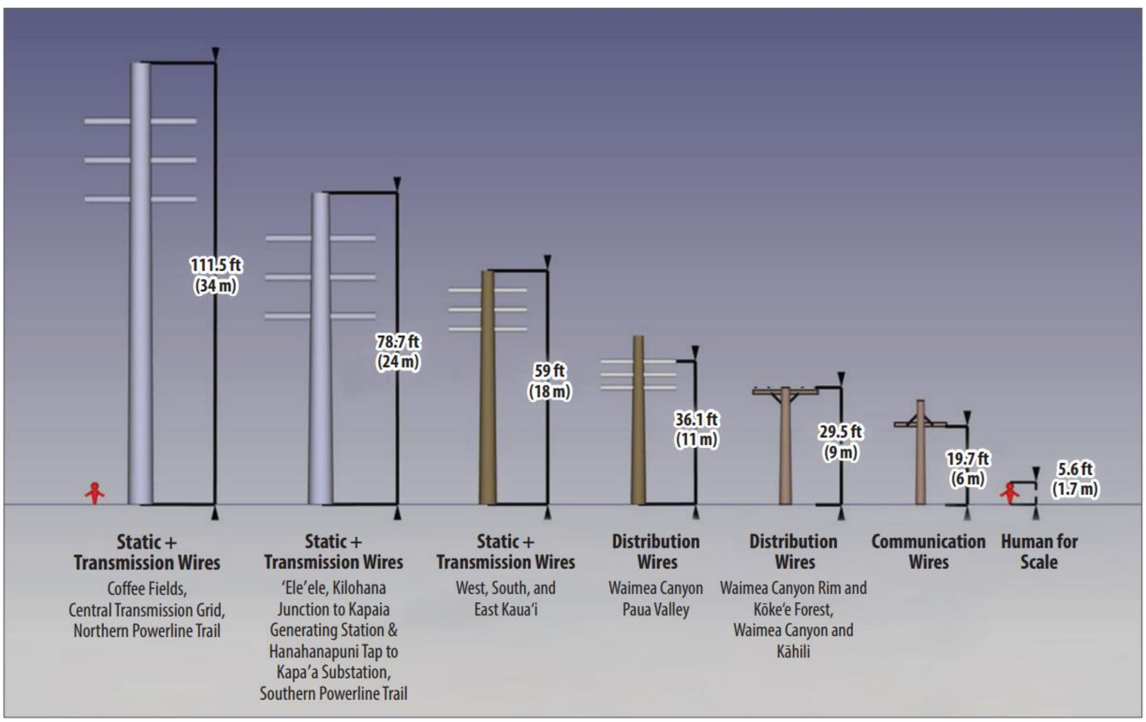

FIGURE 2-2b. Typical wire heights of KIUC transmission, distribution, and communication lines based on general location.

Source: Travers et al. 2019

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Figure 2-2. Typical Wire Types and Heights of KIUC Powerlines

2.1.2 Powerline Modifications

KIUC periodically modifies transmission lines and distribution lines in response to changes in electricity demand. In other cases, KIUC may modify powerlines in response to changing land uses that might interfere with safe and reliable power delivery. In either instance, these powerline modifications are covered activities if they result in a change in wire height, add new powerlines, or expose wires, as described below.

2.1.2.1 Increasing Wire Height

KIUC increases wire height primarily to meet minimum clearance standards. For example, reconductoring, which replaces a smaller conductor with a heavier-duty one, is occasionally necessary to accommodate increasing electrical loads on the lines. To maintain a proper offset distance between the wires, the height of a heavier-duty line must sometimes be increased.

Modification of wires with increased wire heights is a covered activity in this HCP. KIUC estimates that over the 50-year permit term, 16 percent of their existing total transmission wire length (i.e., 27.2 mi [43.8 km]) will require wire height increases. This equates to an average of 0.54 mi (0.9 km) per year of wire modifications for 50 years.

2.1.2.2 Vegetation Management that Exposes Wires

Vegetation management is performed near powerlines to maintain adequate clearance. Vegetation management is a covered activity only when and where it exposes wires that were previously shielded by vegetation.

2.1.3 New or Extended Powerlines

When there is no additional capacity or space available on existing poles or towers, KIUC must construct new powerline corridors with new poles or towers. To save costs, improve efficiency of operations, and minimize visual impacts, KIUC strives to place these new powerlines in an existing right-of-way adjacent to existing power poles or towers. However, there are many cases where this is not feasible owing to narrow rights-of-way or land use constraints that do not allow a wider corridor. In these instances, KIUC would construct a new powerline (with new poles or towers) in a new right-of-way. In addition, there is a very remote chance that storm or other damage to existing powerlines is so severe that new powerlines in a new right-of-way may be required to restore service to an area.

KIUC will also need to expand the system of distribution lines to service new homes and businesses that are developed outside of the existing network of distribution lines. These expansions are expected to require extending existing distribution and/or transmission lines or building new transmission and/or distribution lines.

Operation of new or extended powerlines (for transmission and distribution) is a covered activity in this HCP. It is estimated that 360 mi (579.4 km) of new wires and support structures could be constructed over the 50-year permit term across KIUC's electric system. Construction of new powerlines is not a covered activity because construction activities are not expected to result in take of covered species (Section 2.4, *Activities Not Covered*). Once wires are in place (they do not need to be electrified) they are a covered activity under this HCP.

2.1.3.1 Adding Wires to Existing Powerline Circuits

KIUC adds new powerlines into its existing electric system (i.e., on existing poles or towers and on existing support structures) to increase capacity, especially to carry additional electrical load during times of peak usage. New powerlines can provide redundancy in the system that reduce or prevent power outages for customers. New powerlines are expected in response to growing demand for power due to population growth. In addition, KIUC expects to install new powerlines to connect new power sources (e.g., new renewable generation stations) to the electric grid.

KIUC frequently adds new wires to the existing powerline circuits to accommodate growth in demand and to increase redundancy in the system. In some cases, KIUC can offset the effects of the additional wires by changing the vertical arrangement to a horizontal (i.e., one-level) arrangement.

In all these cases, KIUC does not control where new demands for electrical service will arise. KIUC is a secondary developer of new powerlines that is asked to provide electricity based on the request of a primary developer of the new power demand (e.g., a new residential development, a new commercial development, or a new power generation source).

Construction of new powerlines is not a covered activity under this HCP because construction activities are not expected to result in take of covered species (Section 2.4, *Activities Not Covered*). Once wires are in place (they do not need to be electrified) they are a covered activity under this HCP. KIUC is requesting take coverage for the operation of new wires and support structures in locations that are currently unknown. As mentioned above, KIUC estimates that over the 50-year permit term, a maximum of 360 mi (579.4 km) of new wires will be required; this represents a 24 percent increase from the existing 1,531 mi (2,464 km) of powerlines and would represent an average of 7 mi (11.3 km) per year for 50 years.

2.2 Lighting Operations

KIUC operates nighttime lighting at two of its facilities, for temporary emergency power outage repairs, and for KIUC owned streetlights. This section describes which facility lights, temporary outage repair lighting, and streetlights are covered by this HCP.

2.2.1 Facility Lights

Operation of facility lights at the Port Allen Generating Station and the Kapaia Power Generating Station (Figure 2-1) is a covered activity in the KIUC HCP. Both facilities maintain night lighting for operations, visibility of personnel, and safety.

The Port Allen Generating Station is located at Port Allen east of Hanapēpē. Facility lighting at the Port Allen Generating Station includes 29 KIUC-owned lights mounted on poles and placed throughout the facility and eight lights mounted on building walls. In September 2019, the existing 150-watt high-pressure sodium (HPS) streetlights were retrofitted with 41- and 90-watt white light-emitting diode (LED) bulbs, allowing output to be dimmed while still maintaining visibility for staff. In addition, the eight wall-mounted lights were retrofitted with shielded wall-mounted white LED box lighting.

The Kapaia Power Generating Station is located approximately 1 mi (1.6 km) northwest of the town of Līhuʻe. Lighting consists of KIUC-owned streetlights and building lights placed throughout the facility in the parking lot and outdoor work areas. The streetlights consist of 150-watt HPS bulbs placed close to one another and relatively close to the ground. Each bulb is housed in a shield that completely covers the bulb except for the downward-facing glass. The design reflects all the light downward so that there is no upward lateral light transmission. The building lights use the same design concept but use a lower-wattage bulb.

Despite the light attraction minimization efforts at the Port Allen Generating Station and the Kapaia Power Generating Station, any KIUC infrastructure that produces light at night when the covered seabirds are fledging has the potential to cause fallout, resulting in incidental take. As such, the entire surface of the Port Allen Generating Station and Kapaia Power Generating Station, or approximately 9 acres (3.6 hectares) and 14 acres (5.7 hectares), respectively, are covered under the HCP because seabird fallout may occur anywhere within the stations.

2.2.2 Night Lighting for Repair of Facilities

When equipment failure or powerline damage occurs, KIUC must restore power to its customers as quickly as possible.[3] For the purpose of restoring power, KIUC may need nighttime lighting in order to ensure worker safety during repair or replacement of existing powerlines (in cases where the damage is too extensive to utilize the existing infrastructure), support structures, and substations. While repair work at night due to outages is rare, KIUC is requesting take coverage for the use of night lighting for emergency repair work that occurs during the seabird fallout season (September 15 to December 15) over the 50-year permit term. This emergency nighttime lighting coverage applies for repairs to, or replacement of, existing or new powerlines, support structures, and substations. Substations are not a covered activity, but in the event that repairs at substations are required to restore power outages and require nighttime lighting, the nighttime lighting is a covered activity.

Restoration of power takes on average 1 hour to complete and night lighting is operated for approximately half of that time. The first half-hour is typically used to troubleshoot and setup, and the last half-hour is used to perform the repair using lights. Based on records of past outages, KIUC estimated an average of 1.7 hours per year of emergency nighttime lighting to be necessary during the covered seabird fallout season (September 15 to December 15). This equates to 85 hours total nighttime lighting use over the 50-year permit term with the potential to take covered seabirds.

2.2.3 Streetlights

2.2.3.1 Existing Streetlights

KIUC owns and operates approximately 4,150 streetlights under agreements with the state, County of Kaua'i, and private entities, which includes those located at KIUC facilities as identified in Section 2.2.1, *Facility Lights* (Figure 2-1). All lights operated by KIUC are under its ownership. Most of these lights are on poles and towers that also carry electric lines, but some of the lights are stand-alone fixtures on their own stanchions. All lights are switched on and off at sunset and sunrise automatically by photosensitive switches installed in individual lights. As of 2017, all KIUC streetlights were converted from HPS to more energy-efficient 3,000-kilowatt LED bulbs (Kaua'i Island Utility Cooperative 2017), and of these approximately 75 percent are 41-watt bulbs and

[3] This does not include catastrophic events like Hurricane 'Iniki that threaten human life and property.

approximately 25 percent are 90-watt bulbs. All of KIUC's streetlights have full cutoff shielded fixtures.[4]

Operation of existing KIUC streetlights is a covered activity in the KIUC HCP because they contribute to the lightscape on Kauaʻi. For a streetlight to be considered operational under this HCP, the light must be energized and operational (i.e., streetlight construction, prior to the light being energized and operational, is not a covered activity). Despite efforts to minimize the amount of upward directed light from KIUC streetlights, they may still result in fallout of a covered seabird fledgling, resulting in incidental take. In locations where coastal streetlights are visible from suitable beach habitat, green sea turtle (honu) (*Chelonia mydas*) hatchlings may become disoriented by downward-facing lights, resulting in incidental take.

2.2.3.2 New Streetlights

KIUC expects to operate up to 1,754 new shielded streetlights along Kauaʻi's roadways over the 50-year permit term (an average of 35 new streetlights per year). Based on growth projections on Kauaʻi, the number of new streetlights is not expected to exceed 50 per year. As with all the existing streetlights on Kauaʻi, any new streetlights will also be equipped with full-cutoff shields.

Operation of future streetlights is a covered activity under the HCP for the same reason as described for existing streetlights (Section 2.2.3.1, *Existing Streetlights*). Construction of new streetlights is not a covered activity because installation of the streetlights is not expected to result in take of any covered species given that the light is not operational during construction. KIUC has no authority over the siting of new streetlights because they are the secondary developer asked to provide electricity and install streetlights based upon the request of a primary developer.

2.3 Implementation of the Conservation Strategy

Activities related to implementation of the HCP conservation strategy at the conservation sites may result in incidental take of the covered species. The conservation measures implemented at the conservation sites include construction and maintenance of predator exclusion fences, predator control within and outside of the predator exclusion fences, social attraction to attract covered seabirds to new nesting colony sites within the fenced areas, and selective invasive plant species control. These activities are further described in Chapter 4, Section 4.4, *Conservation Measures*, and are expected to have a net benefit to the covered seabird species (see Chapter 5, *Effects*).

2.4 Activities Not Covered

The KIUC HCP is designed to cover all activities for which KIUC envisions the need for incidental take coverage over the permit term. The following activities and structures were determined by KIUC to not require coverage in this HCP because KIUC does not control the activity or incidental take is not reasonably certain to occur, as explained below. If coverage of any of these activities

[4] *Full cutoff shielded fixtures* are designed to direct the light downward and outward, rather than upward toward the sky.

becomes necessary in the future, KIUC may apply for an amendment to this HCP, as described in Chapter 7, *Plan Implementation*.

- **Construction, Installation, Removal, and Repair of KIUC Infrastructure.** KIUC is not seeking incidental take coverage for the act of construction, installation, removal, or repair of infrastructure, including but not limited to construction of buildings, streetlights, facilities, powerlines, and associated minimization devices (e.g., bird flight diverters). Construction, installation, removal, and repair of KIUC infrastructure is not a covered activity because it is not reasonably certain to result in take of the covered species. Powerlines, including support structures (i.e., poles, towers, and H-frames) are covered once the wires are strung between the supporting structures, even if construction is not complete and the wires are not electrified.
- **Routine Wire Modification and Repair.** KIUC must regularly service and repair all wires, either for preventative modification or in response to equipment failure. Routine modification of wires and supporting structures is not a covered activity unless the modification will increase wire height, add new wires, or expose wires to increased collision risk (i.e., through vegetation maintenance) (see Section 2.1.2, *Powerline Modifications*, for details). These routine modification activities are not covered activities because they are not reasonably certain to result in take of the covered species.
- **Routine Support Structure Modification and Replacement**. KIUC must regularly service and repair all supporting structures (i.e., poles, towers, and H-frames), either for preventative modification or in response to damage. Routine modification of support structures is not a covered activity under this HCP. Replacement of support structures is also not covered in this HCP if the replacement support structure is located along an existing powerline. In addition, increasing support structure height is not a covered activity under this HCP. These routine modification activities are not covered activities because they are not reasonably certain to result in take of the covered species.
- **Operation and Modification of Other Infrastructure within the Port Allen Generating Station and the Kapaia Power Generating Station.** Operation and modification of all KIUC infrastructure within the Port Allen Generating Station or Kapaia Power Generating Station, other than powerlines and facility lights, are not covered activities in the KIUC HCP because they are not reasonably certain to result in take of the covered species. This includes operation and modification of KIUC infrastructure such as buildings, parking lots, fuel storage tanks, water treatment facilities, and gas turbines.
- **Operation and Modification of Service Wires.** Service wires are wires that connect distribution lines directly to buildings or transformers. Service wires are typically low voltage (600 volts or less) and short in length. Service wires typically occur separately but are sometimes mounted with distribution wires; where both are present, service wires are always mounted below the distribution wire. There are cases in which these low-voltage wires are the only electric wires on a pole; however, this mainly occurs in residential areas. In all cases, service wires are not reasonably likely to result in take of the covered species because of the low height and proximity of other structures (e.g., buildings, houses) in the same area as the service wires, making collisions extremely unlikely. Therefore, operation and modification of service wires is not a covered activity in this HCP.
- **Wires Owned by Others.** KIUC does not own or operate all overhead wires in the Plan Area. Distribution wires and other utility wires (at any height) owned and operated by other entities,

even if they are located on KIUC's poles, are not covered by this HCP. These lines are not covered by this HCP because they are not under the control or ownership of KIUC.

- **Streetlights Owned by Others.** KIUC does not operate streetlights owned by other entities. Streetlights owned by others are not a covered activity in this HCP.
- **Operation and Modification of Existing Solar Facilities and Hydroelectric Facilities.** KIUC owns and maintains two solar facilities and two hydroelectric facilities. None of these facilities operate nighttime security lighting and these facilities do not typically involve nighttime repair work. The operation and modification of equipment and structures at these solar and hydroelectric facilities are not reasonably certain to result in take of the covered species. The operation of powerlines connecting these generating facilities to the grid is a covered activity, as described in Section 2.1, *Powerline Operations*.
- **Operation and Modification of Existing Substations and Switchyards.** KIUC maintains electric substations and switchyards throughout its electric transmission system. Similar to solar and hydroelectric facilities, substations and switchyards do not operate nighttime security lighting and are only lit during nighttime repairs (which is a covered activity). The operation or modification of substations and switchyards is not a covered activity because there are no streetlights or exterior building lights that could result in take of the covered species due to light attraction. In the rare case that nighttime repair work at substations and switchyards is necessary to restore power outages in the permit term, the nighttime lighting would be a covered activity (see Section 2.2.2, *Night Lighting for Repair of Facilities*).
- **Decommissioning Infrastructure.** Decommissioning typically involves removing all aboveground structures, lights, and/or electrical infrastructure including, but not limited to, control structures, enclosures, transformers, voltage regulators, A-frames, H-frames, and their respective footings, along with all onsite interconnections with the island-wide grid. This activity is not reasonably certain to result in take of the covered species, and in fact may result in beneficial effects on the covered species where powerlines or lights are removed. Therefore, decommissioning of infrastructure is not a covered activity in this HCP.

Chapter 3
Environmental Setting

Chapter 3 Highlights

Chapter Purpose: This chapter provides an overview of Kauaʻi's existing environment, with a particular emphasis on factors relevant to the effects of KIUC activities on the covered species. Further, it provides an overview of the covered species' habitats, threats, and conservation needs, as well as a description of the data sources for seabird distribution and abundance estimates and trends.

Context: The environmental setting of covered species is necessary background to inform the habitat conservation plan development.

Major Conclusions:	See the following for more information:
• **Environmental setting:** Kauaʻi, known for its steep cliffs, valleys, and coastal plains, has a stable climate with temperatures ranging from 60 to 80 degrees Fahrenheit (15.5 to 26.7 degrees Celsius), and an uneven rainfall distribution with over 400 inches (1,016 centimeters) in the mountains to 30 inches (76 centimeters) on the west coast. There are numerous wetlands in the lowlands that support the covered waterbird species. Coastal cliffs and steep, wet montane forests are where the majority of the existing seabird colonies are located. Native vegetation has undergone extreme alterations due to agriculture and introduced invasive plants and animals. The majority of remaining intact ecosystems are located in the steep interior mountainous areas away from developed areas. Kauaʻi remains mostly undeveloped, with rural communities, tourist resorts, and coastal agriculture as the main land uses. Natural hazards include tsunamis, landslides, storms, sea-level rise, and wildfires, which all may be intensified with climate change.	Section 3.1
• **Seabirds:** Covered seabird species include Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), and the Hawaiʻi distinct population segment of the band-rumped storm-petrel (ʻakēʻakē). Kauaʻi is home to approximately 90% of the Newell's shearwater (ʻaʻo) and 33% of the Hawaiian petrel (ʻuaʻu) populations. For this HCP, the totality of seabirds of each species inhabiting the island is collectively termed the *Kauaʻi metapopulation* of that species. KIUC has compiled the best available data on the distribution and abundance of these Kauaʻi metapopulations to be able to assess the effects of the covered activities and to develop a conservation strategy to minimize and offset impacts, and provide a net benefit to each species.	Section 3.2.1
• **Seabird threats and conservation efforts:** As described in this chapter, the covered seabirds face many threats including artificial lighting causing fallout and collisions with powerlines. KIUC has been involved in seabird conservation since 2001, focusing on minimizing powerline strikes and light attraction, and habitat management and enhancement. KIUC also contributes to the Save Our Shearwaters Program that rescues and rehabilitates the covered avian species as well as other native avian species.	
• **Waterbirds:** Covered waterbird species include the Hawaiian stilt (aeʻo), Hawaiian duck (koloa maoli), Hawaiian coot (ʻalae keʻokeʻo), Hawaiian common gallinule (ʻalae ʻula), and the Hawaiian goose (nēnē). All are both federally and state listed as endangered, except for the Hawaiian goose (nēnē), which has been federally downlisted to threatened but is still state listed as endangered.	Section 3.2.2

The **loss of wetland habitats** is the biggest threat to these waterbird species. Even though the covered activities are not the main threat to waterbirds, they are vulnerable to powerline collisions when taking off and landing.

- **Green sea turtle (honu):** This species is listed as threatened under the federal Endangered Species Act and is protected by Hawaiʻi state laws. Primary threats to green sea turtle (honu) are attributed to human activities leading to habitat loss and direct harm. A significant threat to hatchlings is artificial light attraction. Section 3.2.3

Data Sources: Data for the affected environment section include GIS data from U.S. Geological Survey, State of Hawaiʻi, and National Wetlands Inventory, as well as climate data from the Western Regional Climate Center. The covered species overviews are based on the detailed information in Appendix 3A, *Species Accounts*, and the description of primary data sources is based on annual reports for each dataset from the Kauaʻi Endangered Seabird Recovery Project, Archipelago Research and Conservation, National Tropical Botanical Garden, and Hallux Ecosystem Restoration.

Related Chapters: This chapter provides context for the next two chapters of the HCP: Chapter 4, *Conservation Strategy*, and Chapter 5, *Effects*.

This chapter provides an overview of the existing environment on the Island of Kauaʻi (Kauaʻi) with a focus on factors relevant to effects of KIUC activities on the covered species and the conservation needs of those species on Kauaʻi. More information on the existing environment that could be affected by implementing the KIUC HCP may be found in the environmental impact statement (EIS) prepared pursuant to the National Environmental Policy Act and State of Hawaiʻi Revised Statutes Chapter 343 Hawaiʻi Environmental Protection Act.

Chapter 3, *Environmental Setting*, is divided into two sections.

- Section 3.1, *Affected Environment*, summarizes the relevant physical environment, including physiography, geology, soils, hydrology, climate, and air quality. This section also summarizes relevant land use and the biological environment on Kauaʻi, including vegetation.
- Section 3.2, *Covered Species*, summarizes the ecology, distribution, range, abundance, and current threats to each of the covered species.

3.1 Affected Environment

3.1.1 Physiography, Geology, and Soils

3.1.1.1 Physiography

Kauaʻi has a land area of approximately 550 square miles (sq mi) (1,425 square kilometers [sq km]). Roughly circular in shape, its most striking physiographic features are a high central plateau of over 5,000 feet (ft) (1,524 meters [m]) at the summits of Mt. Waiʻaleʻale (5,148 ft [1,569 m]) and Mt. Kawaikini (5,243 ft [1,598 m]). The central plateau is characterized by steep cliffs and deeply incised valleys along the northern Nā Pali Coast, the 3,600-ft-deep (1,097 m) Waimea Canyon, the broad Līhuʻe Basin on the southeastern quadrant of the island, and extensive coastal plains. These features can be seen on the topographic relief map (Figure 3-1) and the slope map (Figure 3-2) of the island.

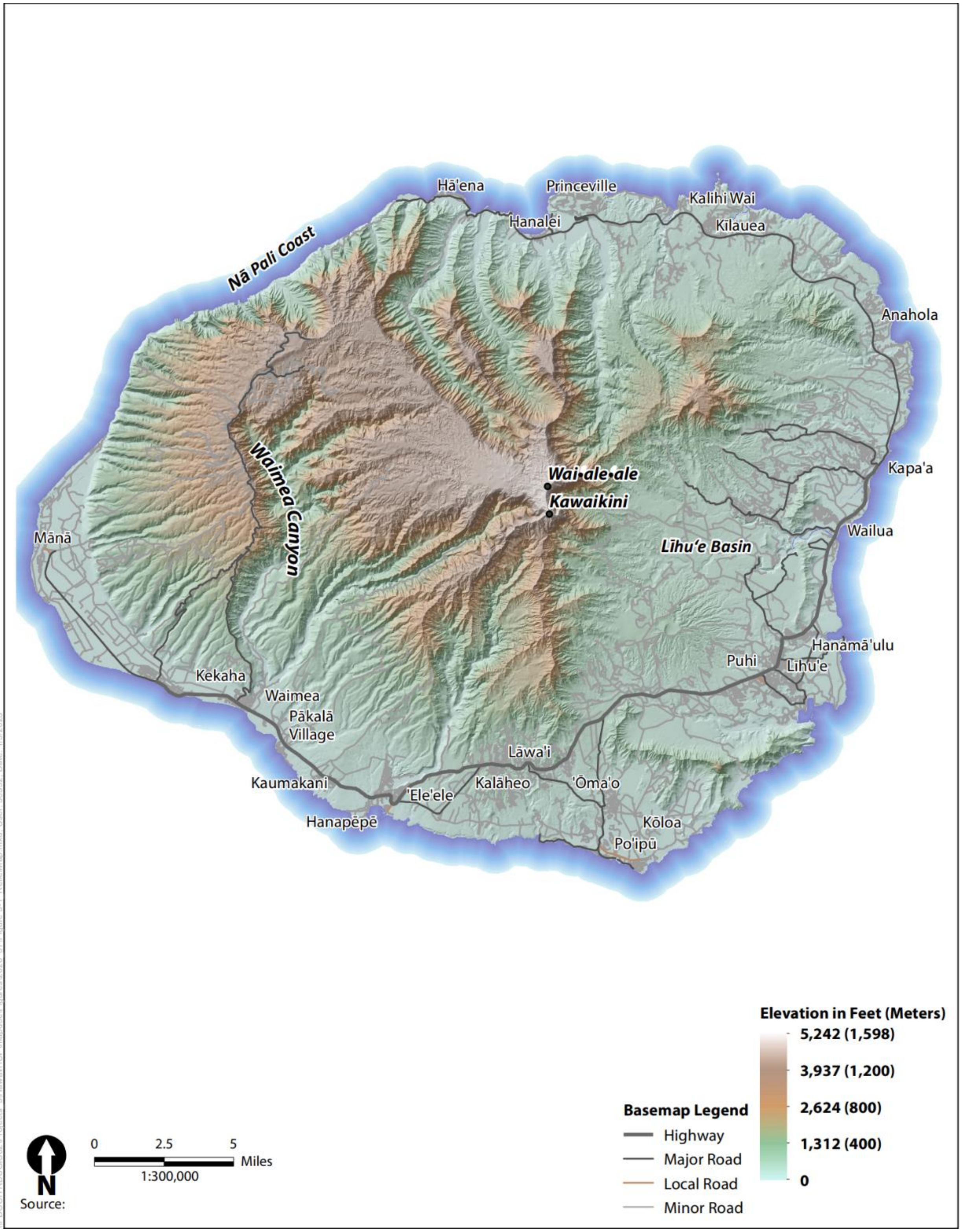

Figure 3-1. Topographic Relief of Kauaʻi

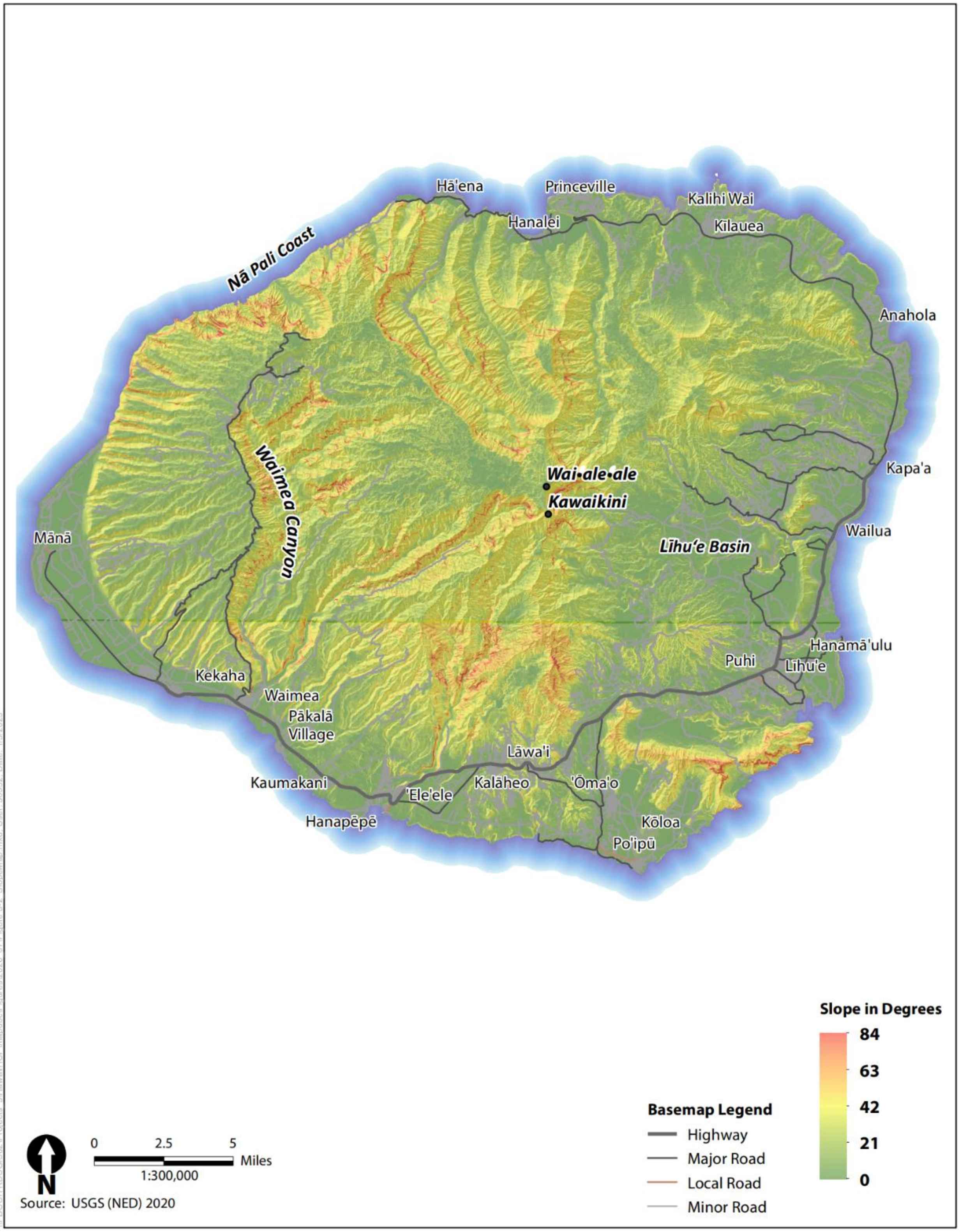

Figure 3-2. Slope Map of Kaua‘i

3.1.1.2 Geology

Kauaʻi, like the other Hawaiian Islands, was formed by magma that emerged from a hotspot beneath the Earth's crust that remained stationary as the plates on the Earth's crust moved over it (Stearns and MacDonald 1960). The main mass of Kauaʻi is believed to be about 3 to 5 million years old, although there were a few small eruptions on Kauaʻi as late as about 500,000 years ago (Juvik 1998). As this magma moved towards the surface, it erupted as lava, pouring out over the ocean floor. Over time, the eruptions formed a typical Hawaiian shield volcano. Deep erosion and weathering of the flows resulted in the topographically and geologically complex landscape present today (Juvik 1998).

3.1.1.3 Soils

As one of the oldest and most geologically complex Hawaiian Islands, Kauaʻi has a relatively high diversity of soil types. The lowland areas have predominantly deep, nearly level to steep, well-drained soils that have a fine-textured or moderately fine-textured subsoil. The western half of the island also has well-drained soils over basalt bedrock. The more rugged areas in central and northwestern portions have relatively shallow, rocky soils (U.S. Department of Agriculture 1973). Seabirds play an important role in soil nutrient recycling in Hawaiʻi, depositing guano that provides an important source of nutrients to the volcanic soils from the marine environment (Rowe et al. 2017).

3.1.2 Hydrology

Figure 3-3 depicts the perennial rivers and streams on Kauaʻi. Like all of the Hawaiian Islands, Kauaʻi's streams respond rapidly to storm rainfall because drainage basins are small and the distance of overland flow is short (Juvik 1998). Most streams on Kauaʻi radiate out from the Waiʻaleʻale-Kawaikini massif[1] in all directions, cutting through intrusive dikes that retard the groundwater movement toward the ocean from high rainfall areas in the interior. In the process, streams tend to receive large influxes of groundwater throughout their length. Thus, unlike most Hawaiian streams, many of the streams on Kauaʻi gain flow as they descend.

Figure 3-4 depicts the distribution of wetlands and open water (i.e., lakes, reservoirs, and other impoundments) on Kauaʻi based on regional data from the National Wetland Inventory (U.S. Fish and Wildlife Service 2020a). Numerous estuarine and freshwater emergent wetlands skirt the lowlands of the island, along with human-made reservoirs and scattered ponds, all of which provide habitat for most of the covered waterbirds (U.S. Fish and Wildlife Service 2011). Freshwater wetlands are also present in the higher elevation, forested areas. Alakaʻi swamp (Figure 3-4) is a montane wet forest located on a high plateau and containing alpine bogs that support federally listed plant species, but the covered species do not occur in these wetlands (75 *Federal Register* 18959).

[1] A block of the earth's crust bounded by faults and shifted to form peaks of a mountain range.

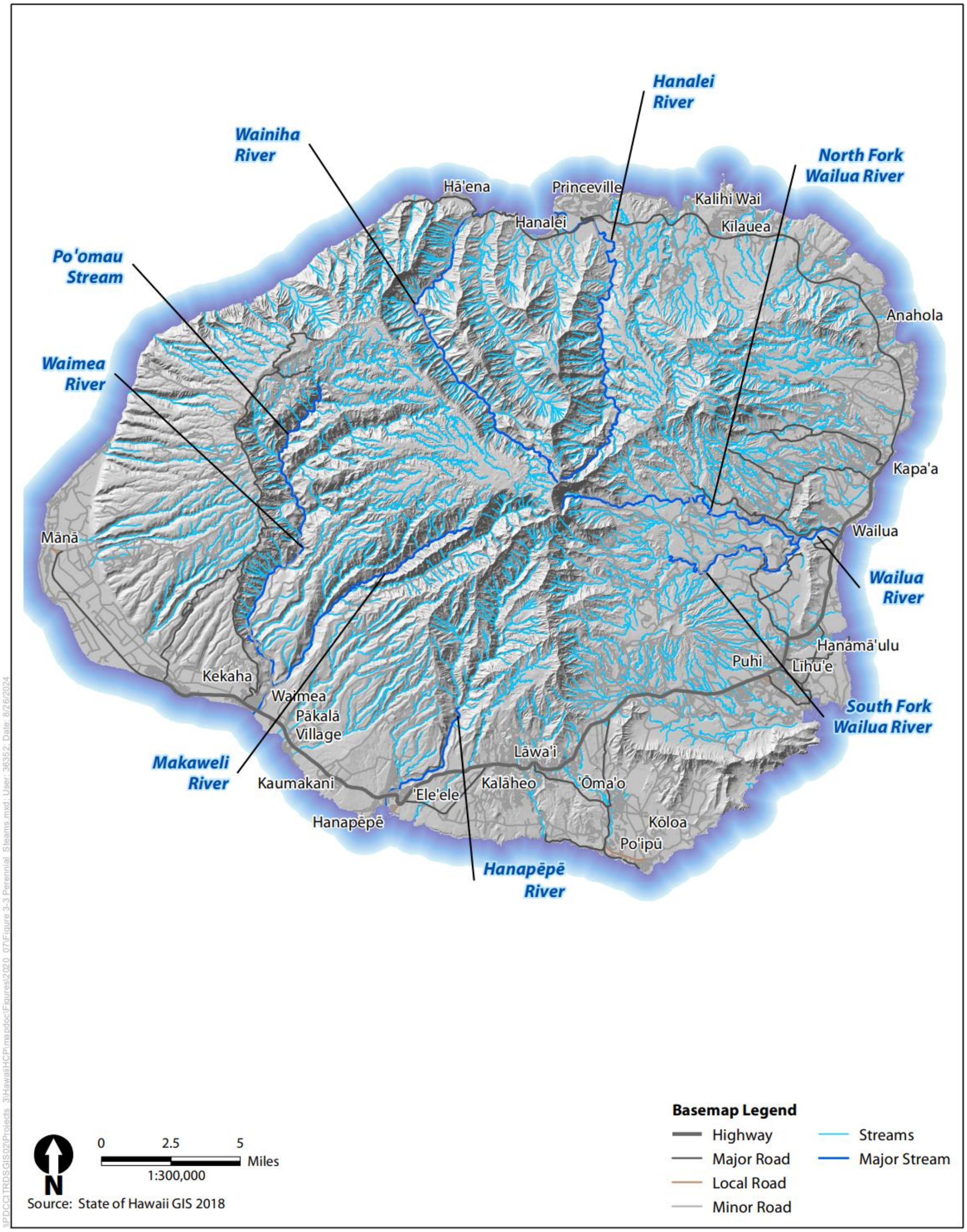

Figure 3-3. Perennial Rivers and Streams of Kauaʻi

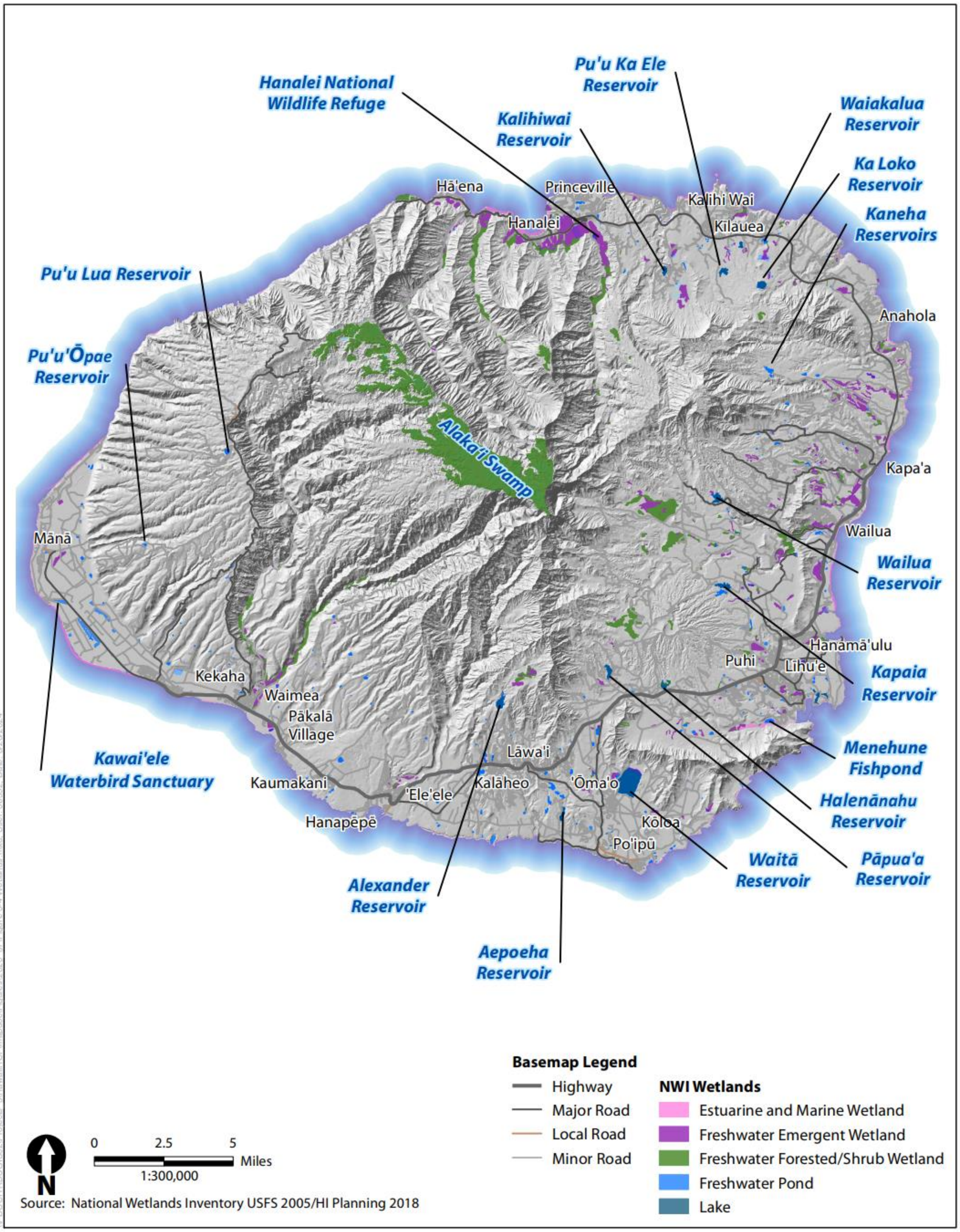

Figure 3-4. Wetlands and Open Waters of Kaua'i

3.1.3 Climate and Weather

3.1.3.1 Wind

The northeast trade winds are the most important determinant of Kaua'i's climate. They represent the outflow of air from the high-pressure region known as the Pacific Anticyclone, whose typical location is well north and east of Hawai'i (Western Regional Climate Center 2018). The trade wind zone moves north and south seasonally and reaches its northernmost position in the summer. Consequently, the trade winds are strongest and most persistent from May through September, when the trade winds are prevalent 80 to 95 percent of the time. From October through April, the heart of the trade winds are south of Hawai'i, and trade wind frequency decreases to about 50 percent (as a monthly average). On a few exposed headlands and in the mountains that catch and concentrate the full force of the trade winds, winds above 40 miles per hour (mph) (64.4 kilometers per hour [kph]) may occur several days each month of the year. In nearly all other locations, however, such winds are infrequent, and then only as the result of a major storm, the passage of a cold front, or an unusual local situation (Western Regional Climate Center 2018).

The land and sea circulations (due to convection air movements) are on a far smaller scale than the circulations of the trade winds or major storm systems, with the exchange of air often being confined to a few square miles. Circulations of this kind are most common on the southern and western coast in locations that are to the leeward with reference to the trade winds and topographically sheltered from them. Land and sea air circulation exhibit a diurnal rhythm. From the late morning until the early evening air moves inland on a sea breeze; sometimes these sea breezes are brisk. During the night and until shortly after sunrise, the air drifts back from land to sea; this movement is usually quite gentle.

3.1.3.2 Rainfall

Kaua'i lies in the path of the persistent northeast trade winds that gather substantial moisture as they pass over the Pacific Ocean. Rainfall along the eastern side of the island is induced by the topographic relief of the mountains as the air is forced to rise over Mt. Wai'ale'ale. At Mt. Wai'ale'ale, on Kaua'i, the annual average rainfall reaches the extraordinary total of 486 inches (in) (1,234.4 centimeters [cm])—over 40 ft (12.2 m). This is the highest recorded annual average in the world (Western Regional Climate Center 2018). As the air descends on the western side of the island, rainfall diminishes drastically towards the town of Kekaha. This results in one of the largest and steepest rainfall gradients on Earth (Ferrier et al. 2013; Juvik 1998) (see Figure 3-5). Average annual rainfall at Waimea on Kaua'i's southwestern shore is less than 30 in (76.2 cm); 20 mi (32.2 km) away at the summit of Mt. Wai'ale'ale, it is more than 400 in (1,016 cm).

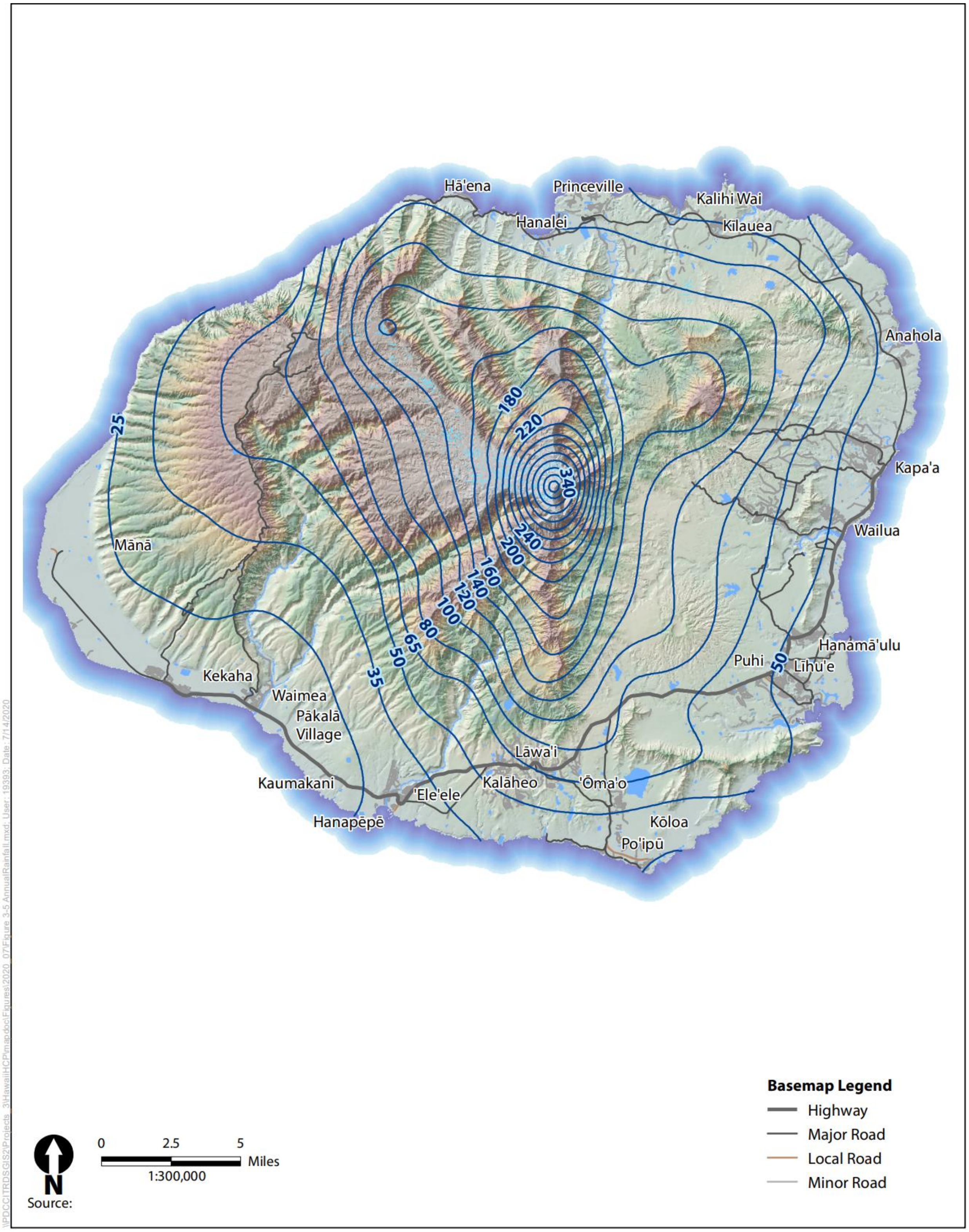

Figure 3-5. Average Annual Rainfall on Kauaʻi, in Inches

Extreme rainfall intensities can occur, with the most intense rainfall events not associated with hurricanes. To take the most extreme instance on record, during the storm of April 13 to April 15, 2018, an automated rain gage near Hanalei on the North Shore recorded 53.57 in (136.1 cm) in 48 hours, including 49.69 in (126.2 cm) during a 24-hour period.

While rainfall can be extremely heavy, very light showers are frequent in most localities. On the windward coast, for example, it is common to have up to ten brief showers in a single day, each producing less than 0.01 in (0.025 cm) of rain. This seeming contradiction is explained by the fact that the usual run of trade-wind weather yields many light showers in the lowlands. Mountain slopes and crests within the cloud belt receive water in the form of fog drip or cloud mists as well as direct rainfall (Western Regional Climate Center 2018).

3.1.3.3 Air Temperature

Kauaʻi, like the other Hawaiian Islands, has one of the most stable climates on Earth. Isolated from large landmasses, Hawaiʻi has a very low annual temperature range (Giambelluca et al. 2008). This muted annual cycle of air temperature is due to the small season-to-season changes in solar radiation and the ocean's moderating influence. Differences in temperature from place to place are mainly due to elevation, with a fairly constant temperature decrease of 3.6 degrees Fahrenheit (°F) (2 degrees Celsius [°C]) per 1,000 ft (304.8 m) from sea level to about 4,100 ft (1,249.7 m) and 2.2°F (1.2°C) per 1,000 ft (304.8 m) above 4,100 ft (1,249.7 m). Small differences in temperature occur between cloudier, wetter, windward locations and sunny, dry, leeward locations at similar elevations (Juvik 1998). Diurnal temperature ranges are smallest in the lowlands, with daytime temperatures commonly in the 70s to 80s (°F) and nighttime temperatures in the 60s to 70s. Mean annual temperatures range between about 72°F (22°C) and 75°F (24°C) near sea level.

Outside the dry, leeward areas, temperatures of 90°F (32°C) and above are uncommon. In the leeward areas, temperatures in the low 90s may be reached on several days during the year, but temperatures higher than these are uncommon.[2] The warmest days are usually during what is known as *Kona weather*, when the trade winds, which come from cooler latitudes, fail and air stagnates over the heated islands (Western Regional Climate Center 2018).

3.1.3.4 Hurricanes, Tropical Storms, and Waterspouts

Major storm systems periodically affect all of the Hawaiian Islands including Kauaʻi. There are four classes of disturbances that produce major storms. Sometimes a cold front sweeps across the islands, bringing with it locally heavy showers and gusty winds. A storm eddy, or low-pressure system, can move past the islands bringing widespread heavy rains often accompanied by strong winds. These low-pressure systems are known as *Kona storms*.[3] A separate and third class of disturbance are those instances of severe weather attributable to low-pressure systems in the upper atmosphere that are not associated with the foregoing cold fronts or Kona storms (Western Regional

[2] The highest temperature on record is from Līhuʻe, which reported 99°F (37°C) on December 23, 2010 (https://www.plantmaps.com/hawaii-record-high-and-low-temperature-map.php).

[3] The term *Kona storm* was originally applied to the slow-moving subtropical cyclones that occasionally enter the Hawaiian area. Increasingly, this term is now applied by the local public to any widespread rainstorm accompanied by winds from a direction other than that of the trade winds.

Climate Center 2018). The fourth class of disturbance is the true tropical storm or hurricane.[4] These are rare, but can pass close enough to the islands to yield heavy rains, high winds, and large waves (Western Regional Climate Center 2018). The official hurricane season in Hawaiʻi is from June 1 through November 1. The number of hurricanes and tropical storms in the central Pacific per year over the last 20 years (1999–2018) has varied from 1 in multiple years to 14 in 2015 with an average of 3.4 per year. Such storms typically bring heavy rains and are sometimes accompanied by strong winds. However, the highest rainfall intensities have not been associated with hurricanes.

Hurricanes and tropical storms have struck Kauaʻi on a number of occasions over the past 50 years. Table 3-1 summarizes the important characteristics of hurricanes that have affected Kauaʻi since 1950. Hurricanes are infrequent, but have had a great effect on Kauaʻi, especially its utility infrastructure. Most recently, on September 11, 1992, Hurricane ʻIniki struck Kauaʻi with sustained winds of 130 mph (209 kph) and caused nearly $2 billion in property and infrastructure damage. Kauaʻi also received the brunt of Hurricane ʻIwa, which struck on November 23, 1982, and produced an estimated $234 million in damage. Tropical storms that do not make landfall in Hawaiʻi can still cause considerable infrastructure damage mostly due to winds and high surf (National Oceanic and Atmospheric Administration n.d.).

Table 3-1. Major Hurricanes Affecting Kauaʻi: 1950 to 2018

		Maximum recorded winds ashore (mph)		
Name	**Date**	**Sustained**	**Peak gusts**	**Category**
Hiki	Aug. 15–17, 1950	68	UNK	1
Nina	Dec. 1–2, 1957	UNK	92	1
Dot	Aug. 6, 1959	81	103	2
ʻIwa	Nov. 23, 1982	65	117	3
ʻIniki	Sept. 11, 1992	92	143	4

Source: State of Hawaiʻi Department of Business, Economic Development, and Tourism 2019:Table 5.53.
Note: Category is based on the Saffir-Simpson Hurricane Scale:
Category 1: wind speed of 74–95 mph (119–153 kph), minimal damage.
Category 2: wind speed of 96–110 mph (154.5–177 kph), moderate damage.
Category 3: wind speed of 111–130 mph (178.6–209 kph), extensive damage.
Category 4: wind speed of 131–155 mph (210.8–249.4 kph), extreme damage.

Hurricanes ʻIniki and ʻIwa both resulted in significant changes in vegetation on the Kauaʻi, especially in the more remote areas of the interior. Hurricane-force winds denuded large areas of densely forested valley walls. Harrington et al. (1997) studied hurricane ʻIniki's effect on forest structure in Puʻu Ka Pele Forest Reserve, Nā Pali Kona Forest Reserve, and Kōkeʻe State Park and found that major overstory species, namely koa (*Acacia koa*) and ʻōhiʻa (*Metrosiderous polymorpha*), were damaged less than the subcanopy species ʻaʻaliʻi kūmakani (*Dodonaea viscosa*) and guava (*Psidium guajava*). Further, the invasive species guava had much higher survival than the native kūmakani. Forest structure and productivity had recovered to a great degree within 2 years after landfall of the hurricane (Harrington et al. 1997).

[4] A *hurricane* is an intense tropical weather system with well-defined circulation and maximum sustained winds of 74 mph (64 knots) or higher. A *tropical storm* is an organized system of strong thunderstorms with a defined circulation and maximum sustained winds of 39 to 73 mph (62.8 to 117.5 kph).

3.1.3.5 Global Climate Change

Global climate change is occurring because of high concentrations of greenhouse gases in the Earth's atmosphere (National Research Council 2010; Intergovernmental Panel on Climate Change 2014). *Climate* is defined as the average weather over many years, and climate change refers to a statistically significant change in the state of the climate or its variability that persists for an extended period, typically for decades or longer (Intergovernmental Panel on Climate Change 2014). Recent assessments demonstrate the Earth is undergoing changes in climate beyond natural variation (National Research Council 2010; Intergovernmental Panel on Climate Change 2014; Melillo et al. 2014). Evidence of long-term changes in climate over the 20th century includes the following.

- An increase of 1.53°F (0.85°C) in the Earth's global average surface temperature
- An increase of 6.7 in (17 cm) in the global average sea level
- A decrease in arctic sea-ice cover at a rate of approximately 4.1 percent per decade since 1979, with faster decreases of 7.4 percent per decade in summer
- Decreases in the extent and volume of mountain glaciers and snow cover
- A shift to higher altitudes and latitudes of cold-dependent habitats
- Longer growing seasons
- More frequent weather extremes, such as droughts, floods, severe storms, and heat waves

Natural hazards on Hawai'i such as tsunamis, landslides triggered by heavy precipitation, storms, sea level rise, and wildfire triggered by drying may be intensified by climate change. Rising temperatures are also causing new stressors such as heat waves. To better understand anticipated increases in temperature, climate models are frequently used. Projections of future climate are developed at many scales, from Global Climate Models to Regional Climate Models, including Regional Climate Models based on Global Climate Model data that have been statistically downscaled to particular regions (Wang et al. 2018), including Hawai'i. Future greenhouse gas emissions scenarios are used in climate model projections of possible future climate conditions.

Hawai'i is already susceptible to tropical storms, which mainly occur between June and November. Based on regional climate models that include Hawai'i, the size and intensity of large-scale storms in the state are expected to increase in coming years. These changes may already be occurring; recent data shows that the proportion of Category 4 and 5 hurricanes have increased at a rate of 25–30 percent of overall recorded hurricane activity, per °C increase in global warming (Holland and Bruyere 2014). These storms are predicted to intensify in both frequency and intensity due to climate change and can bring heavy rains, high winds, and high waves to the islands. Hurricanes do not normally affect the state, as many of these events dissipate into tropical storms or depressions as they approach the island chain. The annual number of tropical cyclones observed in the Central North Pacific has varied over time, with a greater number forming during El Niño years. Future tropical cyclone activity remains uncertain. Projections indicate that the likelihood of both a hurricane landfall and near-landfall on Kaua'i will increase during the 21st century. Understanding and preparing for the projected increase in storm intensity and frequency is critical for addressing the impacts of climate change on the islands. For more details, please refer to Chapter 7, Section 7.3.3.1, *Severe Weather, Natural Hazards, and the Effects of Climate Change*, and Appendix 7C, *Summary of Supplementary Climate Projections*.

A global warming of 2.7°F (1.5°C) is expected to shift the range of many marine species to higher latitudes, reducing the productivity of fisheries and aquaculture (Intergovernmental Panel on Climate Change 2018:B.4.3). Ocean warming from climate change is expected to increase the thermal stratification in the upper ocean, reducing the upwelling of nutrients and decreasing productivity (Fabry et al. 2008). Squid, a primary food source for Newell's shearwater (ʻaʻo) (*Puffinus newelli*), Hawaiian petrel (ʻuaʻu) (*Pterodroma sandwichensis*), and many other seabird species are predicted to undergo shifts in their range and size as a result of warmer ocean temperatures. Individual squid would require more food per unit body size, require more oxygen due to faster metabolism, have a reduced capacity to cope without food, and reduced pH could affect ability for squid to uptake oxygen (Pelc and Jackson 2008). Additional threats to the covered species related to climate change are described in Appendix 3A, *Species Accounts*.

3.1.4 Land Use

Kauaʻi's built environment consists of small, mostly rural communities along the coast margins and plains separated by expanses of open space and agricultural lands. Steep topography across much of Kauaʻi (see Figures 3-1 and 3-2) severely limits development in the interior of the island. There are no incorporated cities on Kauaʻi. The County of Kauaʻi is the one local government agency responsible for all land use planning on the island. Figure 3-6 shows land designations consistent with the Kauaʻi Future Land Use Map in the *Kauaʻi Kākou: Kauaʻi County General Plan* (General Plan) (County of Kauaʻi 2018). The General Plan was designed to avoid urban sprawl by focusing future development, uses, and density within and around existing towns, and preserving agricultural land and open space between towns (County of Kauaʻi 2018). The land use map accommodates projected housing needs within and adjacent to existing developed areas and discourages residential and resort development in new areas not directly adjacent to existing communities. Most of the growth is steered to the Līhuʻe and South Kauaʻi areas. Additional growth is allocated to the Waimea-Kekaha, Hanapēpē-ʻEleʻele, East Kauaʻi, and North Shore areas based on historic and natural increase trends.

A majority of the island is designated as *natural* in the Future Land Use Map—these areas have either limited development potential or are not suitable for development due to topography, hazards vulnerability, sensitive resources, and other constraints. Lands designated as natural generally overlap with the areas that have been identified as existing or potential habitat for the covered species as described in Section 3.2, *Covered Species*.

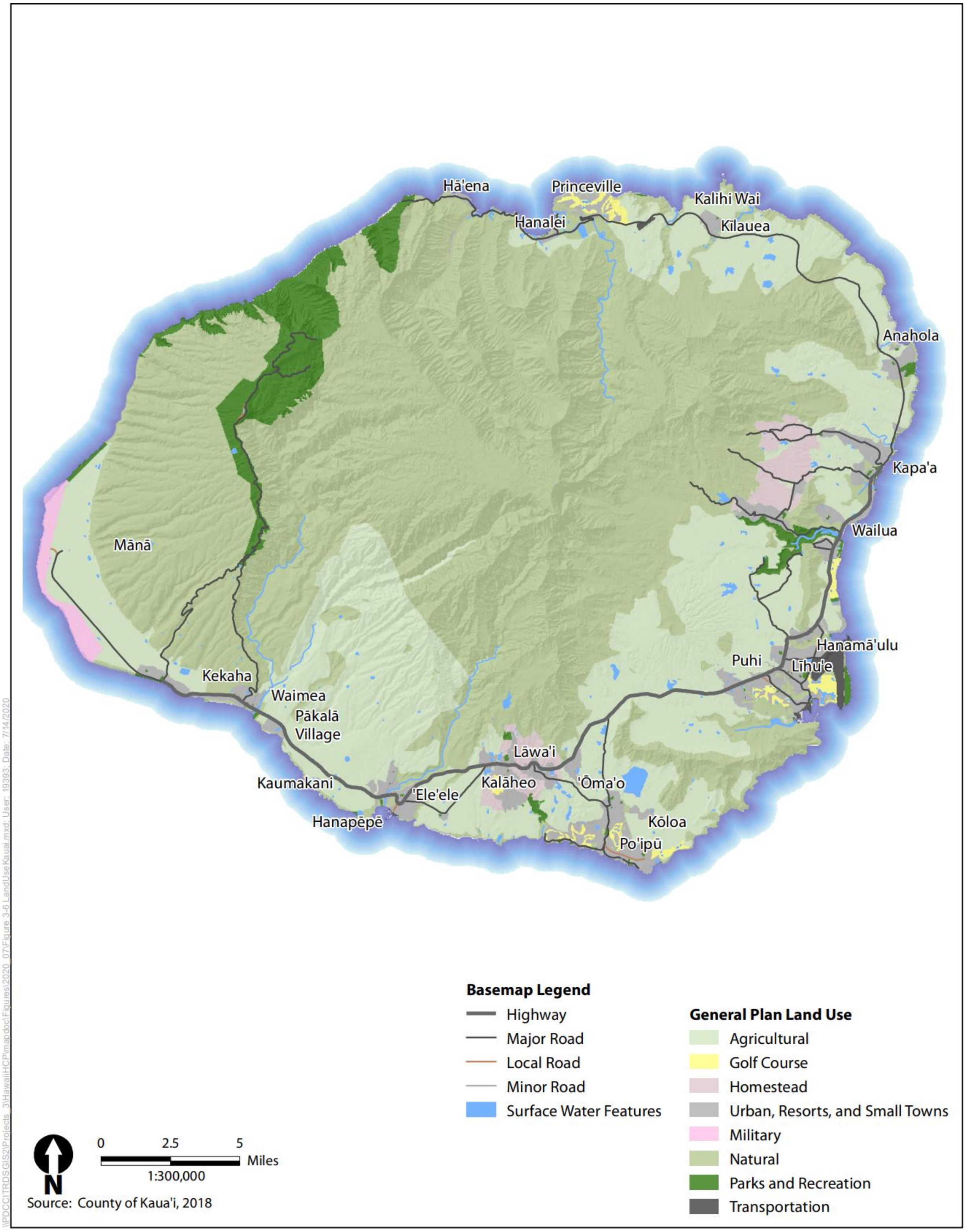

Figure 3-6. Land Use Designations on Kauaʻi

3.1.5 Vegetation

As the oldest of the main Hawaiian Islands, Kaua‘i has relatively high levels of floristic diversity and endemism. Over time, the topography and habitats have become more fragmented, with deeper valleys and other local topographic features creating greater fragmentation of habitats and thus greater isolation and opportunities for speciation. The age of Kaua‘i (3 to 5 million years) has also provided more time for the development of floral biodiversity than on other Hawaiian Islands (Sakai et al. 2002).

Figure 3-7 depicts existing land cover types throughout Kaua‘i as distinct native and alien (i.e., invasive) vegetation types mapped by the U.S. Geological Survey Gap Analysis Program (GAP) and Carbon Assessment of Hawai‘i (CAH) (U.S. Geological Survey 2011, 2017). Terrestrial and wetland vegetation types in the CAH dataset were compared in a crosswalk to the GAP dataset. The majority of the two datasets are identical, but the CAH dataset further divides native and alien vegetation types into moisture categories (i.e., wet, mesic, or dry). To minimize the mapping units, the CAH moisture designations were grouped into corresponding vegetation macrogroups consistent with the GAP dataset. For example, the CAH vegetation types mapped as closed koa-‘ōhi‘a wet forest and closed koa-‘ōhi‘a mesic forest were merged with the GAP vegetation type mapped as closed koa-‘ōhi‘a forest. Following are general descriptions of the existing land cover types.

Native terrestrial vegetation is primarily found in the central portion of the island and consists of montane rainforest dominated by ‘ōhi‘a and/or koa trees. The dominant tree species is more often ‘ōhi‘a but a distinct type of forest in which tall koa trees emerge above the ‘ōhi‘a canopy also exists in areas with deep soils above an elevation of 3,000–4,000 ft (914–1,219 m). These forests are multilayered with smaller trees in the subcanopy including kāwa‘u (*Ilex anomala*), ‘alani (*Melicope* spp.), kōlea (*Myrsine* spp.), and olmea (*Perrottetia sandwicensis*). Epiphytic mosses, liverworts, ferns, and silver-leaved lily pa‘iniu (*Astelia* spp.) are abundant on trunks and branches of large trees. In pristine areas, native ferns are abundant ground cover with scattered shrubs like kanawao (*Broussaisia arguta*) and pūkiawe (*Styphelia tameiameiae*). Lowland rainforest is typically dominated by ‘ōhi‘a with an understory of native trees including kōpiko (*Psychotria* spp.) and hame (*Antidesma platyphyllum*) (Cuddihy and Stone 1990).

Native wet cliff vegetation occurs primarily in the system of valleys running outward from the wet summit plateau region above the montane rainforests in the northern and central portions of the island. This land cover type is often dominated by the native uluhe fern (*Dicranopteris* spp.). The dry cliff vegetation on Kaua‘i occurs on steep-sided interior canyons and northern seacliffs and supports endemics like the ‘ālula (*Brighamia insignis*). Uluhe-dominated shrublands typically occur in patches throughout the island on mountain slopes (Cuddihy and Stone 1990).

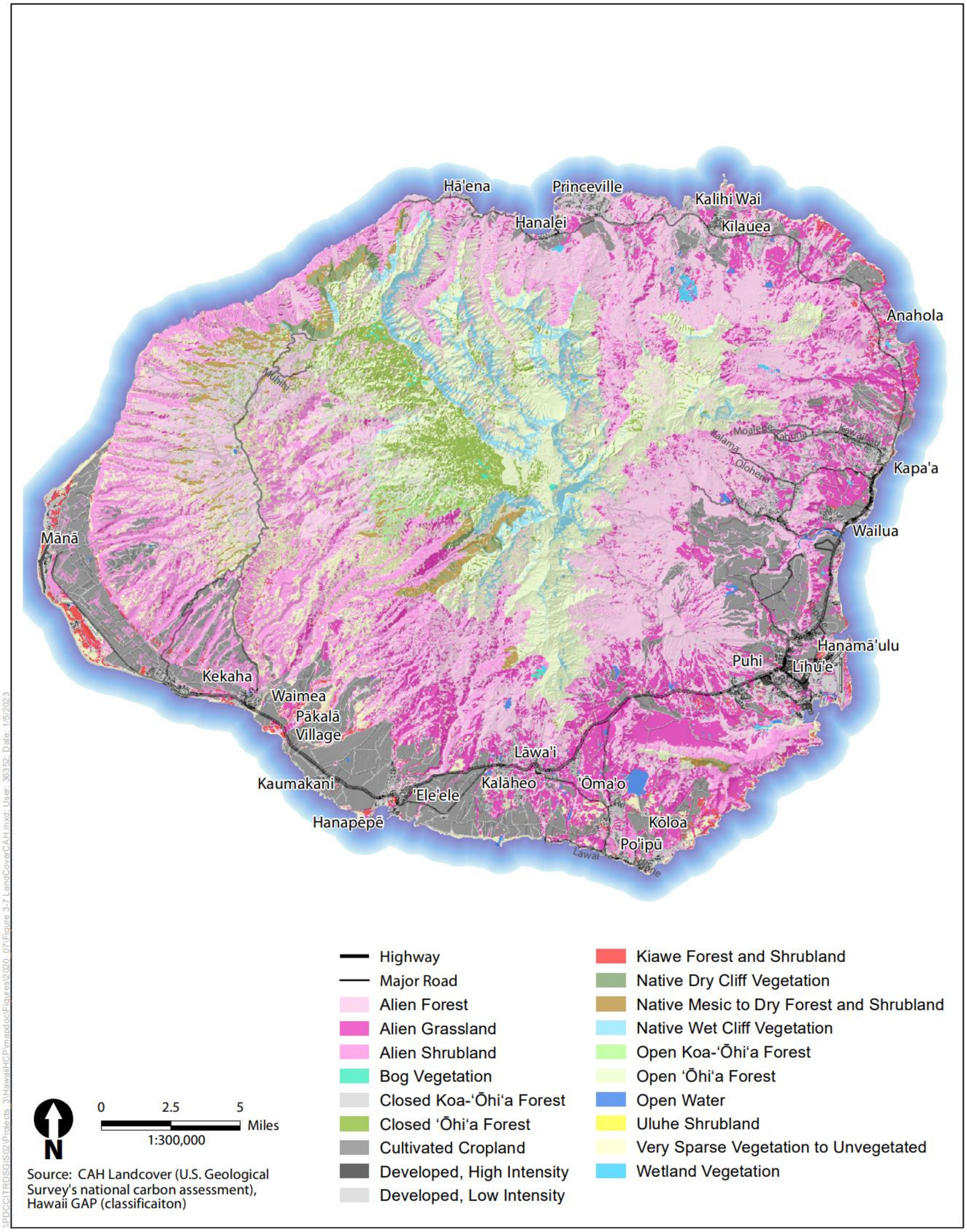

Figure 3-7. Land Cover Types of Kauaʻi

Another type of montane wet land cover is bogs, which are found in very wet, poorly drained places near mountain summits on Kauaʻi. Bogs are characterized by sedges and grasses (*Oreobolus furcatus*, *Carex* spp., *Rhynchospora* spp., *Dicanthelium* spp.) and stunted woody plants including naʻenaʻe (*Dubautia* spp.). Wahiawa Bog (Kanaele Swamp) is one of the island's known bog communities, characterized by shallow, poorly drained acidic peat soils and endemic plant species (Cuddihy and Stone 1990). Numerous estuarine and freshwater emergent wetlands skirt the lowlands throughout the island, along with human-made reservoirs and scattered ponds. Freshwater wetlands are also present in the higher-elevation, forested areas in the central region. Freshwater emergent wetlands typically consist of hydrophytic species including sedges (*Cyperus* spp.), rushes (*Mariscus* spp.), and bulrushes (*Schoenoplectella* spp.) both native and introduced to Kauaʻi (U.S. Fish and Wildlife Service 2011).

Mesic to dry forest and shrubland communities differ from wet montane forests in the relative scarcity of tree ferns (*Cibotium* spp.) and epiphytes, the abundance of shrubs such as pūkiawe in the understory, and a different complement of native ferns in the ground cover. For most of these forests the dominant trees are either ʻōhiʻa or koa, or a mixture of these two species. In a very few sites, mānele (*Sapindus saponaria*) is a co-dominant species in the ʻōhiʻa and koa mixed canopy. Mesic to dry forests have a very restricted distribution on Kauaʻi.

Vegetation known to be introduced to Kauaʻi include kiawe forest/shrubland in addition to alien grasslands, shrublands, and forests. Kiawe (*Prosopis pallida*) is a common invasive tree species known throughout the Hawaiian Islands and along the coastal zone of Kauaʻi. Alien shrublands and forests are characterized by introduced species such as jumbay (*Leucaena leucocephala*), fire tree (*Morella faya*), silk oak (*Grevillea robusta*), New Zealand laurel (*Corynocarpus laevigatus*), albizia (*Falcataria moluccana*), koa haole (*Leucaena leucocephala*) and banana poka (*Passiflora mollisima*) and occur throughout most of the island. Many invasive grasslands are also known from the eastern side of Kauaʻi and consist of a mix of invasive species including but not limited to molasses grass (*Melinis minutiflora*) and bushy beardgrass (*Andropogon glomeratus* var. *pumilus*) (Edmonds et al. 2016; Nagendra 2017; Natural Area Reserves System 2011; National Tropical Botanical Garden 2008).

Native vegetation on Kauaʻi has undergone extreme alterations because of past and present land use (primarily agriculture/cultivated croplands) and the intentional and inadvertent introduction of invasive plants and animals (Benning et al. 2002). Remote island ecosystems such as the Hawaiian Islands have especially low biotic resistance to invasion because island species have evolved in isolation and often have little resistance to competitors, herbivores, and pathogens that have found their way to the island from continental regions (Weller et al. 2011). Browsing, digging, and trampling by introduced ungulates (i.e., pigs, goats, cattle, sheep, and deer) have resulted in the spread of invasive plants because many of the invasive plants can colonize newly disturbed areas more quickly and effectively than Hawaiʻi's native plants. Introduced ungulates are especially devastating for native island species that evolved in their absence (Milchunas and Noy-Meir 2002). Introduced rodents (rats and mice) feed on the fruits, seeds, and new growth of many endemic plants. Furthermore, even with ungulate exclusion and native seed augmentation, regeneration continues to be strongly limited by invasive grasses. Forced out by invasive plants, more than 4,600 endemic plant species have become extinct. Many of the remaining endemic species are listed as threatened or endangered. As a result, native forests are now limited to Kauaʻi's upper-elevation, moist, and wet regions.

The mountainous region of northwest Kauaʻi, where KIUC is managing and monitoring the covered seabirds supports semi-intact, native wet forest dominated by ʻōhiʻa and ʻōlapa (*Cheirodendron fauriei*) with openings in the forest dominated by uluhe. Other native trees common to mesic forests are scattered throughout such as hōʻawa (*Pittosporum glabrum*), pāpala kēpau (*Pisonia* sp.), hala pēpē (*Chrysodracon aurea*), and lama (*Diospyros sandwicensis*) (Edmonds et al. 2016; Nagendra 2017; Natural Area Reserves System 2011; National Tropical Botanical Garden 2008).

Despite the remoteness of these established conservation sites[5], invasive species are also present. They include, but are not limited to, the autograph tree (*Clusia rosea*), octopus tree (*Schefflera actinophylla*), broad-leaved paperbark (*Melaleuca quinquenervia*), Australian tree fern (*Cyathea cooperi*), Himalayan ginger (*Hedychium gardnerianum*), lantana (*Lantana camara*), molasses grass, and bushy beardgrass (Edmonds et al. 2016; Nagendra 2017; Natural Area Reserves System 2011; National Tropical Botanical Garden 2008). These invasive species are believed to be spreading when left unchecked (National Tropical Botanical Garden 2008). The National Tropical Botanical Garden, which owns and manages the Upper Limahuli Preserve, actively works to control invasive species within the Upper Limahuli Preserve with funding from KIUC and others.

3.2 Covered Species

Detailed information on the status, life history, distribution, population trends, and habitat use of each of the covered species is included in the species accounts provided in Appendix 3A, *Species Accounts*. The sections below summarize basic biological information to provide context for the next two chapters of the HCP (Chapter 4, *Conservation Strategy*, and Chapter 5, *Effects*). The reproductive biology, status and trends, and threats to covered seabirds are also summarized below because they are relevant to the impact analysis and conservation strategy. Relevant factors summarized for covered waterbirds include threats and conservation needs, status, habitat affinities, and movement patterns. Relevant factors summarized for green sea turtle (honu) include range, life history, and current known threats.

3.2.1 Covered Seabirds

The seabirds covered in the KIUC HCP include Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), and the Hawaiʻi distinct population segment (DPS) of the band-rumped storm-petrel (ʻakēʻakē) (*Hydrobates castro*) (hereafter band-rumped storm-petrel). Newell's shearwater (ʻaʻo) is state- and federally listed as threatened. Breeding is only known on Kauaʻi, Maui, and Hawaiʻi, but song meter recordings made in 2016 and 2017 indicate that a small number of Newell's shearwaters (ʻaʻo) regularly prospect on Oʻahu (Young et al. 2019).

The Hawaiian petrel (ʻuaʻu) is state- and federally listed as endangered. Once abundant and widely distributed across Hawaiʻi, the majority of the breeding population is now found on Kauaʻi, Maui and Lānaʻi, with smaller populations on Hawaiʻi. Hawaiian petrel (ʻuaʻu) is nearly extirpated on Oʻahu and Molokaʻi (Pyle and Pyle 2017).

The band-rumped storm-petrel (ʻakēʻakē) is also state- and federally listed as endangered. Their current distribution is poorly known (Raine et al. 2017a), but potential breeding sites have been recorded on Hawaiʻi (Banko et al. 1991; Galase et al. 2016), Maui (Banko et al. 1991), Kahoʻolawe

[5] See Chapter 4, *Conservation Strategy*, for additional information on conservation sites.

(Hawaiʻi Heritage Program 1992), Lehua Islet (VanderWerf et al. 2007), and Kauaʻi (Raine et al. 2017a; Wood et al. 2002).

3.2.1.1 Natural History and Life Cyle

The covered seabirds are pelagic, spending most of their time at sea and coming to land only to breed (Ainley et al. 2014; Simons 1985; Spear et al. 2007). During the non-breeding season they travel well away from Hawaiʻi in the tropical Pacific. Newell's shearwaters (ʻaʻo) are absent from waters within 125 mi (201 km) of the Hawaiian Islands in the non-breeding season (winter and autumn) (King and Gould 1967; Spear et al. 1995). Some band-rumped storm-petrels (ʻakēʻakē) remain near their breeding island during the non-breeding season, while others make long-distance movements as far as over 990 mi (1,593 km) south of Hawaiʻi to the Phoenix Islands and Japan (Slotterback 2002; Mitchell et al. 2005).

During the breeding season (March through December, with slight variability in the breeding window by species), the seabirds return to land, where they nest in burrows beneath ferns and tree roots in dense forest and on steep slopes and cliffs. For additional information on suitable habitat and its distribution on Kauaʻi, see Section 3.2.1.5, *Primary Data Sources by Region.*

Adult Newell's shearwaters (ʻaʻo) only fly to and from their burrows at night. Breeding adults fly from the ocean to their breeding site after sunset and leave their burrows and fly from the breeding site to the ocean in the early morning before sunrise. Newell's shearwaters (ʻaʻo) travel between the sea and nests generally nightly to forage and feed their chicks (Ainley et al. 2020). Hawaiian petrels (ʻuaʻu) transit over land to and from the breeding sites mostly in darkness, though some begin to fly ashore just at sunset (Ainley et al. 1997). Unlike Newell's shearwaters (ʻaʻo), Hawaiian petrels (ʻuaʻu) have highly variable flight schedules, with arrivals and departures occurring from sunset to sunrise (Raine et al. 2017b). Band-rumped storm-petrels (ʻakēʻakē) have been observed feeding during the day, but likely also feed at night (Harris 1969; Kauaʻi Endangered Seabird Recovery Project 2019).

Newell's shearwaters (ʻaʻo) remain at sea for the first few years of life, and subadults are thought to start visiting their breeding sites at 2–3 years of age and start breeding at approximately 6 years of age (Ainley et al. 2001; Griesemer and Holmes 2011; Raine et al. 2020). In late March/early April through late April, adults arrive at inland breeding sites to check on their burrows and maintain them. In late April and possibly through mid-May, breeding adults forage at sea to build up reserves (Raine and Banfield 2015; Raine and McFarland 2013), during which time females are gone for 25 to 30 days while males visit the burrows occasionally (Ainley et al. 2020). In early June through July, each breeding pair lays a single egg and parents take turns incubating the egg and going out to sea to feed. Peak overland passage rates for Newell's shearwaters (ʻaʻo) coincide with the late incubation (July) and chick-rearing stages (August) (Travers et al. 2013). In late July through early October, both parents go to sea during the day with one returning each night to feed the chick. Provisioning by both adults continues through September with individual adults being at sea for periods of 1 to 3 nights (Ainley et al. 2014; Raine and McFarland 2013). From late September through mid-November the fledgling flies from its burrow to the sea, with a peak in October.

Hawaiian petrels (ʻuaʻu) on Kauaʻi arrive at their colonies mid- to late March and engage in a period of burrow maintenance or building and socialization. In mid-April, they return to the ocean for approximately 1 month to forage and build up reserves. Upon returning to the colonies in May, each pair lays a single egg and alternates incubating for approximately 55 days. Chicks typically hatch in

July, at which point both parents fly to the ocean to forage and return to feed the nestling. Petrel offspring require up to 5 months of care from both parents to fledge. Both adult male and female Hawaiian petrels (ʻuaʻu) attend to nest duties equally (Simons and Hodges 1998). Fledging typically occurs in late October through mid-December, peaking in November.

Band-rumped storm-petrels (ʻakēʻakē) on Kauaʻi return to nest sites in late May, complete egg laying by mid-June, and fledge in October (Raine et al. 2016a). Incubation averages 42 days and young fledge 70–78 days after hatching (Harris 1969). Fledglings leave the nest between mid-September and late November, with peak fledging occurring in October (Raine et al. 2016a). Based on acoustic data, adults likely leave the nesting grounds in October.

3.2.1.2 Threats

Covered seabirds on Kauaʻi are subject to the following threats (Slotterback 2002; State of Hawaiʻi Division of Forestry and Wildlife 2005).

- Depredation at breeding sites by introduced predators such as pigs (*Sus scrofia*), rats (*Rattus rattus*), feral cats (*Felis silvestris*), barn owls (*Tyto alba*), and feral honeybees (Order: Hymenoptera) (Raine et al. 2020).
- Loss and degradation of breeding habitat caused by introduced ungulates such as pigs and goats (*Capra hircus*), introduced plants and development.
- Artificial lighting from various sources (e.g., streetlights, resorts), which attracts and causes fallout of seabirds and increases their chance of colliding with artificial structures.
- Collisions with powerlines.
- Ocean pollution (e.g., mercury, plastic ingestion, oil spills).
- Factors affecting seabird prey availability in the ocean such as overharvesting by the fishing industry, as well as bycatch.
- Climate change, potentially affecting both terrestrial and ocean conditions.

For species with naturally low reproductive rates that rely on high adult survivorship, introduced threats that increase mortality rates can result in significant population declines. The covered seabirds share these characteristics of low reproductive rates and high adult survivorship, making their populations particularly vulnerable to introduced threats. Newell's shearwaters (ʻaʻo) breed at a late age (6 years to first breeding) and have low fecundity (only one chick per pair each breeding year), and high adult survival (Warham 1990, 1996; Ainley et al. 2001; Griesemer and Holmes 2011; Raine et al. 2020). No specific data exist on the longevity for Newell's shearwater (ʻaʻo) but based on what has been observed among other shearwaters it is reasonable to assume that they can reach a maximum age of 30 years or more (Ainley et al. 2001). Similarly, Hawaiian petrel (ʻuaʻu) have a long lifespan (up to 35 years), do not reproduce until 6 years of age, and lay only one egg per year (Simons and Hodges 1998). They also tend to have high adult survival (Ainley et al. 2001; Griesemer and Holmes 2011; Raine et al. 2020). Band-rumped storm-petrel (ʻakēʻakē) reach sexual maturity between 3 and 7 years of age (Harrison 1990), have only one chick per year, and likely live for 15 to 20 years (State of Hawaiʻi Division of Forestry and Wildlife 2005).

The daily movement patterns of the covered seabirds between breeding and foraging habitats and their relatively low maneuverability make them particularly susceptible to colliding with artificial structures, predominantly utility lines (Travers et al. 2019, 2020). Their nocturnal movements, in addition to the phototropic tendencies of fledglings (i.e., tendency to be attracted to light), make them susceptible to fallout from artificial lighting (Telfer et al. 1987). In addition to human-caused factors, stochastic events such as storms are likely to influence population numbers (Vorsino 2016). Both local and regional storms, depending on their severity and type, can result in significant habitat degradation and loss due to high winds, landslides, and flooding, as well as loss of burrows, chicks, and eggs. Habitat loss and conversion historically has had a major negative effect on the covered seabird species as development has expanded into natural areas along with its accompanying pets, farm animals, vehicles, and other infrastructure (Raine et al. 2016b, 2016c, 2016d).

Compared to Newell's shearwater ('a'o), fewer Hawaiian petrels ('ua'u) are found grounded and turned in to Save Our Shearwaters (SOS) during the fledging season, likely related to a lower level of attraction to artificial light. On average, 9.6 Hawaiian petrels ('ua'u) (compared to 179 Newell's shearwater ['a'o]) were received by the SOS Program annually between 2014 and 2018 (Anderson 2015, 2016, 2017, 2018, 2019).

3.2.1.3 Kaua'i-wide Conservation Efforts

This section describes some of the conservation efforts being implemented on Kaua'i to address the threats to the covered seabirds described in the section above.

Save our Shearwaters

The State of Hawai'i, through its Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW), started operating the SOS Program on Kaua'i in 1979. Since that time, SOS has broadly expanded and is currently independently operating as a state nonprofit and through 501(C)(3) sponsorship by Hawaii Wildlife Center. Through SOS, Kaua'i residents and businesses are encouraged to retrieve any seabirds that have been grounded as a result of fallout from light attraction. Residents and businesses are encouraged to take fallout birds to seabird aid stations established at local fire stations, hotels, and businesses. SOS staff retrieve, provide treatment to compromised birds that show a chance of full recovery, and release birds that are deemed recovered and healthy. During the course of the SOS Program's 37-year history, more than 35,000 Newell's shearwaters ('a'o), 280 Hawaiian petrels ('ua'u), and 25 band-rumped storm-petrels ('akē'akē) have been recovered. Approximately 97 percent of the Newell's shearwaters ('a'o) recovered by SOS have been hatch-year birds on their first flight to the ocean. Historically, approximately 90 percent of the recovered birds survive to be released back into the wild with federally issued permanent bird bands (Save Our Shearwaters 2017).

Kaua'i Seabird Habitat Conservation Plan

As described in Chapter 1, Section 1.2.1, *Kaua'i Seabird Habitat Conservation Plan*, DOFAW and USFWS approved the Kaua'i Seabird Habitat Conservation Plan (KSHCP) in 2020 to provide take authorization for listed seabirds and other listed species as a result of artificial lighting at the covered facilities on Kaua'i. Conservation commitments under the KSHCP include dimming lights during the covered seabird breeding season, contributing funding to the SOS Program, and establishing the Kahuama'a Seabird Preserve with predator control and social attraction measures.

State of Hawai'i Conservation

The State of Hawai'i's Department of Land and Natural Resources (DLNR) manages the 3,579-acre Hono O Nā Pali Natural Area Reserve (NAR) on Kaua'i. The NAR is managed for multiple habitats and species, including nesting seabirds. Surveys of the rim of the upper plateau of the NAR above Wainiha and Kalalau valleys have found breeding locations and activity for all three of the covered seabird species. DLNR conducts predator management for these seabirds (State of Hawai'i Department of Land and Natural Resources 2011).

Additionally, DLNR monitors and manages nesting colonies of Hawaiian petrels ('ua'u) on Lehua Island and implements the Lehua Island Ecosystem Restoration Project, which involves a successful rat eradication program initiated in 2017 and concluded in 2021.

Kīlauea Point National Wildlife Refuge Predator Exclusion Fence

USFWS has constructed an 11,200-foot predator exclusion fence at Kīlauea Point National Wildlife Refuge, protecting multiple rare and endangered species including nesting colonies of Newell's shearwaters ('a'o) and Hawaiian petrels ('ua'u). USFWS has also translocated these covered species from KIUC-managed conservation sites on Kaua'i to this location and are actively monitoring and managing the colonies there. In 2022, USFWS added additional predator exclusion fencing to enclose the majority of the wildlife refuge and predator eradication within the newly fenced area is ongoing.

Koke'e Air Force Station

The U.S. Air Force is conducting seabird conservation work at the Koke'e Air Force Station and surrounding areas with ingress routes to adjacent colonies on Nā Pali Coast. These conservation activities are focused on control of barn owls and cats. This management has been occurring since 2017, and is expected to continue into the foreseeable future.

Pacific Missile Range Facility

The U.S. Navy conducts seabird conservation on the Pacific Missile Range Facility (PMRF) and in conjunction with Readiness and Environmental Protection Integration (REPI) at other locations. REPI funded the ungulate and predator exclusion fences at Honopū, predator eradication, installation of artificial burrows and the initiation of social attraction. At PMRF, conservation activities have included primarily minimizing fallout by modifying and shielding lights, turning off exterior lighting during the breeding season, and conducting predator control (U.S. Fish and Wildlife Service 2014).

KIUC Prior Conservation Efforts

This HCP is based, in part, on a long history of experimentation and implementation of seabird conservation measures initiated by KIUC's predecessor in 2001 and continued by KIUC since their inception in 2002. The conservation measures described in Chapter 4, *Conservation Strategy*, are based on over 20 years of implementing and refining the same or similar measures and the results of field monitoring to determine their effectiveness. This section summarizes the relevant history of this HCP, including the origins of and when each relevant conservation measure began and how it has evolved.

Interim Conservation Measures and HCP Drafts (2001–2011)

In 2001, Kauaʻi Electric began discussions with USFWS and DOFAW regarding the potential for powerline collisions of the covered seabirds on a proposed new powerline that would connect with a Kauaʻi Electric generation facility (Kauaʻi Island Utility Cooperative 2011). In consultation with USFWS and DOFAW, Kauaʻi Electric conducted radar surveys to identify seabird flight paths and altitudes in the vicinity of the proposed powerline. Based on the results of these surveys, the powerline location, design, and height were altered to avoid collision risk to these species (Kauaʻi Island Utility Cooperative 2011).

Following this project consultation, Kauaʻi Electric, USFWS, and DOFAW agreed to simultaneously (1) pursue an HCP that would apply to all of Kauaʻi Electric's system, and (2) begin implementing "interim conservation measures" to immediately reduce and mitigate impacts on listed seabirds while the HCP is being prepared. The first agreement was memorialized in a Memorandum of Agreement (MOA) signed by Kauaʻi Electric and USFWS in November 2002. KIUC continued to honor the 2002 MOA after purchasing Kauaʻi Electric's assets soon after the MOA was signed. In December 2004, KIUC entered into a second MOA with USFWS that contained additional interim conservation measures.

Table 3-2 lists all interim conservation measures and their relationship to this HCP.

Table 3-2. Summary of HCP Conservation Measure History

Interim Conservation Measure	Interim Conservation Measure?	In Short-Term HCP?	Early Implementation of this HCP?	Total Years Implemented Prior to 2025	Proposed in this HCP?
Time period	2001–2010 (10 years)	2011–2016 (5 years)	2017–2024 (7 years)	--	2025–2075
Powerline redesign and reconfiguration	Yes, began in 2001	Yes	Yes	23	Yes (see Conservation Measure 1)
Powerline collision monitoring	No	Yes (began 2011)	Yes	14	Yes (see Conservation Measure 1 and Chapter 6)
KIUC Financial support of Save Our Shearwaters Program	Yes, began in 2001	Yes	Yes	23	Yes (see Conservation Measure 3)
Surveys to identify suitable breeding colonies to protect and enhance	Yes, began in 2002	Yes	Yes (feasibility studies in 2020 and 2023)	22	Yes, as part of adaptive management if needed

Interim Conservation Measure	Interim Conservation Measure?	In Short-Term HCP?	Early Implementation of this HCP?	Total Years Implemented Prior to 2025	Proposed in this HCP?
Predator control at conservation sites	No	Yes, at four sites (1 site at Upper Limahuli, 3 sites within Hono O Nā Pali NAR)	Yes, at 10 sites	14	Yes, at 12 sites
Social attraction at conservation sites	No	No	Yes, at 2 sites	3	Yes, at 4 sites (total)
Seabird colony monitoring	No	Yes (began 2011)	Yes, at 9 sites	14	Yes, at 12 sites
Streetlight retrofit to minimize light attraction	Yes, beginning in 1980s	Yes	Yes, and additional retrofit in 2019, and ongoing	Over 40 years	Yes
Covered facility light retrofit and staff training for bird fallout protocols	Yes, in 2002	Yes	Yes	22 years	Yes

Sources: Kaua'i Island Utility Cooperative 2011: Chapter 1 and Appendix E; U.S. Fish and Wildlife Service and State of Hawai'i Division of Forestry and Wildlife 2018.

In the meantime, KIUC prepared drafts of a comprehensive HCP for its entire system for review by USFWS and DOFAW. In October 2007, KIUC submitted a complete draft HCP for agency review. In December 2008, USFWS and DOFAW acknowledged KIUC's substantial efforts at early minimization and mitigation. USFWS and DOFAW also noted that available information was insufficient to issue KIUC long-term authorizations. Instead, USFWS and DOFAW recommended that KIUC prepare a short-term HCP to provide an opportunity for immediate species benefits while additional information was gathered to support permit decisions over a longer time period. KIUC, USFWS, and DOFAW agreed at the time to pursue state and federal authorizations in two stages.

In the first stage, KIUC would revise its draft HCP to support permits for a period of 3 to 5 years. This interim HCP would commit to conservation measures that would provide immediate benefits to the covered seabirds and would also generate important new scientific information to better inform decisions. KIUC completed the Short-Term HCP in 2011 for a 5-year permit duration, and was issued an incidental take permit.

In the second stage, KIUC, USFWS, and DOFAW agreed that KIUC would participate as a co-permittee in the KSHCP that DOFAW was preparing at the time.

KIUC Short-Term HCP (2011–2016)

KIUC's Short-Term HCP was approved in May 2011 and was implemented over 5 years, until 2016. As described in Chapter 1, *Introduction and Background*, before the Short-Term HCP was prepared, relatively little was known about the distribution, population, and behaviors of the three listed seabirds on Kauaʻi. In addition, little was known about the extent of the effects of KIUC's facilities and operations on these species. Thus, an important goal of the Short-Term HCP was to have KIUC work with conservation partners to implement a suite of specific monitoring and research projects at specific conservation sites to address this scientific uncertainty. These efforts include powerline collision minimization and monitoring, seabird colony monitoring, predator control, monitoring to aid predator control measures, and invasive plant species control. A summary of the work conducted for the Short-Term HCP is provided in Table 3-2.

When the decision was made in late 2008 for KIUC to participate in the KSHCP for long-term take authorization, the KSHCP was expected to be completed by 2012, partway through KIUC's Short-Term HCP. The state and federal take authorization provided by the KSHCP was therefore intended to supersede and replace the take authorization provided by the Short-Term HCP.

By 2015, it was clear that the KSHCP would still not be approved for several years (the KSHCP was approved by USFWS and DOFAW in 2020). Furthermore, data from KIUC's powerline monitoring program suggested that the scale of powerline collisions was incompatible with the scale of impacts contemplated by the KSHCP. Therefore, in 2015 KIUC, USFWS, and DOFAW agreed that KIUC would pursue its own long-term authorizations under its own HCP. KIUC began developing this HCP in 2016 while continuing to implement the conservation measures of the Short-Term HCP.

Early Implementation of this HCP (2017–2024)

After the Short-Term HCP expired in 2016, KIUC continued to implement the Short-Term HCP conservation measures, and conduct extensive monitoring and research on the listed seabirds. KIUC also expanded the number of conservation sites where seabird conservation measures were being conducted. The time period since completion of the Short-Term HCP is considered to be early implementation of this HCP. KIUC reported the results of this interim work to USFWS and DOFAW annually in order to improve techniques and share best practices in annual meetings, monthly update meetings and in multiple technical reports submitted to USFWS and DOFAW (Table 3-2). These conservation measures, monitoring, and research continue today, and include a focus on the effectiveness of conservation measures for the covered seabirds and the nature of impacts of KIUC's facilities on the covered seabirds. More details on the ongoing monitoring program that will be incorporated into the monitoring program for this HCP can be found in Chapter 6, *Monitoring and Adaptive Management Program*. The seabird biological goals and objectives and conservation measures for this HCP builds on the extensive, long-term powerline monitoring, seabird colony monitoring, predator monitoring and control, and research program that KIUC and its predecessor, Kauaʻi Electric, began in 2001 (Table 3-2). Data collected during these many years of seabird monitoring, at most of the same seabird conservation sites selected for this HCP, show that the management actions have been successful at protecting and expanding seabird colonies at these sites, substantially reducing uncertainty in the success of this HCP.

3.2.1.4 Kauaʻi Metapopulation and Three Regions

For the purpose of this HCP, the portion of the total range-wide population of each covered seabird species occurring on Kauaʻi is referred to as the *Kauaʻi metapopulation*. KIUC has identified three primary regions for this metapopulation based on level of anthropogenic threats and conservation opportunities and constraints, in addition to data sources (which differ based on accessibility) (Figure 3-8). These three primary regions are referenced throughout this section to provide context for describing relevant aspects of the covered seabirds' biology, status, and trends on Kauaʻi.

<u>Nā Pali Coast</u>: Low amount of data available, low level of threats, few if any colony management opportunities (due to lack of accessibility).

<u>Conservation Sites</u>: High amount of data available, moderate level of threats. These are sites KIUC is currently managing, and would continue to manage as part of this HCP. These conservation sites are described below.

<u>Remainder of the Island</u>: Moderate amount of data available, high level of threats, few if any colony management opportunities (land ownership and accessibility) but many threat reduction opportunities (powerline strike and light attraction minimization).

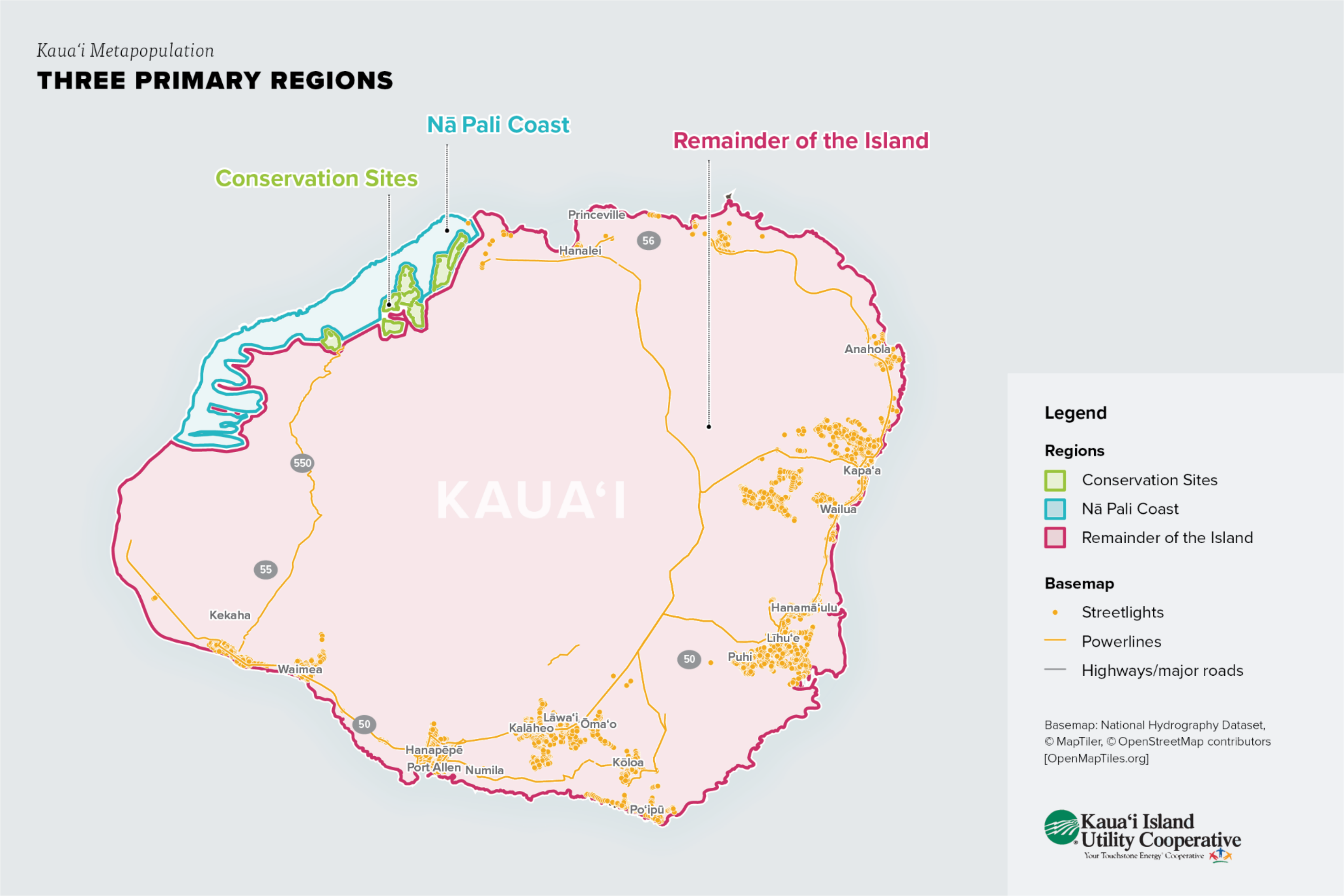

Figure 3-8. Three Regions on Kauaʻi Relevant to the Metapopulation of Covered Seabirds

The primary anthropogenic threats on the covered seabirds vary by geographic location (Figure 3-9). The covered seabirds are least vulnerable to predation in areas inaccessible by most predators such as the Nā Pali Coast. Threats from light attraction and powerline collisions are greatest in developed areas where these structures are located, on the remaining island (Figure 3-9). Figure 3-9 shows locations of major powerlines, and the grey shading on Figure 3-9 shows developed areas where lights are most prominent.

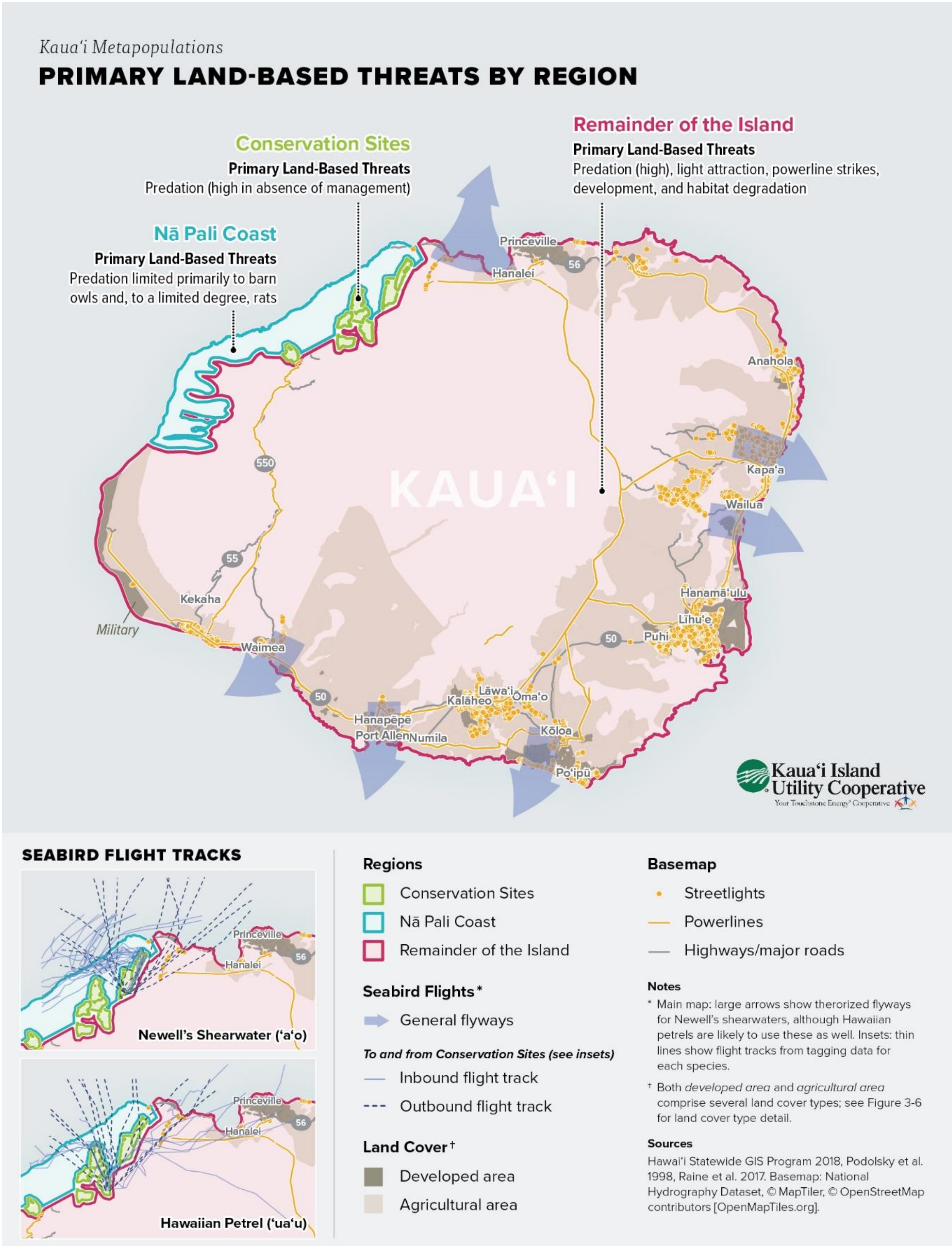

Figure 3-9. Primary Land-Based Threats to the Covered Seabirds, by Region

3.2.1.5 Primary Data Sources by Region

This section describes, for each of the three regions defined above, the data sources KIUC used for understanding abundance, distribution, and abundance trends of the covered seabirds on Kaua‘i and for framing the HCP's conservation strategy based on the best available scientific information. Figure 3-10 lists the data types available from each region, gathered via the data sources described in the following subsections.

KIUC compiled the best available data on distribution, abundance estimates, and abundance trends for Newell's shearwater (‘a‘o) and Hawaiian petrel (‘ua‘u), for the purpose of analyzing the effects of covered activities on these species and developing a conservation strategy to minimize and offset these effects and provide a net benefit to the species. The following subsections describe each data source, the information each source provides, and the level of confidence or uncertainty associated with each source.

Conservation Sites

Acoustic Sensors

Since 2011, acoustic sensors placed strategically among breeding colonies have been the primary source of monitoring data for trends in abundance at the conservation sites (Raine et al. 2024). Data are collected through arrays of multiple acoustic sensors during the breeding season. As call rates are statistically correlated with the number of breeding birds, a change in call rates reflects a change in the breeding population (Raine et al. 2019). While this data is not a reliable measure of breeding bird abundance, it is a very reliable measure of abundance trends.

Burrow Monitoring

Burrow monitoring at KIUC-managed conservation sites has been used since 2011 to monitor reproductive rates of breeding pairs, breeding probability, and predation events at burrows (Figure 3-10). Burrow checks and camera monitoring are conducted each year throughout the breeding season (May through September).

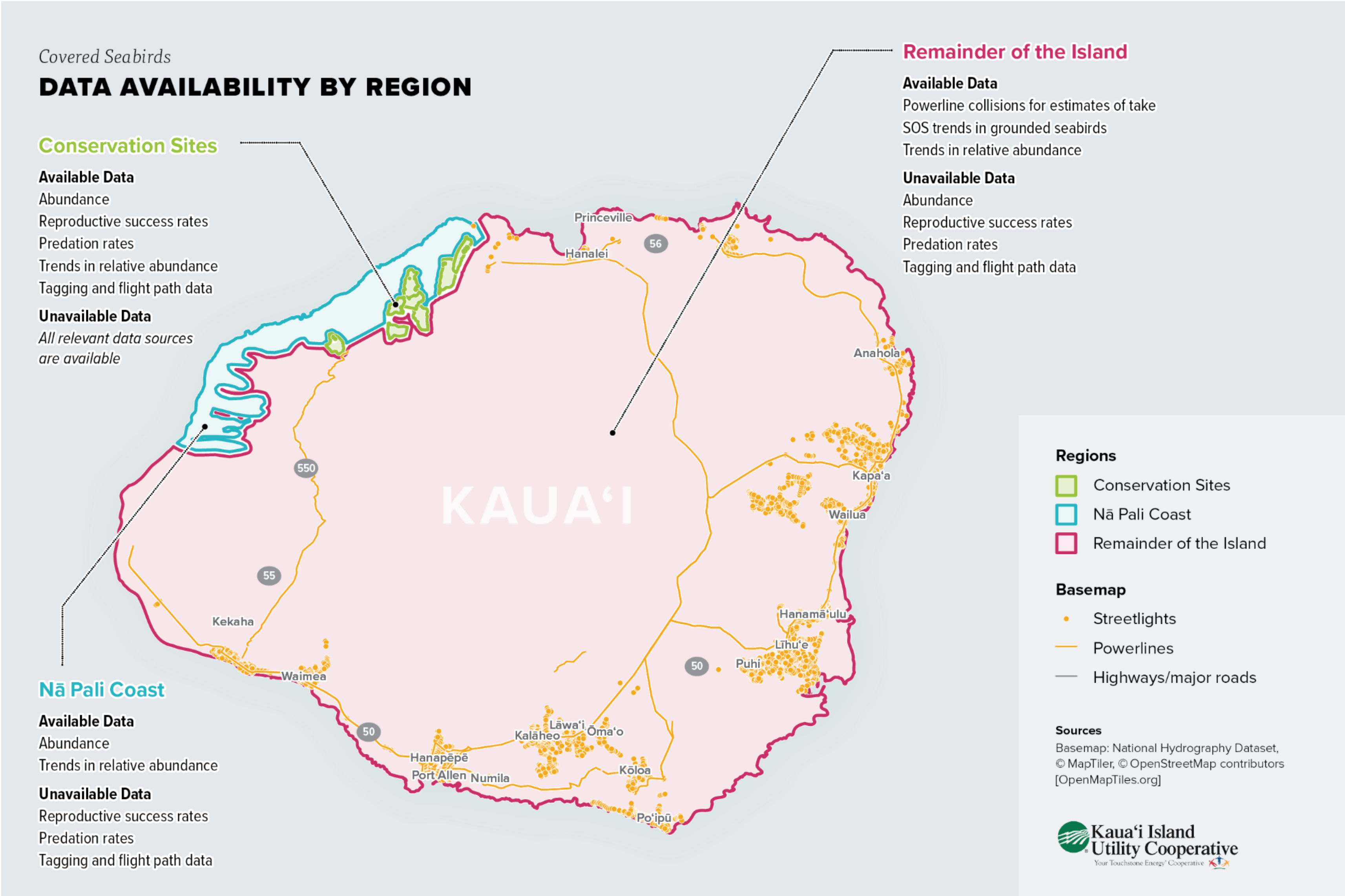

Figure 3-10. Summary of Primary Data Types for the Covered Seabirds, by Region

Habitat Suitability Model and Auditory Surveys

Habitat suitability models and auditory surveys have been a primary approach used to estimate covered seabird abundance throughout Kauaʻi. Troy et al. (2014, 2017) developed habitat suitability models for both Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) using abiotic and biotic environmental parameters (e.g., elevation, wind speed, slope, vegetation cover) that are key nesting habitat characteristic of these species (Figures 3-11a and 3-11b).

From 2006 through 2020, the Kauaʻi Endangered Seabird Recovery Project used habitat models and auditory surveys to locate covered seabird breeding areas. Starting in 2021 this work has been continued and refined by Archipelago Research and Conservation (ARC). Habitat models for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) and auditory surveys were used to help identify appropriate areas for establishing conservation sites.

At the conservation sites, habitat suitability models have been used in conjunction with auditory surveys (where biologists record all seabird calls heard from each survey location during 25-minute survey periods) to determine covered seabird distribution and estimate their numbers within the modeled habitat. While not all modeled habitat on Kauaʻi is accessible, the conservation sites are highly accessible and auditory surveys are conducted annually.

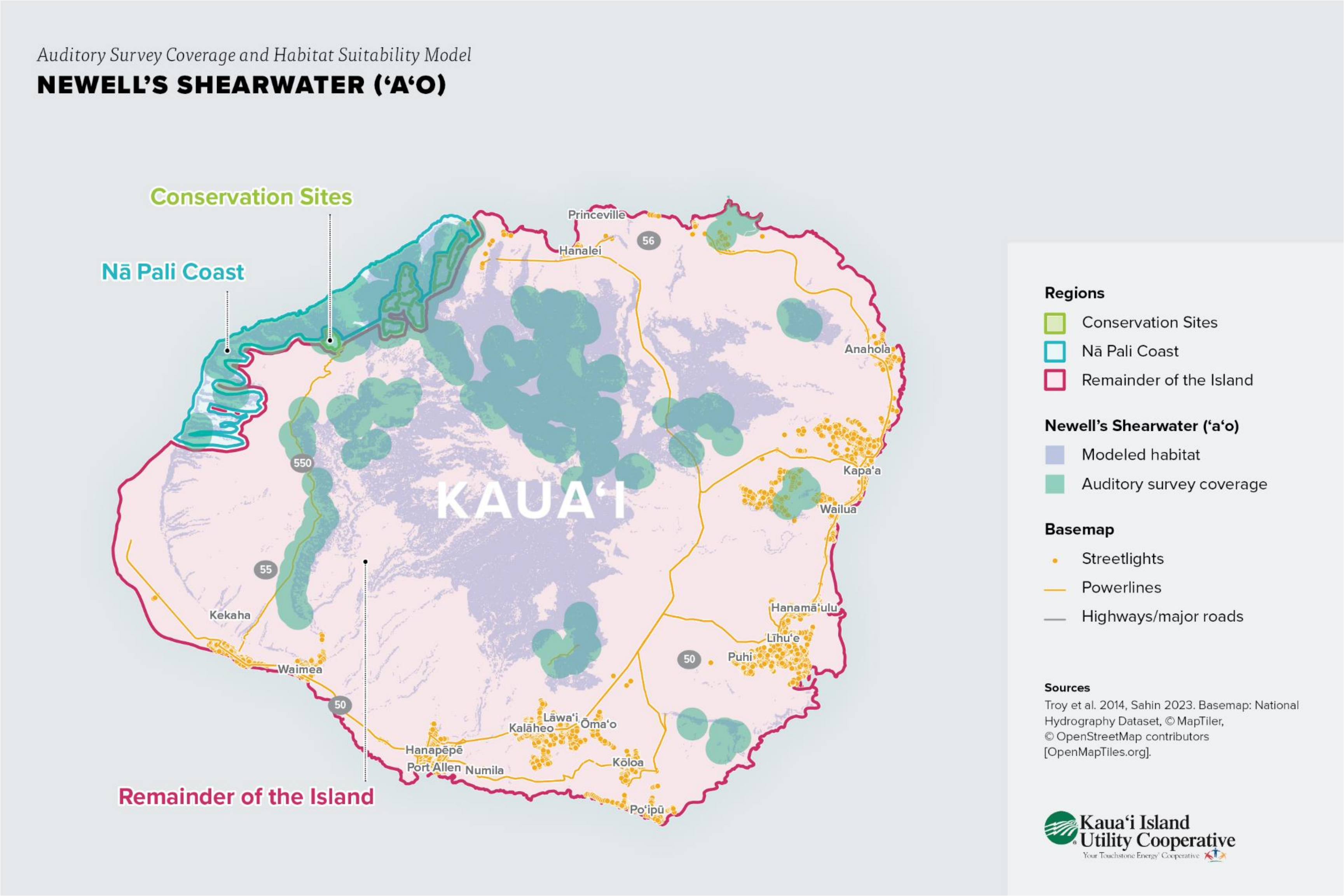

Figure 3-11a. Auditory Survey Coverage Overlaying the Habitat Suitability Model for Newell's Shearwater ('a'o)

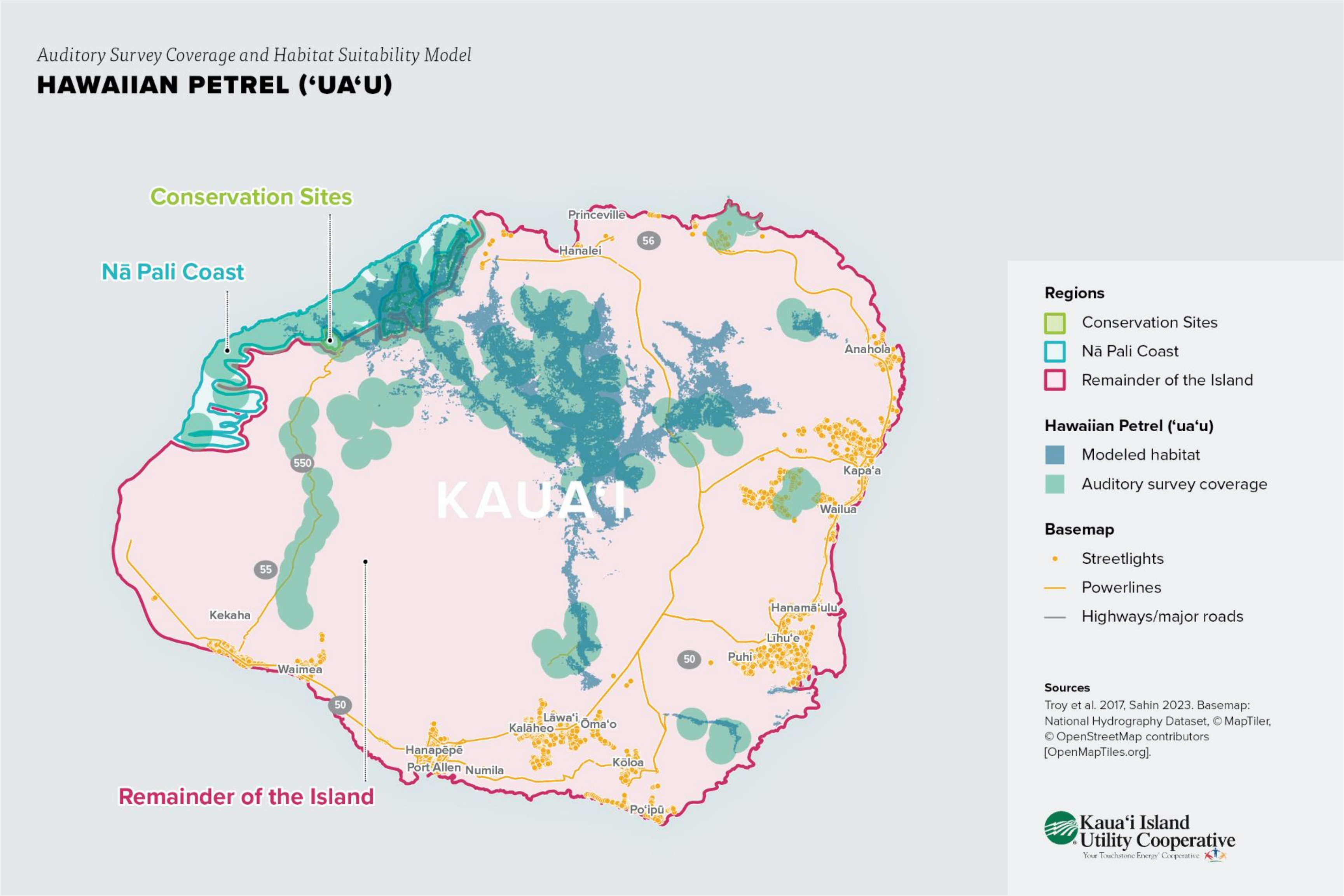

Figure 3-11b. Auditory Survey Coverage Overlaying the Habitat Suitability Model for Hawaiian Petrel (ʻuaʻu)

Nā Pali Coast

Habitat Suitability Model and Auditory Surveys

The habitat suitability model and auditory surveys described above for the conservation sites were also used on the Nā Pali Coast to estimate species distribution and abundance. However, many areas of the Nā Pali Coast are inaccessible for auditory surveys. In areas accessible for surveys throughout Kauaʻi, the fraction of modeled habitat with seabird detections was calculated, and this fraction was then extrapolated to areas of modeled habitat that have not been surveyed. Figure 3-11a and 3-11b show the habitat suitability models and auditory survey coverage for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), respectively.

Acoustic Sensors

Acoustic sensors have been the primary source of monitoring data for trends in abundance along the Nā Pali Coast, due to the remoteness and inaccessibility of this area (Raine et al. 2019). As call rates are statistically correlated with breeding birds, a change in call rates reflects a change in the breeding population (Raine et al. 2024). Long-term call rate data exists for 3 sites on the Nā Pali Coast (2012–present). Since 2014, acoustic sensors have been deployed at 11 additional sites, but funding for deployment of sensors at those additional sites has not been consistent between years and monitoring data are sparse. Starting in 2022, KIUC has been funding long-term acoustic monitoring on the Nā Pali Coast; acoustic sensors were deployed at 20 sites stretching across the Nā Pali Coast in 2023. There are insufficient data at present to analyze call rate trends from the sites under the recently implemented long-term monitoring program. KIUC has committed to funding long-term systematic data collection in this area for the permit term, which will increase the statistical power to detect trends for this area in the future. However, based on interannual comparisons in call rates from available data including previous efforts, a Bayesian trend analysis estimated no significant year-to-year change in call rates during 2019–2023 for Newell's shearwater (ʻaʻo) on the Nā Pali Coast (Raine et al. 2024).

Remainder of the Island

Habitat Suitability Model and Auditory Surveys

As shown in Figures 3-11a and 3-11b, the habitat suitability models and auditory surveys described above for the conservation sites and Nā Pali Coast were also conducted on the remainder of the island and used to estimate species abundance. Auditory surveys in this area are more spatially and temporally sparse based on access limitations (e.g., land ownership, terrain). In areas accessible for surveys, the fraction of modeled habitat with seabird detections is calculated. This fraction is then extrapolated to areas of modeled habitat that have not been surveyed. Density correction factors are applied to areas without survey data to account for lower nesting densities in areas that have been more greatly affected by powerline strikes, light attraction, and predation mortalities (Raine et al. 2019, 2022).

Density correction factors were applied to areas without survey data to account for lower nesting densities in areas that have been more greatly affected by powerline strikes, light attraction, and predation mortalities (Raine et al. 2019, 2022).

Radar Surveys of Abundance Trends on Kauaʻi

The longest-running systematic monitoring study for trends in relative abundance for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) on Kauaʻi is based on radar survey data. This data is reliable in that it has been collected annually and systemically over an extended period of time, starting in 1993. Radar data cannot determine abundance, but it provides a long-term index of abundance that can be used to determine population and distribution trends.

The survey area for radar is limited to coastal areas of eastern, southern, and portions of northern Kauaʻi (area titled *Remainder of the Island* on Figure 3-12), which are the sections of coast accessible to vehicle-mounted radar equipment. While these radar data track trends in the number of birds transiting from the ocean to their nests for much of Kauaʻi, they do not cover the Nā Pali Coast or the proposed conservation sites (and associated flyways), where there are important and protected breeding colonies. The radar data does, however, provide trend information for the developed areas of Kauaʻi with the highest threats from powerlines, light attraction, and invasive predators.

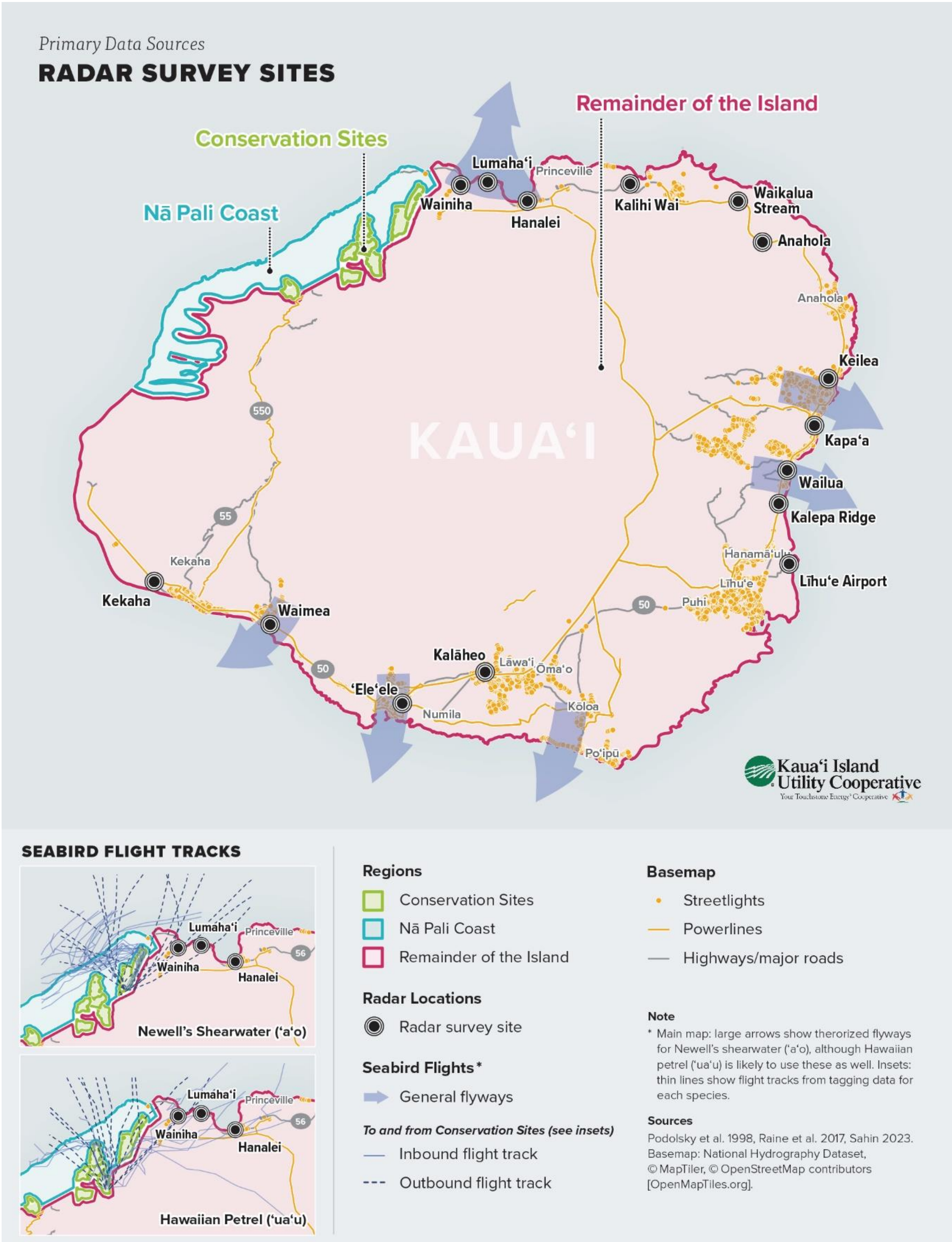

Figure 3-12. Radar Survey Location

Powerline Strike Data

Similar to the recent trend in radar data, powerline strike data collected by KIUC from 2013 to 2019, prior to the majority of the minimization projects, also show no significant trend in annual collisions (Travers et al. 2020, 2023). If there was a continued steep population decline during the period of 2013 through 2019, when unminimized collisions were monitored, a reduction in powerline collisions would be expected as fewer and fewer seabirds would survive to collide with powerlines each year. As with the radar data, the powerline strike data is applicable to the more developed portions of the island where powerlines are located and the greatest collision risks exist, shown as *Remainder of the Island* on Figure 3-10 (see Section 3.2.1.2, *Threats*, regarding areas with highest risk of powerline collisions). Therefore, powerline data is not expected to reflect abundance trends along the Nā Pali Coast or the conservation sites (Figure 3-10). While this data alone may not be a highly reliable source for tracking abundance trends due to multiple factors influencing collision rates, it is informative when taken in combination with the independent estimate of trend from the radar survey, as well as trends in SOS data on seabirds that are found grounded from light fallout in the same general geographic area of Kauaʻi.

Save Our Shearwaters

Data from the SOS Program on collected and rescued covered seabirds provides an additional independent data source on trends in the *Remainder of the Island* area (Figure 3-10). The trend in SOS rescues each year tracks the earlier steep decline observed in the radar index of abundance (Raine et al. 2017b), and the more recent (over the last decade) trend observed in the radar index with no significant decline in abundance (Sahin 2023). As with the radar and powerline strike data, the SOS data is applicable to the more developed portions of the island where streetlights are located, and the greatest light attraction risks exist. Therefore, the SOS data is not expected to reflect abundance trends along the Nā Pali Coast or the conservation sites (Figure 3-10). While these data alone may not be a highly reliable source for tracking abundance, due to multiple factors influencing seabird fallout rates, as well as public discovery and return rates, it does corroborate trends in the systematic radar and powerline strike survey data, which cover much of the same geographic area (shown as *Remainder of the Island* on Figure 3-10).

Other Data Considered

At-Sea Abundance Estimates

The only published estimates of abundance of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) come from transect surveys conducted on ships at sea (Spear et al. 1995; Joyce 2016). These at-sea abundance estimates have significant limitations with regard to quantifying the Kauaʻi metapopulation abundance. For example, the at-sea estimates include serious spatial deficiencies in geographical survey coverage, leading to uncorrected sources of statistical bias if the resulting estimates are assumed to represent total abundance of the species. Further, at-sea estimates alone, even if they could be corrected for these biases, provide only a single abundance estimate for the entire range of the species. For the purpose of analyzing effects of the covered activities and developing an effective conservation strategy for the covered seabirds on Kauaʻi, important spatial differences in mortality risk in different areas of Kauaʻi need to be considered. As such, KIUC has focused on available long-term systematic surveys from Kauaʻi, as described below, for evaluating abundance and trends in different areas of Kauaʻi, rather than relying on at-sea abundance estimates. This data source and the reason it was not used in the HCP is described in more detail in Appendix 5D, Section 5D.2.1.1, *Estimates of Abundance on Kauaʻi*.

3.2.1.6 Kauaʻi Metapopulation Distribution, Abundance, and Trends

This section briefly describes what is known and what is not known about the distribution, abundance, and trends of the covered seabirds on Kauaʻi.

Distribution

As described in Section 3.2.1.5, *Primary Data Sources by Region*, the known nesting distributions of the covered seabirds on Kauaʻi are limited to areas accessible for surveys. Figures 3-11a and 3-11b show where auditory surveys have been conducted for these species in relation to areas estimated to have suitable habitat for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), respectively. Figures 3-13a and 3-13b show the known distribution of these two species. However, additional Newell's shearwaters (ʻaʻo) and Hawaiian petrels (ʻuaʻu) may be nesting within suitable habitat outside the areas surveyed.

Based on habitat modeling and auditory surveys, the majority of the Newell's shearwater (ʻaʻo) known breeding areas are in the northwestern portion of Kauaʻi (Figure 3-13a). These breeding populations are found primarily in mountainous areas within deep valleys and along the edges of steep ridges (Ainley and Holmes 2011; Ainley et al. 2020). The current breeding population of Hawaiian petrel (ʻuaʻu) on Kauaʻi is confined to higher elevations, especially ridge crests, in the northwest portion of the island (Figure 3-13b). No band-rumped storm-petrel (ʻakēʻakē) nests have been located on Kauaʻi. However, based on auditory survey data, breeding likely occurs at several locations on Kauaʻi, primarily in the steep cliff areas of the Nā Pali Coast (Raine et al. 2017a).

There is currently insufficient data available to determine whether the covered seabirds have shifted their distributions of nesting colonies on Kauaʻi over time.

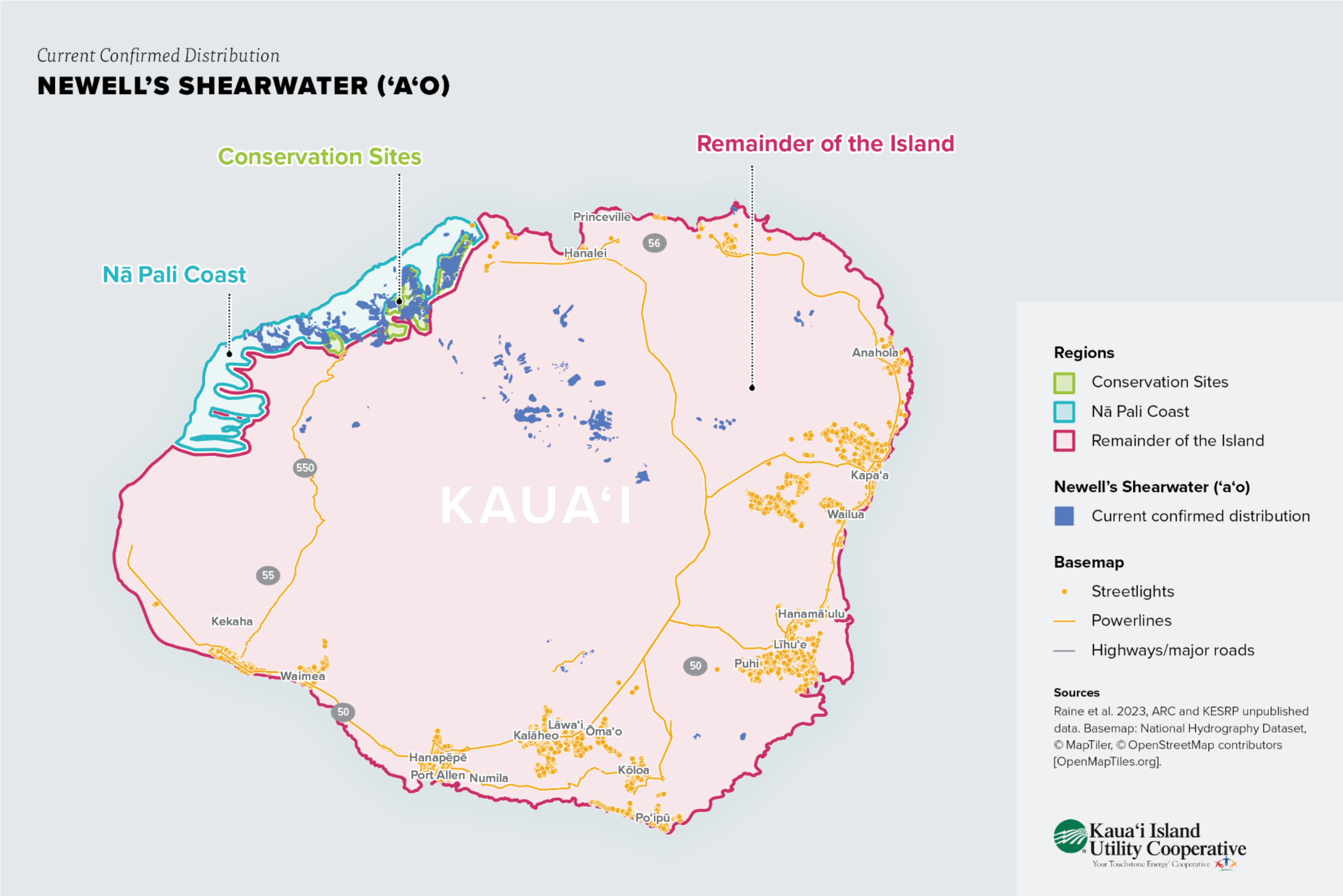

Figure 3-13a. Current Confirmed Distribution of the Newell's Shearwater ('a'o) Based on Contemporary Auditory Surveys

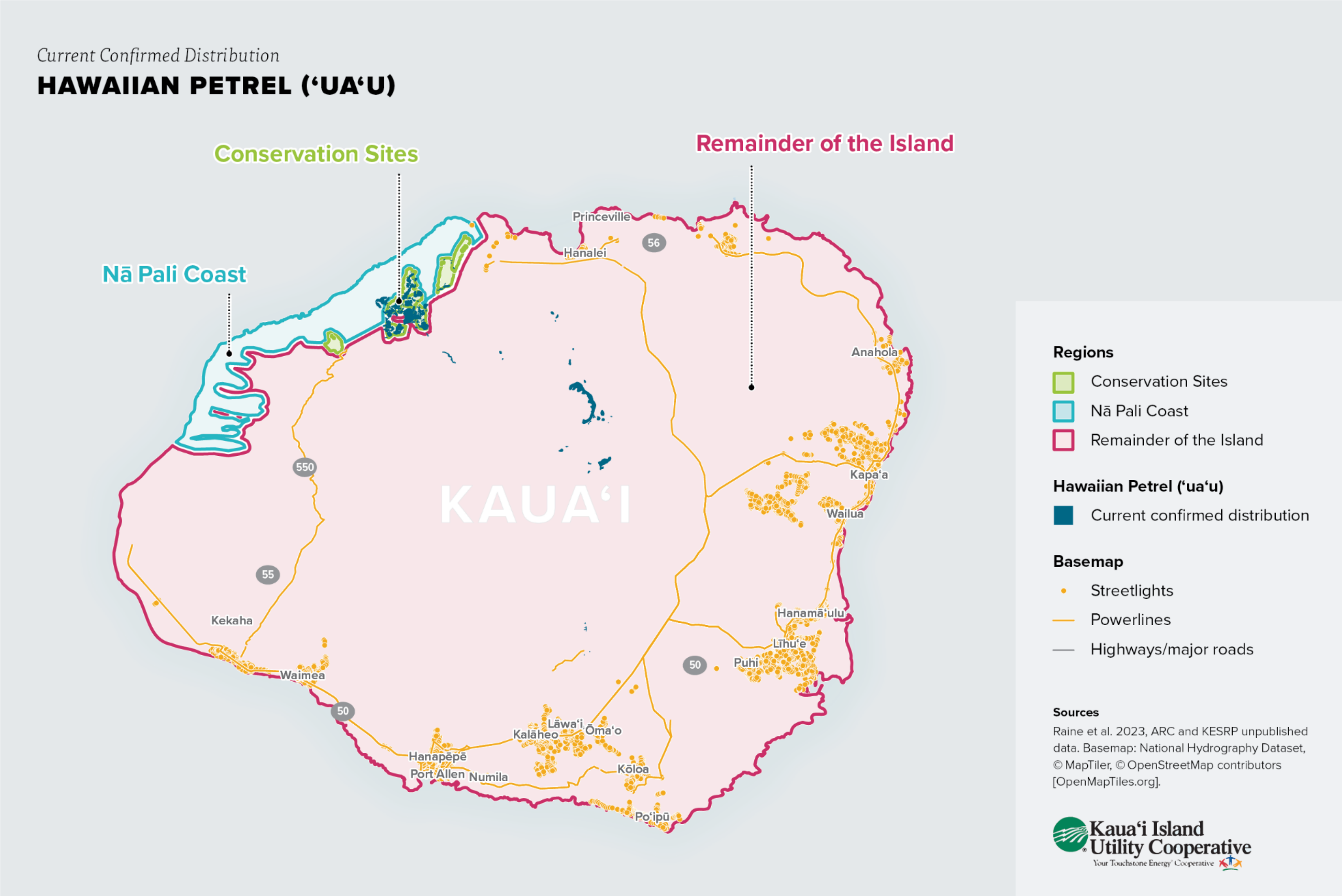

Figure 3-13b. Current Confirmed Distribution of the Hawaiian Petrel (ʻuaʻu) Based on Contemporary Auditory Surveys

Abundance

Kauaʻi supports an estimated 90 percent of the total Newell's shearwater (ʻaʻo) population (Pyle and Pyle 2009; Ainley et al. 2020) and 33 percent of the total Hawaiian petrel (ʻuaʻu) population (Raine in litt.). These estimates are based on expert opinion and are considered approximations. Estimates of abundance from systematic scientific surveys are not available for individual islands.

As described in Appendix 3A, *Species Accounts*, there are several different abundance estimates for the Kauaʻi metapopulations of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu). Different sets of survey data were employed by different studies to estimate total Kauaʻi metapopulation abundance. The various survey datasets all have different yet important spatial gaps in survey coverage. The disparities between these different surveys contribute to apparent inconsistencies between the available estimates of abundance that are described in Appendix 3A, *Species Accounts*.

In an effort to address these inconsistencies in abundance estimates, a population dynamics model was developed for this HCP using the most recent and best available data to model a range of abundance and trends for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu). These modeled scenarios should be viewed as plausible bounds of seabird abundance and trends within the confines of the best available data and biological assumptions for the species. As described in greater detail in Appendix 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*, and Appendix 5E, *Population Dynamics Model for Hawaiian Petrel (ʻuaʻu) on Kauaʻi*, the population dynamics model estimates a current minimum Newell's shearwater (ʻaʻo) abundance on Kauaʻi at 9,536 breeding pairs (Appendix 5D) and a minimum Hawaiian petrel (ʻuaʻu) abundance on Kauaʻi at 8,950 breeding pairs (Appendix 5E).

There are insufficient data available to estimate breeding abundance of band-rumped storm-petrel (ʻakēʻakē) on Kauaʻi. In 2002, Wood et al. estimated 171 to 221 breeding pairs on Kauaʻi, and in the mid-2010s Pyle and Pyle (2017) estimated 250 breeding pairs.

Trends in Abundance

Conservation Sites

12 years of auditory surveys and acoustic monitoring at the conservation sites have demonstrated a positive abundance trend in these areas, with a high level of data confidence (Raine et al. 2024). Acoustic sensors used at KIUC-managed conservation sites indicate positive trends in call rates for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), indicating increasing abundance at these sites (Raine et al. 2024). At conservation sites that have been actively managed and acoustically monitored, there have been statistically significant increases in call rates between the first year of monitoring (ranging from 2012 to 2020, depending on the site) and 2023. The annual rates of increase in Newell's shearwater (ʻaʻo) call rates range between 8.2 percent at Hanakoa and 18.3 percent at North Bog and Hawaiian petrel (ʻuaʻu) range between 8.8 percent at Hanakoa to 26.4 percent at North Bog (Archipelago Research and Conservation 2022).

Nā Pali Coast

Acoustic surveys throughout the Nā Pali Coast, funded by KIUC, started in 2022. Under this long-term data collection program acoustic sensors were deployed at 20 sites stretching across the Nā Pali Coast in 2023. There are insufficient data at present to analyze call rate trends from the sites under the recently implemented KIUC long-term monitoring program. Other than a few previously monitored sites along this coast, long-term trends in call rates have not been systematically monitored (Raine et al. 2024). Available Nā Pali Coast acoustic sensor data suggests that the call rate trends for Newell's shearwater (ʻaʻo) have been relatively flat since ca. 2014 (Raine et al. 2024). However, the data currently available for Nā Pali Coast call rate trends is based on sparse sampling in the early years of data collection, so the precision of the trend estimates is relatively low. KIUC has committed to fund long-term systematic data collection in this area for the permit term, which will increase the statistical power to detect trends for this area in the future.

Remainder of the Island

Although radar data has been used to characterize abundance trends throughout Kauaʻi, it likely underrepresents trends for the conservation sites and Nā Pali Coast, and is likely more reflective of trends for the remainder of the island given the radar survey site locations and seabird flyways (Figure 3-12). The radar data collected between 1993 and 2013 showed a 78 percent decline in numbers of Hawaiian petrel (ʻuaʻu) and a 94 percent decline in numbers of Newell's shearwater (ʻaʻo) (Raine et al. 2017b). Raine and Rossiter (2020), however, indicated that the index of abundance from radar data had leveled out starting around 2009, and that the population trend had stopped declining over the decade prior to 2020 (Figure 3-14). The most recent radar data monitoring report found no significant (positive or negative) trend in the index of abundance for either species from 2010 through 2022 (Sahin 2023).

The radar data combined with powerline strike and SOS data indicate that the abundance trends for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) have been relatively flat over the last decade. The three data sources combined provide a relatively high level of confidence that these species are not declining to the extent they were prior to 2013.

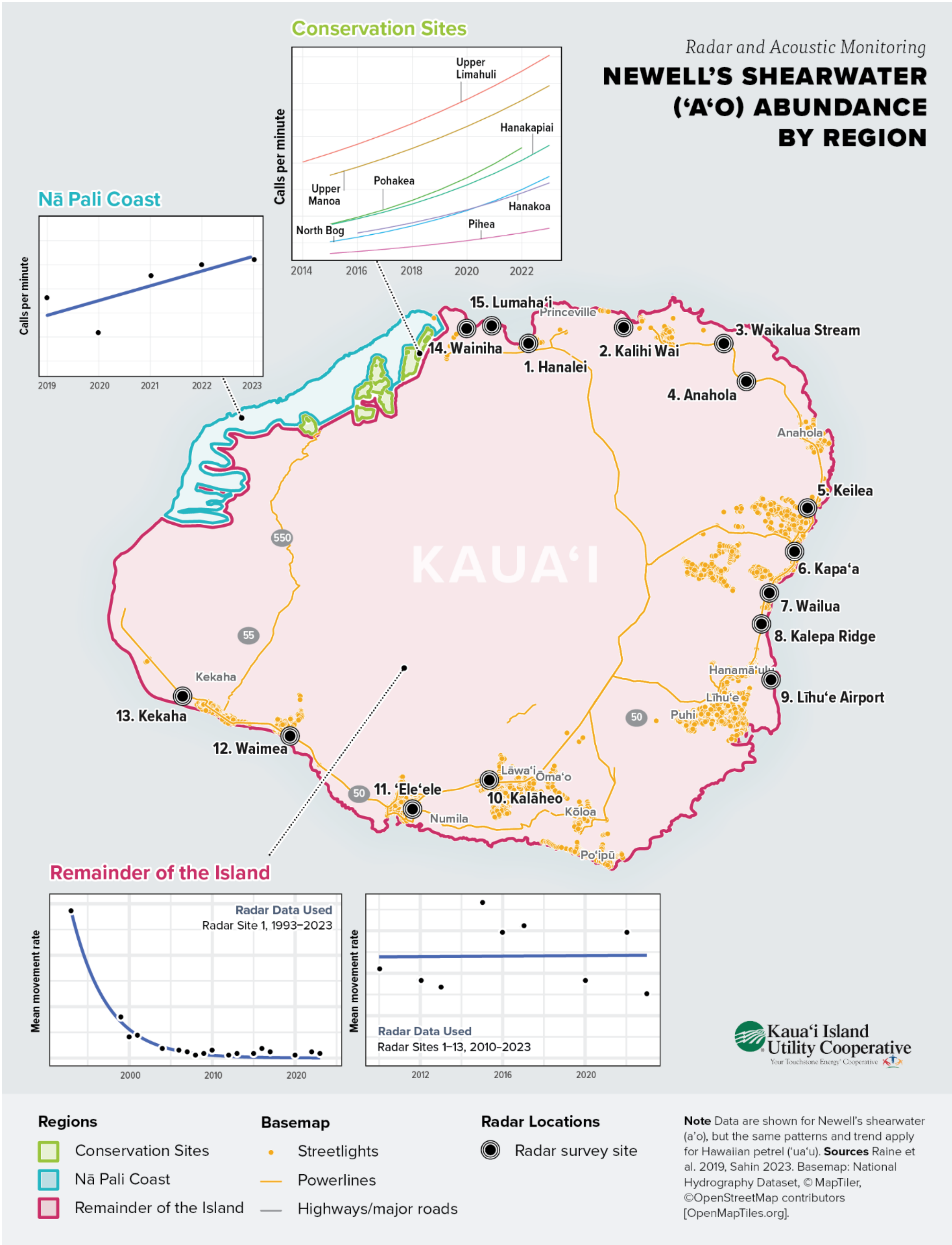

Figure 3-14. Abundance Trends of Newell's Shearwater (ʻaʻo) based on Radar Data, by Region

3.2.2 Covered Waterbirds

Waterbirds covered in the KIUC HCP are the Hawaiian stilt (aeʻo) (*Himantopus mexicanus knudseni*), Hawaiian duck (koloa maoli) (*Anas wyvilliana*), Hawaiian coot (ʻalae keʻokeʻo) (*Fulica alai*), Hawaiian common gallinule (ʻalae ʻula) (*Gallinula galeata sandvicensis*), and the Hawaiian goose (nēnē) (*Branta sandvicensis*). The covered waterbirds are endemic to Hawaiʻi and are state- and federally listed as endangered, except for Hawaiian goose (nēnē), which was federally downlisted to threatened in January 2020 (84 *Federal Register* 69918).

Except for the Hawaiian goose (nēnē), the covered waterbird species are associated only with wetlands and open water habitat in Kauaʻi (Figures 3-3 and 3-4). Hawaiian geese (nēnē) use a wide variety of habitats including coastal dune vegetation and grasslands, sparsely vegetated lava flows, shrublands, and woodlands in areas that typically have less than 90 in (228.6 cm) of annual rainfall (U.S. Fish and Wildlife Service 2004). The Hawaiian goose (nēnē) also inhabits highly altered landscapes such as pastures, agricultural fields, and golf courses (U.S. Fish and Wildlife Service 2004).

All the covered waterbird species are non-migratory, but movements within Kauaʻi and between islands vary by species. Interisland movement is an important strategy for Hawaiian stilts (aeʻo) to exploit food resources, and individuals on Kauaʻi move seasonally to Niʻihau in response to water level changes in Niʻihau's ephemeral lakes (VanderWerf 2012). Breeding habitat differs from foraging habitat for Hawaiian stilts (aeʻo), and individuals move between the two habitats daily. Some seasonal, altitudinal, and interisland movements occur for Hawaiian ducks (koloa maoli), although the timing and mechanics are not well understood (Engilis and Pratt 1993). Hawaiian coots (ʻalae keʻokeʻo) travel long distances, including between islands, in response to rainfall and food source depletion and many move to Niʻihau when suitable temporary ponds are available. It is unknown whether Hawaiian common gallinules (ʻalae ʻula) are capable of interisland movement. Historically, Hawaiian goose (nēnē) flocks have moved between high-elevation feeding habitats and lowland nesting areas and although they are capable of interisland flight, their wings are reduced in size when compared to closely related species.

Long-term census data (1986-2023) indicate that the statewide populations of the covered waterbirds are stable or increasing with global population trends being heavily influenced by Kauaʻi population trends (Gorresen et al. 2024). Over the last two decades the Hawaiian stilt (aeʻo) population has averaged 1,500 individuals (U.S. Fish and Wildlife Service 2020b). The population is currently estimated to be 1,317 to 1,718 birds across the state of Hawaiʻi, with an average of 1,511 birds from 2019 through 2023. The population on Kauaʻi alone is estimated to be 229 to 483 birds, with a 5-year average of 336 (Gorresen et al. 2024). The Hawaiian duck (koloa maoli) statewide population is estimated to be about 2,200 individuals, with 2,000 true (non-hybrid) Hawaiian ducks (koloa maoli) on Kauaʻi and Niʻihau, and 200 on the Island of Hawaiʻi (Engilis et al. 2020). The estimated average population on Kauaʻi from 2019 through 2023 ranged from 516 to 854, for an average of 673 individuals. Hawaiian duck (koloa maoli) on islands other than Kauaʻi are likely hybridized with mallards (*Anas platyrhynchos*; Fowler et al. 2008); therefore, we only considered counts of Hawaiian duck (koloa maoli) from Kauaʻi for our analysis. The State's biannual surveys typically do not include remote wetlands and streams (Engilis et al. 2002), where an estimated 50 to 80 percent of Hawaiian ducks (koloa maoli) are believed to reside on Kauaʻi (Schwartz and Schwartz 1953). The Hawaiian coot (ʻalae keʻokeʻo) population is currently estimated to be 1,306 to 1,858 birds across the state of Hawaiʻi as an average from 2019 to 2023 (Gorresen et al. 2024). The population on Kauaʻi alone is estimated to be an average of 552 birds (400–735) from the same 5-

year time period (2019–2023). The current statewide population of the Hawaiian common gallinule ('alae 'ula) is small but relatively stable with an estimated average of 712 birds (573–870) over 5 years (2019–2023) (Gorresen et al. 2024). The 5-year average population on Kaua'i alone is estimated to be 485 (383–611). The majority of Hawaiian geese (nēnē) are found on Kaua'i. The 2023 Kaua'i population estimate was 2,314 birds, while the statewide population estimate totaled 3,797 individuals (Nēnē Recovery Action Group 2025). This is in comparison to the estimate of 3,865 individuals reported statewide in 2020 (Nēnē Recovery Action Group 2022), and the fewer than 300 individuals at the time of listing in 1967 (U.S. Fish and Wildlife Service 2004).

The most consequential threat to the covered waterbird species has been the loss of wetland habitat. In the last 110 years, approximately 31 percent of coastal plain wetlands have been lost (U.S. Fish and Wildlife Service 2011). Many remaining wetland areas have been invaded by invasive plant species, altering the plant communities, and rendering the habitat unsuitable for some native species such as stilts. Predation by invasive animals such as feral cats and rats continues to negatively affect the covered waterbird species on Kaua'i (U.S. Fish and Wildlife Service 2011). Environmental contaminants such as fuel spills, water pollution, and pesticides continue to degrade habitats that support covered waterbirds. Collisions with vehicles and structures (e.g., powerlines) are also a threat to the covered waterbirds. For example, when taking off and landing, the long, low flight path of Hawaiian geese (nēnē) makes them vulnerable to collisions with stationary structures and moving objects such as vehicles and aircraft (Banko et al. 2020; State of Hawai'i Division of Forestry and Wildlife 2015). Many SOS recoveries of covered waterbirds are from golf courses, where the water features attract these species and render them vulnerable to pesticides and vehicular injuries. The most significant threat facing the Hawaiian duck's (koloa maoli) continued existence is hybridization with feral mallards; as a result, it is now among the rarest of the world's birds (Engilis et al. 2020).

Disease is also a significant cause of mortality for the covered waterbird species in Hawai'i. The most prevalent avian disease that continues to endanger Hawaiian waterbirds is avian botulism. The disease can reappear annually in wetland habitats with stagnant water. The deadly effect, which includes flaccid paralysis and eventual leg paralysis, is caused by a toxin produced by the anaerobic bacteria known as *Clostridium botulinum* (type C). Avian botulism has been documented in the following locations: 'Ōhi'apilo Pond on Moloka'i, Hanalei National Wildlife Refuge on Kaua'i, 'Ōpae'ula Pond and 'Aimakapā Pond on Hawai'i, Keālia Pond National Wildlife Refuge and Kanahā Pond Wildlife Sanctuary on Maui, and at the lake on Laysan Island. Two emerging avian diseases also pose significant threats to the covered waterbirds: West Nile virus and avian influenza H5N1 or "bird flu". Both diseases have yet to be identified in the covered waterbird populations in Hawai'i (U.S. Fish and Wildlife Service 2011).

The impact analysis and conservation strategy for covered waterbirds in this HCP have been developed in recognition that powerline strikes are not a primary source of mortality for these species and that populations are stable or increasing in the Plan Area.

3.2.3 Green Sea Turtle (honu)

Green sea turtle (honu) (*Chelonia mydas*) was listed under the federal Endangered Species Act on July 28, 1978 (43 *Federal Register* 32800). On February 16, 2012, both USFWS and the National Marine Fisheries Service received a petition to identify the Hawaiian green sea turtle (honu) population as a DPS and delist it. After conducting a status review, it was determined on April 6, 2016, that the Hawaiian population of the green sea turtle (honu) met the definition of threatened and was identified as the Central North Pacific DPS (81 *Federal Register* 20057) of the green sea turtle (hereafter green sea turtle) (honu). This DPS of green sea turtle (honu) is also protected by Chapter 195D of the Hawaiʻi Revised Statutes and Section 13-124 of Hawaiʻi Administrative Rules.

The range of the green sea turtle (honu) includes the Hawaiian Archipelago and Johnston Atoll. The Hawaiian Archipelago represents the most geographically isolated chain of islands globally and this DPS's distribution reflects that isolation. From 1965 to 2013, 17,536 individuals of green sea turtle (honu) have been tagged, an effort that has involved all post-pelagic size classes from juveniles to adults. With only three exceptions, all 7,360 recaptures of these tagged turtles were made within the Hawaiian Archipelago. The outliers involved one recovery each in Japan, the Marshall Islands, and the Philippines (Seminoff et al. 2015).

Most green sea turtles (honu) spend most of their lives in open coastline and protected bays and lagoons (Seminoff et al. 2015). While in these areas, green sea turtles (honu) rely on marine algae and seagrass as their primary food, although some populations also forage heavily on invertebrates at different parts of their life cycle. On shore, green sea turtles (honu) rely on beaches characterized by intact dune structures, native vegetation, lack of artificial lighting, and normal beach temperatures for nesting (Limpus 1971; Salmon et al. 1992; Ackerman 1997; Witherington 1997; Lorne and Salmon 2007). On Kauaʻi, green sea turtle (honu) monitoring data collected from 2010 to 2012 were used to calculate an estimated nesting abundance of 16 females (Seminoff et al. 2015). In 2015, Parker and Balazs documented 20 nesting sites[6] around Kauaʻi. Average annual nesting density of green sea turtles (honu) at all Kauaʻi sites is very low, ranging from less than one (i.e., one nest every several years) to one to two nests per year between 2015 and 2020 (State of Hawaiʻi Division of Aquatic Resources 2020). Although nesting density is low, observations of nesting did increase between 2015 and 2020 (State of Hawaiʻi Division of Aquatic Resources 2020).

The primary causes of the decline of green sea turtle (honu) are attributed to a variety of anthropogenic threats; development and public use of beaches, vessel strikes, attraction to artificial lights, bycatch in fishing gear, pollution, interactions with recreational and commercial vessels, beach driving, and major storm events all negatively affect green sea turtles (honu). Three of the most common reasons for sea turtle injury and mortality in Hawaiʻi are entanglement in fishing lines, interactions with fishing hooks, and interaction with marine debris (usually entanglement in nets). Coastal development and construction, vehicular and pedestrian traffic, beach pollution, tourism, and other human-related activities are increasing threats to the basking and nesting population in the main Hawaiian Islands and negatively affect hatchling and nesting turtles on Hawaiʻi's beaches.

Threats resulting from climate change, including habitat loss and effects from warming sea and air temperatures, are characterized as high and the extent to which green sea turtles (honu) can adapt to these changes in nesting beach location and quality is unknown. Climate change will likely also cause higher sand temperatures, leading to increased feminization of surviving hatchings (i.e., changes in sex ratio), which in turn can lead to lower fecundity rates and ultimately population declines (Blechschmidt et al. 2020). Some beaches will also experience lethal incubation temperatures that will result in complete losses of hatchling cohorts (Glen and Mrosovsky 2004; Fuentes et al. 2010, 2011; Blechschmidt et al. 2020). Changes in sea temperatures will also likely

[6] Nesting data reported from Kauaʻi are speculative due to the lack of systematic surveys. Estimates may also be skewed toward high-use beaches and beaches that regularly have resting seals (as this is how green sea turtle [honu] nests have been opportunistically found).

alter seagrass, macroalgae, and invertebrate populations in coastal habitats in many regions (Scavia et al. 2002). Coastal areas denuded of vegetation or with construction can also affect thermal regimes on beaches; thus, they can affect incubation rates and increase the probability of biased sex ratios in hatchling sea turtles. Because of potential tidal inundation associated with lack of vegetation, nests laid in these areas are at a higher risk than those on more pristine beaches (Schroeder and Mosier 2000).

Chapter 4
Conservation Strategy

Chapter 4 Highlights

Chapter Purpose: This chapter describes how KIUC will conserve the covered species, establishes the biological goals and objectives for each covered species, and describes actions KIUC will take to meet those goals and objectives. The chapter provides a blueprint for KIUC to follow for the 50-year permit term to ensure they meet conservation standards under the state and federal endangered species laws and regulations, including fully offsetting the impacts of the taking and providing a net benefit to each covered species.

Context: As described in Chapter 3, *Environmental Setting*, **the three covered seabird species** experience multiple sources of injury and mortality on the Island of Kauaʻi, with the primary threats including invasive predators such as rats, cats, and wild pigs; powerline collisions; and fallout from light attraction. Prior to 2011, relatively little was known about the distribution, population, and behaviors of the three listed seabirds on Kauaʻi. In addition, little was known about the extent of the effects of KIUC's facilities and operations on these species. Since 2011, KIUC has been working with USFWS, DOFAW, and other conservation partners to implement a suite of conservation measures at designated conservation sites occupied by seabird colonies, and to conduct research projects to address scientific uncertainty. This HCP's conservation strategy aims at reducing and offsetting adverse effects on the species, building on over 10 years of KIUC's extensive powerline monitoring, seabird colony monitoring, predator control, and research.

Populations of the **five covered waterbirds** are stable to increasing on Kauaʻi, and while powerline collisions are not a primary threat to these species, KIUC is required under state and federal endangered species laws and regulations to minimize its effects on the species, offset those effects, and provide net benefits to the species.

Major Conclusions	See the following for more information:
Major Conclusions: The conservation strategies for the covered species are summarized as follows.	
• For **Newell's shearwaters (ʻaʻo) and Hawaiian petrels (ʻuaʻu),** the KIUC HCP will contribute to the species' recovery by reducing threats associated with light attraction and powerline collision, funding the Save our Shearwaters (SOS) Program, and implementing predator and invasive vegetation control measures at designated conservation sites. Through the biological objectives, KIUC commits to meeting or exceeding metrics at the conservation sites for: (1) number of breeding pairs; (2) growth rate for breeding pairs; and (3) reproductive success rate. KIUC will also remove predators such as cats, rats, and pigs from breeding sites, fence certain breeding sites to exclude mammalian predators and conduct social attraction within those sites, and ensure invasive plant species do not degrade habitat at the conservation sites.	Table 4-1 Section 4.3 Section 4.4
• For **band-rumped storm-petrel (ʻakēʻakē)**, the HCP will contribute to the species' recovery by reducing threats associated with light attraction and powerline collision, funding the SOS Program, implementing predator control measures near known breeding sites, and conducting social attraction for the species at one conservation site.	Section 4.2.3 Appendix 4B, *KIUC Minimization Projects*

- For the **five covered waterbirds**, the HCP will contribute to the species' recovery by reducing the threat of powerline collisions and by funding the SOS Program.

Appendix 5B, *Light Attraction Modeling for Covered Seabirds*

- For **green sea turtle (honu)**, the HCP will contribute to the species' recovery by increasing the chance of green sea turtle (honu) hatchlings being able to reach the ocean through shielding green sea turtle (honu) nests on beaches that may be affected by KIUC streetlights and other light sources in the vicinity of KIUC streetlights.

Data Sources: Data used to develop the conservation strategy include:

- Powerline collision monitoring data collected by KIUC annually since 2013 throughout the island.
- Radar data that has been collected since 1993 on the covered seabirds, reflecting abundance trends. Data on fallout of seabirds handled by the SOS Program island-wide since 2009, and fallout data from KIUC's lighted facilities since 2011.
- Breeding success, predation presence and rates, seabird activity and abundance estimates, and the conservation needs of covered seabirds on Kaua'i at conservation sites that have been monitored annually since 2011. Most of this work has been published in peer-reviewed journals.
- Sea turtle hatchling studies and conservation needs published from sites around the country, including Hawai'i.

Related Chapters: Chapter 5, *Effects,* describes how the conservation strategy offsets the effects of the covered activities on each covered species, and contributes to each species' recovery. Chapter 6, *Monitoring and Adaptive Management Program,* describes how the conservation measures will be monitored, tracked, and adaptively managed throughout the permit term to ensure the conservation strategy is successfully implemented. Chapter 7, *Plan Implementation*, describes how the conservation strategy will be implemented.

4.1 Introduction

The KIUC HCP conservation strategy is the program that KIUC will implement over the permit term to provide a net environmental benefit to the covered species, contribute to the recovery of the covered species, and fully offset the impacts of the taking of the covered activities on each covered species. The conservation strategy is designed to meet or exceed the statutory and regulatory requirements of the federal Endangered Species Act (federal ESA) and Hawai‘i Revised Statutes (HRS) Chapter 195D, as well as to streamline compliance with the National Environmental Policy Act, Hawai‘i Environmental Policy Act, and other applicable environmental regulations (see discussion in Chapter 1, *Introduction and Background*). Conservation measures identified in the conservation strategy are based on the biological needs of the covered species and will minimize the effects of the covered activities on those species. They also provide mitigation and conservation for the effects of KIUC's covered activities on the covered species that remain, after minimization. See Chapter 5, *Effects*, for a full description of the effects of KIUC's covered activities on each of the covered species.

4.1.1 Overview

The conservation strategy is composed of two primary components that are closely linked—the biological goals and objectives and a set of conservation measures. The biological goals and objectives, described in Section 4.3, *Biological Goals and Objectives,* reflect the expected ecological outcomes of full implementation of the KIUC HCP. The biological goals set out the broad principles KIUC used to guide the development of the conservation strategy. The biological objectives describe the specific conservation commitments. Objectives are measurable and quantitative; they clearly state a desired result and collectively will achieve the biological goals. Biological goals and objectives are the foundation of the conservation strategy and are intended to provide the following functions.

- Describe the desired biological outcomes of the conservation strategy and how those outcomes will provide for the conservation of covered species and their habitats.
- Provide quantitative commitments and timeframes for achieving the desired outcomes.
- Serve as benchmarks by which to measure progress in achieving those outcomes across multiple temporal and spatial scales.
- Provide metrics for the monitoring program that will evaluate the effectiveness of the conservation measures and, if necessary, provide a basis to adjust the conservation measures to achieve the desired outcomes.

KIUC commits to implementing the conservation measures described in Section 4.4, *Conservation Measures*, to achieve the biological goals and objectives. In other words, the conservation measures are the actions KIUC will implement to meet the biological goals and objectives.

4.1.2 Prior KIUC Conservation Measures

This HCP is based, in part, on a long history of experimentation, research, and implementation of seabird conservation measures initiated by KIUC's predecessor in 2001 and continued by KIUC since their inception in 2002. The biological goals and objectives and conservation measures in this HCP for covered seabirds are based on over 20 years of implementing and refining the same or similar measures and the data collected through field monitoring to determine their effectiveness. Chapter 3, Section 3.2.1.3, *Kaua'i-wide Conservation Efforts,* summarizes the relevant history of this HCP, including the origins of and when each relevant conservation measure began and how it has evolved. Table 3-2 lists all interim conservation measures and their relationship to this HCP. In addition, a more detailed summary of each type of available data and how it was used for plan development can be found in Appendix 1A, *Data Used for Plan Development*.

4.2 Methods and Approach

The conservation strategy was developed through extensive discussions and collaboration with the U.S. Fish and Wildlife Service (USFWS) and State of Hawai'i Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW), during and after implementation of KIUC's *Short-Term Seabird Habitat Conservation Plan* (Short-Term HCP; Kaua'i Island Utility Cooperative 2011). It incorporates engineering and biological information regarding the cost, feasibility, and biological effectiveness of various minimization and conservation measures, drawing on techniques and information KIUC has developed through the Short-Term HCP for seabirds (Section 4.1.2, *Prior KIUC Conservation Measures*).

The conservation strategy is based on the best scientific data available as listed in Section 4.2.3, *Information Sources*, and was designed to be quantitative and measurable (Noss 1987).

4.2.1 Regulatory Background on Biological Goals and Objectives and Conservation Measures

HCPs are required to include biological goals and objectives for the covered species, either individually or in groups (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016). HRS Chapter 195D does not require biological goals and objectives in HCPs.

Biological goals are broad, guiding principles based on the biological needs of the covered species, and should broadly describe the desired future conditions for covered species in the Plan Area in succinct statements (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016:9-8). Each biological goal steps down to one or more biological objectives that define how to achieve the goal in measurable terms. As such, biological objectives are expressed as specific desired conditions that are measurable and quantitative when practicable and provide the foundation for evaluating effectiveness of the conservation strategy.

Biological goals and objectives should be developed based on existing conservation information relevant to the covered species. Biological goals and objectives should also be developed to remain attainable given the projected effects of climate change in the Plan Area during the permit term (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016:9-5).

Biological objectives are met through one or more *conservation measures*. Conservation measures can include actions that do any of the following to meet the goals and objectives of the HCP.

- Avoid effects on the covered species, or on other non-covered species (called *avoidance measures*).
- Reduce or minimize effects on the covered species (called *minimization measures*).

- Offset effects on the covered species that remain after avoidance and minimization (called *mitigation*).

In sum, the entire conservation strategy (i.e., all conservation measures together) is intended to meet the regulatory standards under both the federal ESA[1] and HRS Chapter 195D[2] to do the following.

- Minimize and mitigate the impacts of the take to the maximum extent practicable (federal ESA and HRS Chapter 195D).
- Not appreciably reduce the likelihood of survival and recovery of the covered species in the wild (federal ESA and HRS Chapter 195D).
- Increase the likelihood that the covered species will survive and recover (HRS Chapter 195D).
- Provide net environmental benefits (HRS Chapter 195D).

4.2.2 Process of Developing the Biological Goals and Objectives and Conservation Measures

The biological goals and objectives were developed first for the covered seabirds to address the complexities associated with the high level of effects (see Chapter 5, *Effects*) that has degraded the status of the species (Appendix 3A, *Species Accounts*). The seabird biological goals and objectives focus first on minimizing KIUC's impact from powerline strikes and light attraction from streetlights. Second, the biological goals and objectives for covered seabirds focus on fully offsetting the remaining unavoidable effects and contributing to species recovery. Taken together, achieving the goals and objectives will provide a net environmental benefit to the covered species, as explained in Chapter 5, *Effects*.

The biological goals and objectives for the covered waterbirds are very similar to the goals and objectives for the covered seabirds. For example, the covered waterbird biological goals and objectives also focus on minimizing and mitigating the effects of powerline strikes. However, the covered waterbird strategy focuses on minimization efforts at specific locations with the highest probability of waterbird strikes rather than throughout the Plan Area.

The biological goals and objectives for green sea turtle (honu) (*Chelonia mydas*) focus on minimizing the effects of streetlights at active nests in order to minimize hatchling disorientation.

As with any biological system, there are varying degrees of certainty or uncertainty regarding the effectiveness of the conservation measures that will achieve the biological goals and objectives. For example, the conservation measure to enhance seabird colonies at conservation sites in northwest Kauaʻi has a relatively high degree of certainty because KIUC has been implementing and refining these conservation actions since 2011 at multiple sites (see Conservation Measure 4 for details). Similarly, the benefits of the Save Our Shearwaters (SOS) rescue and rehabilitation program are well established because the program has been operating since the 1970s (see Conservation Measure 3 for details). In other cases, however, conservation measures are new or untested. For example, the green sea turtle (honu) nest detection and shielding program is new to Kauaʻi, although similar programs have been implemented elsewhere (see Conservation Measure 5 for details).

[1] 50 Code of Federal Regulations Section 17.22(b)(2)(i).

[2] Hawaiʻi Revised Statute Sections 195D-4(g) and 195D-21(c)(1) and (2).

To address this varying degree of uncertainty, the adaptive management program is a critical component of the KIUC HCP. Adaptive management will allow KIUC to adjust the conservation measures based on the monitoring results so that they are more likely to meet the biological goals and objectives of the HCP. See Chapter 6, *Monitoring and Adaptive Management Program*, for the KIUC HCP's adaptive management strategy.

4.2.3 Information Sources

The conservation strategy was developed by KIUC in close collaboration with USFWS, DOFAW, and other local conservation partners such as Archipelago Research and Conservation (ARC) (species experts formerly with the Kauaʻi Endangered Seabird Recovery Project). It is based on the biological needs of the covered species and the need to meet the regulatory standards described at the beginning of this chapter and in Chapter 1, *Introduction and Background*. The biological needs of the covered species are summarized in the species accounts in Appendix 3A, *Species Accounts*. In addition, several key sources of literature were used to inform the conservation strategy.

- *Hawaiian Dark-Rumped Petrel and the Newell's Manx Shearwater Recovery Plan* (U.S. Fish and Wildlife Service 1983)
- *Hawaiian Dark-Rumped Petrel and Newell's Manx Shearwater Recovery Plan: Newell's Townsend's Shearwater Recovery Criteria* (U.S. Fish and Wildlife Service 2019)
- *Draft Recovery Plan for the Nene or Hawaiian Goose* (U.S. Fish and Wildlife Service 2004)
- *Recovery Plan for Hawaiian Waterbirds*, Second Revision (U.S. Fish and Wildlife Service 2011)
- *Regional Seabird Conservation Plan* (U.S. Fish and Wildlife Service 2005)
- *Hawaii's Comprehensive Wildlife Conservation Strategy* (Mitchell et al. 2005)
- *Hawaiʻi's State Wildlife Action Plan* (State of Hawaiʻi Department of Land and Natural Resources 2015)
- *Newell's Shearwater and Hawaiian Petrel Recovery: A Five-Year Action Plan* (Holmes et al. 2015)
- *Newell's Shearwater Landscape Strategy* (U.S. Fish and Wildlife Service 2017a)
- *Newell's Shearwater Landscape Strategy Appendix II, Modelling Methods and Results used to Inform the Newell's Shearwater Landscape Strategy* (U.S. Fish and Wildlife Service 2017b)
- *Short-Term Seabird Habitat Conservation Plan* (Kauaʻi Island Utility Cooperative 2011)
- *Kauaʻi Seabird Habitat Conservation Plan* (State of Hawaiʻi Division of Forestry and Wildlife 2020)
- *Final Environmental Assessment for Newell's Shearwater Management Actions* (U.S. Fish and Wildlife Service 2016)
- Managing the Effects of Introduced Predators on Hawaiian Endangered Seabirds (Raine et al. 2020a)
- *Underline Monitoring Project Review Draft—Bayesian Acoustic Strike Model* (Travers et al. 2020a)
- *Assessing the Reliability of Existing Newell's Shearwater* Puffinus newelli *and Hawaiian Petrel* Pterodroma sandwichensis *Population Estimates Using Contemporary Tracking Data* (Raine et al. 2021a)
- Post-release Survival of Fallout Newell's Shearwater Fledglings from a Rescue and Rehabilitation Program on Kauaʻi, Hawaiʻi (Raine et al. 2020b)

- *2017 Annual Radar Monitoring Report* (Raine et al. 2017a)
- *2020 Annual Radar Monitoring Report* (Raine and Rossiter 2020)
- *2022 Annual Radar Monitoring Report* (Sahin 2023)
- *Underline Monitoring Project-Power Line Minimization Briefing Document* (Travers et al. 2019a)
- *Underline Monitoring Project Power Line Minimization Briefing Document Supplement 2* (Travers and Raine 2020a)
- *Underline Monitoring Project Annual Reports* for field seasons 2012 through 2022 (Travers et al. 2012, 2013, 2014, 2015, 2016, 2017a, 2018, 2019b, 2020b, 2021a, 2022, and 2023)
- *Using Automated Acoustic Monitoring Devices to Estimate Population Size of Endangered Seabird Colonies on Kauaʻi* (Raine et al. 2019a)
- *KIUC Long-Term HCP Conservation Strategy for the Newell's Shearwater and Hawaiian Petrel to Address Power Line Strikes* (U.S. Fish and Wildlife Service and State of Hawaiʻi Division of Forestry and Wildlife 2018)
- Declining Population Trends of Hawaiian Petrel and Newell's Shearwater on the Island of Kauaʻi, Hawaii, USA (Raine et al. 2017b)
- Post-collision impacts, crippling bias, and environmental bias in a study of Newell's Shearwater and Hawaiian Petrel powerline collisions (Travers et al. 2021b)
- *Endangered Seabird Management Site Ranking Matrix* (Raine et al. 2020c)
- *2020 KIUC Fence Prioritization Evaluation* (Young 2020)

New analysis associated with this HCP included extensive computer modeling of the predicted effects of the covered activities on the covered species and the expected conservation benefits of the conservation measures. These models, which are included as appendices to Chapter 5, *Effects*, informed many of the quantitative population targets and types and amount of mitigation necessary to fully offset KIUC's impacts and result in a net benefit to each of the covered species.

4.2.4 Evaluation of Confidence in Conservation Measure Benefits

This evaluation qualitatively describes the levels of confidence in the predicted benefits to the covered species from the conservation measures. The same assessment is provided at the end of each conservation measure in the last subsection titled *Confidence in Conservation Measure Benefits to the Covered Species.* These assessments are based on the professional judgement of the authors and their evaluation of the strength of data available for each component part of each conservation measure. Data strength is also assessed qualitatively but is based on a combination of quantitative factors such as the following.

- The number of years over which data are collected.
- The recency of the dataset.
- The number of sites at which data are collected.
- Data collected on the covered species on Kauaʻi (vs. a similar species elsewhere).
- The number of individuals sampled for the data collected (n).

- The proportion of a local population sampled (if known).
- The range of conditions under which data are collected.
- The consistency of data results across sites and years.

In each assessment, confidence levels are categorized as either:

- **High** = High confidence in species benefits due to published, consistent results over multiple years across multiple sites and relatively large sample sizes. The samples represent a substantial fraction of the total number of individuals in the area and range of conditions. Data were collected on the covered species on Kauaʻi. Analytical results have been consistent across the time period of the samples.
- **Moderate** = Moderate confidence in species benefits due to inconsistent results over multiple years, or consistent results over a few years. Sample sizes were modest and represent a modest fraction of the total population, or that fraction is unknown. Data were collected on the covered species on Kauaʻi.
- **Low** = Little or no data exists on the benefits of the conservation measure component for the covered species. If data exist, it is for the same species in a different location, or for a similar species elsewhere. If data were collected for the covered species on Kauaʻi, it may be inconclusive and inconsistent; or collected at few sites, over one or a few years, with few individuals, or a combination of these factors.

4.3 Biological Goals and Objectives

The biological goals and objectives for the KIUC HCP describe what the conservation strategy is intended to achieve. The biological goals and objectives are organized by species group: seabirds, waterbirds, and the green sea turtle (honu). Each covered seabird species is listed individually to address differences in Kauaʻi metapopulation size, colony location, and data availability. More details can be found in Appendix 3A, *Species Accounts*, and Chapter 3, Section 3.2.1, *Covered Seabirds*. The covered waterbirds are grouped under one goal because the actions to minimize and mitigate KIUC's effects are the same for all five species and because each species' population on Kauaʻi is thought to be either stable or increasing.

The biological goals and objectives are summarized in Table 4-1. Each biological objective will be met through one or more conservation measures listed in Table 4-1. Detailed descriptions of the conservation measures are found in Section 4.4, *Conservation Measures*. In addition, this section includes a detailed description of the rationale for each biological objective.

Table 4-1. Biological Goals and Objectives and Applicable Conservation Measures

Biological Goals and Objectives	Applicable Conservation Measures (see Section 4.4 for full descriptions of conservation measures)
Newell's Shearwater ('a'o) (*Puffinus newelli*)	
Goal 1. Provide for the survival of the Kaua'i metapopulation of Newell's shearwater ('a'o) and contribute to the species' recovery by minimizing and fully offsetting the impacts of KIUC's taking of this species over the term of the HCP to an extent that is likely to result in numbers of breeding pairs, age structure, population growth rate, and spatial distribution that is representative of a Kaua'i viable metapopulation, thereby providing a net benefit to the species.	
Objective 1.1. Substantially reduce the extent and effect of collisions of adult/subadult Newell's shearwaters ('a'o) with existing and future KIUC powerlines island-wide, as measured against the pre-2020 strike estimate (Appendix 5C, *Bayesian Acoustic Strike Model*), in accordance with the location, extent, and schedule outlined in the HCP.	**Conservation Measure 1.** Implement Powerline Collision Minimization Projects
Objective 1.2. Minimize the adverse effects of artificial light attraction on Newell's shearwater ('a'o) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.	**Conservation Measure 2.** Implement Measures to Minimize Light Attraction, **Conservation Measure 3.** Provide Funding for the Save Our Shearwaters Program
Objective 1.3. Increase the number of Newell's shearwater ('a'o) breeding pairs and fledglings produced annually throughout the duration of the permits by managing and enhancing suitable Newell's shearwater ('a'o) breeding habitat and breeding colonies across 12 conservation sites and reducing the abundance and distribution of key seabird predators at these sites. The success of this objective will be measured by the following metrics, each of which is applied to the 12 conservation sites combined: **Metric 1.** Meet the minimum target breeding pairs defined in Table 6A-3 (lists the minimum breeding pairs per year), as calculated using data from auditory surveys, acoustic surveys, and burrow monitoring. **Metric 2.** Growth rate for breeding pairs annually of at least 1.0% as measured by a 5-year rolling average as inferred from data collection at the conservation sites. **Metric 3.** Maintain a 5-year rolling average 87.2% reproductive success rate. **Metric 4.** Eradicate terrestrial predators within predator exclusion fencing within 1 year of completing fence construction. **Metric 5.** Produce at least one breeding pair within each of the four social attraction sites by year 5 after the completion of predator eradication within	**Conservation Measure 4.** Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites

Biological Goals and Objectives	Applicable Conservation Measures (see Section 4.4 for full descriptions of conservation measures)
the fenced area at each site. Positive growth demonstrated at each site during the portion of the permit term when social attraction is occurring. **Metric 6.** Ensure invasive plant and animal species do not preclude meeting the objective metrics above. **Metric 7.** At least four conservation sites will be occupied annually by breeding pairs for years 1–10 and at least 9 conservation sites occupied by breeding pairs or prospecting birds for remainder of the permit term, as measured by burrow monitoring, call rates, and/or auditory surveys.	
Hawaiian Petrel (ʻuaʻu) (*Pterodroma sandwichensis*)	
Goal 2. Provide for the survival of the Kauaʻi metapopulation of Hawaiian petrel (ʻuaʻu) and contribute to the species' recovery by minimizing and fully offsetting the impacts of KIUC's taking of this species over the term of the HCP to an extent that is likely to result in numbers of breeding pairs, age structure, population growth rate, and spatial distribution that is representative of a Kauaʻi viable metapopulation, thereby providing a net benefit to the species.	
Objective 2.1. Substantially reduce the extent and effect of collisions of adult/subadult Hawaiian petrels (ʻuaʻu) with existing and future KIUC powerlines island-wide, as measured against the pre-2020 strike estimate (Appendix 5C, *Bayesian Acoustic Strike Model*) in accordance with the location, extent, and schedule outlined in the HCP.	**Conservation Measure 1.** Implement Powerline Collision Minimization Projects
Objective 2.2. Minimize the adverse effects of artificial light attraction on Hawaiian petrel (ʻuaʻu) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.	**Conservation Measure 2.** Implement Measures to Minimize Light Attraction, **Conservation Measure 3.** Provide Funding for the Save Our Shearwaters Program
Objective 2.3. Increase the number of Hawaiian petrel (ʻuaʻu) breeding pairs and fledglings produced annually throughout the duration of the permits by managing and enhancing suitable Hawaiian petrel (ʻuaʻu) breeding habitat and breeding colonies across 8 conservation sites and reducing the abundance and distribution of key seabird predators at these sites. The success of this objective will be measured by the following metrics, each of which is applied to the 8 conservation sites combined: **Metric 1.** Meet the minimum target breeding pairs defined in Table 6A-4 (lists the minimum breeding pairs per year), as calculated using data from auditory surveys, acoustic surveys, and burrow monitoring. **Metric 2**. Growth rate for breeding pairs annually of at least 1.0% as measured by a 5-year rolling average as inferred from data collection at the conservation sites.	**Conservation Measure 4.** Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites

Biological Goals and Objectives	Applicable Conservation Measures (see Section 4.4 for full descriptions of conservation measures)
Metric 3. Maintain a 5-year rolling average 78.7% reproductive success rate. **Metric 4**. Ensure that invasive plant and animal species do not preclude meeting the objective metrics above. **Metric 5.** At least six conservation sites will be occupied annually by breeding pairs, as measured by burrow monitoring, call rates, and/or auditory surveys.	
Band-Rumped Storm-Petrel (ʻakēʻakē) (*Hydrobates castro*)	
Goal 3. Contribute to the recovery of the band-rumped storm-petrel (ʻakēʻakē) by reducing threats associated with existing and future KIUC powerlines and streetlights, existing covered facility lights, and introduced predators on Kauaʻi.	
Objective 3.1. Reduce the potential for band-rumped storm-petrel (ʻakēʻakē) collisions with existing and future KIUC powerlines island-wide, in accordance with the location, extent, and schedule outlined in the HCP.	**Conservation Measure 1.** Implement Powerline Collision Minimization Projects
Objective 3.2. Minimize the adverse effects of artificial light attraction on band-rumped storm-petrel (ʻakēʻakē) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.	**Conservation Measure 2.** Implement Measures to Minimize Light Attraction
Objective 3.3. Facilitate the rescue, rehabilitation, and release of band-rumped storm-petrel (ʻakēʻakē) fledglings through funding of the Save Our Shearwaters Program or other certified rehabilitation facility to offset light attraction by KIUC streetlights.	**Conservation Measure 3.** Provide Funding for the Save Our Shearwaters Program
Objective 3.4. Implement predator control, including barn owl control, within the conservation sites to reduce predation of band-rumped storm-petrel (ʻakēʻakē) in areas near and within the Honopū PF conservation site (e.g., Nā Pali Coast).	**Conservation Measure 4.** Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites
Covered Waterbirds: Hawaiian Coot (ʻalae keʻokeʻo) (*Fulica alai*), Hawaiian Gallinule (ʻalae ʻula) (*Gallinula galeata sandvicensis*), Hawaiian Stilt (aeʻo) (*Himantopus mexicanus knudseni*), Hawaiian Goose (nēnē) (*Branta sandvicensis*), and Hawaiian Duck (koloa maoli) (*Anas wyvilliana*)	
Goal 4. Contribute to the recovery of covered waterbird species by reducing threats associated with KIUC powerlines on Kauaʻi.	
Objective 4.1. Reduce covered waterbird collisions with KIUC powerlines in Hanalei, Mānā (Kawaiʻele Waterbird Sanctuary), and other areas in accordance with the location, extent, and schedule outlined in the HCP, and relative to measured collisions in 2020.	**Conservation Measure 1.** Implement Powerline Collision Minimization Projects
Objective 4.2. Facilitate the rescue, rehabilitation, and release of grounded covered waterbirds through funding of the Save Our Shearwaters Program or other certified rehabilitation facility to offset collisions with KIUC powerlines.	**Conservation Measure 3.** Provide Funding for the Save Our Shearwaters Program

Biological Goals and Objectives	Applicable Conservation Measures (see Section 4.4 for full descriptions of conservation measures)
Central North Pacific Distinct Population Segment of the Green Sea Turtle (honu) (*Chelonia mydas*)	
Goal 5. Contribute to the recovery of the species by increasing the ability for green sea turtles (honu) to successfully transit Kauaʻi beaches.	
Objective 5.1. Locate and shield green sea turtle (honu) nests at all locations that are visually affected by KIUC streetlights on an annual basis.	**Conservation Measure 5.** Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program
Objective 5.2. Minimize light effects to the extent practicable from existing and future KIUC streetlights onto beaches with suitable green sea turtle (honu) nesting habitat by implementing practicable minimization techniques that will reduce or eliminate these light effects.	**Conservation Measure 6.** Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle (honu)

4.3.1 Newell's Shearwater (ʻaʻo)

Goal 1. Provide for the survival of the Kauaʻi metapopulation of Newell's shearwater (ʻaʻo) and contribute to the species' recovery by minimizing and fully offsetting the impacts of KIUC's taking of this species over the term of the HCP to an extent that is likely to result in numbers of breeding pairs, age structure, population growth rate, and spatial distribution that is representative of a Kauaʻi viable metapopulation, thereby providing a net benefit to the species.

Objective 1.1. Substantially reduce the extent and effect of collisions of adult/subadult covered seabirds with existing and future KIUC powerlines island-wide, as measured against the pre-2020 strike estimate (Appendix 5C, *Bayesian Acoustic Strike Model*) in accordance with the location, extent, and schedule outlined in the HCP.

Rationale

Reduction of powerline collisions ("strike reduction" is used interchangeably) is key to reducing overall human-caused seabird injury and mortality (Travers et al. 2021b; Travers and Raine 2020a), and hence to retaining the potential for Newell's shearwater (ʻaʻo) recovery. The rate of seabird powerline collisions has affected and is affecting the age structure of the Kauaʻi metapopulation by removing large portions of subadult and adult individuals annually from the population. Because the reproductive strategy of this species evolved to have high adult survivorship with a relatively low number of offspring, increased levels of adult mortality are particularly harmful to this species' population viability. Low adult survivorship (or conversely high adult mortality) reduces the number of breeding birds, which results in less birds being produced and recruited into the population. Left unchecked, this depresses populations to levels where they can become vulnerable to extirpation. A reduction in powerline collisions will lower both subadult and adult mortality, retaining existing breeding adults and allowing for increased subadult recruitment into the breeding population. More adults and subadults not only increases the number of individuals in the population, but improves diversity in age structure and improves the population rate of change (increasing the number of individuals added to the population). In combination with additional objectives for minimization of light impacts (1.2) and mitigation (1.3), the viability of the Kauaʻi metapopulation of Newell's shearwater (ʻaʻo) will improve.

Based on KIUC's 2013–2019 powerline monitoring data and estimated strike reductions of between 40 percent to over 90 percent (see details in Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*), KIUC's powerline minimization projects completed through May 5, 2024, are expected to have reduced seabird powerline collisions by at least 66.4 percent. The number of strike reductions as a result of the minimization measures will be confirmed by powerline collision monitoring through 2027. The comparison point (i.e., baseline) to which all future measurements of powerline strike minimization effectiveness will be compared, is the estimated strike rate derived from a Bayesian model using powerline strike data collected between 2013 and 2019 (Travers et al. 2020a). Subsequent annual minimization levels are calculated relative to the baseline strike rate, both during early implementation of the KIUC HCP as well as for the remainder of the permit term.

All planned powerline minimization projects have been completed prior to permit issuance, with benefits being realized immediately (e.g., Travers et al. 2023). This is especially important for this species given its life history (e.g., age at first reproduction around 6 years, pair bonding between breeding adults, and only one offspring per year). Minimization accomplished over the last several years has resulted in a reduction of thousands of estimated collisions each year for the covered seabirds. A large share of these birds, that would have otherwise been killed or injured colliding with powerlines prior to the minimization measures, will survive at sea and return to breed in the coming years. This is important because to the extent that subadults are more vulnerable to collisions (Cooper and Day 1998), recruitment of subadults to the breeding population is depressed. Effective minimization is therefore expected to increase recruitment to the breeding population by increasing survivorship of subadults. There can be some delay in achieving this benefit because a proportion of subadults that avoid powerline collisions may still be a few years away from reaching breeding age. However, the completion of minimization measures prior to permit issuance means that the benefit of increased recruitment to the breeding population from the younger subadult cohort is expected from the outset of the permit term, without delay. Minimization will continue to be an important tool throughout the permit term for new and existing lines in situations where minimization is not as effective as estimated or where powerline monitoring indicates a significant increase in strikes compared to the estimated strike rate derived from the Bayesian model using powerline strike data collected between 2013 and 2019 (Travers et al. 2020a).

See Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*, for details of the conservation measure proposed to achieve this biological objective.

Objective 1.2. Minimize the adverse effects of artificial light attraction on Newell's shearwater (ʻaʻo) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.

Rationale

Conservation measures with proven success at reducing covered seabird fledgling light attraction have been implemented for KIUC's existing streetlights (full-cutoff shields for lights), in partnership with the County of Kauaʻi (County) and State of Hawaiʻi (State), and for KIUC's covered facility lights. An early study on Kauaʻi showed that the shielding of bright lights reduced fallout of Newell's shearwater (ʻaʻo) fledglings by 40 percent (Reed et al. 1985). Recent studies continue to indicate that the reduction of lateral light spillage reduces light-induced fallout of seabirds (Rodríguez et al. 2017a, 2017b). KIUC also began dimming covered facility lights at the Port Allen Generating Station in 2019 during the seabird fallout season (September 15 to December 15), which reduced Newell's shearwater (ʻaʻo) fallout from an average of five and a half fledglings per year to an average of one fledgling per year (Kauaʻi Island Utility Cooperative 2024).

Another important conservation measure is KIUC's continued financial support of the SOS Program. This program rescues and rehabilitates birds grounded by fallout that are turned in by the public. Most of the birds recovered are either released immediately or rehabilitated and then released back into the wild. Since 1979, the SOS Program has recovered and released more than 32,500 seabirds (Raine et al. 2023a). From 2009 through 2024, 56 to 85 percent of the covered seabirds and 40 to 68 percent of the covered waterbirds that were handled by the SOS Program were rehabilitated and released back into the wild. The limited data available indicates that some of these birds survive and likely return to Kauaʻi to breed. KIUC will provide $300,000 annually to SOS, adjusted annually for inflation increases, throughout the permit term.

The conservation actions described above, and for new lights, will continue to be implemented during the permit term. Increased fledgling survival would increase recruitment, which leads to more future breeding-age individuals in the Kauaʻi metapopulation. Because this species has very low reproductive productivity, increasing recruitment to the breeding-age population, and hence increasing the number of fledglings that can be produced by the metapopulation each year, will contribute to a stable age structure (increased amount of younger age classes in the population), population growth rate, and numbers for the Kauaʻi metapopulation of Newell's shearwater (ʻaʻo).

See Section 4.4.2, *Conservation Measure 2. Implement Measures to Minimize Light Attraction,* and Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program*, for details of the conservation measures proposed to achieve this biological objective.

Objective 1.3. Increase the number of Newell's shearwater (ʻaʻo) breeding pairs and fledglings produced annually throughout the duration of the permits by managing and enhancing suitable Newell's shearwater (ʻaʻo) breeding habitat and breeding colonies across 12 conservation sites and reducing the abundance and distribution of key seabird predators at these sites. The success of this objective will be measured by the following metrics, each of which is applied to the 12 conservation sites combined:

- **Metric 1.** Meet the minimum target breeding pairs defined in Table 6A-3 (lists the minimum breeding pairs per year), as calculated using data from auditory surveys, acoustic surveys, and burrow monitoring.
- **Metric 2.** Growth rate for breeding pairs annually of at least 1 percent as measured by a 5-year rolling average as inferred from data collection at the conservation sites.
- **Metric 3.** Maintain a 5-year rolling average 87.2 percent reproductive success rate.
- **Metric 4.** Eradicate terrestrial predators within predator exclusion fencing within 1 year of completing fence construction.
- **Metric 5.** Produce at least one breeding pair within each of the four social attraction sites by year 5 after the completion of predator eradication within the fenced area at each site. Positive growth demonstrated at each site during the portion of the permit term when social attraction is occurring.
- **Metric 6.** Ensure that invasive plant and animal species do not preclude meeting the objective metrics above.
- **Metric 7.** At least four conservation sites will be occupied annually by breeding pairs for years 1 through 10 and at least nine conservation sites occupied by breeding pairs or prospecting birds for remainder of the permit term, as measured by burrow monitoring, call rates, and/or auditory surveys.

Rationale

Operation of KIUC infrastructure has had substantial effects on the Kauaʻi metapopulation of this species and is one of the primary reasons the metapopulation is at historically low levels. Because approximately 90 percent of the breeding population of Newell's shearwater (ʻaʻo) occurs on Kauaʻi, a Kauaʻi viable metapopulation is critical to retaining the potential for species recovery. A viable metapopulation is an estimated number of individuals within a metapopulation that persists with a high probability in the long term (Frankham et al. 2014) measured by its distribution, population size, age structure, growth rate, and additional demographic variables (e.g., age/cohort survivorship, reproductive success). A Kauaʻi viable metapopulation for Newell's shearwater (ʻaʻo) is quantified as 2,500 breeding pairs and a total population size of 10,000 individuals (U.S. Fish and Wildlife Service in litt.).

The densest colonies of Newell's shearwater (ʻaʻo) in the Plan Area are concentrated in the remote northwestern portion of Kauaʻi and this is where the KIUC Short-Term HCP and early implementation conservation efforts have been focused for more than a decade (Raine et al. 2020c). These efforts have been successfully implemented as demonstrated by, for example, predator control, which has been shown to increase the reproductive success rate for this species by an estimated 35.8 percent between 2011 and 2017 (Raine et al. 2020a), indicating that conservation efforts in this area are critical to achieving a Kauaʻi viable metapopulation. KIUC has secured 12 conservation sites (see Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*) at which to manage and enhance habitat for existing breeding colonies of Newell's shearwater (ʻaʻo). The 12 selected sites total approximately 1,981 acres (802 hectares).[3]

Management actions by KIUC with proven success at improving the reproductive productivity of Newell's shearwater (ʻaʻo) breeding colonies are ongoing at all the selected conservation sites and would continue and be expanded by the HCP for the duration of the permit term. Predator control has been shown to be the most effective tactic to increase the reproductive success rate of Newell's shearwater (ʻaʻo), with estimated increases of 35.8 percent in managed areas (Raine et al. 2020a). Expanding the scale and types of predator control (e.g., installing and maintaining various types of predator exclusion fencing and predator eradication within predator exclusion fences [PF]) will further reduce this significant threat and increase the survivorship of fledglings produced each year. Social attraction within the fenced conservation sites is also expected to accelerate colony recruitment and colony increases and expansion.

All of the conservation measures that support this objective are designed to result in population increases at each conservation site in which Newell's shearwater (ʻaʻo) are breeding. In combination with a substantial reduction in powerline strikes (see Objective 1.1), KIUC's conservation strategy will improve the status of the Kauaʻi metapopulation of Newell's shearwater (ʻaʻo) by continuing to protect and manage existing colonies within conservation sites. (See also Conservation Measure 4. *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites* in Section 4.4, *Conservation Measures*).

<u>Components of a Kauaʻi Viable Metapopulation</u>[4]

Collectively, the successful implementation of the conservation measures is expected to result in a Kauaʻi viable metapopulation of Newell's shearwater (ʻaʻo), as stated in Goal 1. While population viability cannot be directly measured, the following components of population dynamics contributing to viability can be evaluated, some of which are measurable and some of which are not.

- Numbers of breeding pairs

[3] See Appendix 4A, *Conservation Site Selection*, for further details on these conservation sites, their specific characteristics, and how and why they were selected.

[4] All three objectives are necessary to reach the goal of a Kauaʻi viable metapopulation. However, Objective 1.3 is the most relevant to achieving a viable Kauaʻi metapopulation so this discussion is included as part of Objective 1.3.

- Trends in abundance
- Age structure and sex ratio
- Spatial distribution

Each of these components of a Kauaʻi viable metapopulation is explained below.

Numbers of breeding pairs. USFWS (in litt.) estimates that 10,000 individuals (2,500 breeding pairs) represents a Kauaʻi viable metapopulation of Newell's shearwater (ʻaʻo). This estimate considers the roles of age structure, catastrophes, random demographic and environmental fluctuations (stochasticity), and inbreeding depression. Populations maintained above viable levels ensure a higher likelihood of population persistence. For the covered seabirds, a key metric related to population viability is the number of breeding pairs, because this provides the most direct estimate of the effective metapopulation size on Kauaʻi. For this HCP, the number of breeding pairs for the Kauaʻi metapopulation is based on estimates by subpopulation.

The word *subpopulation* is used here to represent a subset of the modeled metapopulation on Kauaʻi. Each subpopulation is defined by a geographic portion of the island which has similar conservation threats and management efforts for the species, as well as similar available data sources for estimating the abundance and trend of breeding pairs that nest within each area (Tables 5D-2 and 5E-2). The modeling framework allows each subpopulation to have its own set of vital rate values (e.g., mortality, carrying capacity) and therefore, potentially different trends in abundance through time. This reflects the fact that pressures such as powerline collisions and predation vary depending on region and topography. Likewise, because predation mortality rates inside the PF will be less than those outside the fences, each of the PF areas is tracked as a separate subpopulation for the purposes of the model.

This definition of subpopulation is purely for the purpose of the model, making no assumptions about demographic independence, genetic structuring, or lack thereof between modeled subpopulations. However, natal fidelity is assumed, such that subpopulation recruitment is internally driven. In other words, individuals that fledge in one subpopulation are assumed to return to breed in the same subpopulation unless they relocate due to social attraction measures.

Metric 1 of Objective 1.3 is designed to ensure that the number of breeding pairs increase as projected and that progress is being made throughout the permit term to expand the subpopulations of all conservation sites to the ultimate target of 4,324 breeding pairs by the end of the permit term (Table 6A-3), which is well above the Kauaʻi viable metapopulation target of 2,500 breeding pairs. The projected number of breeding pairs were derived from the population dynamics model, described in Chapter 5, *Effects*, and Appendix 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*, which presents the methods and results for the effect of KIUC's minimization and conservation actions on the Kauaʻi metapopulation of Newell's shearwater (ʻaʻo). Metric 6 in Objective 1.3 is qualitative; it is included to help ensure that the population-based metrics are met. Breeding pair abundance is monitored on an annual basis through auditory surveys and burrow monitoring at the conservation sites (Raine et al. 2023b), and will continue to be monitored on an annual basis throughout the permit term of this HCP.

Trends in abundance. Declining populations are populations with declining trends in abundance (i.e., with negative rates of population change through time). Populations that are consistently in decline are, by definition, not viable over the long term unless the negative trend in abundance can be stabilized (no longer in decline) or reversed (population growth) before abundance has been reduced below a minimum viable population size. For a population to be viable, trends in abundance must be increasing, or at least under certain circumstances be stable (i.e., not increasing or decreasing) through time. For example, stable trends in abundance are consistent with a viable population if abundance is at high levels relative to the carrying capacity of the environment. In the case of endangered species, however, abundance levels are often by definition at low levels relative to the carrying capacity of the environment, and therefore achieving positive trends in abundance is necessary for population viability.

Metrics 2 and 3 in Objective 1.3 are designed to ensure that the subpopulations within the conservation sites grow annually. Meeting or exceeding the annual population growth rate (Metric 2) and reproductive success rate (Metric 3) will result in a growth rate at the 12 conservation sites combined that supports the goal of a Kauaʻi viable metapopulation being met or exceeded by the end of the permit term. Metric 6 in Objective 1.3 is qualitative; it is included to help ensure that the population-based metrics are met. Trends in abundance are monitored on an annual basis through auditory surveys at the conservation sites (Raine et al. 2023b), and will continue to be monitored on an annual basis throughout the permit term of this HCP.

Age structure and sex ratio. Age structure reflects the proportions of individuals at different life stages, and this variable is an indicator of population status. Growing populations tend to have larger proportions of individuals in younger age classes, while declining populations tend to have lower proportions of younger individuals (although populations with larger proportions of younger individuals may also reflect low adult survivorship). Even though age structure cannot be directly measured, a stable age structure is assumed when the growth rate for breeding pairs is increasing, which indicates that the population is increasing and recruitment is occurring.

Sex ratio is a demographic factor influencing population viability for species that have long-term pair bonding. Although it is not possible to measure or track sex ratio, a 50:50 sex ratio is assumed if reproduction is occurring. For the KIUC HCP, modeled Kauaʻi metapopulation numbers that are increasing would be consistent with a demography that indicates viability because an increase in the modeled metapopulation size occurs when the total annual number of fledglings produced is greater than the number of deaths on an island-wide basis.

Metrics 1, 2, 3, 5, and 7 of Objective 1.3 are designed to ensure that the subpopulations in the 12 conservation sites combined are growing in ways to provide an age structure and sex ratio consistent with a Kauaʻi viable metapopulation. No metrics can be included to measure age structure or sex ratio directly. Sampling and estimating these values is unfeasible because a large proportion of the population (e.g., young subadults) remains at sea during the breeding season.

Spatial distribution. Spatial distribution is an important component of metapopulation viability. For example, the more subpopulations present for a species, all else being equal, the greater the chance that the species can persist in the long term. Species with more subpopulations have a greater chance of withstanding stochastic events. For example, a species with 10 separate subpopulations might lose one or two of these subpopulations because of an episodic environmental event (e.g., hurricane), but the remaining subpopulations can persist if they are distributed in a less affected area. A species with only one or two closely located subpopulations is at much greater risk of losing half or all of the subpopulations in an episodic environmental event.

Spatial distribution is a component of a viable metapopulation for Newell's shearwater (ʻaʻo) (U.S. Fish and Wildlife Service 2019). One reason KIUC proposes to protect and maintain 12 conservation sites is to maximize the potential for long-term survival of colonies in the conservation sites and increase subpopulations to sustain a Kauaʻi viable metapopulation level as determined by USFWS. Through the KIUC HCP, these managed conservation sites will increase the number of subpopulations and yield higher population sizes for the existing subpopulations, improving the chance of survival for the metapopulation in the face of extreme events. All proposed conservation sites occur in the northwest portion of the island because this is the area where existing populations persist in significant numbers, the area has the best remaining available habitat for this species on Kauaʻi, and its distance from ongoing threats such as powerlines and lights means less risk of impact on the subpopulations in this area. For these reasons, agency and seabird expert guidance has determined that this area is the best location for long-term conservation of this species. Even though all conservation sites are located in the northwest corner of the island, they span a distance of approximately 7.1 miles (mi) (11.4 kilometers [km]) of topographically and ecologically diverse areas and are located in several different watersheds, spreading the risk of impacts. Some of the sites are located more inland and are therefore more protected from risks such as prevailing weather exposure, including Pihea, North Bog, and Honopū, while others are more exposed to prevailing weather, such as Pōhākea that terminates at sea cliffs on the Nā Pali Coast. The microclimate also varies between the conservation sites with Honopū being drier than the other sites, and North Bog being the wettest. The farthest distance between sites is Upper Mānoa Valley PF to Honopū PF, approximately 6.2 mi (10.0 km). Honopū sits furthest southwest of all sites, with Pihea located 1.8 mi (2.9 km) east of Honopū, and 0.5 mi (0.8 km) south of Hanakoa. Hanakoa, Pōhākea, and North Bog all share a border with Hanakāpiʻai to the west, north, and south, respectively. The eastern edge of Hanakāpiʻai lies approximately 0.65 mi (1.05 km) from the southwestern tip of Upper Limahuli Preserve, and Upper Mānoa Valley borders the northeastern edge of Upper Limahuli Preserve. See Section 4.4.4.1, *Conservation Sites*, for detailed figures of the location of the sites on the island and in relation to each other, and Appendix 4A, *Conservation Site Selection*, for detailed descriptions of all sites.

Kauaʻi is experiencing high development pressure and the conservation sites are located on state-owned lands protected from development. A greater spatial distribution would be preferred for Kauaʻi metapopulation viability, such as conservation sites scattered throughout Kauaʻi. However, the feasibility of long-term conservation of this species on Kauaʻi outside of the northwestern area is extremely limited because of (1) a lack of high-quality habitat, (2) low-density subpopulations that are impractical to manage intensively, (3) private land that is inaccessible to manage, (4) ongoing significantly higher levels of predation due to proximity to developed areas, (5) ongoing threats of powerlines and lights (albeit minimized), or (6) a combination of several of these factors. Independent monitoring studies, including the long-term radar survey (Sahin 2023), have historically provided information on changes in relative abundance at broad spatial scales outside the conservation sites, and are expected to continue into the future. Monitoring of spatial distribution in large areas of Kauaʻi is infeasible because of large private land holdings with no or limited access.

Metric 5 in Objective 1.3 supports the goal of maintaining spatial distribution because this metric will ensure that all of the social attraction sites are occupied and producing new breeding pairs. Additionally, as stated in Metric 7, the breeding of Newell's shearwater (ʻaʻo) will need to be confirmed at four conservation sites annually for years 1 through 10 and at least 9 conservation sites for the remainder of the permit term will need to be confirmed for breeding or prospecting in order to meet Metrics 1, 2, and 3 of Objective 1.3. Achieving this metric annually will result in a spatial distribution of the species consistent with a Kauaʻi viable metapopulation by the end of the permit term.

In conclusion, if all seven metrics of this biological objective are met, all of the components of a viable metapopulation—numbers of breeding pairs, trends in abundance, age structure and sex ratio, and spatial distribution—would be consistent with a Kauaʻi viable metapopulation (U.S. Fish and Wildlife Service in litt.).

4.3.2 Hawaiian Petrel (ʻuaʻu)

Goal 2. Provide for the survival of the Kauaʻi metapopulation of Hawaiian petrel (ʻuaʻu) and contribute to the species' recovery by minimizing and fully offsetting KIUC's taking of this species over the term of the HCP to an extent that is likely to result in numbers of breeding pairs, age structure, population growth rate, and spatial distribution that is representative of a Kauaʻi viable metapopulation, thereby providing a net benefit to the species.

Objective 2.1. Substantially reduce the extent and effect of collisions of adult/subadult Hawaiian petrels (ʻuaʻu) with all KIUC powerlines island-wide, as measured against the pre-2020 strike estimate (Appendix 5C, *Bayesian Acoustic Strike Model*) in accordance with the location, extent, and schedule outlined in the HCP.

Rationale

Reduction of powerline collisions is key to reducing overall human-caused seabird injury and mortality (Travers et al. 2021b; Travers and Raine 2020a), and hence to retaining the potential for Hawaiian petrel (ʻuaʻu) recovery. The rate of seabird powerline collisions has affected and is affecting the age structure of the population by removing large portions of subadult and adult individuals annually from the population. Because the reproductive strategy of this species evolved to have high adult survivorship with a relatively low number of offspring, increased levels of adult mortality are particularly harmful to this species and its population viability. Left unchecked, low adult survivorship (or conversely high adult mortality) extensively reduces the number of breeding birds, which results in fewer birds being produced and recruited into the population. This depresses populations to levels where they can become vulnerable to extirpation. A reduction in powerline collisions will lower adult mortality, retaining adults and subadults in the population. More adults and subadults not only increases the number of individuals in the population, but improves diversity in age structure and improves the population rate of change (increasing the number of individuals added to the population). In combination with additional objectives for minimization of light impacts (Objective 2.2) and mitigation (Objective 2.3), the viability of the Kauaʻi metapopulation of Hawaiian petrel (ʻuaʻu) will improve.

Based on KIUC's pre-2020 monitoring data and estimated strike reductions of 40 percent to over 90 percent (see details in Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*), KIUC's powerline minimization projects are expected to reduce seabird powerline collisions by at least 66.4 percent by May 2024 when all minimization projects were completed. The powerline strike reduction will be confirmed by powerline collision monitoring through 2027. The comparison point (i.e., baseline) to which all future measurements of powerline strike minimization effectiveness will be compared is the estimated strike rate derived from a Bayesian model using powerline strike data collected between 2013 and 2019 (Travers et al. 2020a). Subsequent annual minimization levels are calculated relative to the baseline strike rate, both during early implementation of the KIUC HCP as well as for the remainder of the permit term.

All planned powerline minimization projects have been completed prior to permit issuance, with benefits being realized immediately (e.g., Travers et al. 2023). This is especially important for this species given its life history (e.g., age at first reproduction around 6 years, pair bonding between breeding adults, and only one offspring per year). Minimization accomplished over the last several years has resulted in a reduction of thousands of estimated collisions each year for the covered seabirds. A large share of these birds, that would have otherwise been killed or injured colliding with powerlines prior to the minimization measures, will survive at sea and return to breed in the coming years. This is important because to the extent that subadults are more vulnerable to collisions (Cooper and Day 1998), recruitment of subadults to the breeding population is depressed. Effective minimization is therefore expected to increase recruitment to the breeding population by increasing survivorship of subadults. There can be some delay in achieving this benefit because a proportion of subadults that avoid powerline collisions may still be a few years away from reaching breeding age. However, the completion of minimization measures prior to permit issuance means that the benefit of increased recruitment to the breeding population from the younger subadult cohort is expected from the outset of the permit term, without delay. Minimization will continue to be an important tool throughout the permit term for new and existing lines in situations where minimization is not as effective as estimated or where powerline monitoring indicates a significant increase in strikes compared to the estimated strike rate derived from the Bayesian model using powerline strike data collected between 2013 and 2019 (Travers et al. 2020a).

See *Conservation Measure 1. Implement Powerline Collision Minimization Projects* (Section 4.4, *Conservation Measures*) for details of the conservation measure proposed to achieve this biological objective.

Objective 2.2. Minimize the adverse effects of artificial light attraction on Hawaiian petrel ('ua'u) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.

Rationale

Conservation measures with proven success at reducing covered seabird fledgling light attraction have been implemented for KIUC's existing streetlights (full-cutoff shields for lights), in partnership with the County and State, and KIUC's covered facility lights. An early study on Kaua'i showed that the shielding of bright lights reduced fallout of Newell's shearwater ('a'o) fledglings by 40 percent (Reed et al. 1985). Recent studies continue to indicate that the reduction of lateral light spillage is beneficial to reducing light-induced fallout of seabirds (Rodríguez et al. 2017a, 2017b). KIUC also began dimming or turning off covered facility lights at the Port Allen Generating Station in 2019 during the seabird fallout season (September 15 to December 15). Although there has been no change in the documented Hawaiian petrel ('ua'u) fallout at KIUC covered facilities before or after light dimming (only one individual was recorded in 2012), as described in Section 4.3.1, *Newell's shearwater ('a'o)*, fallout for Newell's shearwater ('a'o) was reduced from an average of five and a half fledglings per year to an average of one fledgling per year (Kaua'i Island Utility Cooperative 2024), so it is assumed light dimming also benefits Hawaiian petrel ('ua'u). The SOS Program rehabilitates grounded birds turned in by the public and releases them back into the wild. Since 1979, the SOS Program has recovered and released more than 32,500 seabirds (Raine et al. 2023a). From 2009 through 2024, 56 to 85 percent of the covered seabirds and 40 to 68 percent of the covered waterbirds that were handled by the SOS Program were rehabilitated and released back into the wild. The limited data available indicates that some of these birds survive and that the rehabilitated seabirds likely return to Kaua'i to breed. Throughout the permit term, KIUC will provide $300,000 annually to SOS, adjusted annually for inflation increases.

These conservation actions for existing lights and for any new lights would continue to be implemented during the permit term. Increased fledgling survival would increase recruitment which leads to more future breeding-age individuals in the Kaua'i metapopulation. Because this species has very low reproductive productivity, increasing recruitment to the breeding-age population and hence increasing the number of fledglings that can be produced by the metapopulation each year will contribute to a stable age structure (increased amount of younger age classes in the population), population growth rate, and Kaua'i metapopulation numbers for Hawaiian petrel ('ua'u).

See *Conservation Measure 2. Implement Measures to Minimize Light Attraction* and *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program* (Section 4.4, *Conservation Measures*) for details of the conservation measures proposed to achieve this biological objective.

Objective 2.3. Increase the number of Hawaiian petrel ('ua'u) breeding pairs and fledglings produced annually throughout the duration of the permits by managing and enhancing suitable Hawaiian petrel ('ua'u) breeding habitat and breeding colonies across 8 conservation sites and reducing the abundance and distribution of key seabird predators at these sites. The success of this objective will be measured by the following metrics, each of which is applied to the 8 conservation sites combined.

a. **Metric 1.** Meet the minimum target breeding pairs defined in Table 6A-4 (lists the minimum breeding pairs per year), as calculated using data from auditory surveys, acoustic surveys, and burrow monitoring.

b. **Metric 2.** Growth rate for breeding pairs annually of at least 1 percent as measured by a 5-year rolling average as inferred from data collection at the conservation sites.

c. **Metric 3.** Maintain a 5-year rolling average 78.7 percent reproductive success rate.

d. **Metric 4.** Ensure that invasive plant and animal species do not preclude meeting the objective metrics above.

e. **Metric 5.** At least six conservation sites will be occupied annually by breeding pairs, as measured by burrow monitoring, call rates, and/or auditory surveys.

Rationale

Operation of KIUC infrastructure has had substantial effects on the Kaua'i metapopulation of this species and is one of the primary reasons the metapopulation is at historically low levels. Because a large share of the breeding individuals of Hawaiian petrel ('ua'u) occur on Kaua'i, a viable metapopulation in the Plan Area is critical to retaining the potential for species recovery. A viable metapopulation is an estimated number of individuals within a metapopulation that persists with a high probability in the long term (Frankham et al. 2014) measured by its distribution, population size, age structure, growth rate, and additional demographic variables (e.g., age/cohort survivorship, reproductive success). A Kauaʻi viable metapopulation for Hawaiian petrel (ʻuaʻu) is quantified as 2,500 breeding pairs and a total population size of 10,000 individuals (U.S. Fish and Wildlife Service in litt.).

The densest colonies of Hawaiian petrel (ʻuaʻu) in the Plan Area are concentrated in the remote northwestern portion of Kauaʻi and this is where the KIUC Short-Term HCP conservation efforts have been focused for more than a decade (Raine et al. 2020c). These efforts have been successfully implemented as demonstrated by predator control, which has been shown to increase the reproductive success rate for this species by approximately 48 percent between 2011 and 2017 (Raine et al. 2020a), indicating that conservation efforts in this area are critical to achieving a Kauaʻi viable metapopulation. KIUC has secured eight conservation sites, most of which are the same as for the Short-Term HCP (see Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*) at which to manage and enhance habitat for existing breeding colonies of Hawaiian petrel (ʻuaʻu), six of which are currently occupied. These eight sites total approximately 1,959 acres (792 hectares).[5]

Management actions with proven success at improving the reproductive success of Hawaiian petrel (ʻuaʻu) breeding colonies are ongoing at all the selected conservation sites and would continue and be expanded by the HCP for the duration of the permit term. Predator control has been shown to be the most effective tactic to increase the reproductive success rate of Hawaiian petrel (ʻuaʻu) in managed areas (Raine et al. 2020a). Expanding the scale and types of predator control (e.g., installing and maintaining various types of predator exclusion fencing at two conservation sites, predator eradication within predator exclusion fences) will further reduce this significant threat and increase the survivorship of fledglings produced each year.

All the conservation measures that support this objective are designed to result in population increases at the conservation sites. In combination with a substantial reduction in powerline strikes (see Objective 2.1), KIUC's conservation strategy will improve the status of the Hawaiian petrel (ʻuaʻu) metapopulation on Kauaʻi by continuing to protect and manage existing colonies within conservation sites. See Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*, for more details.

<u>Components of a Kauaʻi Viable Metapopulation</u>

Collectively, these measures would result in a Kauaʻi viable metapopulation of Hawaiian petrel (ʻuaʻu), as stated in Goal 2. While population viability cannot be directly measured, the following components of population dynamics that contribute to viability will be evaluated, some of which are measurable and some of which are not.

- Numbers of breeding pairs
- Trends in abundance
- Age structure and sex ratio
- Spatial distribution

[5] See Appendix 4A, *Conservation Site Selection*, for further details on these conservation sites, their specific characteristics, and how and why they were selected.

These components of a viable metapopulation are explained above for Newell's shearwater (ʻaʻo) under Objective 1.3. The same principles apply to Hawaiian petrel (ʻuaʻu) and therefore are not repeated here. The discussion for Hawaiian petrel (ʻuaʻu) is limited to how each of the five metrics of Objective 2.3 support each of the components of a Kauaʻi viable metapopulation for Hawaiian petrel (ʻuaʻu).

Metric 1 of Objective 2.3 is designed to ensure that the number of breeding pairs increase as projected and that progress is always being made throughout the majority of the permit term to expand the subpopulations of all conservation sites combined to the ultimate target of 3,128 breeding pairs by the end of the permit term, which is well above the Kauaʻi viable metapopulation target of 2,500 breeding pairs. The projected numbers of breeding pairs were derived from the population dynamics model, described in Chapter 5, *Effects*, and Appendix 5E, *Population Dynamics Model for Hawaiian Petrel (ʻuaʻu) on Kauaʻi*, which presents the methods and results for the effect of KIUC's minimization and conservation actions on the Kauaʻi metapopulation of Hawaiian petrel (ʻuaʻu). Metric 4 in Objective 2.3 is qualitative; it is included to help ensure that the population-based metrics are met.

Metrics 2 and 3 in Objective 2.3 are designed to ensure that the subpopulations within the conservation sites grow annually. Meeting or exceeding the annual population growth rate (Metric 2) and reproductive success rate (Metric 3) will ensure that eight conservation sites are growing at rates that will meet or exceeded the goal of a Kauaʻi viable metapopulation by the end of the permit term.

Metrics 1, 2, 3, and 5 of Objective 2.3 are designed to ensure that the subpopulations in the 8 conservation sites are growing in ways to provide an age structure and sex ratio consistent with a Kauaʻi viable metapopulation (no metrics can be included to measure age structure or sex ratio directly). Additionally, as stated in Metric 5, six conservation sites need to be occupied by Hawaiian petrel (ʻuaʻu) breeding pairs in order to meet Metrics 1, 2, and 3 of Objective 2.3, ensuring that the spatial distribution of the species by the end of the permit term is consistent with a Kauaʻi viable metapopulation. See Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*.

4.3.3 Band-Rumped Storm-Petrel (ʻakēʻakē)

Social attraction measures, including predator and vegetation control, included in the biological goals and objectives are being implemented for band-rumped storm-petrel (ʻakēʻakē) at Honopū PF. However, the biological objectives for this species focus on the primary threats of artificial light attraction, predation from introduced wildlife species, and powerline collisions.

Goal 3. Contribute to the recovery of the band-rumped storm-petrel (ʻakēʻakē) by reducing threats associated with existing and future KIUC powerlines and streetlights, existing covered facility lights, and introduced predators on Kauaʻi.

Objective 3.1. Reduce the potential for band-rumped storm-petrel (ʻakēʻakē) collisions with existing and future KIUC powerlines island-wide, in accordance with the location, extent, and schedule outlined in the HCP.

Rationale

There have been no documented collisions of band-rumped storm-petrel (ʻakēʻakē) with KIUC powerlines, despite extensive annual monitoring efforts since 2011 (Travers et al. 2019b).

Band-rumped storm-petrels (ʻakēʻakē) are less common and more difficult to detect and also have a different flight pattern and body type than Newell's shearwaters (ʻaʻo) or Hawaiian petrels (ʻuaʻu). Based on these facts, KIUC assumes band-rumped storm-petrels (ʻakēʻakē) are rarely affected by powerline collisions. However, reduction of powerline collisions is key to reducing overall human-caused seabird injury and mortality (Travers et al. 2021b; Travers and Raine 2020a), and hence is likely important for retaining the potential for band-rumped storm-petrel (ʻakēʻakē) recovery. As band-rumped storm-petrel (ʻakēʻakē) populations on Kauaʻi increase as a result of other threat reduction actions by this HCP and other programs, risks for powerline collisions are expected to increase, although collisions by band-rumped storm-petrel (ʻakēʻakē) are still expected to remain relatively rare based on existing data.

Static wire removal and installing bird flight diverters (most spans use a combination of multiple techniques) on powerline spans on Kauaʻi have substantially reduced powerline collisions of covered seabirds, including band-rumped storm-petrel (ʻakēʻakē). These conservation actions will continue to be implemented for new powerlines throughout the permit term.

See Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*, for details of the conservation measure proposed to achieve this biological objective.

Objective 3.2. Minimize the adverse effects of artificial light attraction on band-rumped storm-petrel (ʻakēʻakē) fledglings from all existing and future KIUC streetlights and existing covered facilities by continuing to implement practicable conservation measures throughout the permit term.

Rationale

Fallout from light attraction is a threat to band-rumped storm-petrel (ʻakēʻakē) fledglings, although it appears to be rare based on available data. The SOS Program has rescued between zero and three band-rumped storm-petrels (ʻakēʻakē) annually based on SOS data from 2009 through 2024 (Bache 2025). As band-rumped storm-petrel (ʻakēʻakē) populations on Kauaʻi increase as a result of other threat reduction actions by this HCP and other programs, light attraction fallout of this species is expected to increase. Although band-rumped storm-petrel (ʻakēʻakē) light attraction fallout is still expected to remain relatively rare, minimizing its adverse effects is important to the species' recovery on Kauaʻi.

Conservation measures with proven success at reducing covered seabird fledgling light attraction have been implemented for KIUC's existing streetlights (full-cutoff shields for lights), in partnership with the County and State, and KIUC's covered facility lights. An early study on Kauaʻi showed that the shielding of bright lights reduced fallout of Newell's shearwater (ʻaʻo) fledglings by 40 percent (Reed et al. 1985). Recent studies continue to indicate that the reduction of lateral light spillage reduces light-induced fallout of seabirds (Rodríguez et al. 2017a, 2017b).

KIUC also began dimming covered facility lights at the Port Allen Generating Station in 2019 during the seabird fallout season (September 15 to December 15). Although there has been no documented band-rumped storm-petrel (ʻakēʻakē) fallout at KIUC covered facilities before or after light dimming, fallout for Newell's shearwater (ʻaʻo) was reduced from an average of five and a half fledglings per year to an average of one fledgling per year (Kauaʻi Island Utility Cooperative 2024). It is therefore assumed that light dimming at the covered facilities will also benefit band-rumped storm-petrel (ʻakēʻakē), in similar ways as Newell's shearwater (ʻaʻo).

These conservation actions would continue to be implemented during the permit term, including for new streetlights or new facility lights.

See Section 4.4.2, *Conservation Measure 2. Implement Measures to Minimize Light Attraction*, for details of the conservation measure proposed to achieve this biological objective.

Objective 3.3. Facilitate the rescue, rehabilitation, and release of band-rumped storm-petrel (ʻakēʻakē) fledglings through funding of the SOS Program or other certified rehabilitation facility to offset light attraction by KIUC streetlights.

Rationale

The SOS Program is an established avian rescue and rehabilitation program on Kauaʻi with proven success in improving the survivorship of grounded seabirds (Raine et al. 2020b). The SOS Program has rescued between zero and three band-rumped storm-petrels (ʻakēʻakē) annually based on SOS data through 2024. The SOS Program also has established protocols for collecting and rehabilitating a variety of avian species, including all the covered seabirds. At the start of the permit term, KIUC will provide $300,000 funding annually to SOS, adjusted annually for inflation increases, [6] which is expected to benefit band-rumped storm-petrels (ʻakēʻakē).

See *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program* (Section 4.4, *Conservation Measures*) for details of the conservation measures proposed to achieve this biological objective.

Objective 3.4. Implement predator control, including barn owl control, within the conservation sites to reduce predation of band-rumped storm-petrel (ʻakēʻakē) in areas near and within the Honopū PF conservation site (e.g., Nā Pali Coast).

Rationale

Management actions with proven success at reducing Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) depredations are ongoing at all the selected conservation sites and would continue and be expanded by the HCP for the duration of the permit term. This includes actions to reduce the abundance of rats (*Rattus* spp.), cats (*Felis catus*), and barn owls within the conservation sites. These predators are likely a significant constraint for the current abundance and distribution of band-rumped storm-petrel (ʻakēʻakē) based on documented depredations (Raine et al. 2017c). Although there are no documented band-rumped storm-petrel (ʻakēʻakē) colonies within the conservation sites, social attraction for this species is being implemented at Honopū PF where they will benefit from predator control measures and vegetation management. They are known to occur along the Nā Pali Coast based on call rates detected during auditory surveys (Raine et al. 2017c), and given that cats and barn owls produce many offspring in a short period of time and are highly mobile, it is assumed that predator control efforts at the nearby conservation sites will benefit band-rumped storm-petrel (ʻakēʻakē) breeding along the Nā Pali Coast by reducing depredations.

See *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites* (Section 4.4, *Conservation Measures*) for details of the conservation measure proposed to achieve this biological objective.

[6] Chapter 7, Section 7.4, *Costs of KIUC HCP Implementation*, provides details of KIUC's past funding of this program as compared to the future funding commitment for this program.

4.3.4 Covered Waterbirds: Hawaiian Coot (ʻalae keʻokeʻo), Hawaiian Gallinule (ʻalae ʻula), Hawaiian Stilt (aeʻo), Hawaiian Goose (nēnē), and Hawaiian Duck (koloa maoli)

Goal 4. Contribute to the recovery of the covered waterbird species by reducing threats associated with KIUC powerlines on Kauaʻi.

Objective 4.1. Reduce covered waterbird collisions along KIUC powerlines in Hanalei, Mānā (Kawaiʻele Waterbird Sanctuary), and other areas in accordance with the location, extent, and schedule outlined in the HCP, and relative to measured collisions in 2020.

Rationale

Powerlines at two locations, Hanalei (spans 462–478 and 1297–1328) and Mānā (spans 1–113), likely have the greatest effect on the covered waterbird species (Travers and Raine 2020b) because the powerlines cross protected habitat with a high abundance of waterbirds (Figure 4-1). Static wire removal and installing bird flight diverters (most spans use a combination of multiple techniques) on high-risk line spans for covered waterbirds on Kauaʻi will substantially reduce collisions of covered waterbirds (Raine 2021). As part of a system upgrade, KIUC removed a section of transmission line at Mānā, which will result in reduced waterbird collisions. Additionally, minimization across KIUC's system will decrease the potential for waterbird collisions in other areas outside of Mānā and Hanalei. In a study of blue cranes (*Grus paradisea*) in South Africa, Shaw et al. (2021) found that line markers (i.e., same as diverters or similar in style and effect) reduced powerline collisions by 92 percent in comparison to control spans. Outcomes for covered waterbirds in the Plan Area are expected to be similar to the results of the Shaw et al. study, which shows that diverters can be highly effective for waterbird species. The benefit of static wire removal, and the one section of transmission line removal at Mānā, is that it reduces the number of vertical powerline layers (or levels) that birds must cross or avoid, reducing collision risk for the covered waterbird species.

See Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*, for details of the conservation measure proposed to achieve this biological objective.

Objective 4.2. Facilitate the rescue, rehabilitation, and release of grounded covered waterbirds through funding of the SOS Program or other certified rehabilitation facility to offset collisions with KIUC powerlines.

Rationale

The SOS Program is an established avian rescue and rehabilitation program on Kauaʻi with proven success in improving the survivorship of grounded seabirds (Raine et al. 2020b). The SOS Program also has established protocols for collecting and rehabilitating a variety of waterbird species, including the covered waterbirds. For example, between 2009 and 2024, SOS has rescued and rehabilitated 413 Hawaiian geese (nēnē) and 175 Hawaiian ducks (koloa maoli). KIUC's commitment to provide $300,000 funding annually to SOS starting at the beginning of the permit term, adjusted annually for inflation increases, [7] is expected to benefit the covered waterbird species.

[7] Chapter 7, Section 7.4, *Costs of KIUC HCP Implementation*, provides details of KIUC's past funding of this program compared to the future funding commitment for this program.

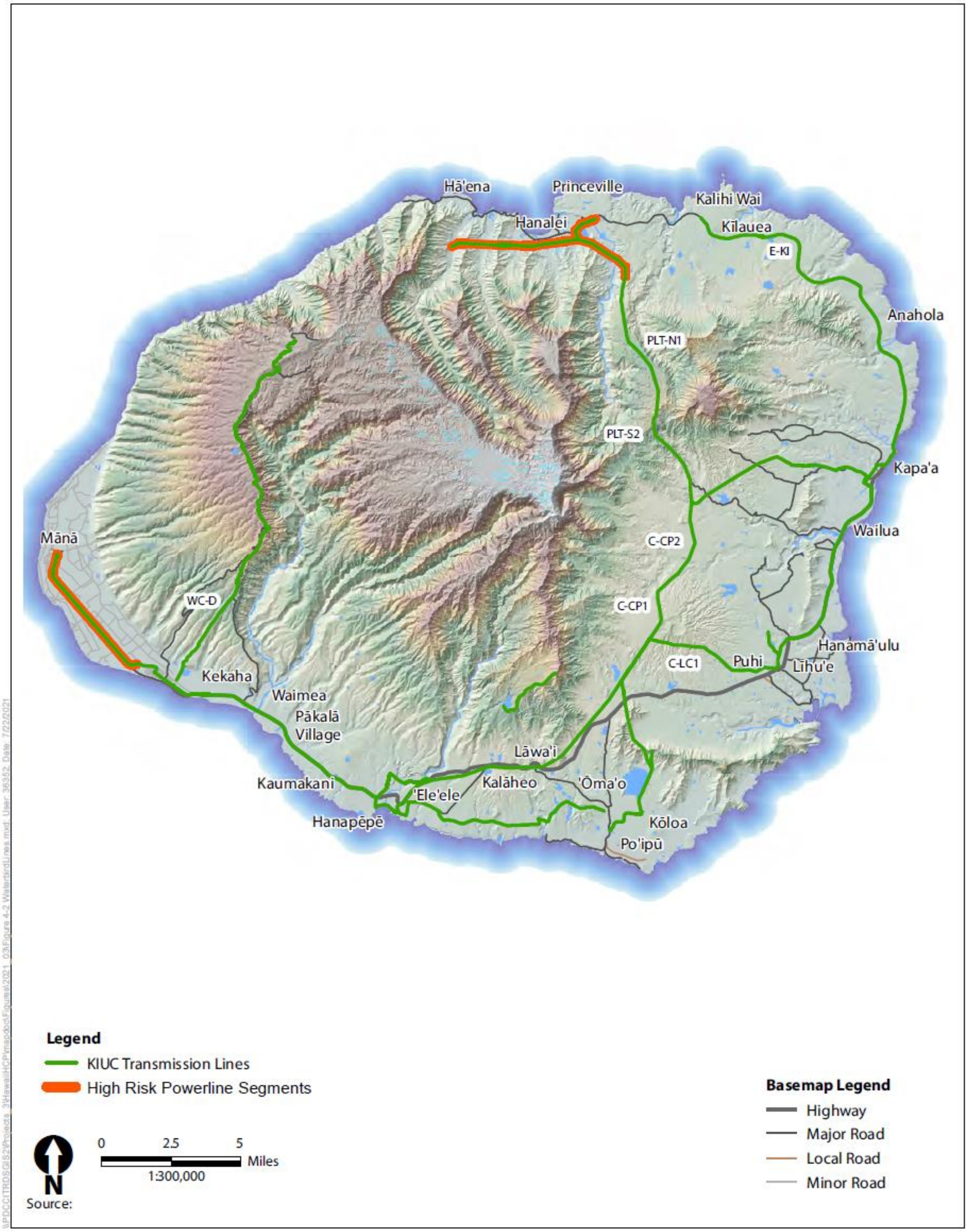

Figure 4-1. High-Risk Powerline Spans for Waterbirds

See Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program*, for details of the conservation measure proposed to achieve this biological objective.

4.3.5 Central North Pacific Distinct Population Segment of the Green Sea Turtle (honu)

Goal 5. Contribute to the recovery of the species by increasing the ability for green sea turtles (honu) to successfully transit Kauaʻi beaches.

Objective 5.1. Locate and shield green sea turtle (honu) nests on beaches that are visually affected by KIUC streetlights on an annual basis.

Rationale

Artificial lights shining on green sea turtle (honu) hatchlings as they emerge from nests at night can cause the hatchlings to move toward the lights instead of toward the ocean. There was an incident in September 2020 on Kauaʻi where green sea turtle (honu) hatchlings from a nest on Kekaha Beach crossed a street and moved toward a KIUC streetlight, and some of the hatchlings were crushed by vehicles. There has been no documented disorientation of nesting adults on Kauaʻi; however, monitoring to date on Kauaʻi has not been systematic.

The DLNR Division of Aquatic Resources (DAR) currently monitors nesting sea turtles (honu) on Kauaʻi, but this program is informal and lacks consistent funding. This HCP will require systematic surveys to locate and protect green sea turtle (honu) nests and placement of temporary shields at locations at risk of light attraction from streetlights. Green sea turtle (honu) nests can be shielded from artificial light sources at the nest site, minimizing the risk of disorientation from streetlights.

See Section 4.4.5, *Conservation Measure 5. Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program*, for details of the conservation measure proposed to achieve this biological objective.

Objective 5.2. Minimize light effects to the extent practicable from existing and future KIUC streetlights onto beaches with suitable green sea turtle (honu) nesting habitat by implementing practicable minimization techniques that will reduce or eliminate these light effects.

Rationale

Coastal streetlights have the potential to cause disorientation of hatchling green sea turtles (honu) if they are visible from suitable green sea turtle (honu) nesting habitat. To date, there has only been a single incident of documented disorientation of green sea turtle (honu) hatchlings attributable to KIUC streetlights. As a part of this HCP, KIUC has identified a total of 29 streetlights that are currently visible from green sea turtle (honu) nesting habitat.[8] Existing coastal streetlights with vegetation or structures currently blocking visible light from the beach could also result in light effects during the 50-year permit term if the physical setting changes, or entirely new streetlights are installed near beaches in the future.

[8] KIUC's 2020 streetlight assessment found that the current condition of the beach has limited suitability for nesting green sea turtles (honu). However, to be conservative, six streetlights along Kūhiō Highway in Wailua are included in the total in the event this habitat becomes more suitable due to future weather patterns.

Although KIUC owns and operates the streetlights on Kauaʻi, the County and State determine the location, height, wattage, and shielding, and must approve any modification. KIUC will work with the County and State to identify practicable minimization measures to reduce streetlight visibility from green sea turtle (honu) nesting habitat. Minimization measures on streetlights that eliminate or reduce lateral light spillage (e.g., shields) could greatly decrease the potential for disorientation of green sea turtle (honu) hatchlings. Minimization measures would, once installed, remain in place in perpetuity. If an entire streetlight is repaired or replaced, the shield would be repaired or replaced as well at the same time, as needed.

See Section 4.4.6, *Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle (honu)*, for details of the conservation measure proposed to achieve this biological objective.

4.4 Conservation Measures

This section describes the conservation measures KIUC will implement or fund to meet the biological goals and objectives described in Section 4.3, *Biological Goals and Objectives*. There are six conservation measures in total.

- **Conservation Measure 1**. Implement Powerline Collision Minimization Projects
- **Conservation Measure 2**. Implement Measures to Minimize Light Attraction
- **Conservation Measure 3**. Provide Funding for the Save Our Shearwaters Program
- **Conservation Measure 4**. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites
- **Conservation Measure 5**. Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program
- **Conservation Measure 6**. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle (honu)

Related management actions that KIUC will implement to achieve the biological goals and objectives are grouped under a single conservation measure. For example, all the actions that KIUC will implement to minimize powerline collisions, which includes powerline reconfiguration, static wire removal, and flight diverters, are described under Conservation Measure 1.

The conservation measures are described with sufficient detail and specificity to allow their implementation. Most of the conservation measures address several biological goals and objectives. As a result of the large scale and long timeframe over which the KIUC HCP will be implemented, the conservation measures are also designed to be flexible and allow adaptive management with increasing knowledge over time. The flexibility provided by the adaptive management program (Chapter 6, *Monitoring and Adaptive Management Program*) is an important component of the conservation strategy.

4.4.1 Conservation Measure 1. Implement Powerline Collision Minimization Projects

This conservation measure describes the actions KIUC will apply to meet the covered seabird and covered waterbird biological goals and objectives for powerline collision minimization. Powerline collision is one of the most, if not the most, important conservation issue for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) on Kauaʻi (Travers et al. 2012, 2013, 2014, 2015, 2016, 2017a, 2018, 2019b, 2021a). Seabird mortality from collisions with KIUC powerlines has significantly contributed to the decline of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) populations and continues to suppress populations of both species (Travers et al. 2013, 2014, 2015, 2016, 2017a, 2018; Raine et al. 2017b). Collisions occur most often with the overhead static wire due to its tall height and position above all other wires (Chapter 2, *Covered Activities*, Figure 2-2a), and because the static wire has a smaller diameter than energized conductors and therefore is less visible. Prior to minimization, static wires were widespread across KIUC's electric system (Chapter 2, Section 2.1, *Powerline Operations*) and were present in nearly all high-collision locations. The other contributing factors for seabird powerline collision risks are the number of wires in a vertical stack, the total wire height, and the position of powerlines along ridgelines or flyways. The greater the number of wires in the vertical stack and the higher the wires, the greater the risk of seabird collision. Powerline aboveground height is highest when wires are strung from ridgeline to ridgeline across a drainage or valley. On Kauaʻi many of the powerline spans with the highest seabird collision risk are strung across mountain drainages.

The minimization actions for the covered seabirds and covered waterbirds under this conservation measure include reconfiguration of powerlines—i.e., changing the profile from vertical to horizontal and reducing the number of layers, also resulting in a reduced total wire height (Chapter 2, Section 2.1.2, *Powerline Modifications*). Reconfiguration projects include the removal of static wire. Other minimization actions for the covered seabirds and covered waterbirds are static wire removal independent of reconfiguration to substantially reduce powerline collisions, and installation of bird flight diverters on many powerlines (reconfigured lines or not) to further reduce powerline collisions. Bird flight diverters make remaining lines far more visible to covered seabirds at dusk and night, and far more visible to covered waterbirds in daylight.

Bird flight diverters are regularly spaced devices that make powerlines more visible to birds, reducing the number of collisions. KIUC uses two types of flight diverters—reflective diverters and light-emitting diode (LED) diverters. Reflective diverters are made of plastic and have a shiny, reflective surface; LED diverters utilize a blinking LED light.

All of these minimization measures are effective at reducing strikes on spans with all levels of collision risks including high-risk areas such as powerlines traversing drainages and valleys and along seabird migration routes. The minimization actions for the covered waterbirds under this conservation measure include reconfiguration, static wire removal and the installation of bird flight diverters (both reflective and LED). In 2023, KIUC also removed a section of 57-kilovolt transmission line in Mānā as a system improvement project, which will further reduce strikes for both seabirds and waterbirds in that area. KIUC completed six minimization projects that are consistent with this conservation measure in 2015 and 2016 during implementation of the Short-Term HCP.

- Installed reflective diverters from the Waimea Bridge to Kaumakani from spans 244 to 254 (approximately 1 mi [1.6 km])

- Installed reflective diverters from Moloaʻa to Kīlauea from spans 1196 to 1214 (approximately 1.8 mi [2.9 km])
- Removed static wire from spans 328 to 342 from Waialo Road to Brydeswood (2.2 mi [3.5 km])
- Removed static wire at span 352 (Fujita Tap) (0.5 mi [0.8 km])
- Removed static wire from spans 328 to 342 (2.2 mi [3.5 km])
- Removed static wire at span 581 (Halewili Positron to Aepo Substation) (0.3 mi [0.5 km])
- Buried underground spans 2030, and 6000 to 6005 (approximately 0.5 mi [0.8 km]) of distribution wires on Kāhili mountain.[9]

These types of minimization actions completed for the KIUC Short-Term HCP are similar to what KIUC has and will implement for this HCP under this conservation measure. However, the minimization for this HCP is much more extensive and comprehensive in addressing reduction of collisions. All planned powerline minimization projects have been completed prior to the start of the HCP permit term with the benefits of reduced powerline collisions realized immediately, which is especially important for the covered species given their lifecycle. The minimization accomplished over the last several years has resulted in a reduction of thousands of estimated collisions each year for the covered seabirds, which is expected to increase recruitment to the breeding population. The completion of minimization measures prior to permit issuance means that the benefit of increased recruitment to the breeding population is expected from the outset of the permit term, without delay.

Minimization will continue to be an important tool throughout the permit term for new lines and for existing lines in situations where minimization is not as effective as estimated or where powerline monitoring indicates a significant increase in strikes compared with the estimated strike rate derived from the Bayesian model using powerline strike data collected between 2013 and 2019 (Travers et al. 2020a).

The minimization that has been conducted as early implementation is included in the HCP, because the reduced powerline collisions are used as the basis for the HCP take request and benefits to the covered bird species from these actions are assumed to take effect immediately upon implementation, which is prior to permit issuance, as a part of the conservation strategy.

4.4.1.1 Powerline Collision Minimization Projects

KIUC utilizes three methods of powerline collision minimization. Discussed first are bird flight diverters and static wire removal projects. These projects will often be implemented together (although not always) and are the most widely used methods of minimization throughout KIUC's system. Discussed in the following section are three powerline reconfiguration projects that KIUC implemented during early implementation for this HCP. Finally, the estimated strike reduction based on all minimization projects completed by May 5, 2024, is discussed. Appendix 4B, *KIUC Minimization Projects*, identifies all reconfiguration projects, bird flight diverters, and static wire removal projects that were implemented by May 5, 2024, by span.

[9] KIUC buried these wires underground because the Underline Monitoring Program indicated that these very short powerlines (19.7–26.2 feet [6–8 meters] above ground) had the highest collision rate on the island because the wires were mounted on a steep mountain ridge running directly through colonies of Newell's shearwaters (ʻaʻo) and Hawaiian petrels (ʻuaʻu).

Bird Flight Diverter and Static Wire Removal Projects

KIUC has installed bird flight diverters (Table 4-2a and Figure 4-2) and removed static wires (Table 4-2a and Figure 4-3) to reduce covered seabird and covered waterbird collisions. Most of KIUC's minimization projects use a combination of bird flight diverters with static wire removal (or with reconfiguration) on the same spans to maximize strike reductions, except in a small number of instances with access constraints. Examples of instances with access constraints are spans north and south of Powerline Trail where the static wire has not been removed (Figure 4-3). Also, static wire remains on one to two spans immediately in front of KIUC's substations to provide maximum protection from lightning at the substations. However, these spans in most cases have reflective diverters installed on the static wire and top layer of transmission, as shown in Figure 4-2. The estimated strike reductions for all projects listed in Appendix 4B, *KIUC Minimization Projects*, pertain to the covered seabirds. Minimization across the entire island is expected to minimize risk of waterbird strikes, but this strike reduction benefit to waterbirds is not shown in the percent strike reduction in Tables 4-2b, 4-2c or Appendix 4B.

Figures 4-2 and 4-3 show the location of each bird flight diverter and static wire minimization project identified in Appendix 4B, *KIUC Minimization Projects*. In a concerted effort to reduce the severity of the effects of the covered activities and achieve the maximum benefits on the covered seabird and waterbird species prior to completion of the HCP, KIUC completed all of the minimization projects identified in Appendix 4B, *KIUC Minimization Projects*, and shown in Figures 4-2 and 4-3 by May 5, 2024. These early implementation projects have installed 113.2 mi (182.2 km) of diverters and removed 82.9 mi (133.4 km) of static wire (Table 4-2a). These minimization actions were often implemented in combination and total approximately 127.3 mi (204.8 km) of KIUC powerlines (Table 4-2c). Strike reductions for all projects listed in Table 4-2b and 4-2c pertain to the covered seabirds.

Table 4-2a. Installation of Bird Flight Diverters and Removal of Static Wires by Year (2015–May 5, 2024) and Cumulatively

Year	Reflective Diverters Installed	LED Diverters Installed	Total Diverters Installed	Static Wire Removed
Prior to 2020	1.34 mi	0.00 mi	1.34 mi	4.35 mi
2020	5.58 mi	1.19 mi	6.77 mi	16.99 mi
2021	33.21 mi	5.48 mi	38.69 mi	30.17 mi
2022	49.70 mi	2.24 mi	51.95 mi	1.70 mi
2023 - 2024	7.40 mi	6.99 mi	14.40 mi	29.70 mi
Total	**97.24 mi**	**15.91 mi**	**113.15 mi**	**82.92 mi**

Table 4-2b lists the 15 powerline spans that had the highest collision risk before minimization and the estimated reduction in risk after minimization efforts through May 5, 2024, were completed. For these spans, the implemented minimization projects resulted in an estimated 78 to 96 percent reduced risk of powerline collisions. The estimated reduction in powerline collision risk is based on data from KIUC's powerline monitoring of the different types of minimization techniques, or combinations thereof.

Table 4-2b. Top 15 Highest Collision Risk Powerline Spans and Minimization Projects (2020–May 5, 2024)

Span	Span Length (mi)	Span Location	Minimization Actions (Year)	Baseline Strike Rate[a]	Strike Rate 2020[a]	Strike Rate 2021[a]	Strike Rate 2022[a]	Strike Rate 2023[a]	Strike Rate 2024[a]	% Strike Reduction[b]
432	0.16	Powerline Trail	LED diverter, static wire removal (2023)	235	235	235	235	16	16	93%
974	0.18	Waipouli Rd to Hana-hanapuni	Static wire removal (2021), reflective diverter (2022)	192	192	68	40	40	40	79%
449	0.12	Powerline Trail	LED diverter, static wire removal (2023)	174	174	174	174	9	9	95%
448	0.12	Powerline Trail	LED diverter, static wire removal (2023)	167	167	167	167	11	11	94%
708	0.14	Kilohana to Līhuʻe Substation	Reconfiguration (2020), static wire removal (2020), reflective diverter (2021)	150	44	25	25	25	25	83%
431	0.09	Powerline Trail	LED diverter (2021), static wire removal (2023)	138	138	14	14	8	8	94%
434	0.28	Powerline Trail	LED diverter, static wire removal (2023)	134	134	134	134	7	7	95%
715	0.2	Kilohana to Līhuʻe Substation	Reconfiguration (2020), static wire removal (2020), reflective diverter (2021)	133	46	46	26	26	26	80%
707	0.18	Kilohana to Līhuʻe Substation	Reconfiguration (2020), static wire removal (2020), reflective diverter (2021)	130	39	22	22	22	22	83%
433	0.17	Powerline Trail	LED diverter, static wire removal (2023)	129	129	129	129	8	8	94%
429	0.2	Powerline Trail	LED diverter, static wire removal (2023)	129	129	129	129	9	9	93%
426	0.57	Powerline Trail	LED diverter, static wire removal (2023)	128	128	128	128	5	5	96%
427	0.29	Powerline Trail	LED diverter, static wire removal (2023)	123	123	123	123	9	9	93%

Span	Span Length (mi)	Span Location	Minimization Actions (Year)	Baseline Strike Rate[a]	Strike Rate 2020[a]	Strike Rate 2021[a]	Strike Rate 2022[a]	Strike Rate 2023[a]	Strike Rate 2024[a]	% Strike Reduction[b]
973	0.11	Kapa'a Substation to Waipouli Rd	Static wire removal (2021), reflective diverter (2021)	122	122	27	27	27	27	78%
428	0.28	Powerline Trail	LED diverter, static wire removal (2023)	116	116	116	116	7	7	94%

[a] Baseline strike rate is the estimated annual strikes per span of covered seabirds combined prior to any minimization. It is calculated through the Bayesian model using powerline monitoring data from 2013 to 2019 (Travers et al. 2020a). See Appendix 5C, *Bayesian Acoustic Strike Model*, for details. Strike rates in subsequent years are recalculated each year with the previous year's monitoring data.

[b] Calculated comparing the 2024 estimated strikes to the baseline strike rate prior to any minimization. Actual strike reduction is being confirmed through annual monitoring efforts.

Table 4-2c. Minimization Effort on Powerlines by Collision Risk Categories as of May 5, 2024

	High Collision Risk	Medium Collision Risk	Low Collision Risk	Total
Baseline strike rate per powerline span[a]	≥30 collisions/yr (up to 235/yr)	≥6 to 29 collisions/yr	<6 collisions/yr	N/A
Number of spans	58	714	921	1,693
Total span miles (%)	9.9 (8%)	55.0 (43%)	62.4 (49%)	127.3
Total baseline strikes (%)	4,458 (28%)	9,007 (56%)	2,632 (16%)	16,097
2024 estimated strikes after minimization (%)	690 (13%)	3,553 (67%)	1,088 (20%)	5,331
Average strike reduction rate	85%	61%	59%	N/A

[a] Baseline strike rate is the estimated annual strikes per span of covered seabirds combined prior to any minimization. It is calculated though the Bayesian model using powerline monitoring data from 2013 to 2019 (Travers et al. 2020a). See Appendix 5C, *Bayesian Acoustic Strike Model*, for details.

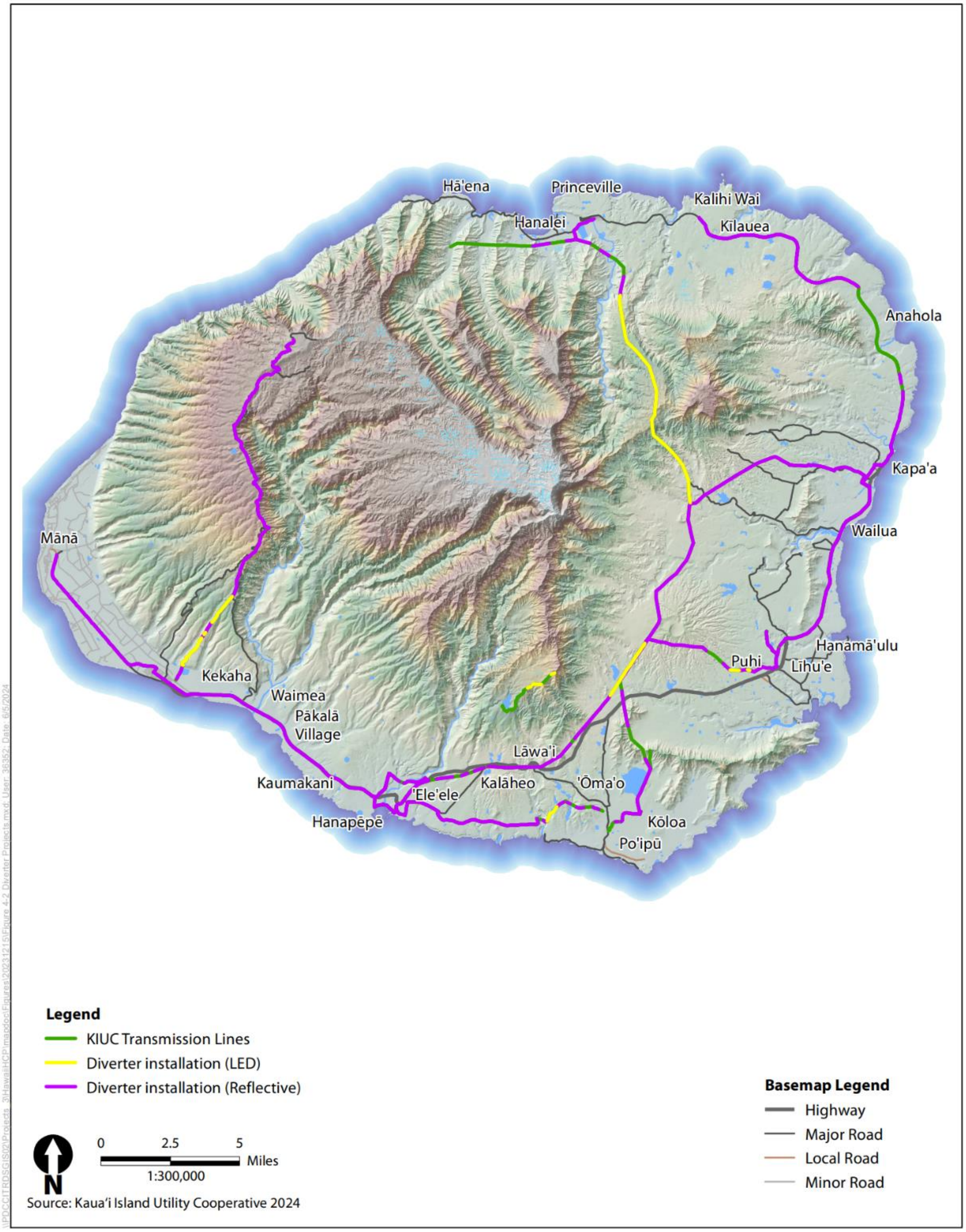

Figure 4-2. KIUC Bird Flight Diverter Minimization Project Locations

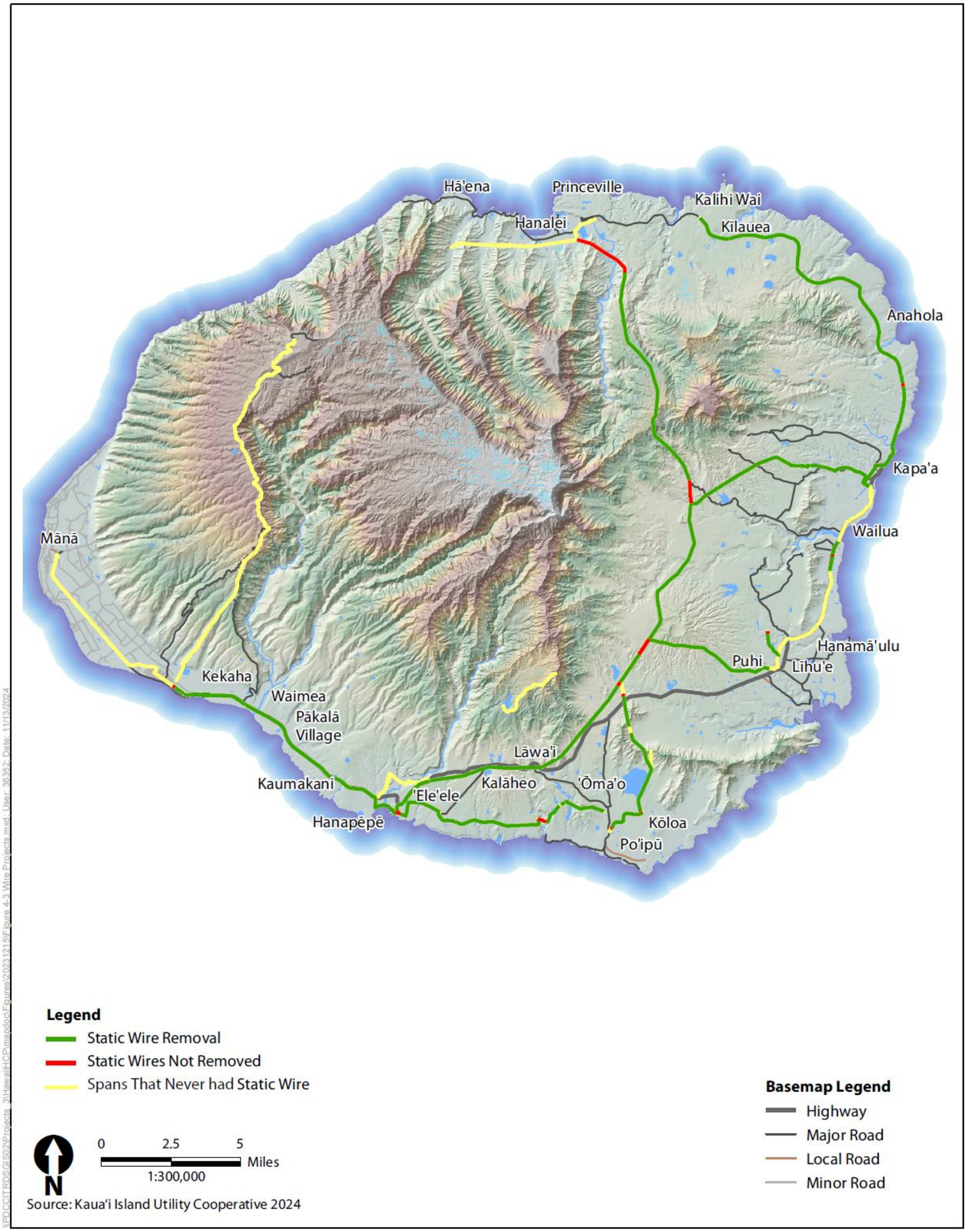

Figure 4-3. KIUC Wire Minimization Project Locations

Powerline Reconfiguration Projects

KIUC implemented three powerline reconfiguration projects in 2020 to reduce covered seabird collisions (Table 4-3, Figure 4-4). The three projects, which total 7.8 mi (12.5 km), include static wire removal and bird flight diverters in combination with the reconfiguration. In summary, these projects accomplished the following.

- **Reduce maximum wire heights**. As shown in Table 4-3, the maximum height of wires along the project segments was reduced by more than 20 feet (ft) (6.1 meters [m]). This reduction in maximum height was achieved through static wire removal and by reducing the number of vertical wire levels of transmission and distribution lines.
- **Reduce the number of vertical wire levels**. The collision risk in these project spans was reduced by reducing the number of vertical wire levels (Figure 2-2), which reduces the number of wires a flying bird could fly at directly. The number of wire levels were reduced in these three projects by 50 percent or more. The number of vertical wire levels was reduced through a combination of static wire removal (which removes the top wire level) and by reconfiguring to a horizontal profile rather than vertical (i.e., multiple wires occur in parallel on the same level).
- **Reduce the vertical profile.** To reduce the number of wire levels and overall wire height, the wires were positioned in a horizontal profile. This reduces the vertical profile of all wires that covered birds are exposed to in their travel path. The vertical distance of wire arrays was reduced substantially in all three projects.

No additional powerline reconfiguration projects are planned at this time. Powerline reconfiguration projects have not been used as extensively as bird diverters and static wire removal because they require extensive planning, approval by the Hawai'i Public Utilities Commission (Hawai'i PUC), and potentially involve public outreach. Therefore, they take much longer to implement. KIUC is focusing the primary minimization effort in this conservation measure on static wire removal and the installation of bird flight diverters. Both of these measures have been found to be very effective in reducing the risk of powerline collisions of covered seabirds and waterbirds, and can be implemented much faster and at a much larger scale across the island. Also see Chapter 8, *Alternatives to Take*, for additional discussion of the alternatives considered to the proposed conservation strategy.

Estimated Reduction in Powerline Collisions Based on Completed Minimization

Based on KIUC's powerline monitoring data, the estimated strike reduction by span ranges from 42 to 95 percent, depending on the minimization technique, or combination of techniques (Tables 4-2b and 4-2c; Figures 4-5a and 4-5b). The minimization projects completed by May 5, 2024, are concentrated on high-risk and medium-risk spans (Tables 4-2b and 4-2c) to maximize the benefit to the covered seabirds. Figures 4-5a and 4-5b show the estimated amount of collision risk reduction that has been accomplished geographically throughout Kaua'i, both in terms of absolute risk reduction (Figure 4-5a) and proportional risk reduction (Figure 4-5b), compared to baseline strike rates.[10] Figure 4-5b shows that the majority of spans are estimated to achieve at least 60 percent risk reduction, and a large number with more than 85 percent reduction. Collectively, KIUC's powerline minimization projects completed by May 5, 2024, are estimated to have reduced seabird

[10] Baseline strike rate is the estimated annual strikes per span of covered seabirds combined prior to any minimization. It is calculated through the Bayesian model using powerline monitoring data from 2013 to 2019 (Travers et al. 2020a). See Appendix 5C, *Bayesian Acoustic Strike Model*, for details.

powerline collisions by at least 66.4 percent. KIUC commits to achieving a reduction in powerline collisions of the covered seabirds by at least 66.4 percent relative to the baseline strike rate, throughout the permit term. The total strike reduction will be confirmed by powerline collision monitoring conducted through 2027. If a 66.4 percent powerline strike reduction relative to the baseline strike rate is not achieved and maintained for the permit term, additional minimization measures will be put in place to reach 66.4 percent, or greater, strike reduction compared to the baseline strike rate (see Chapter 6, Section 6.4, *Take and Effectiveness Monitoring and Adaptive Management Triggers*). KIUC is committed to maintaining this level of strike reduction throughout the permit term.

For the covered waterbirds, the estimated strike reduction through minimization is even higher (90 percent) based on results of a study on another species (Travers and Raine 2020a), since there are no known studies available on the covered waterbird species and powerline strike reductions. Section 4.3.4, *Covered Waterbirds: Hawaiian Coot (ʻalae keʻokeʻo), Hawaiian Gallinule (ʻalae ʻula), Hawaiian Stilt (aeʻo), Hawaiian Goose (nēnē), and Hawaiian Duck (koloa maoli)*, provides more information.

Table 4-3. Powerline Reconfiguration Projects Implemented in 2020

Project ID	Spans	Linear Distance (mi)	Linear Distance (km)	Condition	Average Collision Risk[a] (collisions/yr)	No. of Wire Levels	Vertical Distance of Array (feet)	Vertical Distance of Array (m)	Highest Wire at Structure (feet AGL[b])	Highest Wire at Structure (m AGL)
C-LC1	702–717	2.2	3.5	Original	High (53)	9	60.5	18.4	n/a[c]	n/a[c]
				Reconfiguration	Medium (8)	3	20	6.1	29	8.8
C-CP1	389–400	2.6	4.2	Original	Medium (11)	4	36	11.0	100	30.5
				Reconfiguration	Low (2)	2	11	3.4	75	22.9
C-CP2	401–417	3.0	4.8	Original	Medium (6)	4	36	11.0	100	30.5
				Reconfiguration	Low (0)	2	11	3.4	75	22.9

[a] Collision risk categories: High = ≥30 collisions/yr, Medium = ≥6 to 29, Low = <5 collisions/yr
[b] Above ground level
[c] Information not available

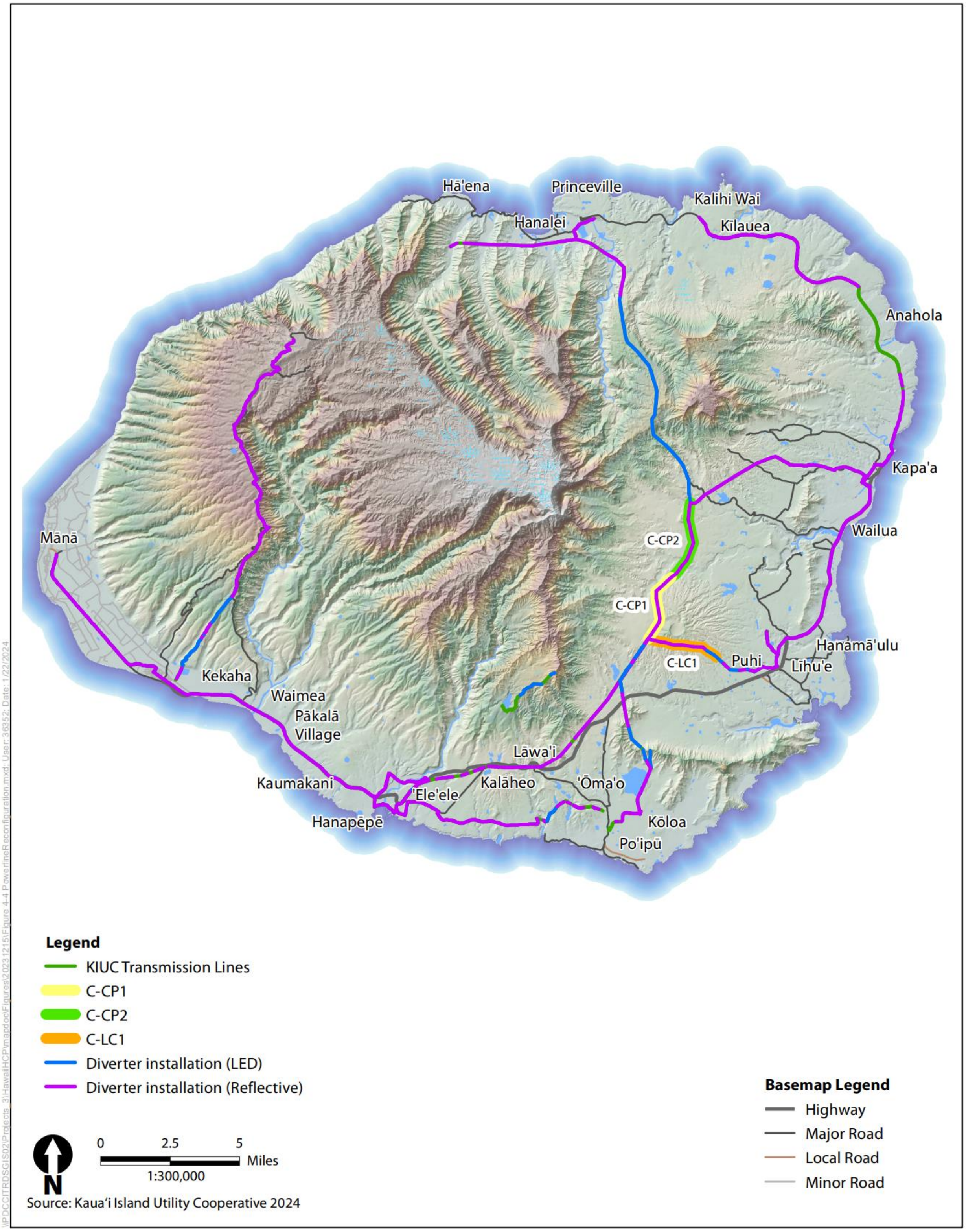

Figure 4-4. KIUC Powerline Reconfiguration Projects Implemented in 2020 with Bird Flight Diverter Installation Overlaid

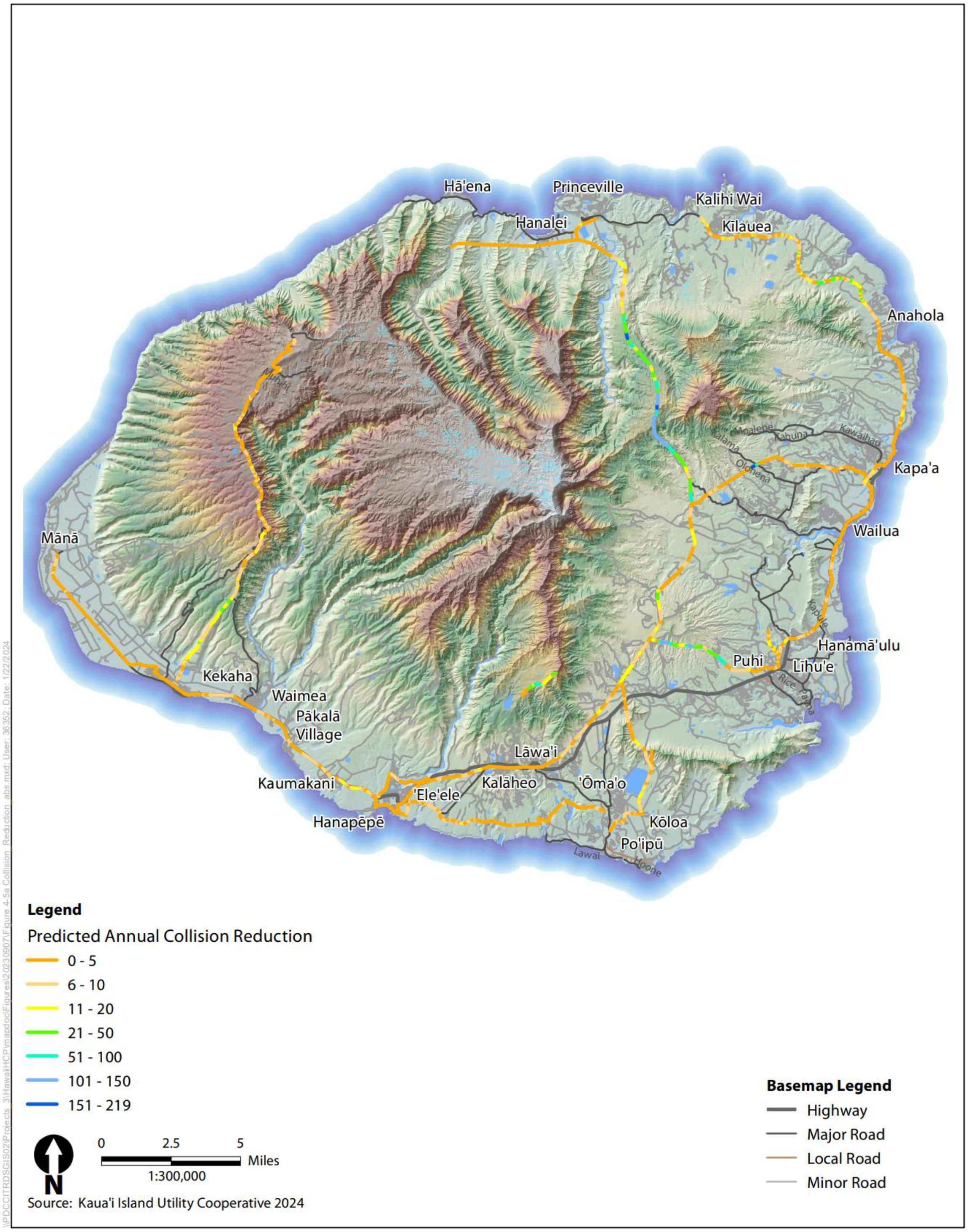

Figure 4-5a. Estimated Reduction (Absolute Values) in Annual Seabird Powerline Collisions in Each Powerline Span by May 5, 2024, Compared to Baseline[11]

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[11] Baseline strike rate is the estimated annual strikes per span of covered seabirds combined prior to any minimization. It is calculated through the Bayesian model using powerline monitoring data from 2013 to 2019 (Travers et al. 2020a). See Appendix 5C, *Bayesian Acoustic Strike Model*, for details.

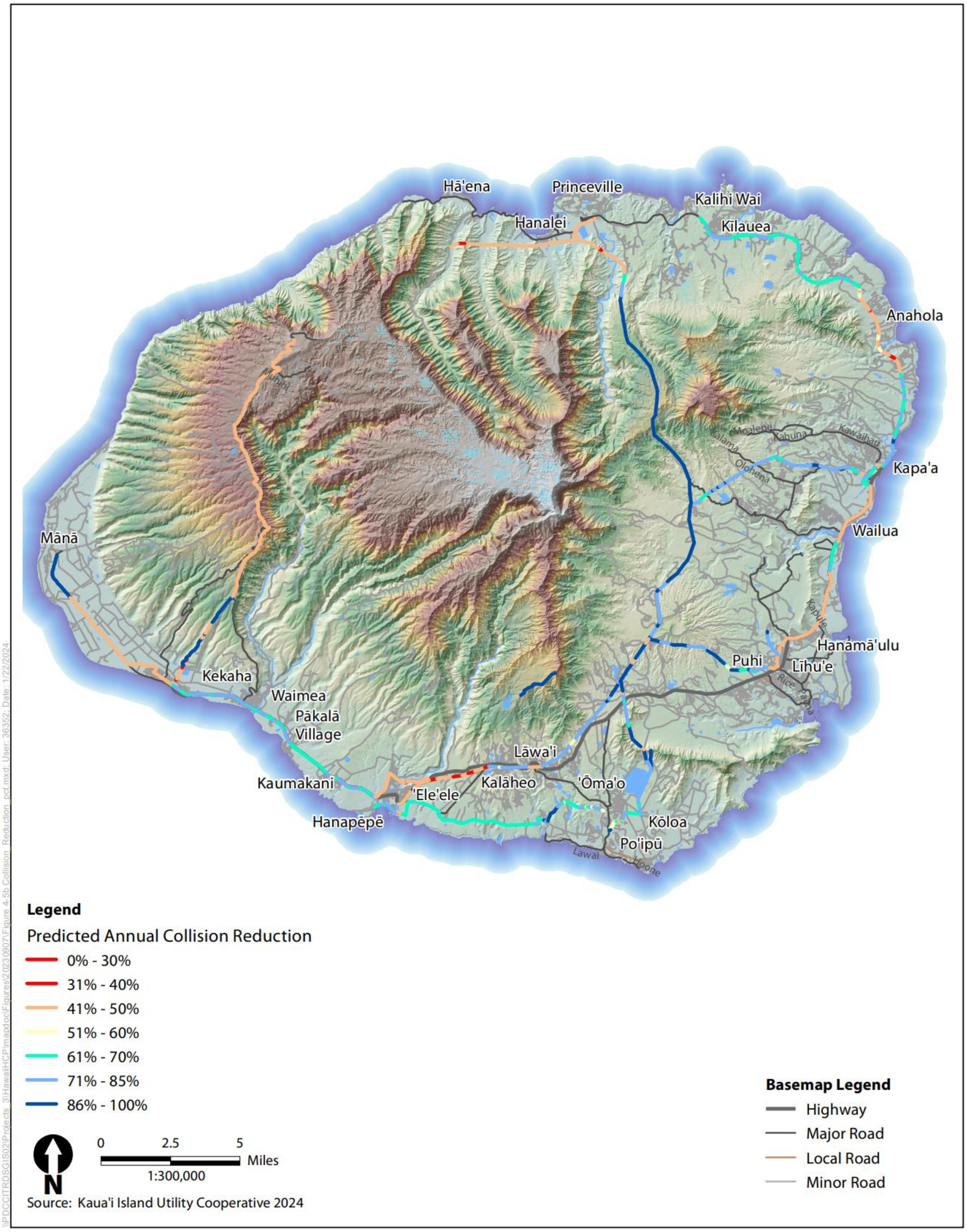

Figure 4-5b. Predicted Proportional Reduction (Percent) in Annual Powerline Collisions of all Seabirds in Each Powerline Span by May 5, 2024, Compared to Baseline[12]

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12 Baseline strike rate is the estimated annual strikes per span of covered seabirds combined prior to any minimization. It is calculated through the Bayesian model using powerline monitoring data from 2013 to 2019 (Travers et al. 2020a). See Appendix 5C, *Bayesian Acoustic Strike Model*, for details.

4.4.1.2 Future Transmission and Distribution Lines

As described in Chapter 2, *Covered Activities*, KIUC will need to construct new transmission and distribution lines during the 50-year permit term to provide power to new development on Kaua'i. New transmission and distribution lines are defined as either new powerlines in new locations (including powerline extensions) or powerline modifications that increase wire height or expose wires, as described in Chapter 2, Section 2.1.2, *Powerline Modifications*. All new powerline installations will be planned and implemented with potential impacts on covered species in mind. Appropriate minimization will be deployed on new powerlines applying the standards described below and with the goal of achieving the greatest practicable level of reduction to potential strike risk in any given location.

KIUC will avoid construction of new transmission and distribution lines in high-collision zones in the Plan Area, to the maximum extent practicable, as determined in coordination with a qualified avian biologist.[13] During the planning process for each new covered transmission or distribution line, existing data, predictive models (Travers et al. 2017b), and coordination with a qualified avian biologist will be used to determine the potential strike rate (strikes per year) per span. Proposed alignments that are modeled to have relatively high strike rates (e.g., as in Figure 5-1a) will be avoided unless there is no alternative route.

As described in Chapter 2, *Covered Activities*, the vast majority of new transmission lines and distribution lines will either be added to existing poles or placed on new poles adjacent to existing lines (i.e., in the same transmission line or distribution line corridor), likely not changing the risk of covered seabird collision from existing conditions. If new powerlines are needed, they will be built to service new development consistent with the current Kaua'i General Plan (County of Kaua'i 2018) and future updates of this plan. Development is not expected to occur in the more remote areas of Kaua'i that currently have little to no development, as explained in the subsections below. Therefore, new powerlines are not likely to substantially change the current collision risk of the covered species. Any new powerline that may increase collision risk would follow the design requirements listed below in *Standards for New Transmission and Distribution Lines*.

Future Development in Northwestern Kaua'i and New Powerlines

The location of the proposed conservation sites in northwestern Kaua'i was selected, in part, because of their isolation from powerlines (see Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*) and, as a result, the very low collision risk of birds breeding there. Specifically, the north shore of Kaua'i west of Hā'ena State Park (at the terminus of the Kūhiō Highway) is free of any transmission lines or distribution lines for approximately 20 shoreline mi (32.2 km) (Figure 2-1). Powerlines occur again starting at Mānā substation on the west side of the island, approximately 4.5 mi (7.2 km) southwest of Polihale State Park, at the intersection of Kao and Kiko Roads. In practical terms, this means that there are no powerlines between the proposed conservation sites and the shortest distance to the ocean where there are known seabird migratory routes to the conservation sites, which was one important reason these conservation site locations were selected.

[13] A qualified avian biologist is defined in this HCP as a biologist with knowledge of and experience with the covered seabirds and powerline collisions, either KIUC staff or contracted biologist.

In addition, the inland areas of the entire western half of Kauaʻi are almost entirely free of powerlines, the only exception being the powerlines along Waimea Canyon Drive and along almost the entire length of Kōkeʻe Road, to the Kalalau Lookout (approximately 15 mi [24 km] inland; Figure 2-1). Kōkeʻe Road ends a little less than 1 mi (1.6 km) from the Kalalau Lookout at Puʻu O Kila Outlook and Pihea Trailhead. Little or no development is expected in any of these areas in the future. This conclusion is based on the following.

- **Future development** projected in the Kauaʻi General Plan (County of Kauaʻi 2018). Only 2 percent of total future growth on the island (218 housing units) is expected in the North Shore Planning Unit, which includes all of the Hanalei District of Kauaʻi (the North Shore Planning Unit in the General Plan) and all existing communities on the north shore. Similarly, the Kauaʻi General Plan projected only 4 percent of total growth (390 housing units) in the Waimea to Kekaha Planning Unit.
- **Land ownership.** All land west of Wainiha Valley and extending to Kekaha in southwest Kauaʻi is owned either by the State or the federal government (e.g., Pacific Missile Range Facility on the west coast) (Figure 4-6 and 4-7). This extensive public land ownership will greatly limit development in western and northwestern Kauaʻi. Future development on state-owned land in this area is highly unlikely due to the majority of the area being designated as a Natural Area Reserve (NAR), Forest Reserve, or State Park. Immediately to the east of the proposed conservation sites, almost the entire Wainiha Valley is currently owned by one landowner. Similarly, almost the entire Lumahaʻi Valley is currently owned by one landowner. This extensive private land ownership is expected to further limit development to the east of the conservation sites.
- **Land use restrictions.** All of northwest Kauaʻi, on both state- and privately owned land, is located within a State-designated Conservation District. The Conservation District designations restrict development in these areas. The majority of the area where the proposed HCP conservation sites are located is in the protected conservation subzone (Figure 4-7) (State of Hawaiʻi Department of Land and Natural Resources 2012). The protected subzone imposes the strictest land use controls, followed by the limited subzone and the resource subzone.[14] Allowed land uses in the resource subzone that are not permissible in the protected subzone include commercial forestry and mining.
- **Topography and isolation.** Western and northwestern Kauaʻi are the most remote and isolated parts of the island. There is no shoreline road between Polihale State Park on the west coast and Hāʻena State Park at the terminus of the Kūhiō Highway on the north shore. The only public inland roads in all of western Kauaʻi are Waimea Canyon Road and Kōkeʻe Drive, all on state lands. This isolation is combined with some of the most rugged terrain on the island, making any new development and associated new powerlines extremely unlikely.

[14] See Hawaiʻi Administrative Rules Section 13-5-22 for identified land uses and required permits for each subzone and proposed land use.

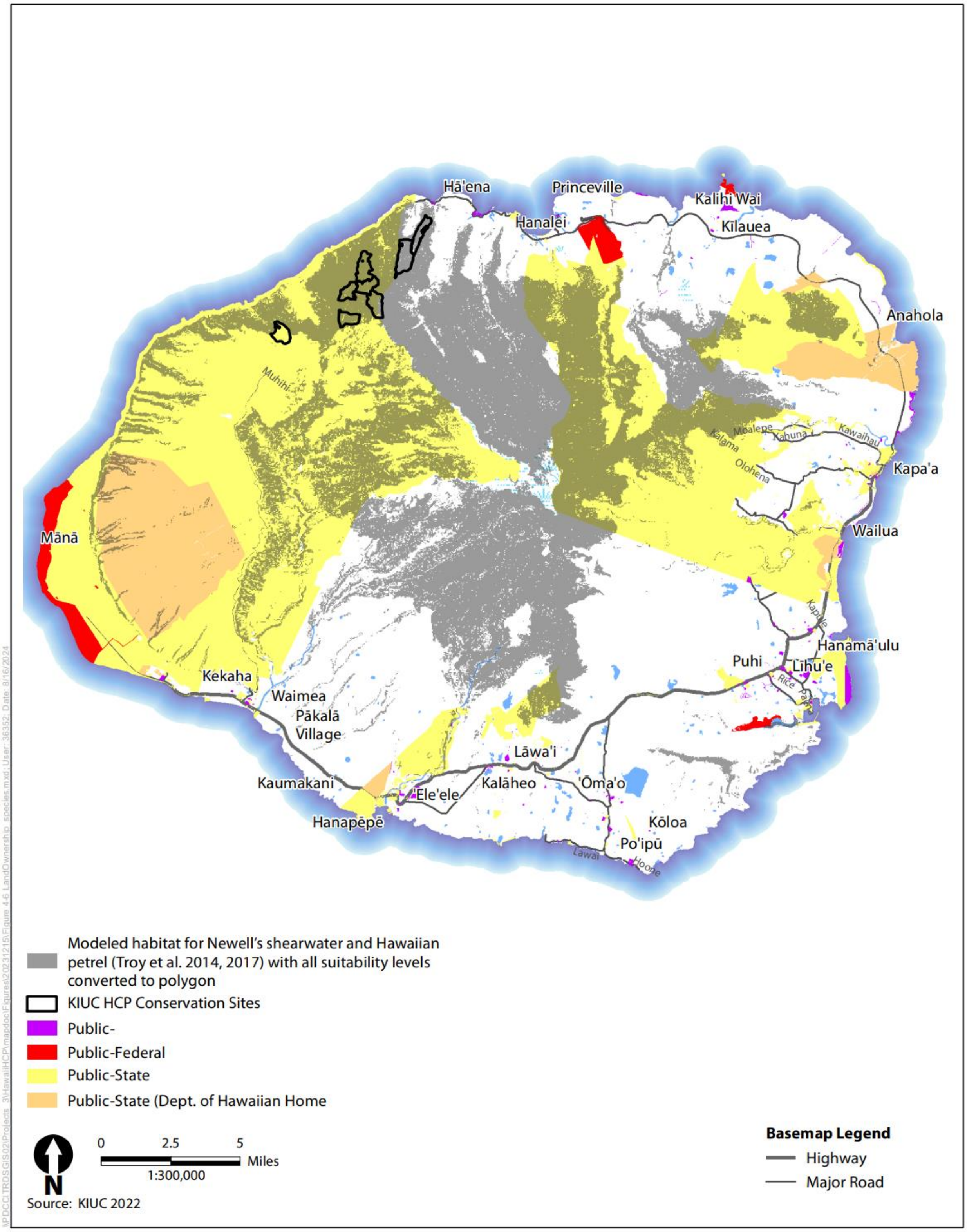


Figure 4-6. Public Land Ownership on Kauaʻi Relative to Conservation Sites and Modeled Habitat for Covered Seabirds

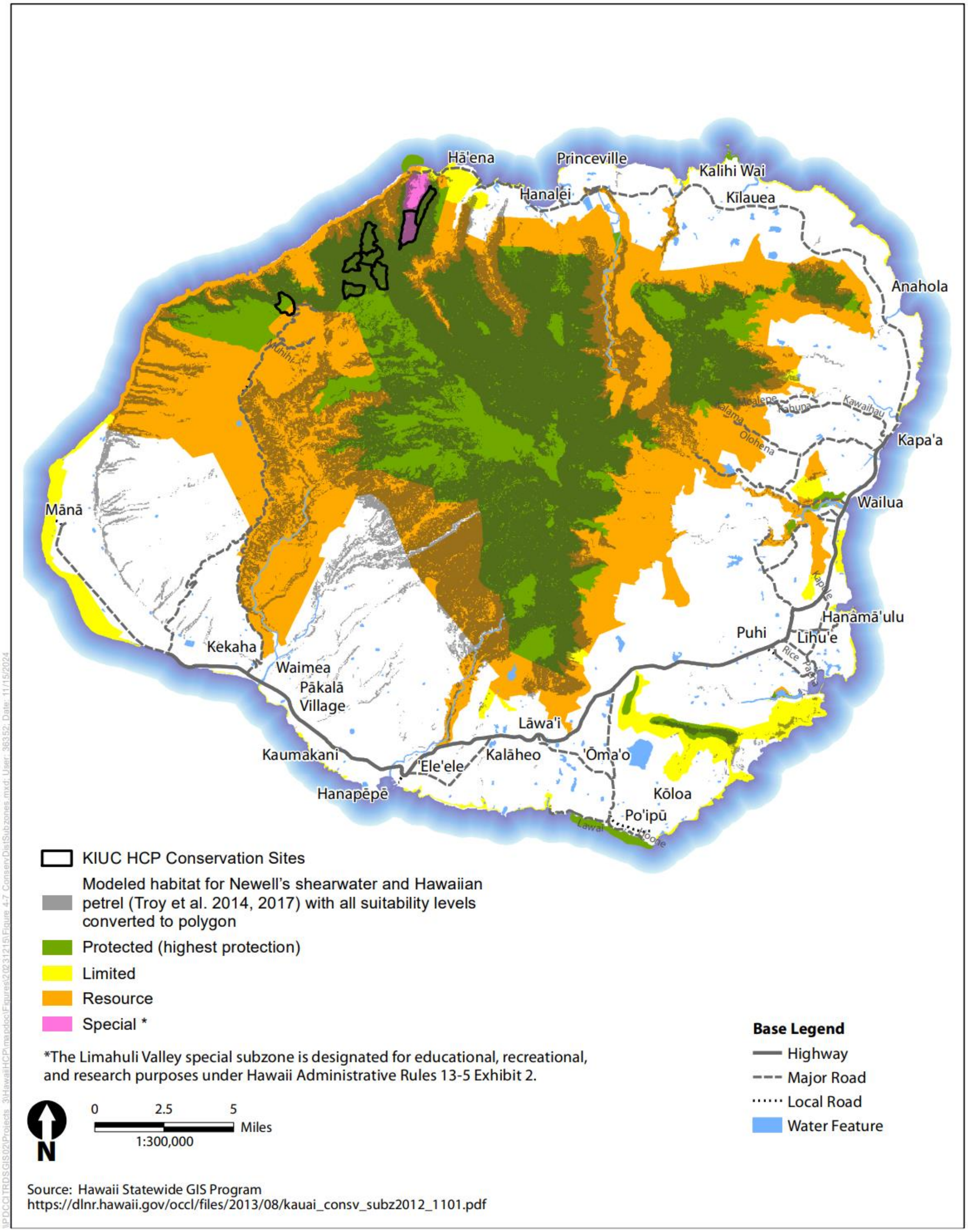


Figure 4-7. State-Designated Conservation District Subzones on Kauaʻi Relative to Conservation Sites and Modeled Habitat for Covered Seabirds

Despite the very low risk of new powerlines being installed north of any of the conservation sites (i.e., in areas between conservation sites and the shortest distance to the ocean), KIUC does not control development planning, cannot eliminate the possibility of power being requested in these areas, and must provide power where it is requested. To account for that possibility, KIUC will follow the review and approval process summarized below for new powerlines in a specific area of Kauaʻi.

Standards for New Transmission and Distribution Lines

KIUC will minimize the potential for collisions on all new transmission and distribution lines on Kauaʻi by applying the following standards for all new transmission and distribution lines. The information in Appendix 5A, *Variables Influencing Powerline Strikes*, has been used to develop the following standards which are incorporated into various aspects of the HCP.

- **No new static wire.** KIUC will not install any new static wires.
- **Minimize powerline height.** New distribution lines will be no more than 45 ft (13.7 m) above ground at the pole. KIUC commits to using a horizontal design standard[15] (or an equivalent or better standard) for new distribution lines throughout the 50-year term of the HCP consistent with engineering and safety requirements and to the extent practicable. There is no maximum aboveground height for transmission lines because they are dictated by Hawaiʻi PUC standards and engineering regulations; however, KIUC will minimize transmission line height when and where practicable.
- **Limit vertical wire levels.** New distribution and transmission lines will be installed in a horizontal plane to the greatest extent practicable.
- **Powerline placement.** To the extent practicable, new powerlines will be sited and constructed to avoid new powerlines in high-collision zones (e.g., ridgelines, tops of slopes, between colonies and the ocean) in the Plan Area. To the extent practicable, KIUC will avoid long powerline spans across valleys (i.e., perpendicular to valleys). As described in Chapter 2, *Covered Activities*, KIUC is required to provide power at any location where requested. In some cases, however, KIUC may have options for the route of new powerlines. This provision will be applied in those cases where KIUC has routing options.
- **Bird flight diverters.** All new powerlines will be evaluated to determine if bird flight diverters are a practicable minimization technique and appropriate given the strike risk at the location. If bird flight diverters are practicable in areas of strike risks, they will be installed at the time of construction. Where powerlines are adjacent to or near roads, reflective diverters will be used. Where powerlines are farther from roads, LED diverters will be used.
- **Review and approval of new powerlines or modification of existing powerlines in northwestern Kauaʻi.** KIUC, USFWS, and DOFAW have jointly developed a special review and approval process for any new powerlines (and streetlights) proposed in a specifically defined area of northwestern Kauaʻi. The details and a map of this specifically defined review and approval area are described in Appendix 4E, *Review of New Powerlines and Streetlights in Northwestern Kauaʻi*. This process also applies to the modification of any existing powerlines in

[15] This design standard requires new distribution circuits to utilize a horizontal arrangement with a single wire layer that is no more than 45 ft (13.7 m) above ground at the pole, minimizing the potential for seabirds to collide with new overhead 12.47-kilovolt distribution lines. KIUC will apply the horizontal design standard to all new transmission lines when and where practicable.

this area that may increase take of the covered seabirds. The specifically defined area where all new powerlines or modification of existing powerline (and new streetlights) must be reviewed and approved by USFWS and DOFAW is called the *Area of Additional Conservation Commitments* and is shown in Figure 4E-1 in Appendix 4E. This special review and approval process is designed to ensure that new powerlines or powerline modifications (or streetlights) will not inhibit the ability of the HCP to achieve the biological goals and objectives.

Based on the same monitoring data described above for existing powerlines under *Bird Flight Diverter and Static Wire Removal Projects*, KIUC has estimated that 80 percent[16] of the anticipated seabird powerline collisions and 90 percent of the anticipated waterbird powerline collisions resulting from the installation of unminimized new powerlines would be avoided with the implementation of minimization techniques (Travers and Raine 2020a). The estimated reduction in powerline collisions for new powerlines factors in horizontal configuration, no static wire, and bird flight diverters applied as appropriate to each specific location. These estimated strike reductions are considered conservative because KIUC also has the opportunity to further minimize collisions by siting new powerlines in lower-risk areas, when practicable.

4.4.1.3 Confidence in Conservation Measure Benefits to the Covered Species

Table 4-4 summarizes the assessment in the confidence of conservation measure benefits for each of the relevant covered species.[17] Based on the assessment in Table 4-4, we conclude that there is a moderate to high degree of confidence in the benefits of this conservation measure for all of the covered species due to powerline collision monitoring on spans where minimization has been employed, including studies on the covered species, and studies on other species.

Table 4-4. Assessment of Confidence in Expected Benefits to the Covered Species from Conservation Measure 1, Implement Powerline Collision Minimization Projects.

Conservation Measure Component by Species	Confidence in Benefit[a]	Sources	Explanation
Newell's shearwater (ʻaʻo) *Hawaiian petrel (ʻuaʻu)*			
Effectiveness of minimization measures in collision risk reduction of at least 66.4%	High	Powerline collision monitoring for field seasons 2012 through 2023; Bayesian model (Travers et al. 2020a); Travers and Raine 2020a	The effectiveness has been assessed through monitoring spans before and after minimization was implemented, and strike reduction estimates have been produced using the Bayesian model for each minimization technique, and combination of techniques.

[16] This is based on Kauaʻi Endangered Seabird Recovery Project estimated strike reductions for spans that have been reconfigured with static wire removal. On average, these minimization measures result in greater than 80 percent strike reduction risk. However, because other factors can affect strike rates, KIUC conservatively assumes unminimized strikes (no HCP) resulting from new powerlines will be reduced a minimum of 80 percent with the minimization techniques presented in this chapter.

[17] See Section 4.2.4, *Evaluation of Confidence in Conservation Measure Benefits*, for the methods used to assess the confidence in this and all other conservation measures.

Conservation Measure Component by Species	Confidence in Benefit[a]	Sources	Explanation
Effectiveness of future powerline design in collision risk reduction of at least 80%	High	Same as above	KIUC has achieved collision reduction of over 80% when powerlines are reconfigured (designs that can be replicated in construction), including static wire removal, and bird-flight diverter installation.
Band-rumped storm-petrel (ʻakēʻakē)			
Effectiveness of minimization measures in collision risk reduction	Moderate	Travers et al. 2019b, 2021b; Travers and Raine 2020a	There have been no documented powerline collisions for this species, but high effectiveness has been documented for similar species on Kauaʻi.
Effectiveness of future powerline design in collision risk reduction	Moderate	Same as above	
Covered waterbirds (all five species)			
Effectiveness of powerline minimization to reduce collision risk at least 90%	Moderate	Travers and Raine 2020a; Shaw et al. 2021	Since there are no studies on these species, assumptions were made using a study on another species on Kauaʻi, and a study on blue cranes in South Africa that found that bird flight diverters reduced powerline collisions by 92%.
Effectiveness of future powerline design in collision risk reduction of at least 90%	Moderate	Powerline collision monitoring for field seasons 2012 through 2022; Bayesian model (Travers et al. 2020a); Travers and Raine 2020a	Based on the same monitoring data as for the seabirds, KIUC estimates that 90% of the anticipated waterbird powerline collisions will be avoided.

[a] See categories of confidence levels explained above Table 4-4 .

4.4.2 Conservation Measure 2. Implement Measures to Minimize Light Attraction

This conservation measure describes the actions KIUC will apply to meet the covered seabird biological goals and objectives for light attraction minimization. Bright artificial lights attract and confuse the covered seabird fledglings, causing them to become grounded (Imber 1975; Telfer et al. 1985). If the light-attracted individuals that become grounded are not rescued, they are at risk of succumbing to injury or mortality due to starvation, predation, collisions with cars, or a combination thereof. KIUC's streetlights and covered facility lights are one source of artificial light in the Plan Area that can result in these effects. Under this conservation measure, KIUC will take actions to reduce and minimize this impact.

4.4.2.1 Streetlights

All KIUC streetlights were retrofitted in 2017 to minimize light attraction and reduce the risk of seabird fledgling fallout while still maintaining lighting necessary for public health and safety of public roads and neighborhoods. KIUC installed full-cutoff shielded fixtures on the approximately 4,150 streetlights it owns and operates. These fixtures effectively direct all light toward the ground and minimize the amount of light directed outward or upward toward the sky, minimizing light visible to seabirds flying overhead. With these full-cutoff shielded fixtures, all KIUC-owned streetlights do not produce light that shines above the 90-degree horizontal plane (Figure 4-8). At the same time, all KIUC streetlights were converted from high-pressure sodium bulbs to more energy-efficient 3000-kilowatt LED bulbs. In 2019, KIUC replaced all green light bulbs in streetlights with white light bulbs to further reduce light attraction.

Figure 4-8. Example of Full-Cutoff Shield Installed by KIUC on a Kauaʻi Streetlight

KIUC has estimated that approximately 1,750 new streetlights (see Chapter 2, Section 2.2.3.2, *New Streetlights*) will be installed during the permit term. All future streetlights will utilize the same light minimization features, installed by KIUC at the time of construction. For the same reasons discussed under Section 4.4.1.2, *Future Transmission and Distribution Lines*, no development is expected north of any of the HCP conservation sites (i.e., in areas between conservation sites and the shortest distance to the ocean). As discussed above, there is currently no shoreline road and no vehicle access between Mānā on the west coast and Hāʻena State Park at the terminus of the Kūhiō Highway on the north shore. In summary, all of the land on this 20-mi (32.2-km) shoreline is state owned, extremely rugged, only accessible by boat or foot trail along a portion of the coast, and protected from future development by strict state land use restrictions (see Figures 4-6 and 4-7). No new streets are expected in this area; therefore, no streetlights are expected either.

However, KIUC does not control development planning and construction and must operate new streetlights where they are built to support new development. To account for that possibility, KIUC, USFWS, and DOFAW have jointly developed a special review and approval process for any new streetlights or powerlines proposed in a specifically defined area of northwestern Kauaʻi. The details and a map of this specifically defined review and approval area are described in Appendix 4E, *Review of New Powerlines and Streetlights in Northwestern Kauaʻi*. The specifically defined area where all new powerlines and streetlights must be reviewed and approved by USFWS and DOFAW is called the *Area of Additional Conservation Commitments* and is shown in Figure 4E-1 in Appendix 4E. This special review and approval process is designed to ensure that new powerlines or streetlights will not inhibit the ability of the HCP to achieve the biological goals and objectives.

4.4.2.2 Covered Facility Lights

KIUC also operates night lighting at two facilities covered by this HCP, the Port Allen Generating Station and the Kapaia Generating Station, called the *covered facilities* (see Chapter 2, Section 2.2.1, *Facility Lights*). KIUC will continue to dim the exterior lighting at Port Allen Generating Station during the fledgling fallout season (September 15 to December 15) to minimize light attraction. At the beginning of the fallout season, all exterior facility lights are dimmed (controlled remotely through a website) to the lowest extent practicable (i.e., consistent with all applicable laws and regulations and allowing KIUC to conduct its work in a safe manner). At the end of the fallout season, lights are returned to full brightness. KIUC began this practice in 2019 and saw significant reductions in fallout at this covered facility. Between 2016 and 2018 prior to dimming the lights, KIUC recorded between four and 10 grounded Newell's shearwaters (ʻaʻo). Following dimming, KIUC recorded no fallout in 2019 and on average one grounded Newell's shearwater (ʻaʻo) from 2020 through 2023 (Kauaʻi Island Utility Cooperative 2024).

Dimming facility lights is not possible at the Kapaia Generating Station because the lights at this facility are not dimmable. Lights at this facility are not proposed to be converted to dimmable lights because the risk of fallout of covered seabirds from lights at the Kapaia Generating Station is extremely low—there has only been one individual of the covered seabirds grounded at the Kapaia Generating Station in the last 12 years.

Interior building lights at covered facilities will be turned off at night during the fledgling fallout season (September 15 to December 15) to avoid light attraction. If interior building lights must be turned on for any portion of the night, retractable screens or shades will be used to block lights from emitting from the building.

In 2019, KIUC retrofitted all the exterior lights at the Port Allen Generating Station and at the Kapaia Generating Station. At the Port Allen Generating Station, KIUC replaced its existing freestanding[18] exterior facility lights with full-cutoff white LED lights and shielded wall-mounted white LED box lighting. Similarly, at the Kapaia Generating Station, all the 150-watt high-pressure sodium streetlights and building lights were shielded to direct light downward, away from the sky. Any new lights installed at the two covered facilities by KIUC during the permit term will utilize these same minimization features. As new technology or information becomes available regarding facility lighting that may further reduce the risk of fallout, KIUC will evaluate the new technology and incorporate it into replacement facility lights, as practicable.

[18] Stand-alone fixtures on their own stanchions or attached to power poles.

4.4.2.3 Night Lighting for Restoration of Power

KIUC may also need to utilize artificial lighting during the seabird fallout season if power outages occur between September 15 and December 15. At work sites where nighttime lighting is required during these 3 months, KIUC will search for grounded birds after the work is completed according to the same protocol used at the covered facilities (Section 4.4.2.2, *Covered Facility Lights*). Nighttime lighting would only be used to respond to power outages, and if lights are used, they are necessary for the safety of workers and to conduct the required power restoration work. Due to the emergency nature of this work and the need to ensure worker safety, minimization of lighting at night for the restoration of power is not possible. If KIUC documents that significant fallout is occurring from night lighting for restoration of power, KIUC will address this issue through the adaptive management program. Chapter 6, Section 6.4.2, *Light Attraction Monitoring and Adaptive Management*, provides more details.

4.4.2.4 Annual Training

KIUC has been conducting training its facility staff since 2002 on how to search for and properly handle downed covered seabirds at the covered facilities. KIUC will continue to conduct its ongoing annual seabird training program prior to the start of the seabird fallout period (September 15 to December 15) using Appendix 6B, *KIUC Site Monitoring Protocols and Procedures for Protected Seabirds*. Training will continue to be provided for staff who conduct or supervise grounded seabird searches at facilities and for staff at work sites addressing power outages at night using artificial lighting. KIUC will provide the training both in person and online so that staff can review it at any time. The protocols and procedures will be updated prior to the first seabird fallout season in Year 1 of HCP implementation, and will continue to be updated as needed when adaptive management is implemented.

The annual training will include an overview of the KIUC HCP, the importance of compliance with the HCP and all relevant environmental laws, and a summary of all the relevant avoidance and minimization measures, best management practices, and conservation measures outlined in the HCP. A qualified professional will lead the training on the covered species and provide specific information regarding the species' appearance and their life histories. The trainer will also describe the covered species rescue protocol consistent with Appendix 6B, *KIUC Site Monitoring Protocols and Procedures for Protected Seabirds*, should a staff member or contractor encounter live or dead covered species. KIUC will maintain a log of the names of staff and contractors who attend and complete the annual training.

4.4.2.5 Predator Removal at Covered Facilities

KIUC's covered generating facilities (Port Allen Generating Station and Kapaia Generating Station) are fenced and manned at all hours. As a result, predators of the covered seabirds such as feral cats, dogs, and pigs (*Sus scrofa*) very rarely enter the facilities. Due to the low number of seabirds grounded at KIUC's covered facilities and due to the high risk of human injury, a formal predator control program will not be implemented. Rather, KIUC staff will maintain rodent traps on a consistent basis to remove rats and mice, and KIUC staff will trap and remove on an as-needed basis feral cats and dogs observed within the fenced facilities and transfer them to a suitable animal shelter or sanctuary. These actions will minimize the risk of depredation of grounded covered seabirds and waterbirds at KIUC's covered facilities (see Appendix 6B, *KIUC Site Monitoring Protocols and Procedures for Protected Seabirds*).

4.4.2.6 Confidence in Conservation Measure Benefits to the Covered Species

Based on the assessment in Table 4-5, we conclude that there is a high degree of confidence in the benefits of this conservation measure for all of the covered seabird species due to it being well documented that artificial lights cause seabirds to fallout. KIUC's streetlights and covered facility lights are one source of artificial light in the Plan Area that can result in these effects, and reducing any light visible to seabirds flying overhead will be beneficial to reducing the risk of fallout.

Table 4-5. Assessment of Confidence in Expected Benefits to the Covered Species from Conservation Measure 2, Implement Measures to Minimize Light Attraction

Conservation Measure Component by Species	Confidence in Benefit[a]	Sources	Explanation
Covered seabirds (all three species)			
Installing full-cutoff shielded fixtures on new and future streetlights and retrofitting exterior lights at covered facilities to direct light downward.	High	Imber 1975 Telfer et al. 1985 Reed et al. 1985 Rodríguez et al. 2017a, 2017b	It is well known that bright artificial lights cause seabird fledglings to become grounded. An early study on Kaua'i showed that the shielding of bright lights reduced fallout of Newell's shearwater ('a'o) fledglings by 40%.
Dimming the exterior lighting at Port Allen Generating Station during the fledgling fallout season (September 15 to December 15).	High	KIUC 2023	KIUC began this practice in 2019 and saw significant reductions in fallout. Between 2016 and 2018 prior to dimming the lights, KIUC recorded between four and 10 grounded Newell's shearwaters ('a'o) annually. Following dimming, KIUC recorded no fallout in 2019 and a total of five grounded Newell's shearwater ('a'o) between 2020–2023.
Turning off interior building lights at covered facilities at night during the fledgling fallout season (September 15 to December 15).	High	Imber 1975 Telfer et al. 1985 Reed et al. 1985	Any measure that minimizes light visible to seabirds flying overhead will help reduce fallout.

[a] See the categories of confidence levels explained above Table 4-4 in Section 4.4.1.3, *Confidence in Conservation Measure Benefits to the Covered Species*.

4.4.3 Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program

The SOS Program is an avian rescue and rehabilitation program that operates year-round on Kaua'i. The initial focus of the program was on rescue and rehabilitation of Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u). The program has since been expanded to include all native bird species including all covered seabirds and covered waterbirds, as well as other, non-covered birds. Under the SOS Program, grounded seabirds, waterbirds, and other birds that are rescued by members of the public or businesses can be turned into SOS Program staff. Injured birds are assessed, rehabilitated if possible, and released back into the wild by trained staff and volunteers and professional veterinary staff. All rehabilitation actions occur at an accredited animal rescue facility with extensive equipment and facilities for any necessary procedure to treat minor injuries or perform major surgery or treatment, including extended stays prior to release back into the wild.

The SOS Program has recovered and released more than 32,500 seabirds since the program was created in 1979 (Raine et al. 2023a). From 2009 through 2024, 56 to 85 percent of the covered seabirds and 40 to 68 percent of the covered waterbirds that were handled by the SOS Program were rehabilitated and released back into the wild[19] (Table 4-6) with the expectation that they would successfully reproduce in future nesting seasons. While rehabilitated and released fledglings of covered seabirds do have reduced survivorship compared with wild fledglings, research has shown that a proportion of rehabilitated fledglings have been documented to successfully migrate to their wintering grounds (Raine et al. 2020b). Using satellite tags, Raine et al. (2020b) found that after 21 days, 28.9 percent of SOS-rehabilitated fledglings were still transmitting in comparison with 50 percent of wild fledglings. However, it is assumed that all the rehabilitated seabirds would have died as a result of collision or grounding injuries, starvation, dehydration, predation, vehicle interactions, or other sources of mortality, if not retrieved, treated, and released by the SOS Program. Consequently, operation of the SOS Program plays a significant role in maintaining sustainable populations of the covered species on Kauaʻi.

Beginning in 2003, KIUC began funding and largely implementing the SOS Program with DOFAW oversight and assistance. For this conservation measure, KIUC commits to fund the SOS Program at $300,000 annually for the duration of the permit term, adjusted annually for inflation increases. As described in Chapter 7, *Plan Implementation*, KIUC funding of the SOS Program will start at $300,000 at the start of the permit term and then increase annually to keep pace with inflation. This funding is anticipated to adequately support the SOS Program (or other equivalent program) for the rescue, rehabilitation, and release of covered seabirds and covered waterbirds affected by KIUC's covered activities and that are found by KIUC, the public, and volunteers. Because KIUC has been the primary source of funding for the SOS Program for most of its history, KIUC's continued financial support at this level ($300,000 annually, adjusted annually for inflation) will ensure that these benefits to the covered species continue for 50 years. The SOS Program has supplemented KIUC's financial support with other sources of funding including grants to address other program needs; this is expected to continue.

For the purposes of this HCP, KIUC's funding of the SOS Program is considered both minimization and mitigation for take of covered seabirds and covered waterbirds. For the covered seabird species that are grounded due to powerline collisions or light attraction from KIUC covered activities (i.e., KIUC streetlights and facility lights), KIUC's funding of the SOS Program minimizes the impact of the taking by rescuing, treating, and releasing the seabirds, minimizing the extent of the injury and the amount of mortality. For the covered waterbird species that are grounded due to powerline collisions, KIUC's funding of the SOS Program minimizes the impact of the taking by rescuing, treating, and releasing the waterbirds, minimizing the extent of the injury and the amount of

[19] The remaining 15 to 44 percent of the covered seabirds and 32 to 60 percent of the covered waterbirds are dead on arrival, their injuries are so severe they must be euthanized, or they succumb to their injuries within 24 hours of admittance.

mortality. KIUC's funding of the SOS Program is considered mitigation for the covered seabird and waterbird species because KIUC funding provides for the rescue, treatment, and release of covered seabirds and waterbirds injured by sources that are not associated with KIUC facilities or with other federal ITP/state ITL holders (e.g., disease, vehicle collisions, dog attacks). Therefore, KIUC's funding of the SOS Program is benefitting the covered seabird and waterbird species unrelated to KIUC take or other federal ITP and/or state ITL holders.

Table 4-6. Number of Individuals of Each Covered Bird Species Handled and Released by the SOS Program, 2009–2024[a]

Species	Individuals Brought to SOS	Dead on Arrival	Died or Euthanized	Released[b]	% Released
Newell's shearwater (ʻaʻo)	2,641	197	194	2,240	85%
Hawaiian petrel (ʻuaʻu)	140	10	50	79	56%
Band-rumped storm-petrel (ʻakēʻakē)	13	0	3	10	77%
Hawaiian stilt (aeʻo)	48	1	24	23	48%
Hawaiian duck (koloa maoli)	259	18	64	175	68%
Hawaiian coot (ʻalae keʻokeʻo)	107	24	34	49	46%
Hawaiian gallinule (ʻalae ʻula)	88	21	31	35	40%
Hawaiian goose (nēnē)	839	127	289	413	49%

[a] Source: Annual data provided by the SOS Program (unpublished).

[b] In rare instances birds were transferred to another site or agency, or there were no data on the status of the bird after intake. These instances are not included here, so the number of released birds, birds that died or were euthanized, and birds that were dead on arrival does not always sum to the total number recovered.

4.4.3.1 SOS Staff Qualifications

To ensure effectiveness of SOS services funded by KIUC, the SOS staff funded through this conservation measure will have the following qualifications.

- The rehabilitation manager will have experience with avian rehabilitation, including direct involvement with a variety of treatments and methods of administration.
- The avian technicians will have significant experience with bird handling and banding (preferably with a variety of metals/sizes/species).
- All bird handlers will have the necessary state and federal handling permits and follow procedures and reporting requirements specified in these permits and in the SOS Operations Manual.

4.4.3.2 Public Outreach and Education

Conservation Measure 3 includes public outreach and education to inform and educate the public about the risks of powerline strikes and light attraction to threatened and endangered species on Kauaʻi. The SOS Program has its own public outreach and education program that KIUC will support as part of its financial support of that program. Also, as part of this measure, KIUC will continue to conduct its own public outreach and education in coordination with the SOS Program. These efforts may include, but are not limited to, the following actions.

- Encourage developers of new commercial and residential development on Kauaʻi to bury powerlines in the areas to be developed, especially in areas with high risk of collision by the covered species.
- Encourage the County to adopt new zoning regulations that require all new developments on Kauaʻi to bury new utility lines.
- Prepare and distribute information on the covered species, the SOS Program, and the HCP in the *Currents* magazine, which is sent via direct mail to all KIUC customers.
- Publicize the SOS Program and the HCP with radio, newspaper, or television announcements, as well as community school programs.
- Develop, assemble, and disseminate a variety of education materials. The SOS Program staff distributes these materials.
    - SOS Program posters
    - SOS Program brochures
    - Seabird activities coloring book
    - Seabird "tattoos"
    - Reusable shopping bags
    - Tee-shirts
- Perform annual seabird public blessings (pule) and release events to promote the cultural connection between the people of Kauaʻi and the covered seabirds.
- Publicize the program at outreach events such as Earth Day, Lighthouse Day, or Agricultural and Environmental Awareness Day.

4.4.3.3 Confidence in Conservation Measure Benefits to the Covered Species

Based on the assessment in Table 4-7, there is a moderate to high degree of confidence in the benefits of this conservation measure for all of the covered species due to the longevity of the SOS Program, the successfulness of the program to rehabilitate and release the covered species, and the data collected through this program on the covered species.

Table 4-7. Assessment of Confidence in Expected Benefits to the Covered Species from Conservation Measure 3, Provide Funding for the Save Our Shearwaters Program.

Conservation Measure Component by Species	Confidence in Benefit[a]	Sources	Explanation
Covered seabirds (all three species)			
Provide $300,000 funding annually, increasing with inflation, to the SOS Program for the duration of the permit term.	High	Raine et al. 2020b, 2023b; SOS Program data (Table 4-6)	Since 1979, the SOS Program has recovered and released more than 32,500 seabirds and has collected long-term data. Released birds survive to a high degree, indicated by a study using satellite tags where after 21 days, 29% of SOS-rehabilitated fledglings were still transmitting in comparison with 50% of wild fledglings.
Covered waterbirds (all five species)			
Offset collisions with KIUC powerlines by funding the SOS Program.	Moderate	SOS Program data (Table 4-6)	The SOS Program has established protocols for collecting and rehabilitating a variety of waterbird species, including the covered waterbirds, and has been collecting data consistently for these species since 2012. The SOS Program has rescued and released a total of 695 individuals of the five covered waterbird species since 2009.

[a] See the categories of confidence levels explained above Table 4-4 in Section 4.4.1.3, *Confidence in Conservation Measure Benefits to the Covered Species*.

4.4.4 Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites

This conservation measure describes the actions KIUC will apply to meet the Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), and band-rumped storm-petrel (ʻakēʻakē) (related only to predator control) biological goals and objectives. The management and enhancement actions identified under this conservation measure will occur exclusively within designated conservation sites on Kauaʻi throughout the permit term. This conservation measure is the primary means of offsetting the impacts of the taking on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) and providing a net benefit for each species (see Chapter 5, *Effects*, for modeling that quantifies this benefit).

4.4.4.1 Conservation Sites

Conservation sites are specific parcels in the Plan Area where KIUC will continue to implement management actions (e.g., predator control, social attraction) to increase the reproductive success of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) breeding colonies, and to benefit band-rumped storm-petrel (ʻakēʻakē) occurring in the region. As part of the early planning process for this HCP, KIUC went through an extensive site selection process to identify and secure suitable conservation sites for the HCP. KIUC considered 32 sites throughout the Plan Area and evaluated them against a set of 14 criteria, which fall into the following eight summary categories. A site could be selected and secured if its total score was high.

- Covered species presence
- High habitat quality
- Low to moderate predator abundance
- Existing management
- Management feasibility
- Accessibility by foot or helicopter
- Landowner willingness
- Low degree of anthropogenic threats (light attraction and powerlines)

This assessment was informed by experts at ARC and Hallux Ecosystem Restoration LLC, who have been conducting these management actions for many years, including as part of the KIUC Short-Term HCP. Pacific Rim Conservation also evaluated potential sites as part of the site assessment process. Details of the evaluation criteria, site assessment, and the evaluation process are found in Appendix 4A, *Conservation Site Selection.*

In addition, USFWS and DOFAW provided extensive input into the site criteria, evaluation, and selection of the proposed conservation sites. During the planning process, USFWS published two important reports that recommended conservation actions to enhance breeding colonies of Newell's shearwater (ʻaʻo) be focused in northwestern Kauaʻi (U.S. Fish and Wildlife Service 2017a, 2019). These studies were based on spatially explicit modeling that considered similar factors to the qualitative assessment described above, including topography, presence of existing breeding colonies, and threats of light attraction.

Based on KIUC's site assessment and the input from USFWS and DOFAW, 12 conservation sites have been identified for the KIUC HCP (Table 4-8, Figure 4-9). These sites were selected because they scored high for the criteria listed above[20] and were consistent with the direction provided by DOFAW and USFWS, and based on the USFWS published reports. Pōhākea PF, Upper Limahuli PF, Honopū PF, and Upper Mānoa Valley PF are smaller areas within their respectively named sites. The four PF sites are identified as separate conservation sites for the purposes of this HCP because they have different levels of predator risks, different monitoring approaches, different conservation actions (social attraction), and different levels of population tracking within their fenced areas than in the surrounding larger conservation areas.

Most of the 12 conservation sites that were selected for the KIUC HCP are the same sites where KIUC has been funding predator control, seabird monitoring, and invasive plant species control annually since 2011 for the Short-Term HCP and in the interim period between the Short-Term HCP and commencement of this KIUC HCP (Table 4-9; see Appendix 4A, *Conservation Site Selection*, for

[20] Many sites did not score high because of low scores on key criteria such as landowner willingness, documented presence of the covered species, site access, or a combination of these factors. Appendix 4A, *Conservation Site Selection*, provides details.

details). This history of managing conservation sites provided KIUC, USFWS, and DOFAW with a large amount of data that was used to determine if the same type of management at these sites would continue to benefit the covered seabird species during HCP implementation. The primary reasons to include these existing sites as conservation sites for the KIUC HCP rather than replace them with new sites were that (1) successful management has already been occurring at these sites for many years, (2) predator populations have largely been suppressed due to years of ongoing intensive predator control, and (3) the data collected at each site indicates an increasing abundance of the covered seabirds at each site, as described in Chapter 5, *Effects*.

Other significant reasons to select the proposed conservation sites included site adjacency, presence of existing fences (Figure 4-10), existing seabird colonies under management by other entities, and initial establishment of conservation sites by other entities. The Upper Limahuli Preserve has a pig exclusion fence surrounding its entire boundary and while the height of the fence is lower than typical for deer (*Odocoileus hemionus*) exclusion, no deer have been detected at the site since the fence was completed. The Hono O Nā Pali NAR contains sections of strategically placed ungulate exclusion fences that, in combination with steep terrain, restrict ungulates from entering Hono O Nā Pali NAR (Figure 4-10). Pihea, North Bog, Pōhākea, Pōhākea PF, Hanakoa, and Hanakāpiʻai are located in the Hono O Nā Pali NAR, which is managed by DOFAW. KIUC added the Hanakoa and Hanakāpiʻai conservation sites in 2021 due to several factors, including existing seabird populations at the two sites, increasing trends in the site subpopulations in response to the initial management based on monitoring data, and existing seabird management occurring in other parts of the Hono O Nā Pali NAR. Honopū is primarily located within the Nā Pali-Kona Forest Reserve, managed by DOFAW, and Kokeʻe State Park, managed by the Division of State Parks. A small portion of Honopū extends into Nā Pali Coast State Wilderness Park, which is managed by the Division of State Parks. Honopū PF is located entirely within Nā Pali-Kona Forest Reserve.

DOFAW, U.S. Navy Pacific Missile Range Facility, and other partners constructed the ungulate and predator exclusion fences at Honopū and Honopū PF, and established the social attraction site at Honopū PF. DOFAW and other partners constructed the predator exclusion fence around Pōhākea PF and established the social attraction site. In 2022, social attraction was initiated at Pōhākea PF by KIUC and at Honopū PF by DOFAW, U.S. Navy Pacific Missile Range Facility, and other partners. KIUC took over management of Pōhākea PF in 2022 and Honopū and Honopū PF in 2023. Tables 4-8 and 4-9 provide an overview of the information provided here.

Table 4-8. KIUC HCP Conservation Site Areas and Ownership (see Figure 4-9 for Locations)

Conservation Site	Size in Acres (hectares)	Ownership Type	Land Management Entity
Upper Limahuli Preserve	374 (151)	Private nonprofit	National Tropical Botanical Garden
Upper Limahuli Preserve PF	4.4 (1.8)	Private nonprofit	National Tropical Botanical Garden
North Bog	257 (104)	State	DOFAW (Hono O Nā Pali NAR)
Pōhākea	292 (118)	State	DOFAW (Hono O Nā Pali NAR)
Pōhākea PF	0.4 (0.16)	State	DOFAW (Hono O Nā Pali NAR)
Honopū	235 (95)	State	Division of State Parks (Nā Pali Coast State Wilderness Park, Kokeʻe State Park) and DOFAW (Nā Pali Kona Forest Reserve)

Conservation Site	Size in Acres (hectares)	Ownership Type	Land Management Entity
Honopū PF	3.3 (1.3)	State	DOFAW (Nā Pali Kona Forest Reserve)
Pihea	193 (78)	State	DOFAW (Hono O Nā Pali NAR)
Hanakoa	179 (72)	State	DOFAW (Hono O Nā Pali NAR)
Hanakāpiʻai	201 (81)	State	DOFAW (Hono O Nā Pali NAR)
Upper Mānoa Valley	228 (92)	Private	KIUC through agreement with landowner
Upper Mānoa Valley PF	13.5 (5.5)	Private	KIUC through agreement with landowner
Total	1,981 (802)		

Table 4-9. History of Management Actions at the KIUC HCP Conservation Sites

Conservation Site	Management Actions (Year Action Began)[a]	KIUC Involvement to Date[a]
Upper Limahuli Preserve	Ungulate exclusion fence (2009) Invasive plant control (2011) Predator control (2011)	Fence construction funded by others. All other conservation actions conducted by KIUC since 2011.
Upper Limahuli Preserve PF	Construction of predator exclusion fence (2023)	New site proposed for KIUC HCP. Predator exclusion fence to be completed by end of 2025.
North Bog	Invasive plant control (2012) Predator control (2012) Hono O Nā Pali NAR ungulate exclusion fence (2014)[b]	Fence construction by DOFAW. All other actions conducted by KIUC since 2012.
Pōhākea	Invasive plant control (2012) Predator control (2012) Hono O Nā Pali NAR ungulate exclusion fence (2014)[b]	Fence constructed by DOFAW. All other actions conducted by KIUC since 2012.
Pōhākea PF	Predator exclusion fence (2021) Invasive plant control (2022) Predator control (2022) Initialization of social attraction (2022)	Fence construction and predator eradication completed by others. KIUC began conducting all management actions, including fence maintenance and initiation of social attraction in 2022.
Honopū	Ungulate exclusion fence (2022) Predator control (2022) Invasive plant control	Fence constructed and initial predator control by others. KIUC began conducting all actions, including fence maintenance at this site in 2023.
Honopū PF	Predator exclusion fence (2021) Invasive plant control (2022) Predator control (2022) Initialization of social attraction (2022)	Fence constructed, initialization of social attraction and predator eradication initiated by others. KIUC began conducting all management actions in 2023, including fence maintenance and completion of predator eradication.

Conservation Site	Management Actions (Year Action Began)[a]	KIUC Involvement to Date[a]
Pihea	Predator control (2012) Hono O Nā Pali NAR ungulate exclusion fence (2014)[b]	Fence constructed by DOFAW. All other actions conducted by KIUC since 2012.
Hanakoa	Predator control (2016) Invasive plant control (2021) Hono O Nā Pali NAR ungulate exclusion fence (2014)[b]	Fence constructed by DOFAW. All other actions conducted by KIUC since 2021.
Hanakāpiʻai	Predator control (2016) Invasive plant control (2021) Hono O Nā Pali NAR ungulate exclusion fence (2014)[b]	Fence constructed by DOFAW. All other actions conducted by KIUC since 2021.
Upper Mānoa Valley	Predator control (2015) Invasive plant control (2024)	Conservation actions conducted by KIUC from 2015–2022 and resumed in 2024.
Upper Mānoa Valley PF	Initiation of construction of predator exclusion fence (2024)	New site proposed for KIUC HCP. Predator exclusion fence to be completed by end of 2027.

[a] Source: Appendix 4A, *Conservation Site Selection*. For details on proposed management actions for this HCP, see Section 4.4.4.2, *Management Actions*. For details on site monitoring, including history, see Chapter 6, *Monitoring and Adaptive Management Program*.

[b] The Hono O Nā Pali NAR contains sections of strategically placed ungulate exclusion fences that, in combination with steep terrain, restrict ungulates from entering Hono O Nā Pali NAR, see Figure 4-10. Ungulate eradication in the NAR is ongoing as of 2024.

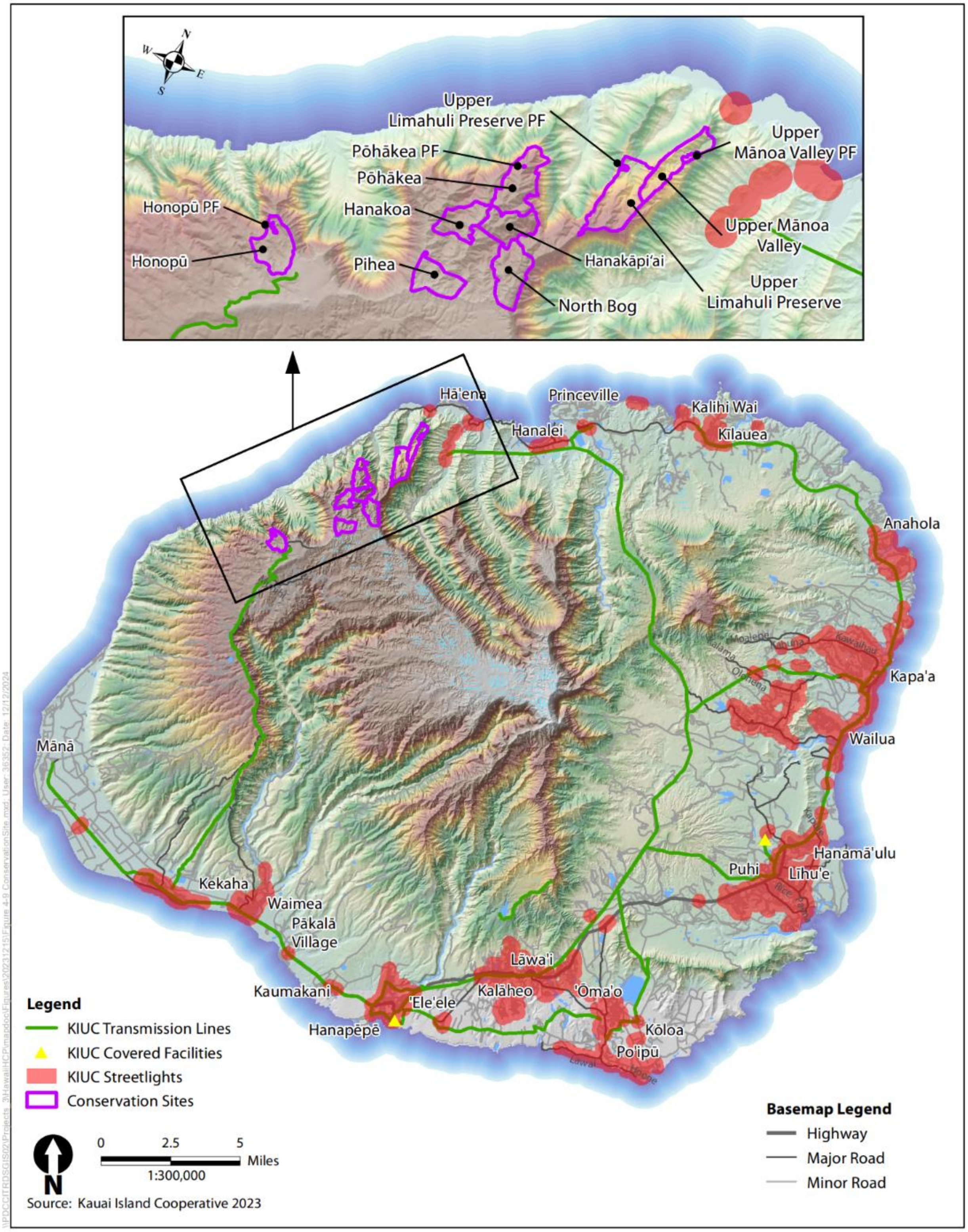


Figure 4-9. Locations of HCP Conservation Sites Relative to KIUC Covered Activities

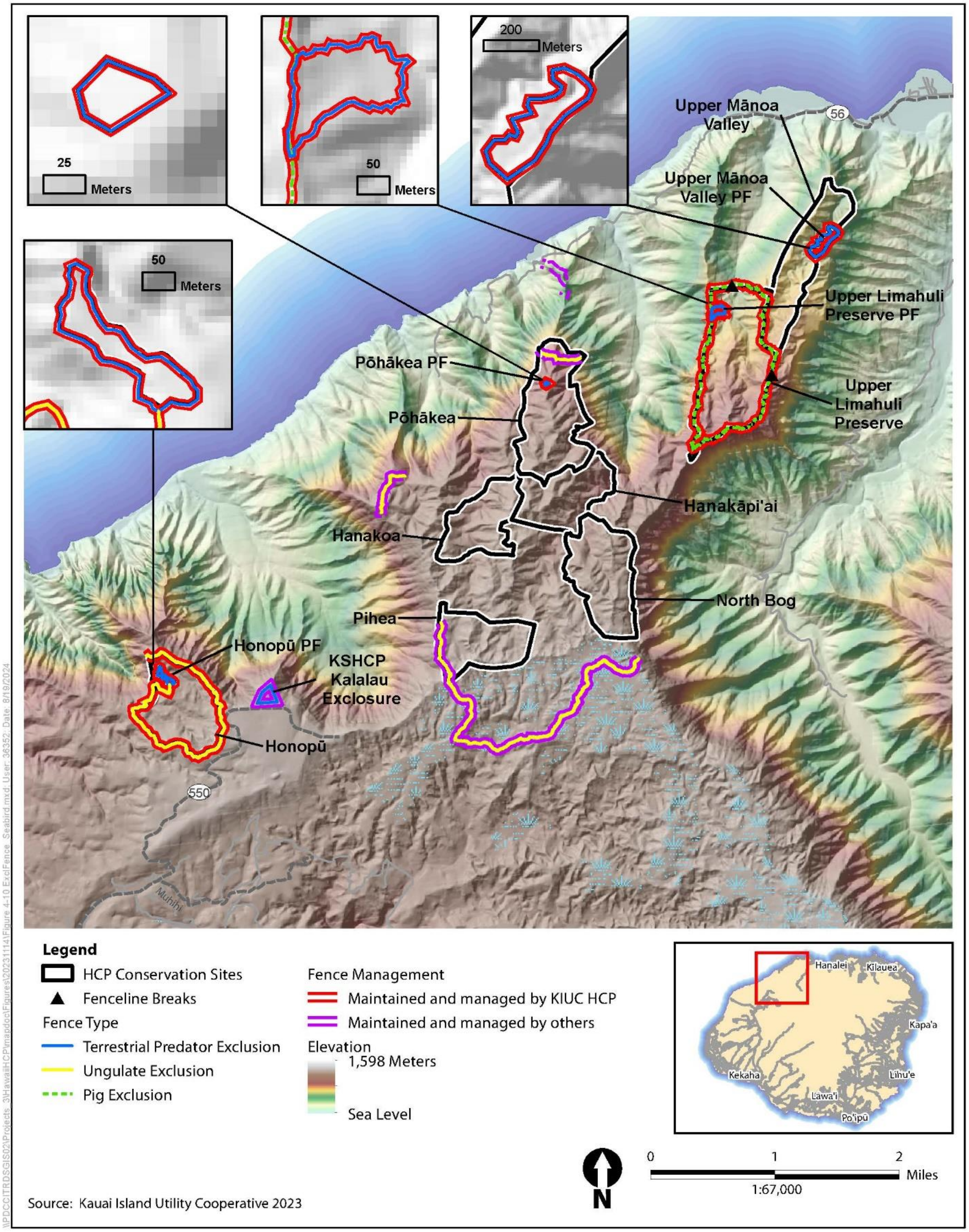


Figure 4-10. Predator Exclusion Fences Supporting the HCP Conservation Sites

Five of the 12 sites currently support both Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) breeding colonies (Table 4-10). Of the remaining seven sites, Honopū primarily supports Newell's shearwater (ʻaʻo) but contains suitable habitat for Hawaiian petrel (ʻuaʻu). Conversely, Pihea currently contains very few Newell's shearwater (ʻaʻo) breeding pairs but supports a robust Hawaiian petrel (ʻuaʻu) population. The Pōhākea PF, Upper Limahuli PF, Honopū PF, and Upper Mānoa Valley PF sites are social attraction sites within predator exclusion fences that contain suitable habitat for the covered seabird species. Social attraction efforts are primarily focused on Newell's shearwater (ʻaʻo), but there is also social attraction at Honopū PF for the band-rumped storm-petrel (ʻakēʻakē). There have been numerous sightings of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) at both Pōhākea PF and Honopū PF, and at Honopū PF one sighting of a band-rumped storm-petrel (ʻakēʻakē) within the first few years of social attraction, but no documented breeding pairs have been confirmed as of 2023. Construction of the predator exclusion fence at the Upper Limahuli Preserve PF site was initiated in 2023 and is scheduled for completion at the end of 2025 (Table 4-9). Regular fence monitoring, maintenance, and repairs will be conducted to maintain the effectiveness of all four terrestrial predator exclusion fences over the 50-year permit term (Chapter 6, *Monitoring and Adaptive Management Program*).

None of the conservation sites support existing known band-rumped storm-petrel (ʻakēʻakē) colonies, but the social attraction for band-rumped storm-petrels (ʻakēʻakē) at Honopū PF is intended to draw the species into that management area.

Together, the 12 conservation sites currently support an estimated colony population of 1,264 to 1,696 Newell's shearwater (ʻaʻo) breeding pairs and an estimated colony population of 2,258 to 3,675 Hawaiian petrel (ʻuaʻu) breeding pairs (Table 4-10). A detailed description of each of the 12 selected conservation sites is included in Appendix 4A, *Conservation Site Selection*.

Table 4-10. Breeding Pairs of Newell's Shearwater (ʻaʻo) and Hawaiian Petrel (ʻuaʻu) at the HCP Conservation Sites in 2021, Based on Auditory Surveys, Burrow Monitoring, and Habitat Suitability Modeling

Conservation Site	Total Site Size (acres/hectares)	Low/High Newell's Shearwater (ʻaʻo) Breeding Pairs[a]	Low/High Hawaiian Petrel (ʻuaʻu) Breeding Pairs[a]
Upper Limahuli Preserve	374/151	498/617	112/135
Upper Limahuli Preserve PF[b, c]	4.4/1.8	0	0
North Bog	257/104	66/80	880/1,261
Pōhākea	292/118	290/464	161/611
Pōhākea PF[b]	0.40/0.164	0	0
Honopū	235/95	90/92	0
Honopū PF[b]	3.3/1.3	0	0
Pihea	193/78	0/1	645/815
Hanakoa	179/72	45/74	171/455
Hanakāpiʻai	201/81	76/85	289/398
Upper Mānoa Valley	228/92	199/283	0
Upper Mānoa Valley PF[b, d]	13.5/5.5	0	0
Total	**1,981/802**	**1,264/1,696**	**2,258/3,675**

Sources: Raine et al. 2019a; Raine 2022; Troy et al. 2014, 2017; Raine in litt.

[a] The breeding pair estimates are informed by auditory survey data and nesting burrow monitoring studies, which have demonstrated a significant relationship between call rates and estimated densities of active nesting burrows (e.g., Raine et al. 2019a; Raine 2022; Troy et al. 2014, 2017).
[b] These conservation sites are bound by small predator exclusion fences that will be managed and maintained as social attraction sites by KIUC. All social attraction areas contain suitable habitat for the covered seabirds.
[c] The predator exclusion fence at this site will be completed in 2025.
[d] The predator exclusion fence at this site will be completed in 2027.

Because KIUC or other entities have been managing most of these sites for covered seabird species well before the start of the permit term (Table 4-9), the measurable benefits to the covered seabirds will be realized much earlier in the permit term than if site management began after permit issuance. Management actions such as predator exclusion fence construction, predator control, and social attraction take several years to implement fully and several years after that to begin to measurably benefit the covered seabirds, but in this case predator control and social attraction will benefit the covered seabirds during Year 1 of HCP implementation due to KIUC's long history of predator management within these conservation sites and the initiation of social attraction at Honopū PF and Pōhākea PF prior to the permit term.

4.4.4.2 Management Actions

This conservation measure includes five management actions that KIUC will employ at all or some of the conservation sites.

- Predator control
- Predator exclusion fencing construction and maintenance
- Maintenance of ungulate exclusion fencing at two sites
- Social attraction
- Invasive plant species control

Table 4-11 shows which management actions are planned for each of the 12 conservation sites during the 50-year permit term.

Table 4-11. Management Actions Implemented in Each Conservation Site

Conservation Site	Predator Control	Predator Exclusion Fencing	Ungulate Exclusion Fencing	Social Attraction	Invasive Plant Species Management[a]
Upper Limahuli Preserve	X	--	X	--	X
Upper Limahuli Preserve PF	X	X	--	X	X
North Bog	X	--	--	--	X
Pōhākea	X	--	--	--	X
Pōhākea PF	X	X	--	X	X
Honopū	X	---	X	--	X
Honopū PF	X	X	--	X	X
Pihea	X	--	--	--	X
Hanakoa	X	--	--	--	X
Hanakāpī'ai	X	--	--	--	X
Upper Mānoa Valley	X	--	--	--	X
Upper Mānoa Valley PF	X	X	--	X	X
Total	**12**	**4**	**2**	**4**	**12**

[a] Invasive plant species management occurs primarily at Upper Limahuli Preserve and the social attraction sites. Invasive plant species management in other areas within the conservation sites is conducted on an as-needed basis.

Interim Management Actions

As described in Section 4.1.2, *Prior KIUC Conservation Measures*, KIUC has been conducting many of the management actions included under this conservation measure within most of the conservation sites (see Table 4-9). These management actions occurred both during implementation of the Short-Term HCP (2011–2016) and since then as early implementation for this HCP (2017–2024), to prepare for implementation of this HCP.

KIUC has been funding colony monitoring and extensive predator control within the Upper Limahuli Preserve, North Bog, Pihea, and Pōhākea conservation sites since 2011 or 2012 (Table 4-9). Invasive plant species control has been funded by KIUC since 2011 in the Upper Limahuli Preserve conservation site. KIUC started funding colony monitoring and predator control at Hanakāpī'ai and Hanakoa in 2021. Colony monitoring, social attraction, predator monitoring and control, vegetation control, and fence maintenance was started by KIUC at Pōhākea PF in 2022 and at Honopū PF in 2023. KIUC's ongoing management (and, in some cases, long history of management) illustrates the practicability of these conservation measures and the fact that the protocols and specifications described in this conservation measure have been applied, tested, and refined for many years. Data collected over the years at all of these sites indicates the management actions have been successful at protecting and expanding seabird colonies and increasing seabird subpopulations at these sites.

The substantial work leading up to this HCP has allowed extensive field testing and refining of tools, equipment, and techniques. However, new technology or approaches may become available during the permit term to improve the effectiveness or cost-efficiency of these measures. If that is the case, the details of these measures may be modified through adaptive management based on results of monitoring and the best available scientific and technical information, as described in Chapter 6, Section 6.4.4, *Conservation Site Monitoring and Adaptive Management*. The management actions are described below.

Predator Control

Predation by introduced species is one of the major factors causing the decline of seabird populations on islands worldwide (Courchamp et al. 2003; Raine et al. 2020a). Predator control is the primary management action to establish predator-free breeding habitat or substantially reduce predation, which is critical to successfully restore productive seabird colonies (Buxton et al. 2014; Jones and Kress 2012; Young et al. 2018; Raine et al. 2020a). For the purposes of this HCP, predators include cats, rats and mice (rodents), pigs, deer and goats (*Capra hircus*) (ungulates), feral bees, and barn owls. Given the length of time necessary for birds to reach sexual maturity (5–6 years), adult mortality is extremely harmful to the species (Raine et al. 2020a).

Terrestrial Predator Control

Terrestrial predator control has been proven to be very effective at increasing seabird nesting productivity on Kauaʻi. Raine et al. (2020a) found that between 2011 and 2017, Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) reproductive success rates increased by a mean of approximately 36 percent and 48 percent, respectively, following predator control operations within managed breeding sites. Without predator control, Raine et al. (2020a) found that modeled population trajectories within all management sites declined rapidly over a 50-year period, with many colonies approaching extirpation. This study further concluded that cats are the most destructive predator, targeting breeding adults to a higher degree than other predators. A single cat is capable of affecting multiple colonies and depredating a large number of birds in a short period of time. Predator control at all sites will be designed to achieve the conservation benefits in Chapter 5, *Effects*.

Intensive predator control will be implemented at all sites without predator exclusion fencing. Intensive predator control creates a virtual fence through strategic placement of trapping and monitoring cameras along known routes and ingress points and around known seabird burrow locations. Based on colony monitoring data collected at KIUC managed sites since 2011, strategic trapping combined with rapid response when predators are detected on camera has proven to be very effective in suppressing depredation and increasing reproductive success rates. Terrestrial predator control methods include deployment of cameras, various trap types depending on targeted species (cats, rats, etc.), bait stations, snares, hunting, and other control methods. The overall number of traps deployed at trapping stations will depend on the detection of predators and the effectiveness of trapping but will not necessarily be constant within conservation sites through time. For instance, in 2019, North Bog contained 203 trapping stations, Pōhākea contained 93 trapping stations, and Pihea contained 95 trapping stations (Pias and Dutcher 2020). Predator control efforts may be timed based on seasonality, rainfall, and the phenology and/or vulnerability to toxicants of endemic species within the fenced area. Traps will also be deployed in other areas where there are high levels of human use such as weatherports, campsites, and other small facilities within the conservation sites. Terrestrial predator control in areas without predator exclusion fencing will focus on high-traffic locations for predators near known breeding colonies. There is a risk that individual covered seabirds may be caught in predator control traps. KIUC has developed protocols for these instances, or for when birds are affected by other HCP related actions, see Appendix 4C, *Protocols for Seabird Trap Interactions at Conservation Sites*. KIUC contractors that perform HCP measures at the conservation sites will follow these protocols.

At four of the conservation sites, predator exclusion fences have been or will be constructed to eradicate terrestrial predators (cats, rats, mice, pigs, goats) and social attraction will be implemented. Depending on terrestrial predator abundance and the total size of the fenced area, complete terrestrial predator eradication can take anywhere from 3 to 12 months to achieve (Young in litt.); individuals must be removed at a rate faster than they can reproduce. Where there are fencing gaps at drainage crossings, traps will be placed 66 ft (20 m) apart to intercept any animals that enter the containment zone. Once terrestrial predators are eradicated within the exclusion fence boundary, as determined by the results of the monitoring program (Chapter 6, *Monitoring and Adaptive Management Program*), this HCP assumes that the habitat within the fenced area will remain free of terrestrial predators except when fences are breached or damaged. In cases of a fence breach or damage, immediate terrestrial predator control will occur within the fenced area in order to remove any predators that may have entered the breach and to maintain predator-free habitat.

Predator exclusion fences will have no effect on barn owls (and may even facilitate perching) or feral bees, so barn owl and feral bee control at the fenced areas will still be necessary for the duration of the 50-year permit term. Some of the conservation sites also have ungulate fences or pig fences that partially or entirely surround the conservation site, as described below and shown in Figure 4-10. For more details and background about the conservation sites and fence installation, see Appendix 4A, *Conservation Site Selection.* The following list describes the planned predator control at each of the conservation sites.

Upper Limahuli Preserve

- Entire 374-acre (151-hectare) conservation site protected by an existing pig exclusion fence (although deer and goat have not been detected in the site since completion of fence construction). Terrestrial predator control (cats, rodents, barn owls, feral bees) and fence maintenance will occur in the entire ungulate fenced area for the duration of the 50-year permit term.

Upper Limahuli Preserve PF

- Predator exclusion fence (approximately 4.4 acres [1.8 hectares]) around a social attraction site to be completed in 2025. Predators will be eradicated within the fenced area and social attraction will be implemented. Barn owl and feral bee control will occur for the duration of the 50-year permit term, as well as fence maintenance.

North Bog

- Entire 257-acre (104-hectare) conservation site is within an area protected by an existing ungulate exclusion fence combined with steep impassable terrain. Terrestrial predator control (cats, rodents, barn owls, feral bees) and fence maintenance will occur in the entire ungulate fenced area for the duration of the 50-year permit term.

Pōhākea

- Entire 292-acre (118-hectare) conservation site is within an area protected by an existing ungulate exclusion fence combined with steep impassable terrain. Terrestrial predator control (ungulates, cats, rodents, barn owls, feral bees) and fence maintenance will occur throughout the entire conservation site for the duration of the 50-year permit term.

Pōhākea PF

- Entire 0.4-acre [0.16-hectare] area is protected by an existing predator exclusion fence. Predators have been eradicated within the fenced area and social attraction was initiated in

2022. Barn owl and feral bee control, as well as fence maintenance, will occur at the site for the duration of the 50-year permit term.

Honopū

- Entire 235-acre (95-hectare) conservation site is within an area protected by an ungulate exclusion fence combined with steep, impassable terrain. Terrestrial predator control (ungulates, cats, rodents, barn owls, feral bees) will occur throughout the entire conservation site and fence maintenance will occur in the entire ungulate fenced area for the duration of the 50-year permit term.

Honopū PF

- Entire 3.3-acre (1.3-hectare) area is protected by a predator exclusion fence. Predators have been eradicated within the fenced area and social attraction was initiated in 2022. Barn owl and feral bee control, as well as fence maintenance, will occur at the site for the duration of the 50-year permit term.

Pihea

- Entire 193-acre (78-hectare) conservation site is within an area protected by an ungulate exclusion fence combined with steep, impassable terrain. Terrestrial predator control (ungulates, cats, rodents, barn owls, feral bees) will occur throughout the entire conservation site for the duration of the 50-year permit term.

Hanakoa

- Entire 179-acre (72-hectare) conservation site is within an area protected by an ungulate exclusion fence combined with steep, impassable terrain. Terrestrial predator control (ungulates, cats, rodents, barn owls, feral bees) will occur throughout the entire conservation site for the duration of the 50-year permit term.

Hanakāpiʻai

- Entire 201-acre (81-hectare) conservation site is within an area protected by an ungulate exclusion fence combined with steep, impassable terrain. Terrestrial predator control (ungulates, cats, rodents, barn owls, feral bees) will occur throughout the entire conservation site for the duration of the 50-year permit term.

Upper Mānoa Valley

- Terrestrial predator control (ungulates, cats, rodents, barn owls, feral bees) will occur throughout the entire 228-acre (92-hectare) conservation site for the duration of the 50-year permit term.

Upper Mānoa Valley PF

- Predator exclusion fence (approximately 13.5 acres [5.5 hectares]) around a social attraction site to be completed in 2027. Predators will be eradicated within the fenced area and social attraction will be implemented. Barn owl and feral bee control, as well as fence maintenance, will occur for the duration of the 50-year permit term.

Aerial Predators

Seabirds are susceptible to predation by barn owls and feral European honeybees.

The terrestrial control methods outlined previously will not control depredation by aerial predators. Additional control methods must be implemented. Barn owl control methods will include targeted trapping and hunting and will occur in areas where barn owls or signs of barn owls (e.g., pellets, feathers) have been observed either incidentally or through the monitoring program (Chapter 6, *Monitoring and Adaptive Management Program*). Barn owl control will occur at all of the conservation sites to reduce further predation of the covered seabird species and increase reproductive success. Feral honeybee control methods include using specialized equipment to vacuum out beehives found in burrows.

A study by Raine et al. (2019b) in which barn owl depredations were recorded between January 2011 and October 2018 across nine study sites found that barn owl control measures, when implemented in a concentrated and systematic fashion, can significantly decrease seabird depredations. This will be particularly important in areas where social attraction will be performed because playing recorded seabird calls will not only attract the target seabird but also hunting barn owls.

Feral honeybee depredations were analyzed in a study by Raine et al. (2023c) in which they found that between 2011 and 2021, 17 bee swarms were recorded at seabird burrows on the islands of Kauaʻi and Lanaʻi, consisting of 14 Hawaiian petrel (ʻuaʻu) burrows and 3 Newell's shearwater (ʻaʻo) burrows. For burrows where bee takeovers occurred, only 30 percent of pairs reinitiated breeding in the following year, despite the hive being removed as soon as it was discovered. At the conservation sites, feral beehives that are located incidentally during other management and monitoring activities will be actively removed using the technique described above, or other techniques based on best available scientific and technical information at the time, to protect the birds as well as fieldworkers in area.

Predator Exclusion Fencing

Predator exclusion fencing for the purposes of this HCP is defined as constructing fences that are impenetrable to most introduced terrestrial predators including feral cats, rats, pigs, and goats. Deer can jump over these fences but will be managed if they are documented in the conservation sites. Predator exclusion fencing supplements terrestrial predator control, which can be highly effective in and of itself, further reducing predation events. Predator exclusion fences are especially effective in protecting against stochastic predation events by terrestrial predators such as cats. Predator exclusion fencing has proven to be an effective means of multi-species predator control for seabird colonies in Hawaiʻi (Day and MacGibbon 2002; Young et al. 2012, 2013; VanderWerf and Young 2014; Tanentzap and Lloyd 2017). Once a predator exclusion fence is built, all target predators must be eradicated within the fence in order for the fence to be effective. After predator eradication, traps will be placed along the boundary of the fence to further limit the potential for predators to reenter the fenced area. Barn owl and feral bee control would continue at sites with predator exclusion fences.

There will be four predator exclusion fenced conservation sites included as part of the conservation strategy for the KIUC HCP. Two small predator exclusion fences will be in place before the start of the permit term (the Pōhākea PF and Honopū PF conservation sites). Predator eradication was completed at both sites and social attraction was initiated prior to the start of the HCP term. KIUC took over management of both sites and the maintenance of these fences prior to the HCP term. KIUC will construct two additional predator exclusion fences, one for the Upper Limahuli Preserve PF by the end of 2025, and one for the Upper Mānoa Valley PF by the end of 2027.

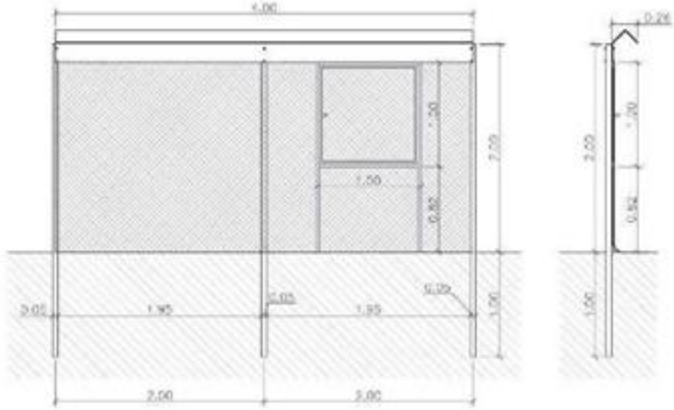
The primary purpose of predator exclusion fencing for this HCP is to establish social attraction sites, which will draw prospecting birds into these sites that would have established burrows elsewhere. Predator exclusion fencing is not being proposed as the primary method to protect existing seabird colonies primarily for three reasons:

- Predator control monitoring since 2011 has demonstrated that intensive predator control without predator exclusion fencing is highly effective.
- Steep terrain and significant erosion issues limit areas where it is feasible to construct predator exclusion fencing.
- Existing colony sizes are large and spread out over large areas, and larger predator exclusion fences are difficult to maintain, have a greater risk of breaches, require longer periods to address predator incursion when breaches occur, and little confidence in eradication feasibility due to size, vegetation cover, and terrain at the large sites.

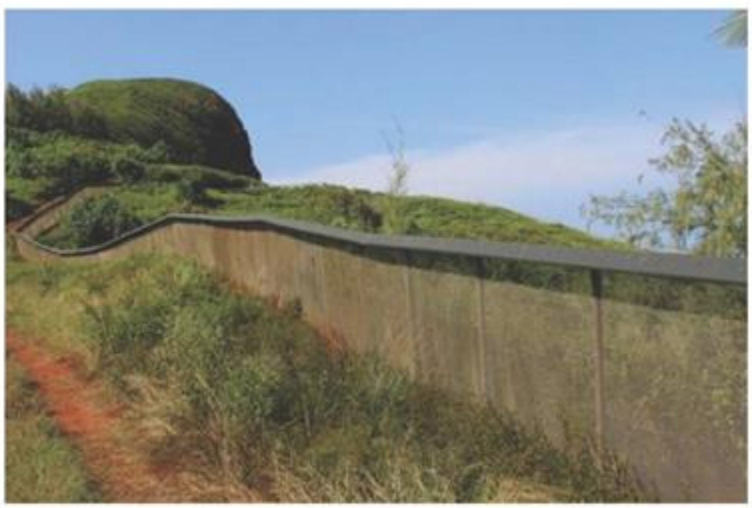
As described above under *Predator Control*, other types of fences are present at or adjacent to the conservation sites, constructed by other entities, that either partially or entirely surround areas where those conservation sites are located (Figure 4-10). Although KIUC did not construct the ungulate fences at Hono O Nā Pali NAR and will not be responsible for their maintenance, they will benefit the covered seabird species within those six HCP conservation sites. The Upper Limahuli Preserve and Honopū ungulate fences were constructed by others, but KIUC will maintain these ungulate fences, which also benefits the covered seabirds, for the duration of the 50-year permit term.

Fencing Specifications

For a fence to be capable of excluding all terrestrial predators, it must meet the following four biosecurity criteria: (1) be sufficiently high that animals cannot jump over it; (2) have a V-shaped hood on top to prevent animals from climbing over it; (3) use small-aperture mesh to prevent animals from squeezing through; and (4) include an underground skirt to prevent animals from digging underneath it (Figure 4-11). Once the fence is constructed and predators are eradicated within the fence, the protected seabird colonies will be inaccessible to terrestrial predators. This will eliminate the threat of terrestrial predator reinvasion into the protected seabird colonies, as long as the fencing remains in good condition.



SOURCE: Pacific Rim Conservation 2017



SOURCE: Young and Eric VanderWerf 2016

Figure 4-11. Predator Exclusion Fencing Design

To achieve these four biosecurity criteria, all predator exclusion fencing will conform to the following specifications (Young and VanderWerf 2014).

- Height[21] of 6.6 ft (2 m) with a 13.1-ft (4-m) buffer immediately on the outside and 6.6-ft (2-m) buffer on the inside of the fence clear of rocks, structures, or vegetation > 1 ft (30 centimeters [cm]) in height in flat terrain to prevent animals from jumping over the fence. The outside buffer may be 6.6 ft (2 m) only if there is a downward slope on the other side of the fence. These fences will be the same height as other predator exclusion fences constructed on Kaua'i.
- Fence base or frame constructed using 8.8-ft-long (2.7-m) posts spaced at approximately 6.6-ft (2-m) intervals along the fence length. Spacing in areas of high winds along ridge lines should be closer together.
- Single-strand wires tensioned to 330 pounds (150 kilograms) horizontally between the posts of poles.
- No fence corner should turn more sharply than 45 degrees.
- No gaps greater than 0.3 inch (7 millimeters [mm]) along more than one dimension between the inside and outside of the fence. This specification should be inspected in the following parts of the fence:
  - All joints between sections of the mesh forming the face of the fence
  - The junction between the mesh and the hood at the top of the fence
  - The joints between each hood section at each post and at each corner and bend in the fence
- A 1-ft-long (30-cm) taut mesh skirt will extend out from the fence base and be secured to the ground with pins or cement and buried to a depth of approximately 4 inches (10 cm) so it is not visible. The mesh will be attached to the posts and posts framework using stainless steel hardware.
- All fence materials will be made of marine-grade "316" stainless steel to minimize rusting and corrosion. This includes the mesh, hood, and screws and other hardware, except for certain fence posts, which, where applicable, will be made of wood treated against termites and rot.
- The face of the fence and the horizontal skirt would have an aperture no larger than 0.5 inch by 0.3 inch (13 mm by 7 mm).
- A V-shaped, cat-proof hood will be installed on top and on the outside of the fence to allow animals to jump out of the enclosure but not to jump inside. The hood will be attached with a stainless steel bracket to each post, and attached to the frame using stainless steel hardware.
  - The rivets or screws used to attach the hood to the brackets should be inserted from the underside, so that only a small nub, and not the head of the screw or rivet, is present on the top of the hood, in order to reduce traction available to animals that reach the top of the hood.
  - All staples, rivets, screws, and pins should be tightly seated so that mesh or hood sections cannot flap to create gaps greater than 0.3 inch (7 mm); all fastening hardware must be of the same type of metal as the mesh.

[21] Height is measured from a point 3.3 ft (1 m) out from the base of the fence, representing the likely jumping position of a cat, vertically to the top of the fence (i.e., the highest point of the hood).

- Single half-door design lockable pedestrian access gates will be located along the fence edge that do not extend to ground level to decrease the chance of animals passing through if the gate is accidentally left open. Pedestrian gates will be installed every 1,640–3,281 ft (500–1,000 m). Gates will be constructed so they can be padlocked to prevent trespass. All gates providing access to the fenced area will:
  - Be designed and attached to the body of the fence in a pest-proof manner, i.e. with no gaps greater than 0.3 inch (7 mm) along more than one dimension when the gate is closed and latched.
  - Have either a mesh skirt or a solid concrete footing beneath the gate entrance that extends out from the gate by no less than 1.1 ft (35 cm).
  - Have a latch or other means by which the gate can be locked and rendered un-openable from the outside.
- Fences will be continuous except across streams, rivers, pools, and other drainageways.[22] Where there is a fencing gap due to a drainage, two parallel fences will be installed to create a containment zone on both sides of the gap. The fence sections immediately above the drainage will be constructed as break-away panels that are not as tightly fastened to the rest of the fence so that in the event a large flood damages the fence, it would only damage these small, replaceable sections.
- Cliff-face tie-ins may be necessary to secure fencing to cliffs.[23]
- To the extent practicable, fences will avoid the need for culverts by using waterfalls and other topographic features for closure instead. In the event that culverts become necessary, all culverts, drainage pipes, and other water channels should pass under the fence in a pest-proof manner and would have the outside entrance to the culvert sealed with a pest-proof culvert screen.
- Earthwork will be kept to a minimum. Fence post holes will be roughly 3.3 ft (1 m) deep and soil or fill will be used to form a gentle mound along the fence alignment so that stormwater will not pass through the fence.
  - The earthworks and substrate adjacent to the fence will not have any channels, tunnels, or gaps greater than 0.3 inch (7 mm) in more than one dimension to extend under the fence from the outside to the inside
  - The ground conditions adjacent to the fence will be such that there is no risk of slumping or erosion that may cause damage to the fence or compromise any of the standards listed above.
- Fencing must be constructed in locations where extensive vegetation does not overhang the fence or where vegetation can be controlled to prevent encroachment and overhanging.
- If any trees or other objects on the outside of the fence must remain within 13.1 ft (4 m) of the fence, those trees and structures should be banded with materials that prevent pests from

[22] Generally, this means a small gap at the top of a high (greater than 20 ft [6.1 m]) waterfall and/or a small gap at a pool immediately above the waterfall.

[23] If cliff-face tie-ins are deemed necessary, that portion of the fence line will be constructed outside the nesting season (i.e., from December to April) to avoid adverse impacts on occupied burrows.

climbing them, and the banded trees should not be in contact or within 13.1 ft (4 m) of other trees on the outside of the fence that are not also banded.

- Fence construction must not damage or destroy threatened or endangered plants or habitat for any listed species (see Appendix 1B, *Evaluation of Species Considered for Coverage*, Attachment 1 for required avoidance measures for Hawaiian hoary bat [ʻōpeʻapeʻa] [*Lasiurus cinereus semotus*], Attachment 2 for avoidance measures for listed plants).
- Fencing must be constructed in locations where human access is possible on both sides of the fence for patrols, monitoring, and fence repair.
- Fencing must be constructed in locations accessible by helicopter to ferry staff, equipment, and materials.
- Where another fence adjoins the predator proof fence on the outside, the predator fence must be 6.2 ft (1.9 m) taller than the other fence to retain the required clearance. For example, if an abutting fence stands 3.9 ft (1.2 m) off the ground, the predator-proof fence must be extended to a height of no less than 10.1 ft (3.1 m) off the ground.

Each predator exclusion fence will be constructed in the following stages: (1) vegetation removal from a 13-ft-wide (4-m-wide) swath along the fence alignment; (2) necessary earthwork; (3) base fence erection; (4) attachment of mesh; (5) attachment of a cat-proof hood; and (6) installation of access components. The fencing crew and fencing materials will be transported to the site either by vehicle, helicopter, or both, which typically takes between 90 and 120 days (*Interim Management Actions* provides more details on construction schedule).

Given the estimated 20-year lifespan of predator exclusion fences, it is expected that each predator exclusion fence will be replaced in whole up to two times during the 50-year permit term. Fence replacements will be completed within two years, unless otherwise agreed to in writing by the agencies. However, segments of the fence may need to be replaced (especially after large storm events that knock down trees or cause landslides). Replacement of fencing segments would entail the same activities as are required for the initial installation as well as the removal and disposal of damaged fencing materials. The replaced segments would be built to meet the same four biosecurity criteria and with the same specifications as the original fence.

There are a number of factors that can constrain the construction of predator exclusion fences within a conservation site. Large sites with steep valleys, dense vegetation, drainages, or crumbling/friable substrate can make predator exclusion fencing very challenging or impracticable. In combination with the high level of infrastructure required for a fence to completely exclude terrestrial predators, these factors may physically prohibit achieving total terrestrial predator exclusion.

To minimize the likelihood of rats or cats stowing away in materials transported into the fenced predator exclusion areas by helicopter, all gear that is to be transported to a conservation site will be packed in an area free of rodents and cats and inspected prior to loading into the helicopter. In addition, traps will be placed in two concentric rings of four traps approximately 33 ft (10 m) and 66 ft (20 m) from each other around helicopter landing zones.

Fence Condition

KIUC will maintain the condition of the terrestrial predator exclusion fencing over the 50-year permit term. KIUC will be responsible for assessing the condition of each predator exclusion fence throughout the permit term according to the following schedule to avoid fence breaches. Acts of nature, accidents, and vandalism are likely to damage the fence over time. Therefore, it is essential to have an effective assessment, maintenance, and repair program to minimize and address fence damage as soon as practicable. If breaches occur, rapid response will be targeted to specific species that have invaded the site. Cat and rodent traps will be purchased in Year 1 of the permit term and kept in reserve for rapid response in the event of a breach.

The following fence assessment schedule is designed to: (1) detect damage quickly after it occurs; (2) ensure that people and resources are available so that emergency repairs can be made in a timely fashion; and (3) that if any predators permeate the fence boundary, they are limited to a small area and removed as quickly as practicable.

- Opportunistic observations of the fence during every trip into and out of a conservation site on helicopters.
- Opportunistic observations of the fence condition when working within the conservation site on other tasks.
- Once a month, in the course of accessing a conservation site via helicopter, fly along the fence alignment and record observations concerning fence condition. This will be done during flights when the weather conditions allow and as soon as practicable after significant storm events (i.e., tropical storms or hurricanes for which the National Weather Service issues warnings for Kauaʻi). If any issues are noted from the air, the fence section in question will be inspected by the ground crew as soon as practicable following the observation.
- Every 3 months, personnel will walk the entire length of the fence on both sides and inspect it for breaches or deterioration.
- Inspections in high-risk areas (e.g., near cliffs, large trees, or streams) as soon as reasonably and safely practicable, following storm events.
- In the event of a predator incursion from an unidentified breach, the fence will also be inspected. A protocol addressing predator incursions for each predator exclusion fence will be developed within one year of an ITP or ITL being issued.

KIUC will have people and resources in place to make emergency repairs, reducing the likelihood of predator expansion if a breach occurs. This will be achieved as follows.

- A single individual designated as the primary point of contact and made responsible for scheduling maintenance and monitoring visits and receiving/acting on reports of a breach or any other relevant observations on the fence.
- An annual risk analysis to identify possible areas of weakness.
- Signs placed at high-risk areas and access points that provide contact information for whom to call in the event that a breach is noticed.
- Fence repair supplies stored near high-risk areas to facilitate efficient repairs.

Predator Exclusion Fence Upon Expiration or Termination of ITP or ITL

Upon expiration or termination of the ITP or ITL, each predator exclusion fence will be inspected by KIUC, USFWS, and DOFAW. Each predator exclusion fence must be fully functional, in good repair, and have a remaining useful life of a minimum 10 years as determined by KIUC, USFWS, and DOFAW.

Social Attraction

More than 95 percent of seabirds are colonial (including the covered seabird species), which means they are attracted to breeding sites by the presence of individuals of the same species and other seabird species (Jones and Kress 2012). Social attraction is a technique that uses attractive social stimuli, generally the sight and sound of the same species, to promote nest initiation by colonial seabirds. Social attraction is used on sites that currently lack social cues but otherwise the location is suitable for nesting (Jones and Kress 2012). Because of their nocturnal flight behavior, acoustical rather than visual techniques are considered to be the most successful means of attracting the covered seabirds as they fly over or near suitable habitat (Miskelly et al. 2009; Young et al. 2019; Raine et al. 2019a). If successful, the strategy can result in relatively high productivity within a small area (Young et al. 2019).

Social attraction using acoustical playbacks in combination with artificial burrows and invasive plant species removal is a proven method to establish new or enhance existing colonies of burrow-nesting seabirds (Gummer 2003; Sawyer and Fogle 2010; McIver et al. 2016; U.S. Fish and Wildlife Service 2016). For example, Newell's shearwater ('a'o) have nested at the Kīlauea Point National Wildlife Refuge on Kaua'i for over 10 years, due to a combination of an egg swap project coupled with social attraction (Byrd et al. 1984; Raine et al. 2021b). Artificial burrows are used to increase nesting density and to eliminate the time a seabird would normally spend digging a burrow to accelerate breeding (Raine et al. 2021b).

Social attraction will only be implemented within predator exclusion fencing (at four conservation sites) because the fencing will largely eliminate the threat from terrestrial predators, increasing the site's carrying capacity and potential for colony expansion or creation (i.e., successful social attraction). There is a risk of predator exclusion fence breaches that would result in predator incursion into the fenced area, which will be addressed through intensive monitoring of the fenceline and rapid response to any breaches that may occur. Social attraction techniques will be used to expand existing colonies and establish new colonies in the conservation sites within otherwise suitable breeding habitat. For this HCP, the primary purpose of the social attraction sites is to draw prospecting birds into the site who otherwise would have established burrows elsewhere rather than to protect existing colonies. For this reason, the social attraction site locations have been strategically selected along known seabird flyways. The methods for social attraction include vegetation clearing, broadcast calls, and artificial burrows using the following three steps.

- **Step 1. Restore targeted habitat to be suitable for nesting.** This step involves removing unsuitable vegetation (e.g., guinea grass [*Megathyrsus maximum*]) from an area at least 1 acre (0.4 hectare) in size and planting suitable native species such as false staghorn fern (uluhe) (*Dicranopteris linearis*). Selected locations should be large enough that they can be incrementally restored and expanded over time to increase the colonies' productivity.
- **Step 2. Install artificial burrows.** Artificial seabird burrows consist of wooden boxes with open bottoms, removable lids, and plastic tunnels for burrow entrances. They are very durable and strong enough to resist warping or physical damage from trampling, tree-fall, and rock-fall in most circumstances, especially when buried in soil substrate. The lids provide easy access and the modular tunnel component can be cut to any length and include turns to keep out light. The artificial burrows are placed in holes dug to half the height of the burrow (if the site does not

allow holes to be dug to the desired depth, then the burrow is covered with sand). Burrows are then painted with reflective paint and the lid weighed down with a sand bag—this, coupled with planting native shade plants around the burrows, minimizes the threat of overheating in the burrow chamber.

- **Step 3. Install social attraction equipment.** A solar-powered sound system is installed in the social attraction site to broadcast calls over the restored habitat with the artificial burrows.

Calls are broadcasted primarily to attract prospecting birds who may be flying over the site, with peak activity being May through the end of July. Broadcasting calls are stopped in mid-August for two reasons: (1) stopping in mid-August allows nearby acoustic sensors to collect at least 1.5 months of data in the absence of broadcasted calls, allowing sufficient data to inform modeling and direct comparisons with previous years; and (2) as a precautionary measure to prevent attracting owls while chicks are at their most vulnerable (once emerged they spend up to 2 weeks coming out of their burrows to exercise, making them particularly vulnerable to owl predation).

As stated in *Predator Exclusion Fencing*, there will be four predator exclusion fences in place for the HCP. Predator exclusion fencing was completed by other entities for Pōhākea PF and Honopū PF conservation sites, social attraction was initiated at both sites in 2022, and KIUC started managing Pōhākea in 2022 and Honopū in 2023. The predator exclusion fence planned at the Upper Limahuli Preserve PF conservation site will be completed by end of year 2025 and predator control will be completed by end of 2026. The predator exclusion fence planned at the Upper Mānoa Valley PF conservation site will be completed by end of year 2027 and predator control will be completed by the end of 2028. Social attraction at both sites will be initiated at the start of the first seabird season after completion of predator eradication.

Upper Limahuli Preserve PF, Pōhākea PF, and Upper Mānoa Valley PF are social attraction sites for Newell's shearwater (ʻaʻo). The Honopū PF will primarily target Newell's shearwater (ʻaʻo), but also includes social attraction for band-rumped storm-petrel (ʻakēʻakē) due to its location adjacent to the cliffs of Honopū Valley. The broadcasting uses local calls for each species, i.e. from Kauaʻi. All social attraction sites are or will be located within larger conservation sites with existing seabird colonies. However, the majority of the social attraction sites did not contain existing burrows within the fenced area, with the exception of Upper Limahuli Preserve PF and Upper Mānoa Valley PF, both of which have a few burrows in and around the proposed fence lines. As of the 2024 breeding season, the two social attraction sites established in 2022 (Pōhākea PF and Honopū PF) have had sightings of prospecting individuals, documented evidence of burrow development, and one confirmed Newell's shearwater (ʻaʻo) breeding pair at Pōhākea PF.

Invasive Plant Species Management

Invasive plant species can degrade covered seabird nesting habitat across the state (Young et al. 2018). Invasive plant species displace and outcompete native vegetation, which alters vegetation composition and structure (Simberloff et al. 2013; VanZandt et al. 2014) and can make nesting burrows inaccessible by the covered seabirds (Raine 2021). Significant colony reduction has been recorded in several historical colonies on Kauaʻi due to multiple reasons, including the rapid spread of invasive plant species (e.g., at Kalāheo, Makaleha, Wailua; based on Kauaʻi Endangered Seabird Recovery Project unpublished data 2021).

The following list of species are those on Kauaʻi that have been identified as the chief invasive plant species to remove from the Upper Limahuli Preserve because of their rapid growth and capability to significantly alter forest structure and understory and thus degrade covered seabird habitat. Appendix 4D, *Best Management Practices for Invasive Plant Species Control*, provides a full list of species.

- Australian tree fern (*Sphaeropteris cooperi*)
- Strawberry guava (*Psidium cattleianum*)
- Himalayan ginger (kāhili ginger) (*Hedychium garderianum*)
- Octopus tree (*Schefflera actinophylla*)
- Pink melastome (*Melastoma candidum*)
- African tulip (*Spathodea campanulata*)
- Passion fruit (*Passiflora* spp.)

KIUC will fund continual invasive plant species management focused on the list of species in Appendix 4D, *Best Management Practices for Invasive Plant Species Control*, within the Upper Limahuli Preserve and the four social attraction sites (including a 30-ft [9-m] perimeter around the outside of the predator exclusion fences). Invasive plant species control will occur in the other conservation sites on an as-needed basis, when observed and documented during monitoring and determined to be spreading or otherwise problematic (Chapter 6, *Monitoring and Adaptive Management Program*). Invasive plant species control methods will include cutting, digging, and herbicide application consistent with best management practices developed by the National Tropical Botanical Garden (NTBG) and others involved in the control of these species in the wet upland forests of Kauaʻi (Appendix 4D, *Best Management Practices for Invasive Plant Species Control*). The methods will be updated as deemed necessary to allow the use of more cost-effective techniques and products if they become available. Invasive plant species control must not damage or destroy threatened or endangered plants or habitat for any listed species (Appendix 1B, *Evaluation of Species Considered for Coverage*, Attachment 1 for required avoidance measures for Hawaiian hoary bat [ʻōpeʻapeʻa]; Attachment 2 for avoidance measures for listed plants).

Management Timing to Minimize Effects on Covered Seabirds

KIUC and its contractors will implement all management actions (i.e., predator control, construction of predator exclusion fences, maintenance of both predator exclusion fences and ungulate fences, social attraction, and invasive plant species management) within protected conservation sites that contain nesting colonies of the covered seabird species (Table 4-11, Figure 4-9) in ways that minimize effects on the covered seabirds. Certain management actions that could disturb nesting seabirds (e.g., construction of predator exclusion fences) can be implemented from December to March, which is outside of the nesting season (April to mid-December) while the covered seabirds are at sea. In other cases, actions such as social attraction will be performed during the nesting season with protocols in place to limit disturbance as much as practicable. These protocols include using particular caution during burrow inspections once a bird has been confirmed using a nest box, limiting movement of staff inside PF areas at night, and limiting vegetation control to only necessary actions and using only manual removal.

Other activities such as infrastructure maintenance and inspections and site preparations (e.g., weatherport or fence maintenance) will also be performed outside of the nesting season, whenever practicable, but if done during the nesting season will be conducted away from existing identified burrow locations and during the day when seabirds are not active. Certain predator control activities can likely occur outside of the nesting season to minimize impacts on the covered seabird species; however, the primary predator control activities must occur within an active colony in order to be effective in protecting seabirds from ongoing threat of depredation in areas where predator exclusion fencing is not present.

KIUC and its contractors will decide on a case-by-case basis if the location of fence construction or site preparation (e.g., weatherport or fence maintenance) that will be implemented is close enough to a breeding colony to disturb it. Some fencing segments may be far enough from the breeding colony within the conservation site that it can be completed at any time of year.

Long-Term Land Agreements

In order to implement the management actions for this conservation measure, KIUC will secure land access through long-term land agreements with the landowners. The land agreements will provide KIUC and KIUC's contractors access to the conservation sites for the entire 50-year permit term for the purpose of conducting HCP related activities. Land access includes access to helicopter landing zones, weatherports, roads, and trails as necessary to conduct HCP related activities.

As noted in Table 4-8, the conservation sites are primarily located on state lands owned by the Department of Land and Natural Resources. The Upper Limahuli Preserve is privately owned by the NTBG and the Upper Mānoa Valley site is privately owned by Richard (Ric) Berry. KIUC has executed land agreements with both NTBG and Ric Berry, copies of which are included in Appendix 4F, *Land Agreement with National Tropical Botanical Garden for Upper Limahuli Conservation Sites*[24] and Appendix 4G, *Land Agreement with Ric Berry for Upper Mānoa Valley Conservation Sites*. Appendix 4H, *State Land Access Package,* contains a letter from DLNR outlining the process for KIUC to obtain access to the conservation sites on state-owned land and permission to conduct HCP activities at those sites. Additionally, the package includes a template non-exclusive easement and standard permit terms and conditions. The final land documents for access to the conservation sites on state-owned land and permission to conduct HCP activities at those sites will require approval by the Board of Land and Natural Resources.

As part of the HCP a permanent conservation easement will be applied to two of the conservation sites located on privately owned land, Upper Mānoa Valley and Upper Mānoa Valley PF. The conservation easement will be held by a public body which qualifies for and holds an income tax exemption under section 501(c) of the Internal Revenue Code of 1954, as amended, and whose organizational purposes are designed to facilitate the purposes of Chapter 198, HRS. The establishment of a conservation easement for these two sites will ensure protection of the sites regardless of changes in land ownership through the term of the HCP, and in perpetuity. A copy of the draft conservation easement is included in Appendix 4I, *Conservation Easement for Upper Mānoa Valley and Upper Mānoa Valley PF Conservation Sites*.

[24] Unforeseen issues developed in April 2025 between National Tropical Botanical Garden and KIUC regarding the Land Agreement with National Tropical Botanical Garden for the Upper Limahuli Preserve conservation sites. KIUC has initiated a dispute resolution process to resolve these issues. If the dispute resolution process results in Upper Limahuli not being used as an HCP conservation site, KIUC will coordinate with USFWS and DOFAW to find an alternative site or sites, minimization, mitigation, or a combination of these actions to make up for the site being withdrawn from the HCP.

4.4.4.3 Confidence in Conservation Measure Benefits to the Covered Species

Based on the assessment in Table 4-12, there is a high degree of confidence in the benefits of this conservation measure for Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u) due to the majority of these measures having been implemented for multiple years at many of the conservation sites, and the monitoring and research that has been conducted at these sites to date that demonstrate the effectiveness of these measures. In addition, several published studies have shown the effectiveness of intensive predator control, predator exclusion fencing, social attraction, and invasive plant species control for seabirds. Less is known specifically about the effectiveness of these measures for band-rumped storm-petrel ('akē'akē), but similarities in breeding behavior and depredation risks to other covered seabird species indicate a moderate degree of confidence that this conservation measure will benefit band-rumped storm-petrel ('akē'akē).

Table 4-12. Assessment of Confidence in Expected Benefits to the Covered Species from Conservation Measure 4, Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites.

Conservation Measure Component by Species	Confidence in Benefit[a]	Sources	Explanation
Newell's shearwater ('a'o) Hawaiian petrel ('ua'u)			
Intensive predator control at all conservation sites.	High	Raine et al. 2020a Table 4-9	Intensive terrestrial predator control has been proven to be very effective at increasing seabird nesting productivity on Kaua'i. Predator control and monitoring has been ongoing in this area for 14 years as of 2024, and since 2017 for 10 of the sites proposed in this HCP.
Predator exclusion fencing (PF) at conservation sites with social attraction.	High	Day and MacGibbon 2002; Young et al. 2012, 2013; VanderWerf and Young 2014; Tanentzap and Lloyd 2017	Predator exclusion fencing has proven to be an effective means of multi-species predator control for seabird colonies in Hawai'i.
Social attraction at the four PF sites.	High	Gummer 2003; Sawyer and Fogle 2010; McIver et al. 2016; U.S. Fish and Wildlife Service 2016; Spencer et al. 2024	This is a proven method to establish new or enhance existing colonies of burrow-nesting seabirds, as demonstrated by several studies on burrow-nesting seabirds, and Newell's shearwater ('a'o) has been documented nesting at a social attraction site on Maui. At the two HCP social attraction sites established in 2022 (Pōhākea PF and Honopū PF) there have been sightings of prospecting individuals, documented evidence of burrow development, and one

Conservation Measure Component by Species	Confidence in Benefit[a]	Sources	Explanation
			confirmed Newell's shearwater (ʻaʻo) breeding pair at Pōhākea PF.
Invasive plant species control at the social attraction sites, and all other conservation sites as needed.	High	Jones and Kress 2012; Simberloff et al. 2013; VanZandt et al. 2014; Raine 2021	Habitat has been shown to be a key factor in establishing new seabird colonies. Significant colony reduction has been recorded in several historical colonies on Kauaʻi due to reasons including the rapid spread of invasive plant species, which can make nesting burrows inaccessible. Removing invasive species will prevent habitat degradation and improve nesting habitat for covered seabirds.
Band-rumped storm-petrel (ʻakēʻakē)			
Predator control, predator exclusion fencing, social attraction, and invasive plant species control.	Moderate	Raine et al. 2017c	Predators are likely a significant constraint for the current abundance and distribution of this species based on documented depredations. Although there are no documented existing band-rumped storm-petrel (ʻakēʻakē) colonies within the conservation sites, social attraction for this species is being implemented at Honopū where they will benefit from predator control measures and vegetation management, actions that have proved to benefit the two other covered seabird species. In addition, intensive predator control of barn owl and cats at the other conservation sites is expected to benefit band-rumped storm-petrel (ʻakēʻakē) in adjacent areas along Nā Pali Coast.

[a] See the categories of confidence levels explained above Table 4-4 in Section 4.4.1.3, *Confidence in Conservation Measure Benefits to the Covered Species*.

4.4.5 Conservation Measure 5. Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program

This conservation measure describes the nest detection and shielding program that KIUC will implement to minimize and offset the effects of light attraction from KIUC streetlights. This action will meet the green sea turtle (honu) biological goals and objectives. The nest detection and shielding program will be implemented throughout the entire 50-year permit term at locations visually affected by KIUC streetlights. New streetlights operated by KIUC and determined to potentially affect green sea turtle (honu) would also be subject to this conservation measure. There is potential for future minimization techniques that would avoid take and preclude the need for nest shielding, for both existing and new streetlights. Therefore, if KIUC demonstrates to the satisfaction of USFWS, DOFAW, and DAR that they have avoided take of green sea turtle (honu) through permanent modification of target streetlights, then KIUC would no longer need to implement nest shielding at those locations (Section 4.4.5.4, *Program Duration*).

4.4.5.1 Nest Detection

Protecting green sea turtle (honu) hatchlings from light disorientation first requires determining which KIUC streetlights are visible from suitable nesting habitat and then locating active nests (i.e., nests at which eggs are present or thought to be present) on those beaches before hatching occurs. There is currently no formal program on Kaua'i to detect, mark,[25] and protect sea turtle nests.

To detect all green sea turtle (honu) nests at risk of light disorientation from KIUC streetlights, KIUC will establish a nest detection program using drone surveys, contracted services, and/or a network of volunteers led by a project coordinator. Monitoring may occur with or without the use of drones, depending on what method is determined most suitable during implementation.

On an annual basis, KIUC will first survey all beaches in the Plan Area with suitable green sea turtle (honu) nesting habitat and KIUC streetlights between March 1 and April 30 to identify locations where KIUC streetlights are visible from the surface of the beach. Once identified, nest detection surveys are required in those locations between May 15 and December 15. Surveys will include all sandy areas visually affected by KIUC streetlights to look for evidence of nesting (e.g., turtle tracks, digging, presence of turtles). Surveys will also include areas on the same beaches not visually affected by KIUC streetlights but that could be affected by non-KIUC light sources. Surveys should be completed at least once per week during peak nesting season (May through July) and bi-weekly for the remainder of the nesting season (August to December).

To initiate the program, KIUC requires a period of at least 6 months after permit issuance. Based on the timeline in the previous paragraph, if the permit is issued before October 1, the program will be initiated the following year prior to the start of the nesting season and nest surveys on May 15. However, if the permit is issued after October 1, it is not feasible for the program to be up and running by March 1 the following year. In this case, the program will be initiated by March 1 in the following year.

The following sections provide an overview of the green sea turtle (honu) nest detection program; further details are provided in Chapter 6, *Monitoring and Adaptive Management Program*.

Drone Surveys

Drones may be utilized to monitor all accessible Plan Area beaches with suitable nesting habitat for green sea turtle (honu) that may be visually affected by KIUC streetlights on an annual basis (May 15 through December 15). The drone surveys may occur at all accessible Plan Area beaches and the data will be included with island-wide data on the timing, extent, and trends of green sea turtle (honu) nesting.

There are multiple steps required for drone operations, including the following.

- Identify drone no-fly zones on Kaua'i.

[25] Marking nests may not be appropriate in all situations because it may draw attention to the nest and lead to vandalism. Nest marking will be determined on a case-by-case basis depending on nest location.

- Conduct required training and licensing for drone operators.
- Purchase equipment (primary and backup) and procure storage space for equipment/supplies, and drone footage.
- Identify safe and accessible drone launch areas for maximum beach coverage that also avoid no-fly zones.
- Finalize data and information transfer protocols from drone flights to project coordinator to inform subsequent site visits (ground truthing) by field volunteers.

If drones are utilized, KIUC's funding will be used to purchase the materials (e.g., drones, vehicle) necessary for the drone surveys. The drone surveys would require two field staff; one staff member to set up, manage data, and serve as a back-up operator, and the second staff member to operate the drone during the green sea turtle (honu) nesting season.

Monitoring Program

A monitoring program will also operate between May 15 and December 15 to supplement the drone surveys. This program will be modeled after Kauaʻi's Hawaiian monk seal (ʻilio holo i ka uaua) (*Neomonachus schauinslandi*) volunteer network that is organized and managed by the DLNR DAR Protected Species biologist on the island. The purposes of the monitoring program will be to do the following.

- Conduct monitoring surveys in areas where drone surveys are not permitted or not practicable to detect possible active nests of green sea turtle (honu).
- Visit all nesting sites identified during drone surveys to field verify them and determine if the nests are active.
- Nightly, monitor active nests that are in view of KIUC streetlights or non-KIUC light sources starting within 15 days of estimated emergence.

The monitoring program is expected to require one full-time project coordinator and one support staff during the monitoring season, as well as other specialized support staff for short periods of time. Volunteers may be used as available and as feasible to fill any of these roles. Network set-up, training, scheduling, and oversight will be provided by the project coordinator.

Once an active nest is confirmed through the monitoring program, KIUC will work with USFWS, DOFAW, and DAR to determine if the nest is within view of any KIUC streetlights or non-KIUC light sources. Each nest will be visited after dark (as soon as possible following its discovery) when the streetlights are illuminated to determine whether any KIUC streetlight or non-KIUC light sources can be observed near the surface of the nest location and along the most likely access path to the ocean. The monitor will stand behind the nest at the sand surface to see if KIUC streetlights or other light sources are visible. If they are not visible, the monitor will note the reason why (e.g., vegetation or buildings blocking the light, light too far away or at an angle where it cannot be seen). The monitor will note if the luminaire face (i.e., the portion of the head from which light emanates—the very bright point-source of the light) itself is directly visible from the nest location. Photographs will be taken from the nest location facing the light source and from the light source facing the nesting location for inclusion in information submitted to the agencies. If the nest is determined to be within view of any KIUC streetlight or other light source and requires shielding, nest documentation will be included in the Annual Report.

For active nests that require shielding, monitors will estimate the age of the nest. KIUC will submit this information to USFWS, DOFAW, and DAR within 30 days of nest discovery for their review.

4.4.5.2 Shield Active Nests from Streetlights

The next step in this program is to install temporary nest shielding for the active nests identified to be within view of any KIUC streetlight or non-KIUC light sources and that require shielding. In this context, temporary means seasonal, and this section describes the duration of the shielding. Program staff will shield all active green sea turtle (honu) nests that have any potential to be at risk of light impacts from KIUC streetlights or non-KIUC light sources using the protocols described in this section. The monitors will be conservative in their streetlight assessment and assume that any nest with even a low potential to be affected by a KIUC streetlight will require shielding.

In 2020, KIUC conducted a field assessment of all its coastal streetlights and identified 29 streetlights that are visible from the following seven beaches (Figures 4-12a through 4-12g).

- Two streetlights at Keālia Beach (Figure 4-12a)
- Four streetlights at Kapaʻa Shoreline (Figure 4-12b)
- Seven streetlights at Wailua Beach[26] (Figure 4-12c)
- Three streetlights at Poʻipū Shoreline (two on Figure 4-12d and one on Figure 4-12e)
- Three streetlights at Kukuiʻula Harbor (Figure 4-12e)
- Three streetlights at Waimea Shoreline (Figure 4-12f)
- Seven streetlights at Kekaha Shoreline (Figure 4-12g)

Program staff will, at a minimum, install temporary nest shielding on the full length of these seven beaches when active green sea turtle (honu) nests are detected (see Section 4.4.5.1, *Nest Detection*). However, nest shielding is expected to be necessary at additional Plan Area beaches during the 50-year permit term if changes in environmental conditions[27] expose nesting habitat to light from additional existing streetlights or from new streetlights installed in coastal areas. In contrast, some beaches at which green sea turtle (honu) nests are shielded may be removed from the program if conditions change to eliminate light attraction risk or beach habitat conditions (e.g., vegetation growth, new structures, beach erosion). As stated in Section 4.4.5.1, *Nest Detection*, KIUC will survey all suitable habitat within the Plan Area on an annual basis to identify these environmental changes and expand or decrease nest shielding as necessary to respond to the changes. Changes to monitored beach locations require consultation with USFWS, DOFAW, and DAR, as described in Section 6.2.2, *Adaptive Management*.

Program staff will install light-proof fencing (Witherington et al. 2014; Witherington and Martin 2003), which is a small, removable light-proof silt fence made of wooden stakes and opaque black silt fence fabric. The light-proof fence will be erected around the nest after approximately 45 days of incubation to minimize the potential for vandalism. The following barrier technique is

[26] In 2020, beach erosion removed most of the suitable habitat for green sea turtle (honu) below the high tide line at Wailua Beach. As such, the current condition of the beach has limited suitability for nesting sea turtles but these lights are identified in the event that the habitat becomes more suitable in the future.

[27] Changes that may affect which green sea turtle (honu) nesting habitat is exposed to lights from streetlights may include vegetation clearing, vegetation damage from storms, construction of structures, demolition of structures, beach erosion, or beach accretion.

recommended wherever light visibility from the nests, as visible from the sand surface, cannot be eliminated or shielded at the light source.

1. The fence must be tall enough to shield the active nest site from lights from nearby streetlights or non-KIUC light sources.
2. Photographs and GPS coordinates of each green sea turtle (honu) nest will be documented.
3. The fence will be placed approximately 15 days prior to the expected emergence date, or when a sandy depression is visible within the defined nest area, to indicate hatchlings are in the process of emerging. Placement must be approved by a qualified biologist (e.g., DAR, National Marine Fisheries Service, DOFAW, USFWS, biological consultant).
4. Photographs of lights at night from the nest surface before and after the fence installation will be taken to confirm the effectiveness of the fence shield.
5. The fence will be in place and maintained daily prior to hatchling emergence to be effective. Adjustments to the fence may be made with approval of a qualified biologist.
6. If hatchlings move beyond the barrier into view of the light source and deviate from a path directly towards the ocean they will be captured and returned to the sheltered path by a permitted biologist.

After the green sea turtle (honu) hatchlings have emerged and entered the ocean, a permitted biologist will remove the fence. The permitted biologist will then be responsible for nest excavation following the *Standard Research Protocols for Nesting and Basking Marine Turtles in the Pacific Region* (U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration 2019) (or another accepted protocol during the 50-year permit term) to confirm the species and determine hatching and emergent success. The permitted biologist will also send any remaining unhatched eggs, deceased hatchlings, or samples (training required) of eggs or deceased hatchlings to the National Oceanic and Atmospheric Administration (NOAA) for DNA analysis.

Hawaiian Monk Seal

Hawaiian monk seals ('ilio holo i ka uaua) are monitored closely on Kaua'i by DAR and NOAA, and often protected by Seal Resting Areas, which include temporary signage and occasionally fencing that are similar in style to those used for green sea turtle (honu) shielding. Hawaiian monk seals ('ilio holo i ka uaua) can give birth year around, but the peak season is March through August. A female monk seal gives birth to a single pup and there are approximately three to five pups born on Kaua'i beaches each year, typically at remote locations where human activity is low. Mother and pup remain on the birth beach for an average of 5 to 7 weeks until the pup is weaned. For the first few weeks, both mother and pup remain primarily on the beach throughout day and evening hours. By the third or fourth week, mother and pup spend increasingly more time in the water and sleep on the beach at night, typically above the tide line.

In discussions with NOAA, information known at this time indicates there is very low risk of conflict between green sea turtle (honu) shielding and monk seal presence (Thomton in litt.). The beaches on Kaua'i where female monk seals are known to pup do not overlap with the seven beaches identified as having streetlights visible from potentially suitable green sea turtle (honu) habitat. Beaches with streetlights are typically in areas with high levels of human activity and/or development.

Other monk seals (non-mother/pup pairs) may haul-out to rest on the seven beaches identified with streetlights visible from potentially suitable green sea turtle (honu) habitat, but they do not remain on beaches for extended periods except when pupping and molting. Typically, monk seals haul-out during the day to rest on the beach and return to the ocean at night to forage, but occasionally remain hauled-out overnight. Seals commonly rest near the tide line to thermoregulate, but may move up the beach to rest; however, it is unlikely that the nest shielding program will conflict with seals resting on the beach.

In the rare event where monk seals are present or pupping on beaches identified for the nest shielding program and green sea turtle (honu) nests are identified within 50 ft (15.2 m) of a monk seal or 150 ft (45.7 m) of where monk seal mother and pup are located, KIUC would contact Kauaʻi DAR, NOAA, and USFWS at the time of detecting this proximity and coordinate with Kauaʻi DAR, NOAA, and USFWS on the best approach based upon the situation for green sea turtle (honu) nest shielding to avoid any disturbance or disruption to the nearby monk seals. In these instances, KIUC would include in the HCP annual report a detailed summary of the coordination with Kauaʻi DAR, NOAA, and USFWS, the avoidance methods used and the outcome.

Figure 4-12a. Streetlights Visible from Green Sea Turtle (honu) Nesting Habitat at Kēalia Beach in 2020

Figure 4-12b. Streetlights Visible from Green Sea Turtle (honu) Nesting Habitat at Kapa'a Shoreline in 2020

Figure 4-12c. Streetlights Visible from Green Sea Turtle (honu) Nesting Habitat at Wailua Beach in 2020

Figure 4-12d. Streetlights Visible from Green Sea Turtle (honu) Nesting Habitat at Poʻipū Shoreline in 2020

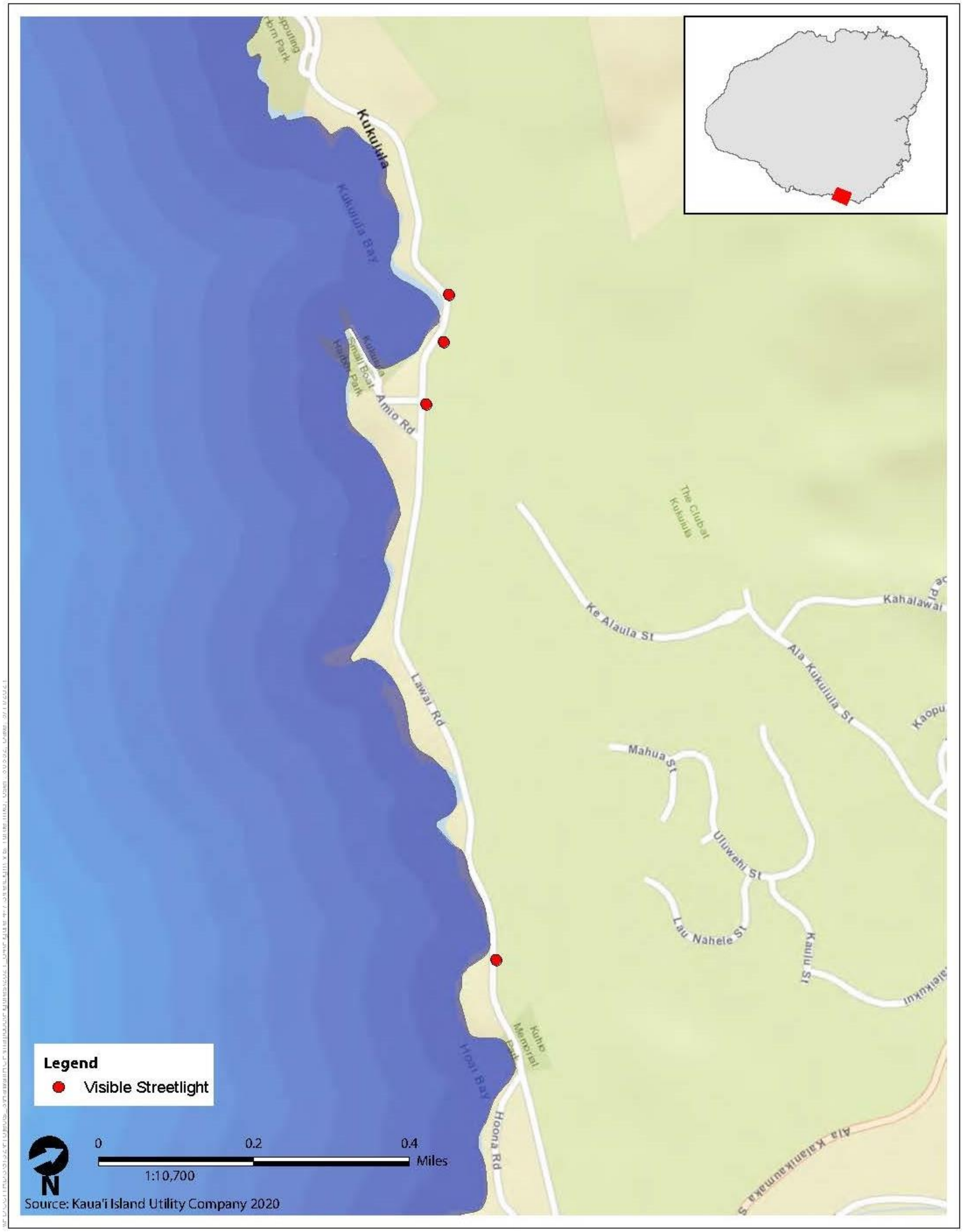


Figure 4-12e. Streetlights Visible from Green Sea Turtle (honu) Nesting Habitat at Kukuiʻula Harbor and Poʻipū Shoreline in 2020

Figure 4-12f. Streetlights Visible from Green Sea Turtle (honu) Nesting Habitat at Waimea Shoreline in 2020

Figure 4-12g. Streetlights Visible from Green Sea Turtle (honu) Nesting Habitat at Kekaha Shoreline in 2020

4.4.5.3 Monitoring Schedule

The green sea turtle (honu) monitoring schedule was developed to increase the frequency of site visits as a nest approaches its estimated hatching date. The objective for increasing the monitoring frequency over time as the nest incubates is to ensure that the monitor is present at the time of hatching to record the outcome and rescue any hatchlings that head away from the shoreline. The following list outlines the monitoring schedule to ensure that monitoring starts as soon as an active nest is located and determined to be at risk of light disorientation from a KIUC streetlight or non-KIUC light sources.

- Initially, active nests will be visited every other day to check their status (e.g., was it washed away by a king tide, was it run over by a vehicle).
- Within 15 days of the estimated hatching date, nests will be visited daily to check for signs of emergence (at which time the temporary light shield will also be installed in anticipation of hatching).
- Within 5 days of the estimated hatching date (assuming a green sea turtle [honu] nest emerges approximately 2 months after egg laying [Seminoff et al. 2015]), monitored nests will be visited twice per day, once during the daytime and once after dark.

If the monitor is not present at the time of emergence, monitors will record (including photographs to supplement the written documentation) the direction and distance of all hatchling tracks away from the nest and search for any evidence of hatchling mortality that may have resulted from disorientation.

Evidence of emergence and take (if any occurs) will be reported to USFWS, DOFAW, and DAR within 24 hours. A permitted biologist with USFWS, DOFAW, DAR, or their designee will then be responsible for final nest excavation to determine species, proportion of eggs that hatched and to send remaining eggs to NOAA for DNA analysis. Any take of a green sea turtle (honu) hatchlings (Chapter 5, Section 5.5, *Effects on Green Sea Turtle (honu)*) will be counted on an annual basis based on the results of that year's monitoring program.

4.4.5.4 Program Duration

KIUC will fund and implement this conservation measure throughout the 50-year permit term or until such time as KIUC modifies all the streetlights potentially affecting nesting green sea turtle (honu) habitat to eliminate these effects. If KIUC modifies all the streetlights identified as a risk to green sea turtle (honu) habitat[28] consistent with Conservation Measure 6 (Section 4.4.6, *Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle (honu)*) to eliminate light attraction of green sea turtle (honu), and commits to continue to modify both new streetlights and additional existing streetlights that become exposed (e.g., vegetation removal) in the same manner, then KIUC will no longer be required to fund the installation of temporary light shields under this conservation measure after consultation and approval from the USFWS, DOFAW, and DAR (Chapter 6, Section 6.2.2, *Adaptive Management*). However, nest detection and nest monitoring on beaches exposed to existing streetlights will continue for a period of 5 years after the installation of the streetlight retrofits to determine their

[28] There are 29 streetlights currently identified as a risk, but this number may go up or down depending on environmental conditions at these locations.

effectiveness. If nest monitoring determines that the permanent light minimization techniques are not effective, this will be addressed through the HCP's adaptive management program.

In addition, KIUC will continue to fund the nest detection and temporary shielding program required under this conservation measure throughout the permit term to identify locations where beach conditions change, resulting in non-minimized streetlights casting light onto suitable green sea turtle (honu) habitat. These additional streetlights will either be modified to eliminate light attraction of green sea turtle (honu), or active nests will be temporarily shielded in these locations consistent with this conservation measure.

4.4.5.5 Annual Training and Reporting

All staff, and volunteers if any, will be required to complete annual training 1 month prior to the start of the green sea turtle (honu) nesting season, provided by USFWS or DAR, or trainers approved by USFWS and DAR. This training will allow them to recognize and differentiate green sea turtle (honu) tracks, signs of nesting, and hatchling activity from other sea turtle species, as well as the proper techniques for installing temporary light shields. The training will also discuss timing of nesting and hatching, other green sea turtle (honu) behaviors that might be observed, and law protecting green sea turtles (honu) when they are on land (State of Hawaiʻi Division of Forestry and Wildlife 2020). KIUC will provide information on the approach and protocol for the streetlight assessment and will provide staff and volunteers with data collection forms to use in the field.

KIUC will develop a data collection form for the monitoring program, which will also be included in the Annual Report. KIUC will develop a standardized data collection form for use during green sea turtle (honu) monitoring that will ensure that all necessary information is collected by green sea turtle (honu) monitors, so that it can be reported accurately in the Annual Report. The data collection forms will include the following information, which has been adapted from the Kauaʻi Seabird Habitat Conservation Plan (State of Hawaiʻi Division of Forestry and Wildlife 2020).

- Date, weather conditions, personnel surveying, time spent on survey.
- Names of beaches monitored and length of beach surveyed.
- Number of nests found.
- Identification and assessment of potential threats at the nest, including light visibility from nest.
- Status of light shield (i.e., if installed, for future streetlights).
- Evidence of hatchling emergence and condition of the nest area (description and photos).
- Date or date range and times of emergence(s). Hatchling emergence may occur within a short period or gradually over several days.
- Direction of tracks.
- Nesting and hatchling emergence success as determined by final nest excavation.

KIUC will report the number and location of beaches surveyed (including which were surveyed via drones or on foot), the number of active nests identified at each location, the light attraction risk assessment for each nest, the number and location of shielded nests, and the hatching success and outcome for each nest (number of hatchlings that made it out of the nest and to the ocean), including the level of shielding effectiveness. In addition, if any active nests are missed by the monitoring program and if any resulting take occurs that can be attributed to KIUC streetlights, KIUC will also report these incidents as soon as possible to USFWS, DOFAW, DAR, and in the Annual Report.

KIUC will also create a map for each Annual Report showing the locations of all of beaches surveyed and active nests detected during the green sea turtle (honu) nesting season, lights visible from the beach, and identify which nests were shielded. Nests will be mapped with a GPS unit to accurately map their locations.

4.4.5.6 Confidence in Conservation Measure Benefits to the Covered Species

The negative effects of artificial lights on sea turtle hatchlings have been studied for decades and are well understood (Witherington and Martin 2003; Witherington et al. 2014). Studies from around the world including Hawai'i (Seitz et al. 2012) show that the presence of artificial lights visible from sea turtle nests disrupts the sea-finding orientation of hatchlings. This disruption causes disorientation, resulting in the hatchlings being unable to find the ocean. As expected, when lights are turned off or shielded with no light visible from the nest, disorientation does not occur and hatchlings successfully find their way to the ocean (Rusenko et al. 2003; Berry et al. 2013; Dimitriadis et al. 2018; Yen et al. 2023). There is a high degree of confidence in the benefit of this conservation measure to green sea turtle (honu) on Kaua'i. However, because this program is new on Kaua'i and untested, the confidence in this specific conservation measure is considered moderate. The shielding of streetlights at active nests in combination with the monitoring program will minimize and fully offset the impacts of streetlights on this species.

4.4.6 Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle (honu)

The primary means of offsetting the impacts of the taking of green sea turtle (honu) is the nest identification and nest shielding program described in Conservation Measure 5. However, there may be additional opportunities to reduce light attraction to green sea turtle (honu). This conservation measure describes how KIUC will pursue additional options for minimization of streetlights that may affect green sea turtle (honu), if measures prove feasible and effective.

As described in Conservation Measure 2, in 2017 KIUC retrofitted all streetlights on Kaua'i with full-cutoff shielded fixtures to direct light toward the ground (below the 90-degree horizontal plane) to minimize light attraction of the covered seabirds. In addition, in 2019 KIUC replaced all green light bulbs with white light bulbs to further reduce light attraction. These modifications were aimed at minimizing the impact of the streetlights on the covered seabirds but do not reduce streetlight visibility from the perspective of green sea turtle (honu) hatchlings. As described in Conservation Measure 5, KIUC determined in 2020 that 29 streetlights were visible from suitable green sea turtle (honu) nesting habitat in the Plan Area.

Additional modifications of streetlights may be possible to reduce light attraction of green sea turtle (honu) hatchlings without compromising public health or safety. KIUC owns and operates all streetlights, but this operation is governed in part by State and County regulations and according to national standards. Both the County and the State have their own sets of limitations and regulations. As a public utility, KIUC cannot unilaterally change its operation of streetlights to protect green sea turtles (honu). Instead, changes in local regulations are needed to allow these changes to be consistent with public health and safety. For example, most counties and cities in coastal Florida have passed county ordinances restricting the types and uses of lights adjacent to beaches in order to protect nesting sea turtles.[29] In Hawaiʻi, Hawaiʻi County and Maui County have lighting ordinances, but only the Maui County ordinance is designed specifically to protect nesting sea turtles.[30]

KIUC will work with the County and State to determine the range of available practicable minimization measures and their timeline for implementation. Practicable light minimization measures are those that are: (1) practicable from an engineering standpoint (e.g., what is compatible with current streetlight equipment), (2) legal and safe (e.g., what is allowed by State/County regulations and safety risk management), (3) financially practicable (i.e., not cost prohibitive), and (4) will benefit the species (i.e., what is known to benefit sea turtles). Light minimization may include techniques such as additional shielding, change in wattage, change in wavelength, or a combination of these. All KIUC streetlight modifications require County and State agreement prior to implementation.

4.4.6.1 Identify and Install Practicable Light Minimization Techniques

In 2020, KIUC began discussions with the County and State regarding potential light minimization measures for green sea turtle (honu) that would be practicable. In 2021, KIUC began testing different shield designs to determine if they are effective in removing light penetration and at the same time will not increase risk to public safety.

The outcome of these discussions may be that there are no practicable light minimization measures for green sea turtle (honu) that can be agreed to between KIUC, the County, and the State. If this is the case, KIUC would not be required to implement this conservation measure further, and instead would continue to implement the temporary shielding required under Conservation Measure 5 throughout the life of the permit term.

If KIUC, the County, and the State reach agreement on practicable minimization measures that can be implemented to reduce potential light effects on green sea turtle (honu) hatchlings, the minimization techniques will be submitted to USFWS, DOFAW, and DAR for their review and approval. Once USFWS, DOFAW, and DAR concur, the agreement between KIUC, the County, and the State will be finalized. Changes to streetlights may also require approval from Hawaiʻi PUC prior to implementation. After approvals and agreements are in place, KIUC will then install the agreed-upon light minimization techniques within an agreed-upon timeframe after execution of the final agreement with the County and the State (and as approved by Hawaiʻi PUC, if applicable). The final agreement and timeline for its implementation will be included in the next Annual Report submitted to USFWS and DOFAW.

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[29] See https://myfwc.com/media/3150/seaturtle-lightordmap.pdf for a map of jurisdictions in Florida that have passed sea turtle lighting ordinances.

[30] See Chapter 14, Article 9 of the Hawaiʻi County Code: http://nenue.cfht.hawaii.edu/ObsInfo/IslandLights/ordinance.html. The Maui County ordinance (Ordinance 5434) was passed in 2022 to help protect sea turtles and native seabirds. It will phase in changes over 3 years to limit the amount of short-wavelength content to no more than 2 percent of blue light, except for neon lights. All outdoor lights, except for neon lights, must also be directed downward with no light shining above the horizontal, be fully shielded, and ensure that no light shines over the ocean.

If new locations are identified where beach conditions change that expose additional green sea turtle (honu) nesting habitat to light from streetlights, KIUC will install the agreed-upon light minimization techniques on those non-minimized streetlights as soon as practicable (and if practicable based on the site-specific considerations), regardless of historic or current green sea turtle (honu) nesting activity. In addition, new streetlights installed in locations where light could be cast onto suitable green sea turtle (honu) habitat will include light minimization techniques consistent with this conservation measure during construction to the degree practicable based on the site-specific considerations. Changes to beach locations where minimization will be applied for green sea turtle (honu) requires consultation and approval from USFWS, DOFAW, and DAR, as described in Section 6.2.2, *Adaptive Management*.

Chapter 5
Effects

Chapter 5 Highlights

Chapter Purpose: This chapter describes how the KIUC HCP covered activities would affect each of the covered species. These adverse effects are evaluated in combination with the beneficial effects of the conservation strategy to inform conclusions regarding expected outcomes from the HCP. The chapter provides the information required under state and federal endangered species laws and regulations regarding the amount and extent of take being requested for each species, the impact of the take on each species, and the anticipated net effects on the species after the conservation strategy is implemented.

Context: In compliance with the federal Endangered Species Act (ESA) and Hawaiʻi ESA, KIUC requests authorization for take of covered species resulting from operation of its electric transmission and distribution system, streetlights, and lights at two facilities. The requested take of covered species would result from collision by seabirds and waterbirds with powerlines or attraction or disorientation by lights for seabirds and the green sea turtle (honu). Population dynamics models were used to evaluate the effects on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), the two species with the greatest level of take and the most available data. Two model scenarios were used to evaluate effects on these two species: a stable trend scenario which is most consistent with current data, and a worse-case scenario in which the abundance of each species is in decline.

Major Conclusions	See the following for more information:
Major Conclusions: The HCP's effects on the covered species are summarized as follows.	
• For **Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu),** the population dynamics models indicate that ongoing take in the absence of conservation would contribute to the potential extirpation of the Kauaʻi metapopulations of these species; this would occur faster under a worse-case scenario. With the proposed conservation strategy, however, the population dynamics models project that in a worse-case scenario the assumed downward population trends would be reversed before the end of the permit term, and in a stable trend scenario the population would increase over the permit term. In addition, population abundance under the worse-case scenario would exceed that of a hypothetical situation in which no KIUC take were to occur. Under the stable trend scenario, subpopulations would likely persist throughout the island and grow substantially at the conservation sites. Under a worse-case scenario, however, the island metapopulation would be concentrated in the northwest part of the island with the fewest threats and where conservation efforts would continue to be focused. In both scenarios, the HCP meets the biological goals for these species (described in Chapter 4, *Conservation Strategy*) of contributing to species recovery, providing for Kauaʻi viable metapopulations of these species, and providing a net benefit to these species.	**Newell's shearwater (ʻaʻo)** Section 5.3.2 Table 5-7 Figures 5-3 to 5-9 **Hawaiian petrel (ʻuaʻu)** Section 5.3.3 Table 5-10 Figures 5-10 to 5-15
• For **band-rumped storm-petrel (ʻakēʻakē)**, the take associated with light attraction and powerline collisions will be minimized. The conservation measures will offset this take and contribute to the species' recovery by funding the Save Our Shearwaters (SOS) Program, implementing predator control measures near known breeding sites, and conducting social attraction for the species at one conservation site.	**Band-rumped storm-petrel (ʻakēʻakē)** Section 5.3.4 Table 5-12

- For the **five covered waterbirds**, the take associated with powerlines will be minimized. Funding the SOS Program to continue the rescue, rehabilitation, and release of waterbirds will mitigate and offset the impacts of the taking and contribute to the species' recovery.
- For **green sea turtle (honu)**, the take associated with light attraction will be minimized through shielding green sea turtle (honu) nests on beaches that may be affected by KIUC streetlights. The impacts of any residual taking will be offset and contribute to the species recovery by shielding nests and protecting hatchlings from other non-KIUC light sources.

Covered waterbirds
Section 5.4
Table 5-13

Green sea turtle (honu)
Section 5.5

Data Sources: Primary data used to analyze effects include:

- Powerline collision monitoring data collected by KIUC annually since 2013 throughout the island on all of the covered birds.
- Radar data that has been collected since 1993 on the covered seabirds, reflecting abundance trends.
- Data on grounded seabirds during fallout season handled by the SOS Program island-wide since 2009, and data on grounded seabirds during fallout season from KIUC's lighted facilities since 2011.
- Breeding success, predation presence and rates, seabird activity and abundance estimates, and the conservation needs of covered seabirds on Kauaʻi at conservation sites that have been monitored annually since 2011. Most of this work has been published in peer-reviewed journals.
- Sea turtle hatchling studies and conservation needs published from sites around the country, including Hawaiʻi.
- An assessment by USFWS and KIUC of the suitable green sea turtle (honu) habitat on Kauaʻi and likely impacts from nearby streetlights.

Related Chapters: Chapter 3, *Environmental Setting*, describes what is known about key natural history elements and the status and trends of the covered species on Kauaʻi. Chapter 3 also describes the data sources and level of confidence in the existing information. This information provides the context for the effects analysis. Chapter 4, *Conservation Strategy,* describes the measures KIUC will implement to minimize and offset impacts on the covered species, and contribute to the covered species' recovery. Chapter 6, *Monitoring and Adaptive Management Program,* describes how monitoring and adaptive management will ensure that take limits established in Chapter 5 are not exceeded. Chapter 6 also describes how KIUC will ensure the effectiveness of the conservation measures (described in Chapter 4) to minimize and offset the impacts of the taking and contribute to species recovery.

5.1 Overview

This chapter describes how the KIUC HCP covered activities would affect the covered species and presents conclusions regarding expected outcomes from implementing the conservation strategy (described in Chapter 4, *Conservation Strategy*). Those conclusions are reached through a systematic, scientific evaluation of the: (1) estimated adverse effects on the covered species resulting from the HCP covered activities and their effects pathways, (2) the estimated beneficial effects of the conservation measures, and (3) the estimated net effects of the HCP as a whole. This chapter provides the information for the U.S. Fish and Wildlife Service (USFWS) and Hawaiʻi Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) to evaluate whether the criteria for a federal incidental take permit and state incidental take license, respectively, have been met. For additional details on the ecology of the covered species and threats to these species, see Appendix 3A, *Species Accounts*.

This chapter is organized into four sections. Section 5.2, *Effects Pathways*, describes the effects pathways for each adverse effect mechanism associated with the covered activities. Section 5.3, *Effects on Covered Seabirds*, Section 5.4, *Effects on Covered Waterbirds*, and Section 5.5, *Effects on Green Sea Turtle (honu)*, address effects on covered seabirds, covered waterbirds, and green sea turtle (honu) (*Chelonia mydas*), respectively. For each species or group of species, this chapter describes the analytical methods and results for estimating take, the impacts of the taking on the species, the beneficial effects of the conservation strategy, and the net effects of the HCP on each species.

5.2 Effects Pathways

This section describes the mechanisms by which the covered activities affect the covered species, called *effects pathways*. The section characterizes factors that influence the type and extent of covered species take, informing the avoidance and minimization measures and effects. Effects pathways are described for each of the two primary mechanisms of effects of KIUC's covered activities: powerlines and light attraction. Light attraction is discussed separately for covered birds and green sea turtle (honu) because of the distinct mechanisms of effects on these covered species.

5.2.1 Powerlines

This section describes the various factors influencing covered bird species collisions with powerlines, and the effects these collisions have on the covered bird species (Section 5.2.1.1, *Variables Influencing Powerline Strikes*). The effects on covered bird species are described separately for the covered seabirds (Section 5.2.1.2, *Powerline Strike Effects Pathways for Covered Seabird Species*) and covered waterbirds (Section 5.2.1.3, *Powerline Strike Effects Pathways for Covered Waterbird Species*).

5.2.1.1 Variables Influencing Powerline Strikes

A range of variables play a role in the likelihood of the covered bird species striking powerlines. These variables include, but are not limited to, the following.

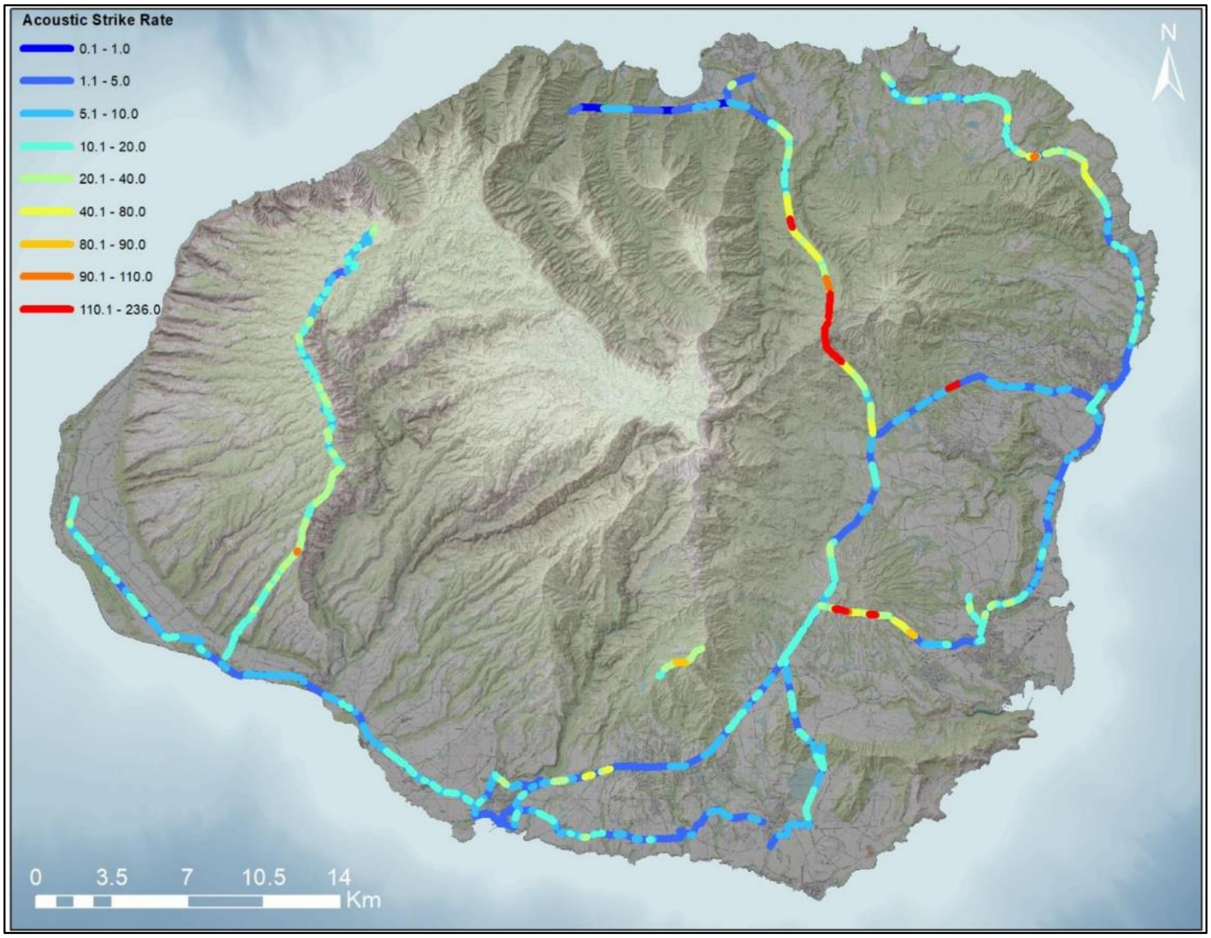
- Location of powerlines
- Seasonality

- Topography
- Height of vegetation as it relates to the powerlines and level of shielding
- Height and configuration of wires, including wire thickness, number of wires, and vertical arrangement of wires
- Flight height and speed of birds and their ability to maneuver
- Number of birds in transit in a region
- Wind speed and direction
- Flight paths relative to wind
- Ambient light levels (Travers et al. 2021)

In some areas of Kauaʻi two or more of these variables contribute to increased risk, which increases the overall risk level in those areas. For example, the location of powerlines combined with flight height and speed may increase the risk level at certain spans. Powerlines that are downslope of a covered seabird nesting colony may be at a higher risk for seabird-powerline collisions due to the speed at which the birds leave their montane burrows, especially if those lines are not shielded by vegetation. Powerlines that cross a valley or drainage typically result in wires being positioned higher above the ground at mid-span compared to powerlines traversing flat terrain. Increased aboveground wire height places the wires into higher airspace, where a greater proportion of the local seabird passages occur. Powerlines located near or between wetlands and other water features present a relatively high risk to covered waterbirds because of their proximity to high-use habitat areas. Each of the variables influencing powerline strikes, with an emphasis on seabirds, is described in greater detail in Appendix 5A, *Variables Influencing Powerline Strikes.*

Newell's shearwater (ʻaʻo) (*Puffinus newelli*) and Hawaiian petrel (ʻuaʻu) (*Pterodroma sandwichensis*) flight paths between the ocean feeding areas and montane breeding habitats intercept powerlines, static wires, and fiber optic cables owned and operated by KIUC. Since 2011, KIUC has funded extensive powerline monitoring across its transmission line system on Kauaʻi. The goal of this monitoring has been to better understand the amount, location, and nature of powerline interactions with the covered seabirds and to inform the most effective ways to reduce collision risk. Although this program was originally designed to detect seabird collisions, there have also been observations of collisions by the covered waterbirds and the powerline monitoring program has been revised to include monitoring of waterbird collisions. This powerline monitoring program, formerly called the Underline Monitoring Program, and now called Infrastructure Monitoring and Minimization Project, consists of visual observations and acoustic monitoring. The acoustic monitoring provides information on the number of collisions along each line, but acoustic monitoring data does not distinguish between species or provide information on the fate of birds after they collide with powerlines. Data from visual observations are used to determine species composition, passage rate, flight height, and behavior in relationship to powerlines on Kauaʻi. These data are then used to estimate collision risk and how risk varies across the powerline grid. Visual observations are also used to determine the immediate fate of birds when a collision occurs (Travers et al. 2021) and validate acoustic monitoring to quantify collisions when observers are not present. Acoustic monitoring consists of strategically placing acoustic recording devices along powerlines to detect strikes and determine which powerline sections pose the greatest risk to endangered seabirds.

Collision risk for the covered seabirds varies geographically in the Plan Area. Figure 5-1a shows the relative collision risk in the Plan Area of Newell's shearwaters (ʻaʻo) and Hawaiian petrels (ʻuaʻu) based on 2013 to 2019 acoustic strike monitoring data, while Figure 5-1b shows the relative collision risk for these species based on current monitoring data as of 2024, post-minimization. Locations with higher acoustic detected collision risk coincide with observed collision risk for these species. Visual observations indicate covered waterbirds are also susceptible to powerline collisions, particularly at powerlines near wetlands where these species concentrate.



Source: Travers et al. 2020:40

Figure 5-1a. Estimated Rates of Bird Strikes per Wire Span in 2019

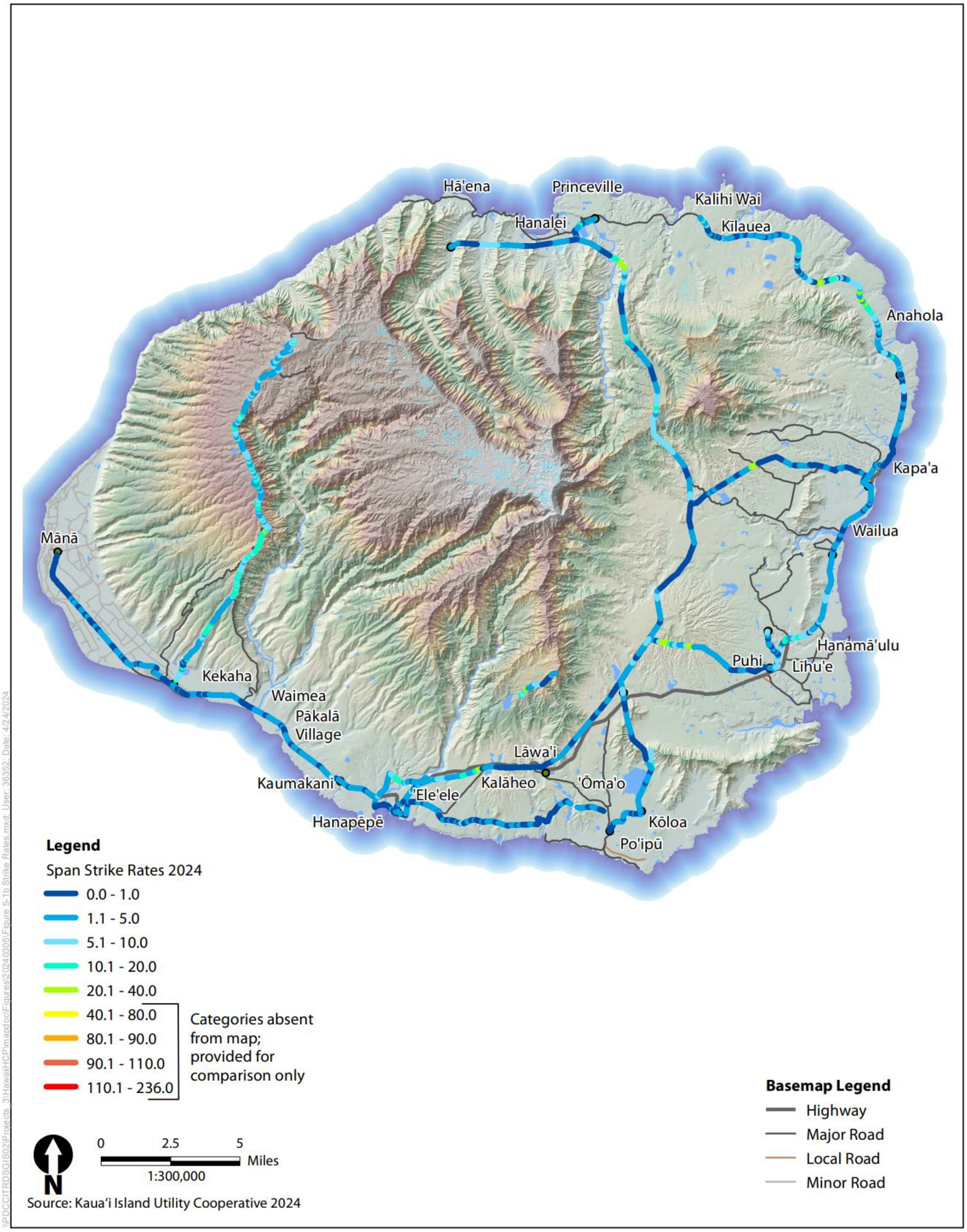


Figure 5-1b. Estimated Rates of Bird Strikes per Wire Span as of 2024

5.2.1.2 Powerline Strike Effects Pathways for Covered Seabird Species

Powerlines are one of the most significant threats to Newell's shearwater (ʻaʻo) and Hawaiian petrels (ʻuaʻu) on Kauaʻi. Although there have been no documented powerline strikes associated with band-rumped storm-petrels (ʻakēʻakē) (*Hydrobates castro*), observations of this species skimming over a section of powerlines in Waimea Canyon indicate that this species may also occasionally strike powerlines (Travers et al. 2021). The sections below describe the best available information on powerline collisions and the mechanisms by which they affect covered seabird species.

Injury or Mortality

When a covered seabird strikes a powerline, there are a number of possible outcomes (Travers et al. 2021, 2023a). Some birds lightly graze the powerline and fly away with little or no injury. Other birds may strike a powerline more directly, causing more severe injuries, but still be able to fly away with compromised flight; in these cases, their injury may result in mortality later, or their injury may cause the indirect loss of an egg or chick if they are unable to successfully care for their young. Finally, in other cases severe powerline strikes are likely to cause the bird to be grounded immediately; all or almost all grounded birds are likely to result in mortalities.

Types of injury resulting from powerline collisions include the following (Haas et al. 2003; Cooper and Day 1998; Travers et al. 2021).

- Internal injuries (e.g., bone fractures)
- Plumage damage (e.g., missing feathers; primaries and secondaries sheared off, preventing the bird from flying; head, belly, and flank feathers removed in patches, which may cause waterproofing issues, leading to hypothermia and death)
- Eye injuries
- Head injuries (physical injuries and neurological injuries that are not detectable from visual inspection)
- Skin injuries (e.g., torn open and torn off skin, open muscle, sinew, and bone tissue)

Energetic Costs, Reduced Survival or Reduced Reproductive Success

A majority of covered seabird powerline collisions do not result in immediate grounding or altered flight indicative of an injury that would result in grounding shortly thereafter (Travers et al. 2021). However, birds observed flying away from powerline collisions with typical/normal flight may have injuries not detectable in the short window of time observers can track a bird post-collision. These less severe injuries or subsequent behavior changes can result in reduced survival, increased energy costs or reduced reproductive success due to injuries suffered (e.g., loss of feathers or eye, head, or skin injuries). These injuries that are not observable post collision (e.g., loss of feathers, scratches to the eye, bruising, lacerations) may affect the ability of the bird to fly, gain or maintain flight, steer, balance, or slow down, leading to loss of control and increased energetic costs to maintain altitude (Croll and McLaren 1993). Most importantly, the loss of feathers may result in the loss of waterproofing, which is of particular concern for the deep-diving Newell's shearwater (ʻaʻo). This loss of feathers would then affect the ability of a bird to thermoregulate, which may be an important factor in increasing mortality (Weimerskirch et al. 2019).

If a breeding adult collides with a powerline and survives but does not return to its breeding grounds, it does not breed that year or its egg or chick will not survive, and this results in a loss of productivity. For example, to date, eight adult Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u) that collided with powerlines and were grounded have been released with a satellite tag after being rescued, rehabilitated, and released by the Save Our Shearwaters (SOS) Program. While 75 percent of these seabirds survived (only as a result of human intervention), none returned to a breeding colony that year, suggesting that all had a failed breeding season (Raine and Driskill 2020). Furthermore, if either seabird parent dies due to a powerline collision, its egg or chick is assumed to be lost because the egg/chick relies on both parents for incubation, provisioning, protection from predators, and chick rearing (see Appendix 3A, *Species Accounts*).

If a powerline collision results in death of a breeding adult, there is a loss of productivity for what would have otherwise been the remainder of that individual's lifespan. Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u) are long-lived species (30 or more years in the wild) which return to breed every year (Raine et al. 2017). The death of one individual in a breeding pair also has implications for the surviving bonded mate. The surviving bird will lose reproductive capacity until it secures a new partner. It is very unlikely that the surviving bird will find a mate and successfully breed in the year following the loss of a mate (Raine in litt.), so it will lose productivity for at least 1 year and possibly more (Ainley et al. 2001).

5.2.1.3 Powerline Strike Effects Pathways for Covered Waterbird Species

The effects pathways for covered waterbird species striking powerlines are very similar to the covered seabirds. Grounded waterbirds, however, are generally more capable of regaining flight than the covered seabirds. The covered waterbirds spend large proportions of their lives on the ground or waterbodies and are able to regain flight. Grounded waterbirds that survive and do not regain flight, however, are vulnerable to predation and vehicle collisions, and may experience loss of productivity through energetic costs or other injury.

The life history of the covered waterbirds is substantially different than the covered seabirds, resulting in less vulnerability than the seabirds to population effects resulting from powerline collisions. That is, the covered waterbirds produce four or more offspring per year, mature much earlier in age than the covered seabirds (the covered waterbirds breed in their second year), and require much less parental care (i.e., young of the covered waterbirds leave the nest within days of hatching and become independent in several weeks); therefore, populations of the covered waterbirds are far less vulnerable to individual mortalities than the covered seabirds (see Appendix 3A, *Species Accounts*).

5.2.2 Light Attraction

This section describes the various factors influencing fallout of the covered seabirds and its effects on these species, as well as light attraction and disorientation in green sea turtles (honu). There is no evidence that the covered waterbirds are affected by light attraction and the resultant fallout, so they are not discussed further in this section.

5.2.2.1 Variables Influencing Light Attraction

Artificial lighting often disorients and alters flight patterns of some bird species, including the covered waterbirds. After flying around the lights, these birds can tire or inadvertently hit a structure and may become grounded, an event referred to as fallout (Imber 1975; Telfer et al. 1985). Factors influencing light attraction and fallout include brightness, wavelength, and direction of light, and location of lights relevant to critical life stages (e.g., seabird fledglings leaving nests).

Operation of streetlights is the primary KIUC covered activity affecting the covered seabirds, but facility lights and night lighting for repairs to restore power can also attract seabirds and result in fallout. Although patterns of fallout on Kauaʻi are complex and result from various independent conditions (Troy et al. 2013), the primary source of attraction is bright lights. An early study on Kauaʻi showed that the shielding of bright lights can reduce fallout by 40 percent (Reed et al. 1985), and recent studies continue to indicate that the reduction of lateral light spillage is beneficial to reducing light-induced fallout (Rodríguez et al. 2017a, 2017b). While efforts to shield lights can effectively reduce fallout, these efforts do not appear to eliminate it. Several studies have shown that fallout patterns are also influenced by the location and brightness of artificial lights relative to seabird colonies, the proximity of lights to the coastline, and the wavelengths emitted by different light types (Troy et al. 2011, 2013; Rodríguez et al. 2015, 2017a, 2017b, 2017c; Longcore et al. 2018). Based on preliminary reports, the visual system of Newell's shearwaters (ʻaʻo) may be sensitive to violet and ultraviolet wavelengths, and these attractive wavelengths are more prevalent in "cool" light (e.g., 5000K light-emitting diode [LED]) and less prevalent in "warm" light (e.g., 3000K LED) (Longcore et al. 2018:Figure 1). Additional details on the potential variable effects on the covered seabirds depending on type and wavelength of lighting is provided in Appendix 5B, *Light Attraction Modeling for Covered Seabirds*.

KIUC operates three types of lights that potentially attract covered seabirds—streetlights, external lights at its covered facilities, and night lighting for emergency repairs. KIUC has taken steps to reduce light attraction at its streetlights and covered facilities by shielding light fixtures using full-cutoff shields and dimming covered facility lights during the seabird fledging season (see Chapter 4, Section 4.4.2, *Conservation Measure 2. Implement Measures to Minimize Light Attraction*).

Even with the streetlight modifications to reduce light output and direct all light at the ground, streetlights remain a source of light attraction. However, it is rare to be able to pinpoint which streetlight is the cause of light attraction fallout incidents because most streetlights are found in areas with many other light sources (Appendix 5B, *Light Attraction Modeling for Covered Seabirds*). Additionally, for covered facilities, the covered seabirds may be attracted to non-KIUC lights in the surrounding area but land within the facility and vice-versa. Newell's shearwaters (ʻaʻo) are regularly found under streetlights every year.

Light Attraction Effects Pathways for Covered Seabirds

Fallout of covered seabirds resulting from light attraction occurs seasonally during the autumn months in conjunction with the seabird fledging season (September 15 to December 15). Light attraction primarily affects fledgling seabirds on their first flight from their nesting colonies to the ocean (Reed et al. 1985; Telfer et al. 1987). However, adults may also be attracted to artificial lights when transiting to and from their nesting colony during the breeding period, particularly when lights are near the breeding colony (Raine et al. 2018; Center for Biological Diversity 2016).

When fledglings leave their nest for the first time in the hours following sunset, they are at risk for becoming attracted to artificial lights. This attraction may also occur after young fledglings reach the ocean and are then attracted inland by coastal lights, which explains why they are frequently grounded in coastal areas that are quite distant from their colony (Troy et al. 2013; Rodríguez et al.

2015). There is also a potential for attraction to occur on their outbound journey prior to reaching the ocean (Troy et al. 2013).

Injury or Mortality

When attracted to artificial lights, seabirds can become confused, disoriented, or blinded by the light. Light-attracted birds may circle repeatedly and become grounded, which involves landing on the ground in locations where they usually do not land and from which they are unable to take off due to injury, exhaustion, confusion, and/or lack of height and wind speed. Before grounding, seabirds may collide with structures (e.g., powerlines, poles, buildings) and be injured or killed (Reed et al. 1985).

If light-attracted individuals that become grounded are not rescued, they are at risk for succumbing to injury or mortality due to starvation, predation, collisions with cars, or a combination thereof. Covered seabirds have difficulty resuming flight from level ground (Telfer et al. 1987). These species are adapted to flying long distances over the ocean rather than taking off from the ground. Their relatively large wingspans allow them to glide over the ocean for extended periods, but long wingspans make it challenging to generate enough lift for takeoff from a flat surface, especially without any headwind. They are accustomed to launching themselves from elevated positions in the mountainous areas where they nest. Once grounded in flat terrain, covered seabirds are susceptible to dehydration, starvation, predation from introduced predators, or collision with a vehicle (Telfer et al. 1987).

Studies conducted by Travers et al. (2013) and Podolsky et al. (1998) reported mortality rates[1] of grounded Newell's shearwaters (ʻaʻo) between 40 and 43 percent. The actual rate is likely higher, since some grounded birds are removed by predators, some land on private property and may not be found or reported, and some birds hide under vegetation or structures and are not found[2] (Podolsky et al. 1998; Ainley et al. 2001; Travers et al. 2013; Raine et al. 2018).

Energetic Costs, Chick or Egg Mortality

Birds that become disoriented by lighting but do not become grounded may experience energetic costs in reorienting themselves, as additional energy may be expended during flight to regain orientation. If either seabird parent dies due to fallout, the loss of its egg or mortality of its chick occurs because the egg/chick relies on both parents for incubation, provisioning, predator protection, and chick rearing (Ainley et al. 1997). Fallout is primarily experienced by fledglings; therefore, effects on parents and hence on eggs and chicks are expected to be relatively infrequent except in fallout events related to breeding adults such as the mass fallout event at Kōkeʻe Air Force Station in 2015 (Raine et al. 2018).

5.2.2.2 Light Attraction Effects Pathways for Green Sea Turtle (honu)

Sea turtles typically arrive on beaches to nest at night and emergence occurs nocturnally (Witherington et al. 2014). Artificial lighting visible from the nesting location can disorient

[1] Also referred to in literature and in the glossary (Chapter 10) as *crippling rate*.

[2] In August and September 2015 at the Kōkeʻe Air Force Station on Kauaʻi at least 123 Newell's shearwaters (ʻaʻo) and six Hawaiian petrels (ʻuaʻu) had fallen out and were recovered. Many of these birds were found hiding under structures (Raine et al. 2018). All of the recovered seabirds were adults, the majority of which had brood patches, indicating that even experienced breeding adults, once grounded, may not be able to take off and are likely to hide in vegetation or under buildings (Raine and Banfield 2015). This situation also indicates that adults are susceptible to groundings in areas where inappropriate lighting is set up near breeding colonies (Raine et al. 2018). Once grounded, uninjured birds seek shelter, utilizing any nearby crawl spaces or dense bushes. This makes them particularly difficult to find by human searchers.

hatchlings as they emerge from sand nests at night, leading them to wander aimlessly or head inland (Witherington et al. 2014). Hatchlings normally orient themselves based on the brightest light sources, which is usually the moon, but can become disoriented when there is a brighter light source nearby. For additional details on the ecology of green sea turtle (honu) or threats to this species, see Appendix 3A, *Species Accounts*.

Hatchlings unable to find the ocean are likely to die due to dehydration, predation, or from vehicular collision should they enter roadways (Witherington and Martin 2000; Witherington et al. 2014). While a considerable amount of research has been conducted to identify what levels of artificial lighting may be problematic for nesting behaviors, there is no simple measure of how various light intensities affect sea turtles, or what level of light intensity may be tolerable without impact (see, for example, Witherington and Martin 2003).

5.2.3 Conservation Strategy Implementation

The conservation strategy will result in multiple beneficial effects on covered species. Powerline collision and light attraction minimization measures will reduce take of covered species. Management and enhancement of seabird breeding colonies will reduce the abundance and distribution of seabird predators, increase the number of fledglings produced annually, and improve the survival rates of adult and chicks. KIUC funding of the SOS Program will minimize the effects on covered seabird and waterbirds from various sources (KIUC and non-KIUC) and provide for increased survival and reproduction of the covered waterbird species through the rescue and release of injured covered seabirds and waterbirds.

The conservation strategy may also result in a minimal amount of take of covered seabirds and covered waterbirds. There is the potential for individual birds to be caught in predator traps or otherwise affected by conservation activities (e.g., weatherport collision). The number of birds anticipated to be taken as a result of conservation measures is described in Section 5.3, *Effects on Covered Seabirds*, and Section 5.4, *Effects on Covered Waterbirds.*

5.3 Effects on Covered Seabirds

This section describes the estimated effects of the covered activities on the covered seabirds over the life of the 50-year permit term. Section 5.3.1, *Methods for Quantifying Take and Assessing Effects on the Covered Seabirds*, describes KIUC's assessment methods, and each of the subsequent sections provides a species-specific analysis in the context of each species' abundance, distribution, and other relevant factors. This section also indicates the levels of take requested for each covered seabird, and describes the impact of the taking on the population of each covered species, and the expected beneficial and net effects on each species.

5.3.1 Methods for Quantifying Take and Assessing Effects on the Covered Seabirds

This section describes the methods KIUC applied to quantify take and assess the effects of the covered activities on the covered seabirds. This section includes a description of the models and methods used to estimate the adverse effects of powerline collision, the adverse effects of fallout from light attraction, and the beneficial effects of the conservation strategy. Methods and assumptions associated with modeling are further described in the following appendices associated with this chapter:

- Appendix 5B, *Light Attraction Modeling for Covered Seabirds*
- Appendix 5C, *Bayesian Acoustic Strike Model* (for powerline collisions)
- Appendix 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*
- Appendix 5E, *Population Dynamics Model for Hawaiian Petrel (ʻuaʻu) on Kauaʻi*

5.3.1.1 Use of Population Dynamics Models

KIUC developed custom population dynamics models for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) for the following specific uses in the HCP:

1. Model the plausible bounds of Kauaʻi metapopulation trends over the 50-year permit term based on available data.
2. Estimate the annual level of take over the 50-year permit term, which is expected to change as the size of the Kauaʻi metapopulation[3] changes (see below for an explanation of the Kauaʻi metapopulation).
3. Evaluate the benefits of powerline strike minimization (Conservation Measure 1) on Kauaʻi metapopulation trends.
4. Evaluate the impacts of the requested take authorizations from KIUC's covered activities on the Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) metapopulations and trends.
5. Quantify the benefits of the seabird breeding colonies in the conservation sites (Conservation Measure 4) proposed in Chapter 4, *Conservation Strategy*, to the Kauaʻi metapopulations of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu).
6. To determine the net effects (i.e., adverse and beneficial effects combined) of the HCP covered activities and conservation measures on the Kauaʻi metapopulations of the two seabird species, and to quantify and estimate the timing of the net benefits provided by the HCP, as required by the state Endangered Species Act (ESA).
7. To provide metrics against which to track metapopulation abundance trends during HCP implementation over the 50-year permit term.

The population dynamics models for the Kauaʻi metapopulation of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) take into account the reproduction, numbers of individuals, and distribution of these two species on Kauaʻi. These models are based on the most current and best available data and assumptions developed specifically for this purpose. The Kauaʻi metapopulation was chosen as the unit of analysis for Newell's shearwaters (ʻaʻo) in the model because an estimated 90 percent of all Newell's shearwater (ʻaʻo) breed on Kauaʻi and because the Kauaʻi metapopulation coincides with the Plan Area for this HCP. Similarly, the Kauaʻi metapopulation of Hawaiian petrel (ʻuaʻu) was chosen as the unit of analysis because a large portion of the species[4] occurs on Kauaʻi.

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[3] For the purpose of this HCP, the portion of the total range-wide population of each covered seabird species occurring on Kauaʻi is referred to as the *Kauaʻi metapopulation*.

[4] Estimates of the share of breeding individuals of Hawaiian petrel (ʻuaʻu) on Kauaʻi range from approximately 33 percent (Raine in litt.) upward. Recent work suggests that the number of breeding individuals on Maui, Lānaʻi, and possibly Molokaʻi are substantially greater than previously believed. For details see Section 3A.2.4, *Distribution and Population Trends*, in the species account for Hawaiian petrel (ʻuaʻu) in Appendix 3A, *Species Accounts*.

The population dynamics model is subdivided into 17 subpopulations[5] for Newell's shearwater (ʻaʻo). Twelve of these subpopulations are the proposed 12 conservation sites described in Chapter 4, *Conservation Strategy* (Conservation Measure 4, *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*). The remaining five subpopulations correspond to portions of Kauaʻi that share similar population characteristics (i.e., each area encompasses breeding colonies with similar levels of conservation risk as well as available monitoring data). Appendix 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*, provides descriptions and a map of these subpopulation locations (Figure 5D-1).

Appendix 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*, describes the model (including the parameters that went into the model such as reproductive rate, number of birds for each species, and species distribution on Kauaʻi) and results for Newell's shearwater (ʻaʻo). Appendix 5E, *Population Dynamics Model for Hawaiian Petrel (ʻuaʻu) on Kauaʻi*, describes the model and results for Hawaiian petrel (ʻuaʻu). Both models use the same structure for each species and only differ in some assumptions used, which are identified in each appendix.

A population dynamics model was not developed for band-rumped storm-petrel (ʻakēʻakē) because of the lack of data on this species.

Two Model Scenarios: Worse-Case Trend and Stable Trend

For each species, two hypothetical abundance trend scenarios were modeled to estimate the plausible bounds of abundance trends based on available data. Figure 5-2 provides a graphic representation of the abundance trends for each scenario and the data upon which each scenario was based.[6]

For the January 2023 public review draft of this HCP, KIUC developed the population dynamics models for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) with the assumption that abundance for both species is rapidly declining outside of the conservation sites (Kauaʻi Island Utility Cooperative 2023). This model applied a rapidly declining trend outside of the conservation sites to provide a highly conservative evaluation of the effects of the HCP on the species, and consistent with long-held assumptions on the status and trends of both species. To estimate the plausible bounds of abundance trends outside the conservation sites, KIUC used the available and most current data applicable to areas outside the conservation sites to develop a second model scenario based on the more recent trends in these areas. To distinguish the two model scenarios, they are called:

- *Worse-case trend* population dynamics model scenario (or worse-case trend scenario) assumes the population trend at model initiation is in rapid decline in areas outside the conservation sites, which is a far worse species status than the second model (further explained below). This approach is intended to estimate the lower plausible bound of abundance trends outside the conservation sites.

[5] The term *subpopulation* is used here for the purposes of the HCP to distinguish between groups of individuals associated with breeding colonies located in different parts of the island and that are exposed to different types and levels of threats. It is unknown whether distinct populations exist on Kauaʻi, so that term is avoided. Together, these subpopulations make up the Kauaʻi metapopulation.

[6] This only shows abundance trends used for the worse-case and stable trend scenarios, from radar data. See Chapter 3, Figure 3-14, for abundance trends on the Nā Pali Coast and conservation sites from other data sources.

- *Stable trend* population dynamics model scenario (or stable trend scenario) assumes the population trend outside of the conservation sites is relatively stable, as explained below. This approach is intended to estimate the upper plausible bound of abundance trends outside the conservation sites.

The following three independent datasets suggest that the island-wide population of both covered seabirds has been *stable*[7] over the last decade, not declining.

1. Radar data collected by the Kauaʻi Endangered Seabird Recovery Project (KESRP) from 2010 through 2022 from 15 coastal sites in northern, eastern, and southern Kauaʻi (Sahin 2023) found no significant change in population trend for both species during this time period, despite the steep population decline prior to 2010 (Raine et al. 2017; Figure 5-2). The radar data do not include the northwestern portion of the island where the conservation sites are located. However, colony monitoring data from the conservation sites located in the northwestern portion of Kauaʻi indicates a positive trend in abundance since 2011.
2. Powerline strike data collected by KIUC from 2013 through 2019 also show no significant trend in annual collisions prior to the vast majority of the minimization projects, during the same period described for radar data above (Travers et al. 2020). If there had been a consistent steep population decline during this period (2013 through 2019), when unminimized collisions were monitored, we would expect a reduction in powerline collisions as fewer and fewer seabirds would have survived each year to collide with powerlines. (Significant strike rate reductions have been estimated from the monitoring data since minimization projects for this HCP began in 2020; these reductions are consistent with strike rate reductions relative to strike rates on unminimized spans [Travers et al. 2023b].)
3. Data from the SOS program on collected and rescued seabirds from light attraction fallout is also consistent with a stable trend in abundance of both covered species starting in 2012. SOS provides an independent data source, which tracks the earlier steep decline observed in the radar index of abundance starting in 1993 (Raine et al. 2017) and has more recently shown a similar stable trend as the radar index as well since 2010 (e.g., Sahin 2023).

The data indicating a rapidly declining population in fact only reflect the trend for one radar site (Hanalei) that shows the greatest decline since 1993 (Figure 5-2), and therefore KIUC termed the population dynamics scenario developed under the assumption of a declining population the *worse-case trend* scenario. Since the datasets listed above do not indicate a current rapidly declining population, KIUC then developed a second model scenario for both species based on a stable abundance trend consistent with radar data (termed the *stable trend* scenario). Tables 5-1 and 5-2 provide the assumptions applied to each scenario for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), respectively.

[7] KIUC uses the word *stable* for the covered seabirds in this HCP to refer to estimates indicative of abundance levels that have shown no signs of significantly increasing or decreasing over multiple years of data collection. While high subadult powerline mortality rates could result in a lag of negative abundance trends due to the unstable underlying age structure (fewer individuals reaching breeding age), the available data suggest that this is not the case. KIUC has found through separate exploratory model runs that the observed 13 years of stable trend (2010–2022 "stable" radar trend index of abundance) would not be possible under a scenario in which age structure is adversely affected through high subadult mortality rates, unless one assumes much higher (near 100 percent) rates of adult survival during that time in the areas of Kauaʻi most affected by anthropogenic mortality.

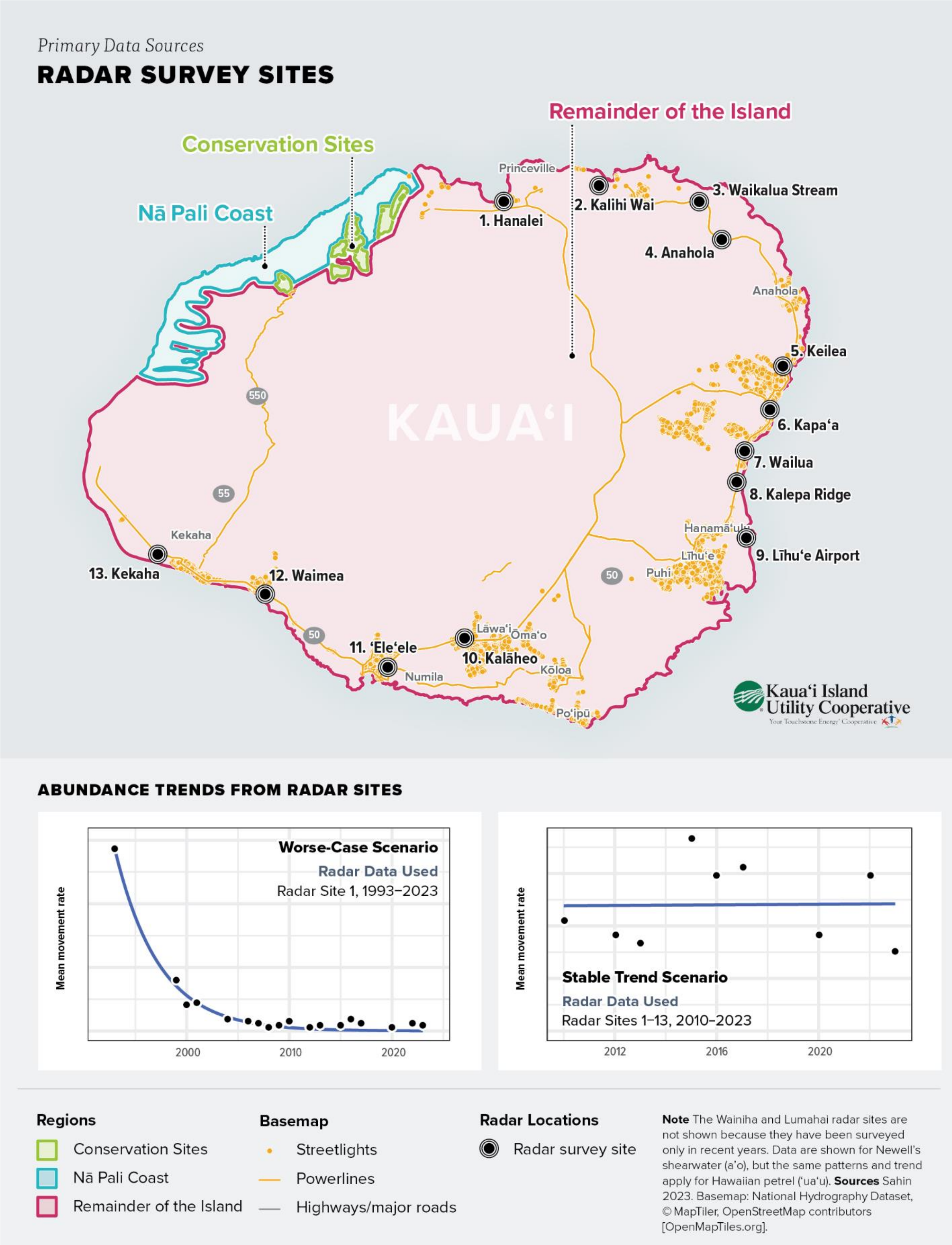


Figure 5-2. Radar Data Used for Abundance Trends Scenarios for Covered Seabirds

Table 5-1. Model Assumptions under each Scenario for Newell's Shearwater (ʻaʻo)

	Differences Between Model Scenarios		
Model Parameter	**Worse-Case Trend**	**Stable Trend**	**Source**
Annual metapopulation growth rate pre-HCP	-7.4%	0%	See Figure 5-2.
Fledgling "Natural" Survival (Age 1)	37% per year	53% per year	Worse case based on assumed 30% survivorship to breeding age. Stable trend based on estimates for unminimized powerline collisions (2013–2019) and flat radar trend (2010–2022)
Post-fledgling and Adult "Natural[8]" Survival (Age 2+)	92% per year	96% per year	Worse case based on Manx shearwater in North Atlantic. Stable trend based on estimates for unminimized powerline collisions (2013–2019) and flat radar trend (2010–2022)
Reproductive Success Rate	56% per year	Same	Appendix 5D, Table 5D-7; c.f. 87% reproductive success rate at the conservation sites.
Uncontrolled Adult Predation Mortality Rate (without predator control)	3% per year	Same	Appendix 5D, Table 5D-6
Sex ratio (M:F)	50:50	Same	Appendix 5D, Table 5D-7
Age at sexual maturity	6 years	Same	Appendix 5D, Table 5D-7
Breeding probability (Age 6+)	0.993	Same	Appendix 5D, Table 5D-7
Proportion of powerline collisions that are Newell's shearwater (ʻaʻo)	0.70	Same	Appendix 5D, Table 5D-4
Proportion of powerline collisions that result in mortality	0.28	Same	Appendix 5D, Table 5D-4
Proportion of powerline collisions that are subadults	0.79 (Proportion of collisions that are adults = 0.21)	Same	Appendix 5D, Table 5D-4
Annual island-wide powerline mortality minimization rate for HCP	0.664	Same	Appendix 5D, Table 5D-8
Total abundance in Hanalei to Kekaha (total individuals all ages) at start of permit term in 2025	12,888	96,056	Appendix 5D, Table 5D-12 and Table 1 in Attachment 5D-1.

[8] The word *natural* is used here to refer to modeled vital rates in the absence of anthropogenic mortality on Kauaʻi, i.e., natural survival and reproductive rates are those when anthropogenic mortality rates are set to zero in the population model and correspond to resulting population growth rates at R_{MAX}. Any anthropogenic sources of mortality without available estimates (e.g., any fisheries bycatch) are subsumed in the *natural* survival rates. The natural reproductive success rate is based on estimates under dedicated predator control at the conservation sites.

Model Parameter	Differences Between Model Scenarios		
	Worse-Case Trend	Stable Trend	Source
Ending total abundance Hanalei to Kekaha in 2075	125	276,659	Appendix 5D, Table 5D-12 and Table 1 in Attachment 5D-1.
Total abundance at the conservation sites (total individuals all ages) at start of permit term in 2025	5,003	6,683	Appendix 5D, Table 5D-12 and Table 1 in Attachment 5D-1.
Ending total abundance at conservation sites in 2075	16,939	234,991	Appendix 5D, Table 5D-12 and Table 1 in Attachment 5D-1.

Table 5-2. Model Assumptions under each Scenario for Hawaiian Petrel ('ua'u)

Model Parameter	Model Scenario		Source
	Worse-Case Trend	Stable Trend	
Annual metapopulation growth rate pre-HCP	-8%	0%	See Figure 5-2
Post-fledgling and adult "natural[9]" survival (Age 2+)	92% per year	96% per year	Worse case based on Manx shearwater in North Atlantic. Based on estimates for unminimized powerline collisions (2013–2019) and flat radar trend (2010–2022) Estimates for unminimized powerline collisions (2013–2019) and flat radar trend (2010–2022)
Fledgling "natural" survival (Age 1)	37% per year	53% per year	Based on unminimized powerline collision mortalities (2013–2019) and flat radar trend estimate (2010–2022)
Reproductive success rate	41% per year	Same	Appendix 5E, Table 5E-7; c.f. 78% reproductive success rate at the conservation sites
Uncontrolled adult predation mortality rate (without predator control)	3% per year	Same	Appendix 5E, Table 5E-6
Sex ratio (M:F)	50:50	Same	Appendix 5E, Table 5E-7
Age at sexual maturity	6 years	Same	Appendix 5E, Table 5E-7
Breeding probability (Age 6+)	0.982	Same	Appendix 5E, Table 5E-7
Proportion of powerline collisions that are Hawaiian petrel ('ua'u)	0.30	Same	Appendix 5E, Table 5E-4
Proportion of powerline collisions that result in mortality	0.288	Same	Appendix 5E, Table 5E-4

[9] The word "natural" is used here to refer to modeled vital rates in the absence of anthropogenic mortality on Kaua'i, i.e., natural survival and reproductive rates are those when anthropogenic mortality rates are set to zero in the population model and correspond to resulting population growth rates at R_{MAX}. Any athropogenic sources of mortality without available estimates (e.g., any fisheries bycatch) are subsumed in the "natural" survival rates. The "natural" reproductive success rate is based on estimates under dedicated predator control at the conservation sites.

Model Parameter	Model Scenario: Worse-Case Trend	Model Scenario: Stable Trend	Source
Proportion of powerline collisions that are subadults	0.79	Same	Appendix 5E, Table 5E-4 (Proportion of collisions that are adults = 0.21)
Annual island-wide powerline mortality minimization rate for HCP	0.664	Same	Appendix 5E, Table 5E-8
Total abundance in Hanalei to Kekaha (total individuals all ages) at start of permit term in 2025	14,412	60,911	Appendix 5E, Table 5E-11 and Table 1 in Attachment 5E-1.
Ending total abundance Hanalei to Kekaha in 2075	722	103,840	Appendix 5E, Table 5E-11 and Table 1 in Attachment 5E-1.
Total abundance at the conservation sites (total individuals all ages) at start of permit term in 2025	8,325	12,692	Appendix 5D, Table 5D-12 and Table 1 in Attachment 5D-1.
Ending total abundance at conservation sites in 2075	11,406	129,106	Appendix 5D, Table 5D-12 and Table 1 in Attachment 5D-1.

The modeled outcomes under each scenario (worse case and stable trend) provide important reference points for understanding the effects of the covered activities (powerline collisions and light attraction from streetlights and facility lights) on the covered seabirds, and of the island-wide benefits of the HCP conservation sites. Neither the worse-case nor the stable trend scenario should be considered representative of realistic projections of abundance of the covered seabirds into the future. Instead, the modeled scenarios for these two abundance trends can be viewed as plausible bounds of what may occur given different suites of assumptions, and described in the following subsection, and based on the available data.

Hypothetical Outcome Comparisons

As required under the state and federal ESA, this HCP evaluates the *impacts* of the taking on each covered seabird species' long-term survival and likelihood of recovery. This HCP also assesses the benefits of the conservation measures described in Chapter 4, *Conservation Strategy,* and evaluates these benefits in combination with the impacts of the taking to ascertain the net effects of the HCP on each species. To this purpose, KIUC developed a set of hypothetical outcomes using the population dynamics models for Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u) to isolate selected variables. Each of the comparisons is described in Table 5-3. The effects analyses for Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u) (Sections 5.3.2 and 5.3.3) then provide the modeled outcomes for each comparison under the stable trend and worse-case scenarios. Table 5-3 summarizes how the hypothetical modeled outcomes from each comparison were used to assess adverse, beneficial, and net effects on the species.

Table 5-3. Comparisons Used for Effects Analysis for Newell's Shearwater ('a'o) and Hawaiian Petrel ('ua'u)

Comparison Name	Description	Purposes of Comparison in Effects Analysis
Proposed HCP (blue line)[a]	Proposed HCP with all proposed, minimized take (light attraction and powerline collisions) and all conservation measures relevant to covered seabirds, except Conservation Measure 3 (Funding SOS Program). Benefits of SOS Program rescues and recoveries are excluded from the model because for purposes of this HCP, 100% mortality is assumed for all fallout birds.	• Assess Benefits of Conservation Measure 4**.** Compare modeled abundance trends under the HCP with modeled abundance trends under the *Proposed Take with Minimization Only* (#2) to evaluate outcomes with and without Conservation Measure 4 at the conservation sites. See Section 5.3.2.4, *Beneficial Effects and Net Effects,* subsection titled *Beneficial Effects of Conservation Measure 4, Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites.* • Assess Net Effects of the HCP (Proposed Take **and** Conservation). Compare modeled abundance trends under the HCP with modeled abundance trends under *No-Take* (#4), which includes neither take nor conservation, to evaluate the net effect (i.e., combined adverse and beneficial effects) of the HCP. See Section 5.3.2.4, *Beneficial Effects and Net Effects,* subsection titled *Net Effects based on Population Dynamics Model.*
Proposed Take with Minimization Only (purple line)[a]	Includes all proposed take (light attraction and powerline collisions). Includes Conservation Measure 1 that minimizes powerline collisions and Conservation Measure 2 that minimizes light attraction for seabirds. Excludes Conservation Measure 3 (Funding SOS Program) and Conservation Measure 4 (seabird conservation sites).	• Assess Benefits of Conservation Measure 4. Compare to *HCP* (#1). • Assess Benefits of Powerline Minimization. Compare modeled abundance trends under *Proposed Take with Minimization Only* with modeled abundance trends under *Take with No Minimization or Conservation* (#3) to evaluate benefits of Conservation Measure 1. See Section 5.3.3.3, *Impacts of the Taking,* subsection titled *Effects of Minimization.* • Assess Impact of the Take Prior to Mitigation. Compare modeled abundance trends under *Proposed Take with Minimization Only* with modeled abundance trends under *No-Take* (#4) to analyze the effects of proposed take on the status of the species. See Section 5.3.3.3, *Impacts of the Taking,* subsection titled *Impacts of the Taking based on Population Dynamics Model.*
Take with no Minimization or Conservation (also called Unminimized Take)[b] (red line)[a]	Includes take from covered activities (light attraction and powerline collision) that would hypothetically occur without Conservation Measure 1 (powerline minimization).[a] Excludes Conservation Measure 3 (Funding SOS Program) and	• Assess Benefits of Powerline Minimization. Compare to *Proposed Take with Minimization Only* (#2).

Comparison Name	Description	Purposes of Comparison in Effects Analysis
	Conservation Measure 4 (seabird conservation sites).	
No Take/No HCP (grey line)[a]	Hypothetical situation in 2024 in which all KIUC powerlines are removed and all KIUC streetlights and covered facility lights are turned off permanently. Therefore, no KIUC take of seabirds occurs after 2024.[c] Excludes all seabird conservation measures (Conservation Measures 1 through 4).	• Assess Net Effects of the HCP (Proposed Take **and** Conservation). Compare to *HCP* (#1). • Assess Impact of the Take Prior to Mitigation. Compare to *Proposed Take with Minimization Only* (#2).

[a] The color indicated here is used in the figures for the effects analyses for Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u), Sections 5.3.2 and 5.3.3.

[b] No minimization of existing powerline or future powerlines. Under the worse-case scenario with this take with no minimization or conservation comparison, all subpopulations are projected to decline rapidly until approximately 2060 and then begin to level off, but with a continuing decline. The estimated population trajectory of the take with no minimization or conservation comparison is based on the following assumptions: (1) predation rates measured at monitored colonies prior to dedicated predator control are applied to every subpopulation; (2) no predator control occurs at any of the HCP conservation sites; and (3) powerline strikes and light attraction continue, but no powerline minimization occurs, other than what previously occurred as part of the Short-Term HCP.

[c] The No-Take comparison includes take of covered seabirds prior to 2024 (i.e., past take prior to HCP) in order to compare effects of HCP implementation. All other comparisons also include effects of past powerline collision and light attraction of covered seabirds prior to the HCP.

5.3.1.2 Powerline Collisions—Methods

This section describes KIUC's methods for estimating take of covered seabirds associated with powerline collisions (also called powerline strikes). As described in greater detail in Section 5.2.1, *Powerlines*, take of the covered seabirds can take several forms, including injury or mortality of adults or juveniles, and the loss of eggs or chicks as a result of the injury or mortality of a breeding adult. This section also includes the assumptions used for the purpose of estimating amounts for each of these forms of take.

Estimating Powerline Strikes (Measurable Unit of Take)

As described in Section 5.2.1.2, *Powerline Strike Effects Pathways for Covered Seabird Species,* there are a number of possible outcomes when a covered seabird strikes a powerline, ranging in severity from slightly grazing the powerline with little to no injury, to immediate mortality. No studies of powerline strikes on the covered birds to date have been able to quantify the exact number of birds injured or killed as a result of powerline collisions. This would require not only recording all birds striking powerlines, but also tracking the outcome of all of those strikes (Travers et al. 2021; Bevanger 1998). Various estimates of injury or mortality have been made, but these have been based on untestable assumptions about data biases (Bevanger 1998). While these estimates could be useful in evaluating overall effects of powerline collisions on the covered seabird species, they are not estimates that can be measured in the field and verified through monitoring. Therefore, based on current technology and techniques, the exact amount of mortality or injury of the covered seabirds from powerline strikes is indeterminable. Instead, the amount of mortality and injury must be estimated based on the best available data.

As described in the HCP Handbook, if take by number of individuals cannot be determined accurately, take limits can be expressed in a variety of ways, provided: (1) there is a causal link between the surrogate unit of take and actual take of the species, and (2) a clear standard is determined for when the level of anticipated take has been exceeded (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016). Consistent with this guidance, KIUC is defining its request for take of each covered seabird resulting from powerline strikes as the *number of powerline strikes* as recorded through acoustic monitoring. In other words, the number of powerline strikes serves as a reasonable and measurable (i.e., it can be acoustically monitored in the field) surrogate for the amount of actual take of Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u). The actual number of birds injured or killed as a result of powerline strikes cannot be measured directly.

KIUC applied the following analytical steps to estimate the number of powerline strikes anticipated for Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u) over the 50-year permit term. The method for establishing the take limit for of band-rumped storm-petrel ('akē'akē) is described separately in Section 5.3.4, *Requested Take and Effects on Band-Rumped Storm-Petrel ('akē'akē)*. Take from powerline collisions, expressed as the total number of collisions (strikes), was quantified using the following steps, each of which is described later in this section:

1. Estimated the annual collision rate for both species combined using data from 2013 through 2019.
2. Used passage rates, flight heights, and powerline interaction data on observed powerlines and powerline collisions to determine the proportion of strikes attributable to each species. These proportions were then applied to the total annual collision rate to estimate the number of annual strikes for each species.
3. Estimated the anticipated reduction in powerline collisions from powerline minimization measures described in Chapter 4, *Conservation Strategy*. This anticipated reduction was then applied to collision rates estimated under Step 1.
4. Calculated the annual number of strikes over time as a function of changing abundance through the population dynamics model.
5. Estimated the amount of additional powerline collisions expected from new powerlines built during the permit term.

The following describes each of these five steps in detail.

Step 1: Estimate Annual Collisions with Existing Powerlines

KIUC based its initial annual strike estimates on a 2020 Bayesian acoustic strike model, using powerline collisions monitoring data from 2013 to 2019 (Travers et al. 2020). Appendix 5C, *Bayesian Acoustic Strike Model*, outlines the methods and results for this model. In summary, the model is based on data gathered from acoustic sensors placed on power poles throughout the island to record powerline strikes. A Bayesian hierarchical modeling framework was employed to estimate the annual rate of bird-powerline collisions based on the acoustic sensor data from 2013 through 2019. The cumulative mean annual number of bird strikes for all powerline spans was estimated at 16,392 (Travers et al. 2020).[10]

[10] This number is slightly reduced from the number reported in the 2020 Bayesian model (Appendix 5C, *Bayesian Acoustic Strike Model*) due to minor errors resulting from double counting of strikes on Powerline Trail, incomplete minimization prior to 2019, and duplicate span numbers causing doubling of strikes for those spans.

Step 2: Determine Proportion of Powerline Strikes Attributed to Each Covered Species

The acoustic strike estimates are for collisions of all birds combined (i.e., covered seabirds, covered waterbirds, and non-covered birds) because the acoustic recordings of powerline strikes cannot differentiate between species. Data were collected from more than 6,000 hours of observer monitoring to assess the initial rate of seabirds hitting powerlines and species composition. Strike estimates were allocated to species by using a combination of observations of passage rate, observations of flight height, and powerline interaction data per unit length of wires by time of day and night. Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u) vary in their flight behavior, data about which was used to estimate the proportion of collisions attributed to each species.

To quantify collision for covered seabirds versus covered waterbirds, KIUC assessed the proportional collision risk of various avian species including the covered waterbirds and the covered seabirds based on observations at Mānā (Travers and Raine in litt.).[11] Based on this assessment, 545 annual strikes estimated at Mānā were removed from the combined number of annual unminimized strikes attributed to Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u), which results in an adjusted total combined annual strikes for Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u) of 15,847 (= 16,392 – 545). Of these 15,847 birds, 70 percent are assumed to be Newell's shearwater ('a'o) and 30 percent are assumed to be Hawaiian petrel ('ua'u) (Appendix 5C, *Bayesian Acoustic Strike Model*; Appendix 5D, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i*). This provides an estimated annual collision number prior to KIUC HCP minimization of 11,093 for Newell's shearwater ('a'o) and 4,754 for Hawaiian petrel ('ua'u) based on the Bayesian acoustic model and field observations.

There have been no direct observations of band-rumped storm-petrel ('akē'akē) colliding with powerlines (Travers et al. 2021). In addition, general visual detections and observations of band-rumped storm-petrel ('akē'akē) can be complicated by the difficulty in identifying the species compared with other similar sized species. Based on the extreme rarity of strikes and the challenge of species identification, a reliable collision estimate could not be determined. Instead, a small amount of take was estimated for this species independent of the calculations above, as described in Section 5.2.1.2, *Powerline Strike Effects Pathways for Covered Seabird Species*. The effects analysis for band-rumped storm-petrel ('akē'akē) is based on this take limit.

Step 3: Apply Anticipated Reduction in Collisions due to Minimization Measures

As described in Chapter 4, Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*, KIUC is minimizing the impacts of its powerlines on covered species by implementing physical modifications to and/or installing bird flight diverters on transmission and distribution lines across the island. Travers and Raine used the 2020 Bayesian model results (Appendix 5C, *Bayesian Acoustic Strike Model*) to estimate the strike rate reductions and potential benefit of these minimization actions. Based on these results, they concluded that KIUC's powerline minimization projects reduce powerline collisions from 42 to 96 percent, depending on the covered species and the location and type of the minimization project (Travers et al. 2020).[12]

To determine how much take to request, KIUC applied the minimization strike reduction estimates provided by KESRP in 2020 to calculate the estimated reduction in seabird strikes for each

[11] This estimate is for all avian species other than the covered seabirds potentially colliding with KIUC powerlines at Mānā, not just covered waterbirds.

[12] 96 percent is the maximum reported minimization from powerline reconfiguration (strike reduction depends on reconfiguration plan and terrain).

minimized powerline span. The estimated reduction in seabird strikes takes into account all completed and planned minimization projects through 2024. The estimated strike reduction (i.e., number of bird strikes reduced) for all minimized powerline spans in KIUC's system was based on the type of minimization method used at the span and the estimated reduction of strikes for that method, the length of the span, and the collision risk estimated at that span.

Using the Bayesian model strike estimates for each span and the KESRP estimated strike reductions for each minimization method at each span, KIUC developed a minimization model to calculate the estimated island-wide strike reduction and strikes remaining after minimization completed through 2024. The estimated strike reductions for each minimized powerline span were then summed to calculate an island-wide strike total and overall strike reduction.

KIUC completed an extensive island-wide minimization plan in 2024, and ongoing powerline strike monitoring through 2027 will be used to compare with the estimated strike reductions. Monitoring for 3 years after the minimization plan has been completed is necessary to account for annual variation and sufficient time for all minimized spans to be monitored. KIUC commits to achieving an island-wide minimization strike reduction of at least 66.4 percent by the end of 2024 (i.e., a reduction in powerline strikes of at least 66.4 percent compared to the number of annual strikes prior to any minimization). Table 5-4 summarizes the estimated annual reductions in powerline strikes through minimization.

Table 5-4. Summary of Reductions in Powerline Strikes Through Minimization, Annually

		Strikes reduced	***Strikes remaining***	***% of Unminimized Strikes Reduced***	
Year	**Strikes [a]**	**Annual**	**Annual**	**Annual**	**Cumulative**
Baseline	15,847				
2020	13,546	2,300	11,246	14.52%	14.52%
2021	10,265	3,281	6,984	20.71%	35.22%
2022	8,113	2,152	5,960	13.58%	48.81%
2023	5,496	2,617	2,879	16.51%	65.32%
2024	5,331	165	5,167	1.04%	66.36%[b]

[a] All strike values for spans 1–113 were multiplied by a factor of 1-(545/842) to exclude the estimated 545 strikes attributable to waterbirds for these spans.

[b] Maximum reduction reached by May 5, 2024. Minimization reduction assumed to remain constant over 50-year permit term beginning in 2025.

Step 4: Calculate Annual Strike Numbers over Time as a Function of Changing Abundance

As the abundance of different subpopulations of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) changes over time, either up or down, there will likely be corresponding increases or decreases in powerline collisions in different areas of Kauaʻi if the per-capita collision risk remains constant for each subpopulation. The population dynamics model for each species described in Section 5.3.1.1, *Use of Population Dynamics Models*, and Appendices 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*, and 5E, *Population Dynamics Model for Hawaiian Petrel (ʻuaʻu) on Kauaʻi*, were used to estimate the plausible bounds of abundance projections over time and apply these abundance projections to annual strike projections for each scenario. The per-capita risk of collision is not uniform across subpopulations. For example, because the subpopulations in the conservation sites have a very low risk of powerline collisions and light attraction, increases in future abundance in those areas will result in only small increases to annual powerline collisions or light attraction–induced fallout. On the other hand, decreases in abundance of the subpopulations with highest risk (e.g., Hanalei to Kekaha) would result in large decreases in future powerline collisions and light attraction–induced fallout, as fewer high-risk individuals in these subpopulations are transiting powerlines and areas with streetlights over time.

As described in Section 5.3.1.1, *Use of Population Dynamics Models,* KIUC modeled both a *worse-case trend* and a *stable trend* scenario for each species. The take estimates of the worse-case scenario are significantly lower than the take estimates under the stable trend scenario because the worse-case scenario predicts a rapidly declining subpopulation in Hanalei to Kekaha. Hanalei to Kekaha has both the largest initial abundance of any subpopulation (it is also by far the largest area) and the highest risk of powerline collisions and light attraction–induced fallout. For the reasons described earlier and in Appendices 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*, and 5E, *Population Dynamics Model for Hawaiian Petrel (ʻuaʻu) on Kauaʻi*, KIUC believes that this scenario can be considered to represent the lowest plausible bound of abundance in Hanalei to Kekaha area, and likely substantially underestimates the growth of the two covered seabirds in Hanalei to Kekaha. As described in Section 5.3.1.1, the assumed rapid decline in the worse-case trend scenario is not consistent with recent radar and powerline collision data. Therefore, take estimates for the HCP are based on the stable trend scenario, which is consistent with the recent radar and powerline monitoring data. This approach provides a more realistic take estimate consistent with powerline monitoring data since 2013, avoids underestimating take of the covered species during HCP implementation, and reduces the risk of an HCP amendment early in implementation.

Step 5: Estimate Strikes from New Powerlines

This HCP covers KIUC's installation of up to 360 circuit miles (mi) (579.4 kilometers [km]) of new powerlines, or an average of 7 circuit mi (11.3 km) of new wires per year for 50 years (Chapter 2, Section 2.1.3, *New or Extended Powerlines*). In this HCP, KIUC commits to apply high standards of collision minimization to all new powerlines in order to minimize strikes from new powerlines, as described in Chapter 4, Section 4.4.1.2, *Future Transmission and Distribution Lines*. Based on estimated strike reduction rates ranging from 42 to 96 percent for reconfiguration, static wire removal, and bird flight diverters (Travers and Raine 2020), KIUC has estimated that powerline collisions that could result from the installation of new powerlines can be reduced by at least 80 percent[13] for the covered seabirds by employing minimization at the time of installation (Chapter 4, Section 4.4.1.2, *Future Transmission and Distribution Lines*).

- 360 circuit mi (579.4 km) of new powerlines divided by 1,531 circuit mi (2,464 km) of existing transmission and distribution lines = 23.5 percent increase of powerlines on the landscape.
- 23.5 percent increase in circuit mi of existing transmission and distribution lines multiplied by 20 percent strikes remaining (i.e., after 80 percent reduction of strike risk from minimization) = 4.7 percent increase in strikes from new powerlines.
- Assuming an even pace of installing new powerlines each year, the increase in future strikes was calculated by applying a linear increase in the strike rate each year (i.e., an increase of 0.094

[13] This is based on KESRP estimated strike reductions for spans that have been reconfigured with static wire removal. On average, these minimization measures result in greater than 80 percent strike reduction risk. However, because other factors can affect strike rates, KIUC conservatively assumes unminimized strikes (no HCP) resulting from new powerlines will be reduced a minimum of 80 percent with the minimization techniques presented in Chapter 4, *Conservation Strategy*.

percent each year), such that by buildout at year 50, the strike rate was equal to the estimated 4.7 percent increase in strikes.

Estimating the Form of Take

KIUC is quantifying and tracking take from powerline collisions by the total number of strikes, as described above. Based on these estimates, KIUC has also estimated each form of take likely to occur from powerline collisions (i.e., no observed injury, injury, mortality, or indirect take of chicks or eggs) for the purpose of evaluating the impact of the taking and developing an appropriate mitigation package.

As described in Section 5.2.1.2, *Powerline Strike Effects Pathways for Covered Seabird Species*, estimating the number of avian mortalities and injuries resulting from powerline collisions is challenging because the fate of individuals is very difficult to determine after a collision, and data samples are not large enough to generate statistically valid estimates. Estimating bird mortality and injury has typically been done by conducting ground searches and then adjusting counts to account for biases related to factors such as searcher efficiency, carcass removal rate by scavengers, searchability of the habitat, and crippling bias.[14] These correction factors are often subjective and based on limited data (Bevanger 1995; Travers et al. 2021). As described in Section 5.2.1.2, *Powerline Strike Effects Pathways for Covered Seabird Species,* the use of acoustic monitoring devices eliminates these various biases because it does not rely on observers finding birds along search corridors. These devices record powerline collisions directly through acoustic monitoring of wire strikes rather than through counting individuals found during ground-level searches (in search corridors under powerlines). During implementation, the number of powerline collisions (strikes) will be quantified on an annual basis based on acoustic monitoring of powerlines strikes. As described in the next chapter, KIUC has refined these monitoring techniques over the last decade to optimize geographic coverage. Direct measurement of birds that collide with powerlines and are grounded is infeasible because of the rarity of collisions that result in groundings, biases associated with difficulty finding grounded birds in dense vegetation or birds that have left the search corridor, and access limitations on extensive private land (Travers et al. 2021).

Because of the limitations described above, the fate of the covered seabirds after powerline collisions is inferred based on the best available data. The best available data to date regarding the outcome of bird collisions is a study by Travers et al. (2021) in which 121 seabird collisions with powerlines on Kauaʻi were observed over a 6,000-hour observation period to evaluate post-collision elevation loss and flight characteristics. This study is described in Section 5.2.1.2, *Powerline Strike Effects Pathways for Covered Seabird Species*. Table 5-5 summarizes the assumed outcomes from the 121 observed collision events.

[14] Crippling bias is a measure used for monitoring techniques that involve estimating the number of dead or injured birds by searching under powerline corridors. It is the measure of the number of birds that hit a powerline (or any other structure) but continue to transit beyond the range of the search corridor before dying undetected. Crippling bias is used for studies that quantify mortality rate based on the number of dead birds found within search corridors under powerlines (not the method used in this HCP).

Table 5-5. Assumed Outcomes of Powerline Collisions based on Travers et al. 2021

Observed Events (121 strikes observed)[a]	Proportion of Observed Strikes	Assumed Outcome in HCP	Counted in Take Request?
Immediately grounded[b]	13.0%	Mortality (28.8% total)	Yes
Unknown outcome (either immediately grounded or crippled)[c]	10.2%		
Observed leaving search corridor with severe post-collision flights[d]	5.6%		
Some elevation loss	24.5%	Injury (to the extent egg or chick is lost that year)[e]	Yes
Total mortality and injury	*53.3%*[f]		
Powered flight	46.7%	No injury (to the extent egg or chick is lost that year).	Yes
Total powerline collisions	*100%*		

[a] Based on over 6,000 hours of field observation.

[b] Birds were classified as "immediately grounded" if they had the largest observed elevation losses (164 feet [50 meters]) and post-collision flight characteristics were either "no flight" or "seriously compromised flight."

[c] Birds were classified as "unknown outcome" if elevation loss was 36 to 75.5 feet (11 to 23 meters) and post-collision flight characteristics were either "no flight," "seriously compromised flight," or "compromised flight."

[d] This includes "no flight", "seriously compromised flight", and "compromised flight".

[e] Although it is possible some form of minor injury could occur to any bird striking powerlines, the 24.5% is applied for injury to the extent that an injured adult could lose its egg or chick for the reproductive year of the injury.

[f] All strikes are counted toward take estimates. 53.3% of strikes are assumed to result in either mortality or injury to the extent that it results in egg or chick mortality during the same breeding year as the collision.

Annual Mortality and Injury from Powerline Strikes

As described in Section 5.2.1.2, *Powerline Strike Effects Pathways for Covered Seabird Species*, it is not possible to definitively know the fate of seabirds that strike powerlines unless they are found under the powerlines or tracked (e.g., radio tagged). It is important, however, to distinguish between mortality and injury for purposes of estimating the overall effects of powerline collisions on each species. KIUC used the best available data from Travers et al. (2021) to estimate these outcomes. Based on this study, 28.8 percent of the covered seabird powerline strikes are assumed to result in grounded birds (regardless of species) (Table 5-5). All grounded birds are assumed to die immediately due to impact or shortly thereafter due to starvation, dehydration, or predation.

Estimating the number of non-lethal injuries resulting from powerline collisions is even more challenging than estimating mortality, since non-lethally injured birds generally leave the search corridor under powerlines and cannot be observed. KIUC used as a proxy for non-lethal injury the proportion of birds that were observed in Travers et al. (2021) to lose elevation after striking powerlines. Based on this approach, 24.5 percent of covered seabird collisions are assumed to result in non-lethal injury (regardless of species) (Table 5-5). The proportion of birds observed having powered flight after collisions accounts for 46.7 percent of covered seabird collisions. These were assumed to result in no injuries or minor injuries, and were labeled 'no observed injury' for the purpose of the form of take.

For the purpose of this HCP, it is assumed that all covered seabirds grounded from powerline collisions result in mortality, even though an unknown percentage of those birds are turned in to the SOS Program, subsequently released, and survive to reproduce later.

Indirect Take of Eggs or Chicks

As described in Section 5.2.1.2, *Powerline Strike Effects Pathways for Covered Seabird Species*, an egg or chick may be lost when a parent seabird strikes a powerline. Both parents are required to care for chicks and eggs, so if one parent dies or is injured, it is likely the chick or egg will be lost. KIUC therefore assumed the loss of one egg or chick for each adult bird killed or injured as a result of powerline collisions, assuming an 80:20 proportion of subadult to adult powerline strikes (Cooper and Day 1998). This loss of a chick or egg as a result of injury or mortality of an adult is termed *indirect take* for the purpose of this HCP.

The 80:20 estimated proportion for subadults versus adults currently represents the best available data. However, this estimate is based on a small sample size of 14 Newell's shearwater (ʻaʻo) carcasses collected during 1993 and 1994, and classification of reproductive status was limited to external examination for brood patches and worn feathers (indicative of nesting, and hence reproductive maturity). No Hawaiian petrel (ʻuaʻu) carcasses were found in the Cooper and Day (1998) study, to provide a separate species-specific estimate. A more detailed necropsy program is ongoing, including internal examinations of gonads for both Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) carcasses from powerline collisions. The results of the necropsy study will provide a more accurate estimate of the proportion of subadults and adults that are killed by powerline collisions, because the external characteristics (i.e., brood patches and worn feathers) may change throughout the breeding season, and therefore external characteristics may not be as reliable an indicator of reproductive status as gonads. However, at present, the ongoing necropsy study is still based on a small sample size, and results are not yet available that would warrant superseding the available estimate from Cooper and Day (1998). The uncertainty around the available 80:20 point estimate (i.e., given the limited sample size of 14, the relatively large 95 percent confidence intervals for the proportions, from 52:48 to 92:8 subadult to adult) is integrated in the population dynamics modeling of impacts of powerline collisions on the Kauaʻi metapopulations, as discussed in Appendices 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*, and 5E, *Population Dynamics Model for Hawaiian Petrel (ʻuaʻu) on Kauaʻi*.

Approach for Requested Take

KIUC is seeking state and federal authorization for the take from powerline collisions that would remain after it implements the minimization measures detailed in Chapter 4, Section 4.4, *Conservation Measures*. The total annual number of projected strikes varies by year but the HCP will cover take associated with the total projected number of strikes over the 50-year permit term based on the stable trend scenario. The take request is based on the stable trend model scenario because it is consistent with powerline collision data and radar data collected since 2010 (Sahin 2023; Travers et al. 2020).

Monitoring conducted since 2013 indicates there are natural annual variations that affect the number of covered seabirds present on Kauaʻi, the flight patterns of those that are present on Kauaʻi, and other factors (e.g., weather) affecting the number of collisions that occur in any given year. Such variation makes it impractical to set specific annual limits; therefore, take limits are defined as the total number of birds taken during the permit term. A 5-year rolling average of the annual take amounts will be used to track take and be monitored against annual performance standards for the purpose of adaptive management (see Chapter 6, *Monitoring and Adaptive Management Program*). Therefore, if the 5-year rolling average of annual take exceeds the amount projected based on the model (Appendix 6A, *Adaptive Management Comparison Tables*, Tables 6A-1 and 6A-2), adaptive management is triggered but it is not a violation of the federal incidental take permit or state incidental take license.

The overall requested take from powerlines is established based on the assumption that KIUC can achieve a 66.4 percent reduction in powerline collisions by the end of 2024. This estimated strike reduction due to minimization will be confirmed by powerline collision monitoring through 2027. The take limit also takes into account local increases in collision risk that may result from exposing powerlines as a result of vegetation maintenance or raising the height of powerlines (i.e., KIUC will be held to the same take limit even with modifications such as exposing or raising powerlines). Additionally, the take limit applies only to the total estimate for each species, not to each type of covered activity. In other words, if the actual amount of take from one type of covered activity exceeds the estimate, that is not a permit violation as long as the total amount of take for all covered activities remains below the limit for the total amount of take for all covered activities.

5.3.1.3 Light Attraction and Fallout—Methods

As described in Chapter 4, Section 4.4.2, *Conservation Measure 2. Implement Measures to Minimize Light Attraction*, KIUC has minimized and will continue to minimize its light-related impacts on the covered seabirds throughout the life of the permit term, as follows.

- Using full-cutoff shields for streetlights and covered facility lights.
- Using white LED lights on outdoor lights at its covered facilities.
- Managing facility lighting at Port Allen Generating Station so that lights are dimmed during the fledgling fallout season (September 15 to December 15).

These measures have reduced and will continue to reduce the risk of take from light attraction of the covered seabirds to the maximum extent practicable. Despite these efforts, some risk of light attraction and fallout remains. Take estimates associated with light attraction are based on the analysis and calculations described in detail in Appendix 5B, *Light Attraction Modeling for Covered Seabirds*. The requested take authorization is considered a conservative estimate (i.e., a likely overestimate) for the following reasons.

- Take estimates from light attraction are based on remotely sensed radiance data in October 2018. This mapping precedes KIUC's minimization of light attraction at KIUC's facilities through light dimming, which began in 2019.
- KIUC used a constant annual rate of light attraction, with the maximum amount of annual take from full buildout of streetlights assumed in Year 1 of HCP implementation, when in fact full buildout will occur gradually through the permit term.

KIUC may implement additional minimization measures to further reduce take through the monitoring and adaptive management strategies described in Chapter 6, *Monitoring and Adaptive Management Program*.

Appendix 5B, *Light Attraction Modeling for Covered Seabirds*, describes the process for quantifying take of the covered seabirds from attraction to lights owned and operated by KIUC. KIUC light sources covered in the HCP include streetlights, two KIUC covered facilities (Port Allen Generating Station and Kapaia Power Generating Station), and night lighting for emergency repairs. Methods to quantify take are summarized in the following subsections. KIUC assumed take associated with light attraction primarily for non-breeding birds (i.e., fledglings); therefore, a negligible amount of indirect take of eggs or chicks from killed or injured adults is anticipated. KIUC assumed 96 percent of fallout consisted of fledglings and the remainder were breeding adults.[15]

Fallout from Streetlights

The streetlight assessment applied an approach developed in collaboration with USFWS and DOFAW to assign fallout documented by the SOS Program to streetlights based on the proportional contribution of those lights to the lightscape of Kauaʻi. The proportional assessment was developed using remotely sensed radiance (brightness) collected by a sensor on the Suomi National Polar-Orbiting Partnership Satellite. This sensor is designed to provide global measurements of the intensity of nocturnal visible and near-infrared light on a daily basis (Cao et al. 2020). The process used to estimate fledgling fallout due to streetlights included the following steps.

1. Partition radiance data from 2018 on Kauaʻi according to the existing spatially explicit SOS sectors that encompass all areas of the island with streetlights.[16]
2. Assess recent island-wide satellite data of the lightscape on Kauaʻi in 2018.
3. Estimate the radiance generated by a single streetlight based on a sample of remote streetlights that are isolated from other sources of nighttime light.
4. Estimate the proportional contribution of streetlights to radiance by sector.
5. Derive an estimate of fallout occurring due to streetlights in each sector.
6. Apply a correction factor to account for seabirds that were grounded but not detected.

KIUC compared three methods for estimating radiance per streetlight: nonparametric bootstrapping, Bayesian regression, and cross validation. All three methods produced similar estimates with overlapping confidence limits. KIUC concluded from its variance analysis that, during the months of maximal fallout (October and November), there is a predictable relationship between streetlight count per sector and the radiance of that sector, and that this relationship can be used to estimate the radiance of an area given the number of streetlights. This held true regardless of whether the method used to estimate variance was derived from bootstrapping, Bayesian regression, or cross validation. Given the insensitivity of the results to the alternative analytical approaches examined, and that the bootstrapping approach relies on fewer parametric assumptions than the alternatives, the original method of bootstrapping was applied to the analysis (Appendix 5B, *Light Attraction Modeling for Covered Seabirds*).

The correction factor KIUC used to account for seabirds that were grounded but not detected by citizens and turned in to SOS was based on literature that provided insight into the lower limit of detectability. KIUC estimated a detectability rate of 10.4 percent. The reasoning and calculation used to drive this assumption are explained below.[17]

Podolsky et al. (1998) searched intensively for dead birds in proximity to powerlines in urban and suburban areas, inconspicuously marked all dead individuals, and coordinated with the SOS Program to determine if any of these dead birds were subsequently turned in by citizens. In total, 50 dead birds were marked and 8 were found by citizens and turned in to SOS. This would indicate that

[15] 96 percent fledglings assumption is based on Raine et al. (2020a).

[16] SOS has partitioned Kauaʻi into 35 spatially explicit sectors to understand the spatial distribution of seabird injuries.

[17] Also see Appendix 5B, *Light Attraction Modeling for Covered Seabirds*, for additional details.

SOS had a 16 percent (8 SOS birds/50 total dead birds) discovery rate of dead birds. However, as Travers et al. (2021) specifically noted, "residents are extremely unlikely to pick up a dead bird and pass it on to [SOS] thus resulting in an underestimate of this cohort". Given that, this discovery rate is likely a worse-case scenario for the detectability of live birds.

Despite considering the 16 percent a minimum detection rate for live birds, there are confounding aspects that can interfere with the detection of live birds that needed to be factored in. Specifically, live birds can be mobile and thus have the ability to hide. To account for this, it was assumed that the 50 dead birds were alive and that there were an unknown number of additional dead birds that would remain undiscovered and would never be turned into SOS. Data from Travers et al. (2021) indicated that 35 percent of grounded birds were dead. Knowing the number of documented live birds (50) and the ratio of birds that are alive (100 percent minus 35 percent) allows the additional number of grounded birds that are dead and will remain undetected by SOS searcher to be calculated using the following equation.

$$Count\ of\ dead\ birds = \frac{50\ live\ birds * 35\ percent\ of\ birds\ found\ dead}{65\ percent\ of\ birds\ found\ live} = 26.9$$

In this scenario, there would be a total of 76.9 birds (50 live and 26.9 dead) available to be discovered and submitted to SOS, with just 8 live birds ultimately being turned into SOS; thus, the overall detectability rate for SOS from fallout at streetlights would be 10.4 percent (8 found birds divided by 76.9 grounded birds).

For the purpose of this HCP, it is assumed that take from fallout, whether detected or not, will result in 100 percent mortality in the population dynamics model, even though an unknown percentage of those birds are turned in to SOS, subsequently released, and survive to reproduce later. Although KIUC has applied measures to minimize light attraction and will continue to apply minimization as described in Chapter 4, Section 4.4.2, *Conservation Measure 2. Implement Measures to Minimize Light Attraction*, the extent to which these measures reduce take attributed to KIUC streetlights is not quantifiable; therefore, this HCP uses assumptions as described above and in Appendix 5B, *Light Attraction Modeling for Covered Seabirds*.

Fallout from Lights at KIUC Covered Facilities

For the two covered facilities, Port Allen Generating Station and Kapaia Power Generating Station (Chapter 2, *Covered Activities*), take was estimated using the average number of downed birds found at each facility as documented in KIUC facility monitoring logs (Kaua'i Island Utility Cooperative 2024) and the SOS database. The take estimate for KIUC facilities is based on an 8-year average (2016–2023) for Newell's shearwater ('a'o) and a 13-year average (2011–2023) for rarer species (i.e., Hawaiian petrel ['ua'u] and band-rumped storm-petrel ['akē'akē]).

This is a conservative estimate, since KIUC began dimming the lights in 2019 during the fallout season and drastically reduced fallout/take to zero birds in 2019 and one bird in 2020.

KIUC factored in a searcher efficiency correction of 25 percent for the data from covered facilities. A detectability factor greater than the detectability factor for streetlights (10.4 percent) was used for several reasons. First, 50 percent is the detectability rate used for similarly monitored facilities covered in the Kaua'i Seabird HCP (KSHCP), although annual reports from this effort have indicated that a 50 percent detectability rate is overly optimistic (State of Hawai'i Division of Forestry and Wildlife 2020). Also, KIUC covered facilities are fenced and monitored for pests, which greatly reduces predation of downed birds prior to detection and rescue. KIUC uses traditional pest control methods such as traps and pest control for rats and mice. Any stray cats that make it into the fenced facilities are captured using live traps and removed from the property. KIUC trains staff to identify and search for covered species and these trained staff conduct focused, dedicated searches for downed seabirds during the seabird fallout season twice daily (3–4 hours after sunset and one hour before sunrise) (Chapter 4, Section 4.4.2, *Conservation Measure 2. Implement Measures to Minimize Light Attraction*, and Chapter 6, Section 6.4.2, *Light Attraction Monitoring and Adaptive Management*). Searchers are equipped with an Oppenheimer Seabird Recovery Kit and recovered birds are transported to an SOS Aid Station (Appendix 5B, *Light Attraction Modeling for Covered Seabirds*). KIUC staff have monitored and maintained inspection logs for these facilities during the seabird fallout season (September 15 through December 15) since 2011.

Fallout from Night Lighting for Restoration of Power

In rare cases when KIUC must illuminate work areas at night to restore power when equipment failure or powerline damage occurs, this may cause covered seabird fallout. As described in Chapter 2, Section 2.2.2, *Night Lighting for Repair of Facilities*, an estimated 85 hours of cumulative night lighting during the seabird fallout period will be needed for repairs over the 50-year permit term, in limited locations where repairs are needed. Because the take estimate for streetlights is conservative as described above, and fallout from lighting at temporary work areas is expected to be rare, this HCP assumes that take attributable to the operation of night lighting for restoration of power falls within the take estimated for streetlights. That is, any take as a result of night lighting is not distinguished from take associated with streetlights.

Estimating the Form of Take

KIUC is quantifying take from light attraction in terms of the amount of fallout (i.e., number of birds that fall out of the sky), as described above. There are no data or estimates available on the fate of all birds that fall out from light attraction.

For the purpose of this HCP, it is assumed that take from fallout, whether detected or not, will result in 100 percent mortality. This assumption provides a conservative estimate of effects. An unknown percentage of birds that experience fallout are turned in to SOS, subsequently released, and survive to reproduce later. However, successful rescue and release is not factored into the take request associated with fallout.

Because fallout is assumed to consist of primarily non-breeding birds (i.e., fledglings), (see Section 5.2, *Effects Pathways*), fallout is expected to result in only a small amount of indirect take of eggs or chicks. KIUC assumed 96 percent of birds that experience fallout will be fledglings, with the remainder (4 percent) being breeding adults. Therefore, 4 percent of seabird fallout was assumed to result in indirect loss of eggs or chicks.

5.3.1.4 Take from Management at Conservation Sites—Methods

To estimate the number of covered seabirds anticipated to be taken as a result of management at the conservation sites, KIUC evaluated data from 2015 through 2024 on seabirds affected by management actions for all of KIUC's conservation sites during that period. Based on this data, the two seabird species that are likely to be affected by management actions at the conservation sites are Hawaiian petrel (ʻuaʻu) and Newell's shearwater (ʻaʻo).

From 2015 through 2024, a total of 57 birds, 55 of which were Hawaiian petrel (ʻuaʻu) and Newell's shearwater (ʻaʻo), were affected by management actions at the conservation sites with the primary cause being predator trapping (impacts on covered waterbirds are discussed further in Section 5.4, *Effects on Covered Waterbirds*). In response to these incidents, predator trapping methods were refined to reduce the risk of seabirds getting trapped without compromising trapping effectiveness. To account for these changes in trapping methods, data from 2020 through 2024 were used to estimate take and calculate the ratios of species, mortality, injury, and non-injury expected as a result of impacts from conservation site management activities.

On average there were an estimated 2,318 Hawaiian petrel (ʻuaʻu) breeding pairs (4,636 individuals) and 1,289 Newell's shearwater (ʻaʻo) breeding pairs (2,578 individuals) from 2020 to 2024 across the KIUC conservation sites (Kauaʻi Endangered Seabird Recovery Project 2020, 2021; Raine et al. 2022, 2023, 2024). Over this same period, a total of 36 seabirds were affected: 30 Hawaiian petrel (ʻuaʻu) and 6 Newell's shearwater (ʻaʻo). On average from 2020 to 2024, there were 6 Hawaiian petrel (ʻuaʻu) and 1 Newell's shearwater (ʻaʻo) affected by management activities at the conservation sites annually. Therefore, over this period conservation site management activities resulted in impacts on 0.13 percent of the breeding population for Hawaiian petrels (ʻuaʻu) and 0.05 percent of the breeding population for Newell's shearwater (ʻaʻo) annually.

Of the 36 incidents affecting covered seabirds from 2020 to 2024, 83.3 percent resulted in no injury, 2.8 percent resulted in injury, and 13.9 percent resulted in mortality. Assuming incident rates will increase as the presence of seabirds and density of burrows increases at the conservation sites, KIUC doubled these rates—0.26 percent for Hawaiian petrel (ʻuaʻu) and 0.09 percent for Newell's shearwater (ʻaʻo)—to calculate the take for the permit term and applied it to the target viable metapopulation of 2,500 breeding pairs (5,000 individuals) of each species for a take of 647 Hawaiian petrels (ʻuaʻu) and 233 Newell's shearwaters (ʻaʻo) over the 50-year permit term. For estimating the indirect take of eggs and chicks resulting from loss of adults, one mortality of one chick is assumed for every adult mortality or injury. The estimated take breakdown by no injury, injury, and mortality is shown in Tables 5-7a and 5-7b for Newell's shearwater (ʻaʻo) and Tables 5-10a and 5-10b for Hawaiian petrel (ʻuaʻu).

This estimate is considered conservative because it is based on assuming all affected birds are breeders, although at least a portion of birds affected by trapping are likely to be prospecting birds. Non-breeders (prospecting birds) are generally more active in the conservation sites due to exploring the site in search of burrow locations. Breeding birds have an established burrow location that they return to each year, which generally means they wander about the site less frequently than non-breeders. These movement patterns have been observed at KIUC managed sites since 2011. Based on the data, most incidents occur in the months of April through July, which overlaps with the timeframe when prospecting birds typically occur at the sites.

5.3.1.5 Impacts of the Taking—Methods

The federal ESA requires that the HCP applicant analyze the impact of the taking on the covered species, which should be described relative to the species' reproduction, numbers, and distribution (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016). The Hawaiʻi ESA has the same requirement.[18] This analysis evaluates the *impacts* of the taking on the species as a whole (or a portion of the species' range that coincides with the Plan Area), and on the species' long-term survival and likelihood of recovery.

[18] Hawaiʻi Revised Statute Section 195D-21(b)(2)(C).

Although there has been historic take of the covered seabirds from KIUC operations, the impact of the taking assessed in an HCP is based on the take authorized within the HCP's permit term. The impacts of take that has occurred prior to permit issuance are factored into the population dynamics models because the models assess effects relative to the current status of the island-wide metapopulation, which, in turn, is based on past effects from all threats as well as past powerline strikes and minimization projects. Using estimated trends from radar survey data to initialize the model also integrates the effects of powerline collisions and light attraction fallout prior to the HCP, to the extent available data allow, because the initial modeled trend is based on radar survey data starting in 1993.

Although not a required component of an HCP, KIUC evaluated the extent to which the proposed minimization measures are expected to reduce impacts on the Newell's shearwater (ʻaʻo) Kauaʻi metapopulation compared with a scenario in which this minimization did not occur. To do this, KIUC compared modeled abundance trends based on the proposed take with modeled abundance trends under a hypothetical situation in which powerlines have not been minimized as provided for by this HCP[19] (i.e., static wires not removed, no powerline reconfiguration, no bird flight diverters installed); this is called the "take with no minimization or conservation" comparison (Table 5-3).

To evaluate the impacts of the taking on the species, KIUC compared the impacts of the taking on the modeled Kauaʻi metapopulation abundance trajectories (1) without take from KIUC covered activities (the no-take/no HCP comparison), and (2) with take from KIUC covered activities including minimization but without conservation actions (proposed take with minimization only comparison). Section 5.3.1.1, *Use of Population Dynamics Models*, provides additional information on these scenarios. KIUC evaluated these comparisons under both the *worse-case* scenario and the *stable trend* scenario.

A population dynamics model could not be developed for band-rumped storm-petrel (ʻakēʻakē) due to their rarity and a lack of species-specific data. Impacts of the taking on band-rumped storm-petrel (ʻakēʻakē) were addressed qualitatively. The qualitative analysis for impacts of the taking on the band-rumped storm-petrel (ʻakēʻakē) included similar considerations as the quantitative analysis for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) in terms of evaluating the taking in the context of the overall distribution and abundance of this species and relative to the estimated metapopulation on Kauaʻi.

5.3.1.6 Benefits of the Conservation Strategy and Net Effects—Methods

For each covered seabird species, KIUC assessed the benefits of the conservation measures (see Chapter 4, *Conservation Strategy*) and evaluated these benefits in combination with the impacts of the taking to ascertain the net effects of the HCP on the species.

To evaluate the benefits of the conservation strategy and net effects on Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), KIUC used the population dynamics model scenarios summarized above and described in detail in Appendix 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*, and Appendix 5E, *Population Dynamics Model for Hawaiian petrel (ʻuaʻu)* on *Kauaʻi*. Using the model for each species to evaluate the benefits of the conservation strategy, KIUC compared the modeled abundance trends with and without the conservation strategy, all other factors being equal. That is, KIUC compared the proposed take with minimization only comparison (minimized take without mitigation) and a comparison that assumes full implementation of the HCP (HCP

[19] In this scenario, minimization that occurred for the Short-Term HCP is still applied.

scenario/minimized take with mitigation) (Table 5-3). KIUC assessed these results under both the worse-case scenario and the stable trend scenario, to evaluate a range of possible outcomes. Section 5.3.2.4, *Beneficial and Net Effects*, and Section 5.3.3.4, *Beneficial and Net Effects*, provide the results of this analysis. These sections also illustrate the timing of conservation benefits and when they occur relative to the impacts.

The modeled abundance trend outcomes for the entire Kauaʻi metapopulations of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) help evaluate the combined adverse effects of the HCP covered activities and the beneficial effects of the HCP conservation measures. Benefits of the conservation strategy and net effects on band-rumped storm-petrel (ʻakēʻakē) were estimated qualitatively, incorporating the impacts of the taking (5.3.4.2, *Impacts of the Taking*), and making qualitative assumptions regarding the benefits of the conservation measures on this species.

KIUC's commitment is to provide for the survival of the Kauaʻi metapopulations of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) to an extent that is representative of a Kauaʻi viable metapopulation, as articulated in the biological goals and objectives. It is important to note that the population metrics for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) described in biological objectives 1.3 and 2.3, respectively (see Table 4-1), are based on the population dynamics model under the worse-case scenario, not the stable trend scenario. This approach is appropriate because these metrics at the conservation sites would be most difficult to meet under a scenario with the lowest plausible intrinsic growth rate, which is the case under the worse-case scenario.

The estimates for requested take of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), in contrast, are based on the stable trend scenario of the population dynamics model. This approach is consistent with the recent radar and powerline monitoring data and provides a more realistic take estimate consistent with powerline monitoring data since 2013. In addition, this approach avoids underestimating take of the covered species during HCP implementation and therefore reduces the risk of an HCP amendment early in implementation (see Section 5.3.1.1, *Use of Population Dynamics Models*, for further explanation).

Although the two population dynamics model scenarios provide upper and lower bounds on plausible trends in abundance and associated levels of future take under the HCP, several key assumptions differ between the two scenarios. In particular, for the worse-case scenario, the underlying biological assumptions are more conservative, i.e., the "intrinsic[20]" rate of increase in abundance for the worse-case scenario is lower than modeled under the stable trend scenario. The biological assumptions differ between the scenarios because given estimated anthropogenic mortality levels, it is not possible to match the observed stable radar trend since 2010 unless natural survival rates—and hence reproductive success rates, which are a function of breeding adult survival rates—are higher than assumed in the worse-case scenario (see also Appendix 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*, and Appendix 5E, *Population Dynamics Model for Hawaiian petrel (ʻuaʻu)* on *Kauaʻi*, and Attachments 5D-1 and 5E-1). The different sets of biological assumptions between the scenarios are needed to span the range of plausible field conditions given gaps and uncertainties in available data.

Because of the differences in biological assumptions between scenarios, results from one scenario cannot be compared with results from the other scenario to draw conclusions of interest to

[20] "Intrinsic" refers to rate of increase in abundance that would result in the PDM given "natural" vital rates, which are those values for vital rates assumed or estimated in the absence of anthropogenic impacts, including powerline collisions, fallout and non-native predators.

management. For example, it would be incorrect to calculate the take offset by comparing growth in abundance under the worse-case scenario to the projected take under the stable trend scenario. This definition of offset would be internally inconsistent, being based on two different sets of underlying biological assumptions. In other words, the higher levels of projected take under the stable trend scenario would not be biologically possible under the more conservative assumptions of the worse-case scenario. Likewise, attempting to derive offset using projected take from the worse-case scenario relative to projected growth from the stable trend scenario would also lead to an incorrect conclusion of offset under the HCP. In this example, comparing projected levels of take from one scenario against rates of growth in abundance in the other scenario cannot be done because the species cannot simultaneously have two intrinsic rates of growth in abundance.

5.3.2 Requested Take and Effects on Newell’s Shearwater (‘a‘o)

This section specifies KIUC’s requested take for Newell’s shearwater (‘a‘o), analyzes the effects of the take, and evaluates the beneficial and net effects of KIUC’s conservation measures. Section 5.3.2.1, *Level of Take*, provides the upper limits of take KIUC is requesting for Newell’s shearwater (‘a‘o). Section 5.3.2.2, *Population Dynamics Model Results*, compares population dynamics model results between the worse-case and stable trend scenarios. Section 5.3.2.3, *Impacts of the Taking*, describes the extent to which KIUC will minimize take, and describes the impacts of the minimized taking consistent with Section 10(a)(2)(A) of the federal ESA. Section 5.3.2.4, *Beneficial Effects and Net Effects*, describes how measures to offset the requested (minimized) take will result in a net benefit (as required by the state ESA) to the Kaua‘i metapopulation of this species and offset the impact of the taking (as required by the federal ESA).

5.3.2.1 Level of Take

Table 5-6 describes how the assumed outcomes of powerline strikes are calculated and how the take request for powerline strikes was determined. Table 5-7a and 5-7b provide the total requested take amounts for Newell’s shearwater (‘a‘o) and estimated amounts for each form of take for the 50-year permit term (Table 5-7a) and annually (Table 5-7b). KIUC requests all forms of take of Newell’s shearwater (‘a‘o) that result from the following.

- Up to 280,476 strikes over 50 years of adults and subadults from existing powerlines resulting in indirect take of 29,899 eggs and chicks, for a total take of 310,375 from existing powerlines.
- Up to 12,558 strikes over 50 years of adults and subadults from new powerlines resulting in indirect take of 1,339 eggs and chicks, for a total take of 13,897 from new powerlines.
- Fallout of up to 3,345 individuals over 50 years from light attraction of existing KIUC-owned and operated streetlights, resulting in indirect take of up to 134 eggs and chicks, for a total take request of 3,479.
- Fallout of up to 1,025 individuals over 50 years from light attraction of new KIUC-owned and operated streetlights, resulting in indirect take of up to 41 eggs and chicks, for a total take request of 1,066.
- Fallout of up to 650 individuals over 50 years from light attraction of existing KIUC-owned and operated facilities, resulting in indirect take of up to 26 eggs or chicks, for a total take request of 676.

- Injury or mortality of up to 39 individuals (mortality of 32 and injury of 7), and no observed injury of 194 birds over 50 years as a result of management actions at the conservation sites, resulting in indirect take of up to 39 eggs or chicks for a total take request of 272.

The estimates for amount of take associated with each form of take (Tables 5-7a and 5-7b) is a rough approximation based on the best available data. Because the fate of birds resulting from powerline collisions and fallout cannot be measured in the field (see explanation in Section 5.3.1, *Methods for Quantifying Take and Assessing Effects on the Covered Seabirds*), informed assumptions based on the best available data will be used to estimate outcomes of strikes and fallout, and the effect of take on the population. .

Table 5-6. Powerline Strike Take Request and Form of Take Calculations

			Estimates by Assumed Outcomes of Powerline Strikes, From Travers et al. 2021 study, see Table 5-5			Indirect take
Source of Take	**Unit of Take**	**Take request**	**Mortality (take)**	**Non-lethal Injury (take)**	**No Observed Injury (assumed take)**	**Eggs and Chicks**
New and existing powerlines	Powerline strikes	a+b+c+d	a	b	c	d
Calculations for powerline strike mortality, injury, and no observed injury (powered flight). Take request includes all estimated powerline strikes, regardless of outcome, and the indirect take of chicks and eggs. The no observed injury category (c) assumes no mortality or injury, as defined[a].		*Total estimated powerline strikes based on the PDM, and indirect take of chicks and eggs.*	28.8% * total strikes (+ loss of chick or egg)	24.5% * total strikes (+ loss of chick or egg)	46.7% * total strikes (no mortality or injury)	20% * (a + b)

[a] Mortality and non-lethal injury are assumed to result in loss of egg or chick. No observed injury might result in minor injury but not to the extent that an egg or chick is lost.

Table 5-7a. Newell's Shearwater (‘a‘o) Requested Take Over Permit Term by Unit of Take (Powerline Strikes, Fallout, and Conservation Site Management), and Estimated Amount by Form of Take based on Stable Trend Scenario

		Total Over 50 Years				
			Estimates by Form of Take[a, g]			
Source of Take	**Unit of Take**	**Request by Unit of Take[f, g]**	**Mortality[b]** (adults+sub-adults)	**Non-lethal Injury[c]** (adults+sub-adults)	**No Observed Injury[d]**	**Indirect Take of Eggs and Chicks[e]** (adult mortality + adult injury)
Existing powerlines	Powerline strikes[f]	310,375	80,777	68,717	130,982	29,899
New Powerlines	Powerline strikes[f]	13,897	3,617	3,077	5,865	1,339
Existing streetlights	Fallout (light attraction)	3,479	3,345	-	-	134
New streetlights	Fallout (light attraction)	1,066	1,025	-	-	41
Covered facilities	Fallout (light attraction)	676	650	-	-	26
Conservation program	Conservation site management[b]	272	32	7	194	39
Total		**329,765**	**89,446**	**71, 800**	**137,041**	**31,477**

[a] These are rough estimates based on the best available data, although little to no data are available for some of these estimates, and it is not possible to track how many birds are injured or killed or how many eggs or chicks are lost due to powerline strikes and fallout. For details on how these were estimated, see Section 5.3.1.2, *Powerline Collisions—Methods*, subsection titled *Estimating the Form of Take.*

[b] For powerline strikes, 28.8% of strikes is a proxy for mortality based on proportion of birds grounded from Travers et al. (2021). The HCP assumes that 100% of fallout due to light attraction results in mortality. For conservation site management, based on data, KIUC assumed 13.9% of birds affected would be killed and that 2.8% would result in non-lethal injury, and the remaining would result in no observed injury.

[c] For powerline strikes, uses 24.5% of powerline strikes as a proxy for non-lethal injury based on proportion of birds that lose elevation but are not grounded, from Travers et al. (2021). For fallout due to light attraction, assumes 100% of fallout results in mortality. Although some birds experiencing fallout will be rehabilitated by SOS, KIUC applied an assumption of 100% mortality for a conservative estimate of effects.

[d] For powerline strikes, assumes 46.7% of strikes may result in minor injuries but not to the extent that an egg or chick is lost. Based on proportion of birds with powered flight, from Travers et al. (2021).

[e] For powerline strikes, assumes 20% of injuries and mortalities are breeding adults and one egg or chick is taken for every breeding adult injured or killed. For lights, as described in Section 5.3.1.3, *Light Attraction and Fallout—Methods*, 4% of fallout was assumed to consist of breeding adults; therefore, 4% of fallout was assumed to also result in indirect take of a chick or egg. For conservation site management, assumed conservatively that all affected birds are breeding adults.

[f] For powerline strikes, the number of strikes are a surrogate metric for take. KIUC requests take of covered seabirds in all forms (mortality, injury, no observed injury, and indirect take of eggs and chicks) associated with the requested take as measured by number of powerline strikes.

[g] All numbers are rounded to nearest whole number. Numbers less than 1 are shown as "<1" to signify a non-zero number, rather than rounding to zero. Numbers may not add up due to rounding.

Table 5-7b. Newell's Shearwater (ʻaʻo) Estimated Average Annual Take by Unit of Take (Powerline Strikes, Fallout, and Conservation Site Management), and Estimated Amount by Form of Take based on Stable Trend Scenario

		Average Annual[a, h]				
			Estimates by Form of Take[b]			
Source of Take	**Unit of Take**	**Estimates by Unit of Take[g, h]**	**Mortality[c]** (adults+sub-adults)	**Non-lethal Injury[d]** (adults+sub-adults)	**No Observed Injury[e]**	**Indirect Take of Eggs and Chicks[f]** (adult mortality + adult injury)
Existing powerlines	Powerline strikes [g]	6,207	1,616	1,374	2,620	598
New Powerlines	Powerline strikes [g]	278	72	62	117	27
Existing streetlights	Fallout (light attraction)	70	67	-	-	3
New streetlights	Fallout (light attraction)	21	20	-	-	1
Covered facilities	Fallout (light attraction)	14	13	-	-	1
Conservation program	Conservation site management [c]	5	1	<1	4	1
Total		**6,595**	**1,790**	**1,436**	**2,741**	**630**

[a] For powerline strikes, these numbers are expected to be highly variable from year to year. The average annual anticipated take is based on the 50-year take limit divided by 50. For annual take estimates based on 5-year rolling averages, see Appendix 6A, Table 6A-1.

[b] These are rough estimates based on the best available data, although little to no data are available for some of these estimates, and it is not possible to track how many birds are injured or killed or how many eggs or chicks are lost due to powerline strikes and fallout. For details on how these were estimated, see Section 5.3.1.2, *Powerline Collisions—Methods*, subsection titled *Estimating the Form of Take.*

[c] For powerline strikes, 28.8% of strikes is a proxy for mortality based on proportion of birds grounded from Travers et al. (2021). The HCP assumes that 100% of fallout due to light attraction results in mortality. For conservation site management, based on data, KIUC assumed 13.9% of birds affected would be killed and that 2.8% would result in non-lethal injury, and the remaining would result in no observed injury.

[d] For powerline strikes, uses 24.5% of powerline strikes as a proxy for non-lethal injury based on proportion of birds that lose elevation but are not grounded, from Travers et al. (2021). For fallout due to light attraction, assumes 100% of fallout results in mortality. Although some birds experiencing fallout will be rehabilitated by SOS, KIUC applied an assumption of 100% mortality for a conservative estimate of effects.

[e] For powerline strikes, assumes 46.7% of strikes may result in minor injuries but not to the extent that an egg or chick is lost. Based on proportion of birds with powered flight, from Travers et al. (2021).

[f] For powerline strikes, assumes 20% of injuries and mortalities are breeding adults and one egg or chick is taken for every breeding adult injured or killed. For lights, as described in Section 5.3.1.3, *Light Attraction and Fallout—Methods*, 4% of fallout was assumed to consist of breeding adults; therefore, 4% of fallout was assumed to also result in indirect take of a chick or egg. For conservation site management, assumed conservatively that all affected birds are breeding adults.

[g] For powerline strikes, the number of strikes are a surrogate metric for take. KIUC requests take of covered seabirds in all forms (mortality, injury, no injury, and indirect take of eggs and chicks) associated with the requested take as measured by number of powerline strikes.

[h] All numbers are rounded to nearest whole number. Numbers less than 1 are shown as "<1" to signify a non-zero number, rather than rounding to zero. Numbers may not add up due to rounding.

5.3.2.2 Impacts of the Taking

This section describes the impact of the taking of Newell's shearwater (ʻaʻo) on the Kauaʻi metapopulation of this species and on the species as a whole, as required under Section 10(a)(2)(A)(i) of the federal ESA. Beneficial effects of measures to offset these impacts are described in Section 5.3.2.4, *Beneficial Effects and Net Effects*.

This section provides a brief background on the species' status and trends and describes why and how the species is vulnerable as a result of ongoing mortalities. It describes the adverse effects KIUC covered activities have had on the metapopulation in the past, and the potential implications of ongoing unminimized take. This section then describes how KIUC's take minimization measures under the HCP are expected to improve outcomes for the metapopulation, under both the worse-case scenario and the stable trend scenario. It then describes the impacts of the proposed, minimized take under both initial trend scenarios. Finally, this section provides a conclusion on the impacts of the taking based on the supporting information herein.

Species Status and Trends

The range-wide breeding population of the Newell's shearwater (ʻaʻo) is distributed on Kauaʻi, Maui, and Hawaiʻi, with a smaller number on Oʻahu. Approximately 90 percent of the breeding population is on Kauaʻi (Appendix 3A, *Species Accounts*). Radar and SOS data indicate that Newell's shearwater (ʻaʻo) abundance in the eastern, southern and portions of the northern regions of Kauaʻi sharply declined through the 1990s and first decade of the 2000s. However, subsequent radar data in addition to SOS and powerline strike data indicate that the abundance trends for these breeding populations on Kauaʻi have been relatively stable since 2010, albeit at reduced abundance levels compared to the 1990s. The three data sources, when taken together, provide independent corroborating evidence that there is has been no appreciable trend in abundance since 2010 in areas outside northwestern Kauaʻi (i.e., recent abundance has been neither increasing nor decreasing). Little long-term data is available for the Nā Pali Coast (outside the conservation sites), but acoustic sensor and auditory survey data indicate that there are relatively high numbers of Newell's shearwater (ʻaʻo) in this area of Kauaʻi. However, there is no clear signal from available acoustic data, i.e., since 2014, that there has been a significant trend in abundance (up or down). Finally, 12 years of systematic acoustic monitoring of call rates at the conservation sites have demonstrated ongoing positive trends in abundance under existing predator control measures. Those trends in abundance are also corroborated by independent burrow monitoring data at the conservation sites. Observed reproductive success rates from burrow monitoring have been very high at the conservation sites during the last decade, which is consistent with the data on increasing call rates and hence increasing abundance over the same time period. Chapter 3, Section 3.2.1, *Covered Seabirds*, and Section 5.3.1.1, *Use of Population Dynamics Models*, provide additional background information on abundance trends for the Kauaʻi metapopulation of this species.

Effects of Covered Activities on Species Status and Trend

Because the Newell's shearwater (ʻaʻo) reproductive strategy has evolved to have high adult survivorship with a relatively low number of offspring, adult mortality is particularly detrimental to the species. Left unchecked, low adult survivorship (i.e., high adult mortality), along with reduced reproductive success and chick survivorship, will depress the population to a level where it can become vulnerable to extirpation. Small subpopulation sizes can result in poor colony recruitment, which further decreases the species population viability. The historic decline of the Newell's shearwater's (ʻaʻo) Kauaʻi metapopulation is the result of a variety of factors including powerline strikes, light attraction fallout, predation by introduced species, stochastic events such as hurricanes that damage breeding habitat, and climate shifts potentially altering shearwater food availability.

Operation of KIUC infrastructure has had substantial adverse effects on the Kauaʻi metapopulation of this species for decades. Unminimized seabird powerline collision rates affect the age structure of the population by removing large portions of subadult and adult individuals annually from the population, predominantly in the Hanalei to Kekaha area. Light attraction associated with KIUC's covered activities has also had adverse effects on population structure predominantly in the Hanalei to Kekaha area, but less than powerline collisions because most take associated with light attraction (over 95 percent; see Table 5-2) is associated with first-year, non-breeding birds. In addition, the number of adult mortalities from light attraction are estimated to be an order of magnitude lower than from powerline collision (4,365 vs. 84,394 over the permit term).

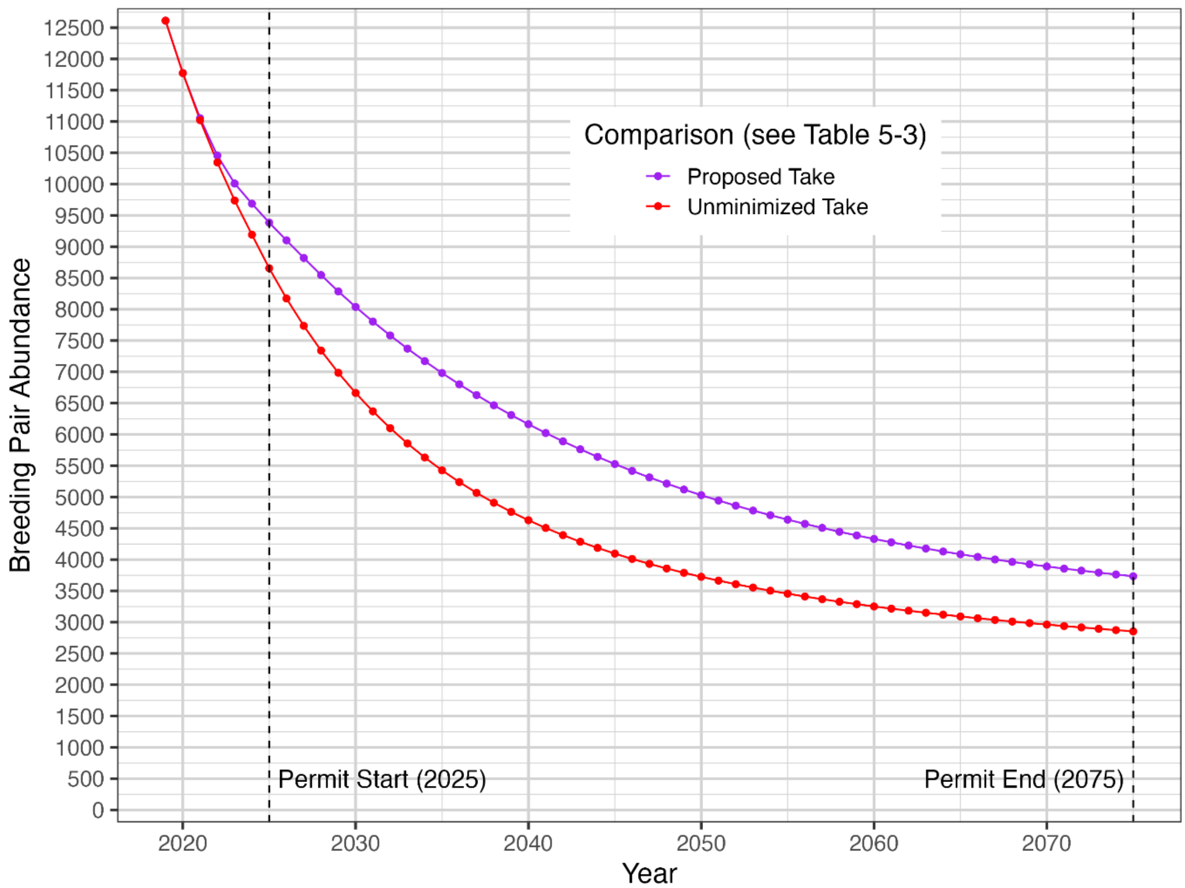
Fallout from light attraction still has an effect on the number of prospecting birds remaining in the population returning to breed. Collectively, the long-term effects of powerline collisions and fallout from attraction to streetlights, combined with severe predation and habitat modification (Raine et al. 2017), are likely the primary reasons the metapopulation is at historically low levels. See Chapter 3, Section 3.2.1*, Covered Seabirds*, for a more in-depth description of past impacts on the Kauaʻi metapopulation. Because at least 90 percent of the range-wide individuals of Newell's shearwater (ʻaʻo) occur on Kauaʻi, a Kauaʻi viable metapopulation is critical to the species' survival and recovery.

Effects of Minimization

Reduction of annual Newell's shearwater (ʻaʻo) collisions with existing powerlines consistent with Objective 1.1 is a significant step toward reducing the decline of this species on Kauaʻi. The minimization measures will result in substantial ongoing reduction in take compared with the unminimized condition throughout the permit term. Chapter 4, Figures 4-5a and 4-5b show the amount of collision risk reduction expected throughout Kauaʻi, both in terms of absolute risk reduction (Figure 4-5a) and proportional risk reduction (Figure 4-5b).

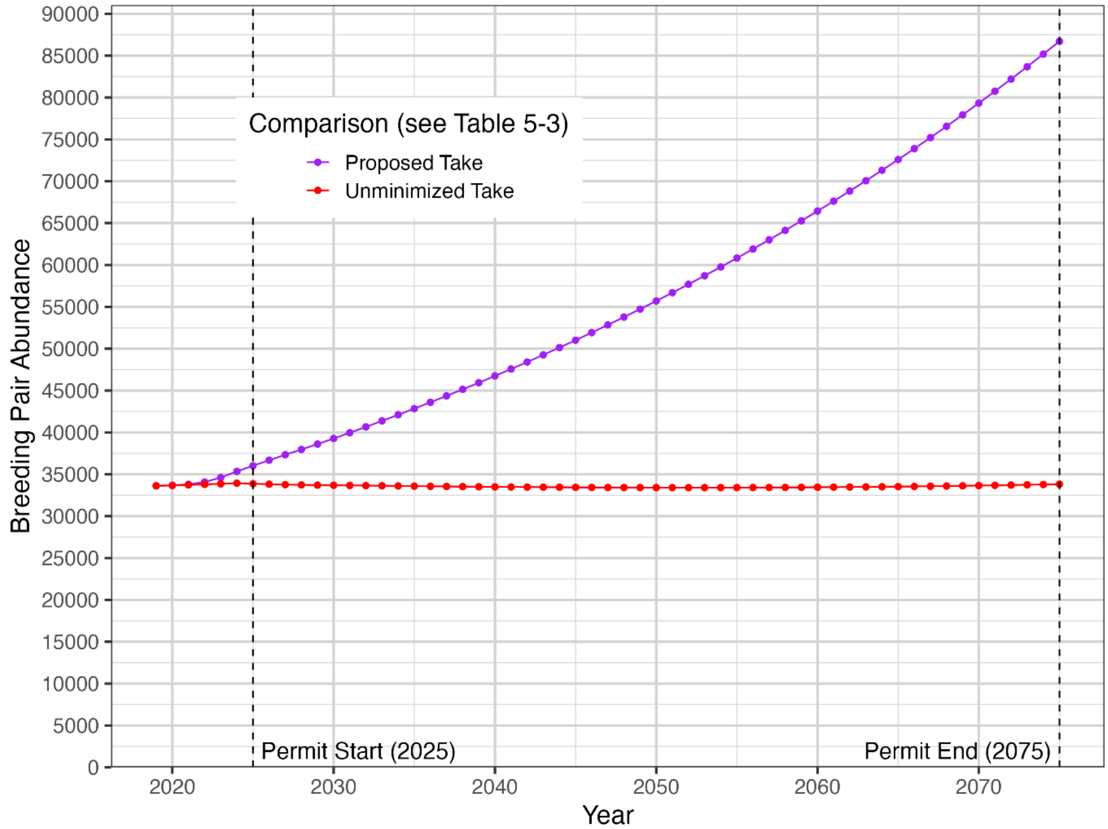
Take limits have been established for the HCP based on this expected take minimization. Chapter 6, Section 6.4.1.2, *Take Monitoring of Powerline Strikes*, describes how take will be monitored and minimization measures will be adaptively managed to ensure the take limit is not exceeded. As shown by comparing the take with no minimization or mitigation and proposed take with minimization only comparisons on Figure 5-3 (see Table 5-3 for description of each comparison), this estimated reduction in collisions is expected to improve the population rate of change. This is the anticipated result of retaining more adults and subadults, improving demography, age class structure, and population size.

The differences between minimized and unminimized take are greater under the stable trend scenario (Figure 5-3b) than under the worse-case scenario (Figure 5-3a) because under the stable trend scenario there are more birds in areas vulnerable to powerline collisions, which is anticipated to result in a higher anticipated annual strike rate. In contrast, under the worse-case scenario, the majority of birds in the Hanalei to Kekaha area are assumed to be rapidly declining, resulting in a lower anticipated annual strike rate, and the majority of remaining birds are assumed to be concentrated at the conservation sites, which are far less vulnerable to powerline collisions.



Modeled Kauaʻi metapopulation for Newell's shearwater (ʻaʻo) without powerline strike minimization (red line) vs. with powerline strike minimization (purple line). The difference between these two lines represents the beneficial effects of powerline strike minimization under the worse-case scenario. The benefits of all other conservation measures are excluded. In all similar graphs in this chapter, each dot represents one year.

Figure 5-3a. Worse-Case Scenario: Effects of Minimization on Newell's Shearwater (ʻaʻo) Kauaʻi Metapopulation (All Subpopulations)



Modeled Kaua‘i metapopulation for Newell’s shearwater (‘a‘o) without powerline strike minimization (red line) vs. with powerline strike minimization (purple line). The difference between these two lines represents the beneficial effects of powerline strike minimization under the stable trend scenario. The benefits of all other conservation measures are excluded.

Figure 5-3b. Stable Trend Scenario: Effects of Minimization on Newell’s Shearwater (‘a‘o) Kaua‘i Metapopulation (All Subpopulations)

In addition to the powerline minimization described in the preceding paragraphs, KIUC has committed to minimizing light attraction consistent with Conservation Measure 2*. Implement Measures to Minimize Light Attraction.* Conservation measures with proven success at reducing covered seabird fledgling light attraction have been implemented for KIUC’s existing streetlights (full-cutoff shields for lights), in partnership with the County of Kaua‘i (County) and State of Hawai‘i (State), and KIUC’s covered facility lights. An early study on Kaua‘i showed that the shielding of bright lights reduced fallout of Newell’s shearwater (‘a‘o) fledglings by 40 percent (Reed et al. 1985). Recent studies continue to indicate that the reduction of lateral light spillage reduces light-induced fallout of seabirds (Rodríguez et al. 2017a, 2017b). KIUC also began dimming covered facility lights at the Port Allen Generating Station in 2019 during the seabird fallout season (September 15 to December 15), which reduced Newell’s shearwater (‘a‘o) fallout from an average of five and a half fledglings per year to an average of one fledgling per year (Kaua‘i Island Utility Cooperative 2024). These conservation actions as described above will continue to be implemented during the permit term, including for new lights. Increased fledgling survival increases recruitment, which leads to more future breeding-age individuals in the Kaua‘i metapopulation. Because this species has very low reproductive productivity, increasing recruitment to the breeding-age population, and hence increasing the number of fledglings that can be produced by the metapopulation each year, will contribute to a stable age structure (increased amount of younger age classes in the population), population growth rate, and numbers for the Kaua‘i metapopulation of Newell’s shearwater (‘a‘o).

Impacts of the Taking based on Population Dynamics Model

As described in Section 5.3.1.5, *Impacts of the Taking—Methods*, KIUC evaluated the impacts of the taking over a 50-year period by comparing a hypothetical no-take comparison with the proposed take with minimization only comparison (both without Conservation Measure 4. *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*). The differences between the no-take and proposed take with minimization only comparisons in Figures 5-4a and 5-4b reflect the impact of KIUC's requested take on the species throughout the permit term in the absence of Conservation Measure 4. *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*. Results are presented based on the worse-case model scenario (Figure 5-4a) and the stable trend model scenario (Figure 5-4b).

Population Dynamics Model Results

Table 5-8 compares model results between the worse-case scenario and the stable trend scenario. The following sections describe model results as they pertain to the anticipated level of take, impacts of the taking on the species, beneficial effects of the conservation strategy, and net effects of the HCP (including both take and conservation). As mentioned previously, neither the worse-case nor the stable trend scenario should be considered representative of realistic projections of abundance of the covered seabirds into the future. Instead, the modeled scenarios for these two abundance trends can be viewed as plausible bounds of what may occur given different suites of assumptions and based on the available data. In reality, the outcome from the HCP is likely to be somewhere between the results from the two scenarios. As such, the effects analysis in this chapter examines the results of both scenarios for the purpose of framing the range of possible outcomes for each of the two covered seabird species.

Table 5-8. Newell's Shearwater ('a'o) Model Results for each of Two Scenarios for the Kaua'i Metapopulation

	Model Scenario	
Model Result	**Worse Case**	**Stable Trend**
Metapopulation growth rate at end of permit term (2075)	1%	4%
Starting island-wide metapopulation size (total individuals, all ages) in 2025 (A)[a]	32,293	119,887
Ending island-wide metapopulation size in 2075 (B)[c]	25,930	492,566
Starting abundance at all HCP conservation sites in 2021 (C)	3,967[b]	Same
Ending total abundance at all HCP conservation sites in 2075 (D)[c]	16,939	234,991
Net gain at all HCP conservation sites (E = D – C)	12,972	231,024
Year when island-wide metapopulation growth becomes positive	2055	2021
Total number of predicted powerline collisions over the 50-year permit term (F)	34,554	293,034
Total injury and mortality resulting from powerline collisions over the 50-year permit term (G)	22,537[d]	187,426[d]

[a] Initial abundance is estimated based on assumed trend, unminimized collision estimate, and R_{MAX} model

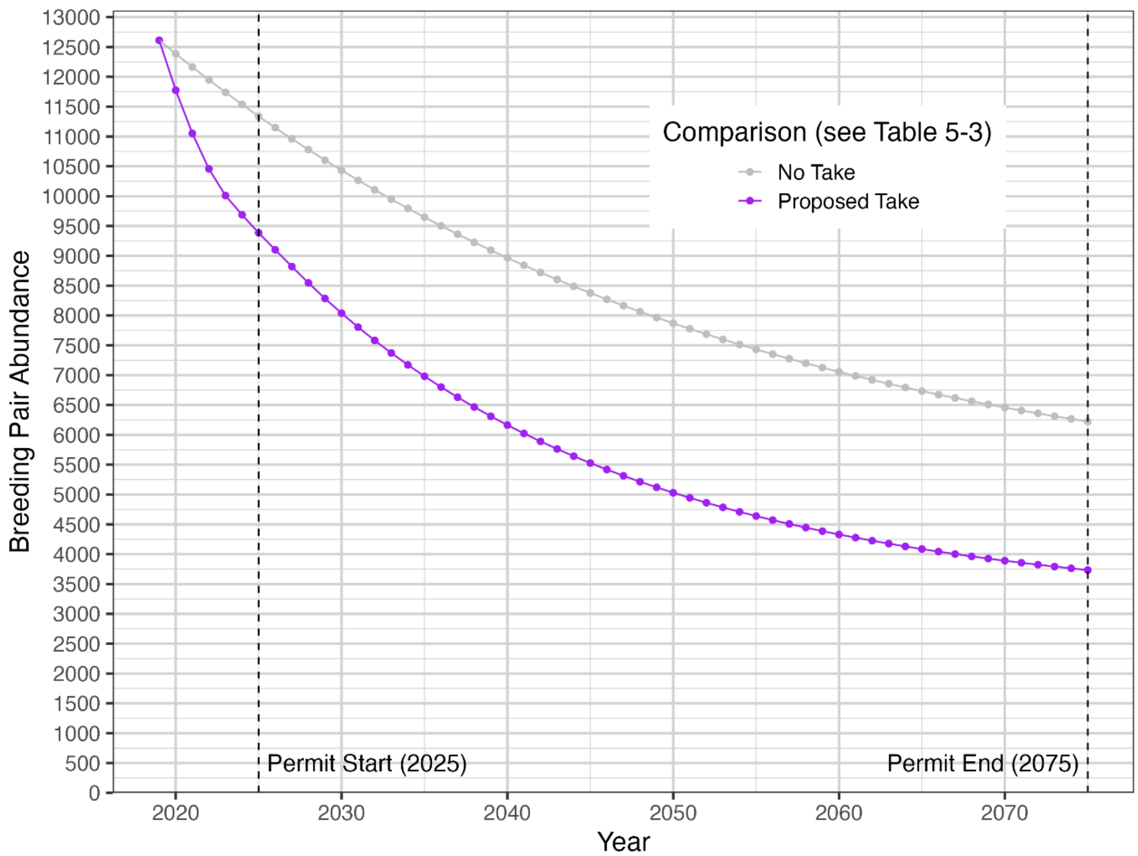
[b] Estimated from burrow monitoring, auditory surveys and habitat suitability modeling

[c] Projected abundance levels do not assume a carrying capacity (i.e., an upper limit to the subpopulation sizes) outside the predator exclusion fences. This approach pertains to both modeling scenarios. Neither scenario is expected to perfectly predict the future. Rather, the two scenarios provide plausible bounds on projected future abundance.

[d] Includes loss of chicks and eggs.

Worse-Case Model Scenario

As described in Appendix 5D, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i*, in the hypothetical absence of take related to KIUC operations,[21] under the worse-case scenario the Kaua'i metapopulation would continue to decline at an estimated annual rate of 1.8 percent per year (Lambda = 0.982[22]; Figure 5-4a, grey line). This is the modeled rate of decline that results from setting powerline and fallout take (from both direct take on individuals and indirect take of eggs and chicks resulting from killed or injured adults) to zero and applying the predation mortality and reproductive success rates estimated at conservation sites prior to implementation of KIUC's predator control measures. The trajectory under the no take/no HCP comparison suggests that the effects of predation and other threats remain substantial contributors to the species' decline even without the adverse effects of KIUC covered activities.



Modeled Kaua'i metapopulation for Newell's shearwater ('a'o) under a hypothetical situation in which there is no KIUC-related take (grey line) vs. with the take proposed under this HCP (purple line). The difference between these two lines represents the impact of the taking on the metapopulation under the worse-case scenario. The benefits of all other conservation measures are excluded.

Figure 5-4a. Worse-Case Scenario: Impacts of the Taking on Newell's Shearwater ('a'o) Breeding Pair Abundance and Trends Prior to Mitigation

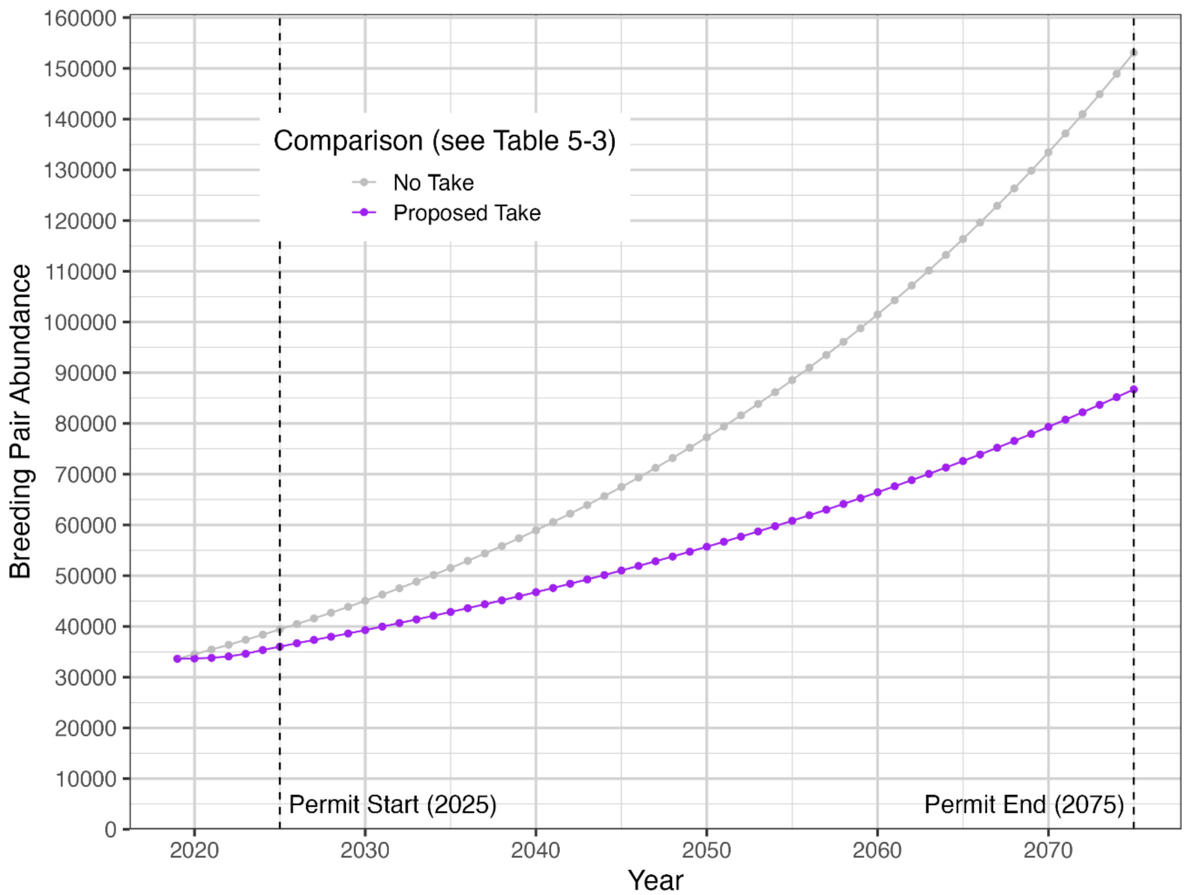
[21] Since KIUC powerlines are already in operation and their removal would be infeasible, this no-take scenario is hypothetical and used only as a basis for evaluating the impact of the taking.

[22] Lambda (λ) represents the annual population multiplier. A lambda of 1.0 indicates a population that is replacing itself but not growing or declining (i.e., a population with consistent numbers through time). A lambda above 1.0 indicates a growing population. A lambda below 1.0 indicates a declining population.

As shown by the purple line on Figure 5-4a, even with powerline collision minimization, under the worse-case scenario, the continued loss of Newell's shearwaters (ʻaʻo) as a result of KIUC covered activities could have an appreciable negative effect on the abundance of the metapopulation of Newell's shearwaters (ʻaʻo) in the absence of mitigation to offset these effects (i.e., without Conservation Measure 4*. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*). Although both the purple line (proposed take only without minimization or mitigation) and grey line (no take/no HCP) indicate ongoing decline of the species, the Kauaʻi metapopulation size under the proposed take with minimization only comparison is well below the metapopulation size under the no-take comparison throughout the permit term. In the absence of mitigation, this population loss could render the species more vulnerable to extirpation on Kauaʻi due to random chance events such as catastrophic weather events, disease outbreaks, or genetic stochasticity. With unmitigated take, the metapopulation could fall to a level at which any future loss in abundance beyond the permit term would be unsustainable, because stressors on the species are likely to continue contributing to the species' decline. Once the population falls below a minimum size for sustaining a viable population, chances of extirpation are high. As described in the following section, however, the proposed conservation strategy is expected to offset the impacts of the taking (as required by the federal ESA) and result in a net benefit to the species (as required by the state ESA), even under the worse-case scenario.

Stable Trend Scenario

Under the stable trend scenario, the Kauaʻi metapopulation would increase substantially under both the proposed take and no-take comparisons, although the increases would be considerably greater for the no-take comparison (Figure 5-4b). While the proposed take would substantially diminish projected abundance levels compared with no-take (Figure 5-4b), the total metapopulation abundance would be considerably higher than under the worse-case scenario and the number of breeding pairs by the end of the permit term would be substantially higher than needed to maintain a Kauaʻi viable metapopulation, even without conservation measures (see *Metapopulation Viability*, in Section 5.3.2.3, *Beneficial Effects and Net Effects*).



Modeled Kaua‘i metapopulation for Newell’s shearwater (‘a‘o) under a hypothetical situation in which there is no KIUC-related take (grey line) vs. with the take proposed under this HCP (purple line). The difference between these two lines represents the impact of the taking on the metapopulation under the stable trend scenario. The benefits of all other conservation measures are excluded.

Figure 5-4b. Stable Trend Scenario: Impacts of the Taking on Newell’s Shearwater (‘a‘o) Breeding Pair Abundance and Trends Prior to Mitigation

Conclusion, Impacts of the Taking

Newell’s shearwater (‘a‘o) is highly vulnerable to ongoing mortalities from various sources, and KIUC’s activities have contributed to the decline of the Kaua‘i metapopulation. KIUC’s minimization measures (without additional compensatory measures) would reduce the downward trend under the worse-case scenario (Figure 5-3a), and contribute to a substantial metapopulation increase under the stable trend scenario (Figure 5-3b). Under both scenarios, the proposed, minimized take would considerably diminish the metapopulation abundance by the end of the permit term compared with a no-take scenario (Figures 5-4a and 5-4b). For example, under the worse-case scenario, the proposed take (with minimization, but no mitigation) is projected to reduce the final metapopulation abundance by approximately 40 percent compared to without take. Under the stable trend scenario, the proposed take (with minimization, but no mitigation) is projected to reduce the final metapopulation abundance by approximately 30 percent compared to without take.

The reduced abundance resulting from take would be expected to have a greater effect on the species under the worse-case scenario (Figure 5-3a) than the stable trend scenario (Figure 5-4b) because the metapopulation numbers could dip to unsustainable levels under the worse-case scenario, as described above. The following section describes beneficial and net effects of KIUC's conservation measures and how those result in full offset of the impacts of the taking and result in net benefits to the species.

5.3.2.3 Beneficial Effects and Net Effects

This section describes the beneficial and net effects of KIUC's conservation measures, including a substantial reduction in predation and increase in the survivorship of chicks produced each year, as well as accelerated colony recruitment through social attraction at conservation sites within predator exclusion fences. These beneficial outcomes will increase reproductive success at Newell's shearwater ('a'o) breeding colonies and prevent considerable declines in the metapopulation abundance under the worse-case and stable-trend scenarios (including extirpation under a worse-case scenario), thereby offsetting the impact of the taking and result in a net benefit to the species.

Beneficial Effects of the Offset Measures

This section addresses beneficial effects of KIUC's measures to offset the minimized take, focusing on Conservation Measure 4. *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites.* This section also provides additional information on the beneficial effects of Conservation Measure 3. *Provide Funding for the Save our Shearwaters Program*. The beneficial effects of conservation measures related to minimization (Conservation Measure 1. *Implement Powerline Collision Minimization Projects*, and Conservation Measure 2. *Implement Measures to Minimize Light Attraction*) have been described above under *Impacts of the Taking*.

The conservation measures to offset take are designed to result in early improvements in the viability of the Newell's shearwater ('a'o) metapopulation on Kaua'i by focusing conservation efforts in areas expected to have the greatest benefit to the species. The early nature of the beneficial effects is described under *Population Dynamics Model Comparison.*

Beneficial Effects of Conservation Measure 4, Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites

As described in Chapter 4, *Conservation Strategy*, KIUC will offset the requested take of Newell's shearwater ('a'o) primarily by managing and enhancing breeding colonies across 12 conservation sites with suitable breeding habitat, and reducing the abundance and distribution of key seabird predators at these sites in northwestern Kaua'i. Through these measures, KIUC will substantially increase the number of breeding pairs and fledglings produced annually to reverse the historic downward trend of this species' Kaua'i metapopulation as determined by radar and acoustic call rates.

Management actions with demonstrated success at improving the reproductive success of Newell's shearwater ('a'o) breeding colonies are ongoing and would continue and be expanded by the HCP for the duration of the permit term.[23] Expanding the scale and types of these conservation actions (e.g., installing predator-proof fencing at feasible sites) is expected to further reduce predation and increase the survivorship of fledglings produced each year. Social attraction within the conservation sites with predator exclusion fences is also expected to accelerate colony recruitment by drawing birds from unprotected colonies into the conservation sites where management is occurring and birds are much more protected. This is expected to benefit the species by moving birds out of areas with higher mortality risk and into conservation sites with lower mortality risk. This emigration

[23] For a history of the conservation sites, see Chapter 4, Section 4.2.4, *Prior KIUC Conservation Measures*.

from colonies outside conservation sites into conservation sites is expected to reduce recruitment levels into breeding colony subpopulations outside of the conservation sites while increasing recruitment into conservation site subpopulations, which is taken into account in the population dynamics model (Appendices 5D, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i*, and 5E, *Population Dynamics Model for Hawaiian Petrel ('ua'u) on Kaua'i*).

Predator control at the conservation sites is expected to maintain high reproductive success rates of Newell's shearwater ('a'o) in these protected conservation sites. Predator control that either establishes predator-free breeding habitat or substantially reduced predation is required to successfully restore productive seabird colonies (Buxton et al. 2014; Jones and Kress 2012; Raine et al. 2020b). Given these are long-lived seabirds with relatively low rates of reproduction (i.e., a single egg per year per breeding pair), adult mortality is particularly harmful to the species. Predation by introduced species has depressed seabird populations to a level where they are extremely vulnerable to extirpation (Raine et al. 2020b).

Terrestrial predator control at conservation sites managed by KIUC has been proven to increase seabird nesting productivity on Kaua'i. For example, Raine et al. (2020b) found that between 2011 and 2017, Newell's shearwater ('a'o) reproductive success rates increased by a mean of approximately 36 percent and 48 percent, respectively, following predator control operations within managed breeding sites. Additionally, Raine et al. (2020b) found that barn owl (*Tyto alba*) control measures, when implemented in a concentrated and systematic fashion, can significantly decrease seabird depredations. Without predator control, Raine et al. found that modeled population trajectories within all management sites declined rapidly over a 50-year period. With predator control measures at KIUC-managed sites, abundance across the conservation sites as measured through trends in call rates from acoustic monitoring has been increasing. For example, call rates of Newell's shearwater ('a'o) at Upper Limahuli Preserve nearly doubled between 2014 and 2022 (Raine et al. 2023).

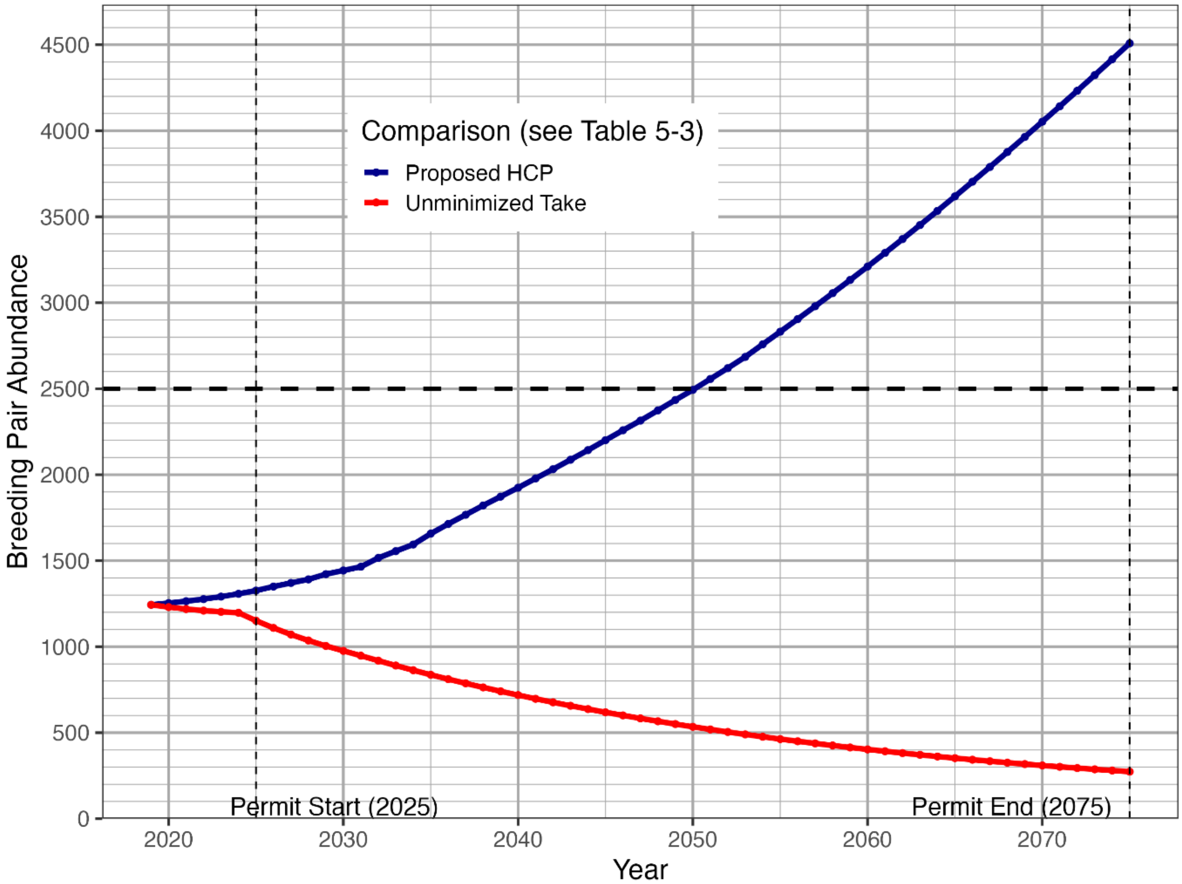
Substantial metapopulation increases and improved survival at the conservation sites, in combination with minimizing take island-wide, are expected to reverse the current island-wide population decline under the worse-case scenario and establish a Kaua'i viable metapopulation that is increasing for each species (as defined by meeting the HCP biological objectives associated with biological goals 1 and 2). Although numbers of breeding pairs are expected to decrease outside conservation sites under the worse-case scenario, redistribution of the metapopulation to the northwestern portion of the island will substantially reduce the vulnerability of Newell's shearwater ('a'o) to predation, powerline collisions, and light attraction, reversing the downward metapopulation trends for these species.

Population Dynamics Model Comparison

KIUC compared a hypothetical outcome without Conservation Measure 4. *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites* (i.e., the proposed take with minimization only comparison) with projected outcomes from the HCP to evaluate the beneficial effects of Conservation Measure 4. *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*. Figures 5-5 through 5-7 provide relevant results from the population dynamics model as they relate to beneficial effects on subpopulations.

Figure 5-5a shows the metapopulation trajectory for Newell's shearwater ('a'o) at all conservation sites combined under the worse-case scenario. Figure 5-5a demonstrates substantial benefits resulting from the conservation strategy, and these benefits are seen early in the permit term.

According to the model, the total breeding pair abundance of Newell's shearwater (ʻaʻo) at all of the conservation sites combined is expected to increase immediately, with the rate increasing continuously through the permit term (blue line). Under this worse-case scenario, the total abundance at the conservation sites alone combined is expected to reach the threshold of 2,500 breeding pairs by approximately 2051,[24] about halfway through the permit term. Conversely, without the conservation strategy, abundance declines throughout the permit term.

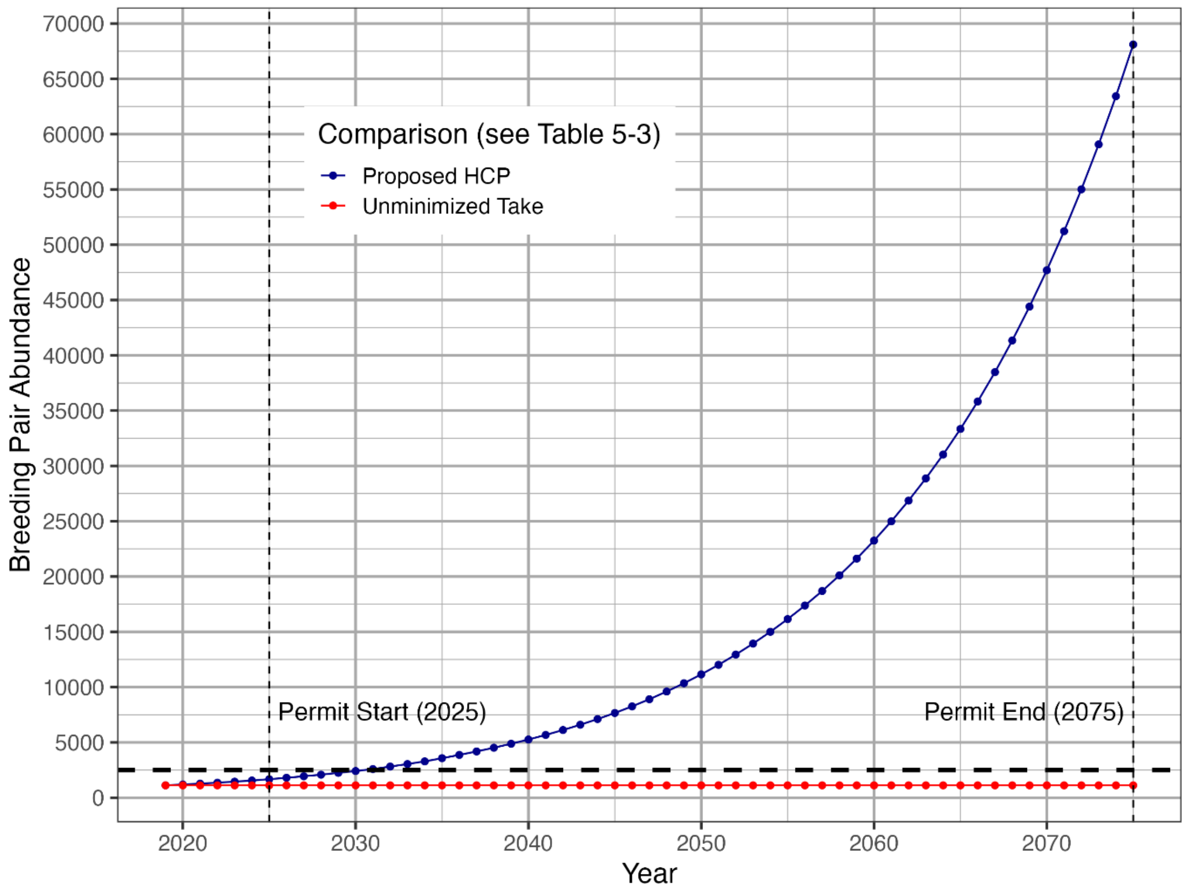


Abundance of Newell's shearwater (ʻaʻo) at all conservation sites with predator control, without the HCP (no minimization or mitigation; red line) vs. with the minimization and mitigation proposed in the HCP (blue line). The difference between these two lines represents the beneficial effects of the combined minimization and mitigation under the worse-case scenario. The dashed black horizontal line indicates 2,500 breeding pairs, the point at which the Kauaʻi metapopulation reaches an abundance that USFWS and DOFAW consider to be a viable metapopulation.

Figure 5-5a. Worse-Case Scenario: Beneficial Effects of Conservation Strategy at all Conservation Sites Combined for Newell's Shearwaters (ʻaʻo)

Figure 5-5b shows the modeled abundance for Newell's shearwater (ʻaʻo) at all conservation sites combined under the stable trend scenario. The red line in Figure 5-5b represents the modeled abundance without minimization or mitigation, indicating a slow growth rate throughout the permit term. In this scenario, natural recruitment is able to slightly overcome the adverse effects of predators (without predator control) and the low risk of powerline collision and light attraction for birds leaving from or arriving at these sites.

[24] As described in Chapter 4, *Conservation Strategy*, 2,500 breeding pairs is the amount that USFWS and DOFAW consider to represent a minimum Kauaʻi viable metapopulation of Newell's shearwater (ʻaʻo).



Modeled abundance for Newell's shearwater (ʻaʻo) of take without the HCP (red line) vs. with the HCP (blue line). The difference between these two lines represents the beneficial effects of the combined minimization and mitigation under the stable trend scenario. The dashed black horizontal line indicates 2,500 breeding pairs, the point at which the Kauaʻi metapopulation reaches an abundance that USFWS and DOFAW consider to be a viable metapopulation.

Figure 5-5b. Stable Trend Scenario: Beneficial Effects of Conservation Strategy at All Conservation Sites Combined for Newell's Shearwaters (ʻaʻo)

The blue line represents the modeled abundance with the proposed minimization and mitigation in place. With the HCP, growth at the conservation sites occurs immediately and continues to increase exponentially over time. The model does not assume a limit to the abundance (i.e., carrying capacity) of the species at the conservation sites. This assumption may or may not be accurate. Many of the conservation sites are several hundred acres in size, are unfenced (see Chapter 4, Tables 4-8 and 4-9) and could theoretically support very large breeding colonies of birds at high densities observed at smaller sites. Furthermore, as the subpopulations at each conservation site increase, they are likely to attract prospecting birds and new breeding pairs from outside the conservation sites, even after social attraction recordings cease within predator-proof fences. Although the assumption of no carrying capacity at the conservation sites is not meant to perfectly represent reality, it is also the case that, under the stable trend scenario abundance would be expected to increase in other larger areas of Kauaʻi outside the conservation sites, as a result of reducing a substantial source of take through powerline minimization measures. Newell's shearwater (ʻaʻo) abundance has been estimated to have been reduced by 95 percent during the observed decline in the 1990s and early 2000s (Raine et al. 2017). In other words, the metapopulation abundance has been estimated to be at approximately 5 percent of pre-decline abundance. This means that the Kauaʻi metapopulation would need to increase to 20 times its current size before abundance reached pre-decline levels. Projections of abundance under the stable trend scenario at the conservation sites do not reach 20 times current abundance levels until the year 2060, or 70 percent through the duration of the 50-year permit term (Figure 5-5b). Total abundance of the Kauaʻi metapopulation (all subpopulations combined) is projected to increase under the stable trend scenario, but to only reach five times current metapopulation abundance by the end of the permit term (Figure 5-9b). The overarching results of the stable trend scenario, e.g., whether the metapopulation will reach and maintain a viable abundance level, as well as the resulting projected levels of take under the HCP (which are driven by abundance levels in more vulnerable areas of Kauaʻi, outside of the conservation sites) are not sensitive to assumptions of carrying capacity at that the conservation sites.

Figures 5-6a and 5-6b provide projections of abundance at each conservation site that currently supports Newell's shearwater (ʻaʻo).[25] In the first four figures (Upper Limahuli Preserve, Pōhākea, Honopū, and Upper Mānoa Valley) the two conservation sites at each location are combined (e.g., Upper Limahuli Preserve + Upper Limahuli Preserve PF). Plots showing projections for each conservation site separately can be found in Appendix 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*. Figure 5-6a demonstrates that, under the worse-case scenario, conservation measures implemented at eight of the conservation sites (four conservation site locations) will substantially benefit Newell's shearwater (ʻaʻo), and do so relatively quickly. The four conservation sites with dedicated, intensive predator control and excluding the predator-exclusion fence (Upper Limahuli Preserve, Pōhākea, Honopū, and Upper Mānoa Valley) have the largest estimated current abundance of breeding pairs (Table 4-10), and therefore are projected to have the largest net increase in abundance by the end of the permit term. These four conservation sites also support four conservation sites with PFs. The location of these PFs was selected because of their proximity to known major flyways for Newell's shearwater (ʻaʻo) and the relatively large number of existing breeding pairs (indicating high suitability of habitat and a local source of birds to colonize the PF) in the surrounding conservation site.

The three conservation sites that see only moderate levels of benefit for Newell's shearwater (ʻaʻo) are Hanakāpiʻai, Hanakoa, and North Bog, which are conservation sites primarily inhabited by Hawaiian petrel (ʻuaʻu) colonies. These areas are also projected to have similar percentage increases in abundance, but because they have fewer starting breeding pairs, they are projected to have a smaller absolute increase in abundance by the end of the permit term than the four conservation sites described above. By comparison, Figure 5-6a illustrates that breeding pair abundance at every conservation site will decline almost immediately without the HCP (red line; i.e., without predator control and without minimization) and eventually become locally extirpated.

[25] The conservation site Pihea is not shown because it does not support the species and is not expected to support the species. See Appendix 4A, *Conservation Site Selection*, for details.

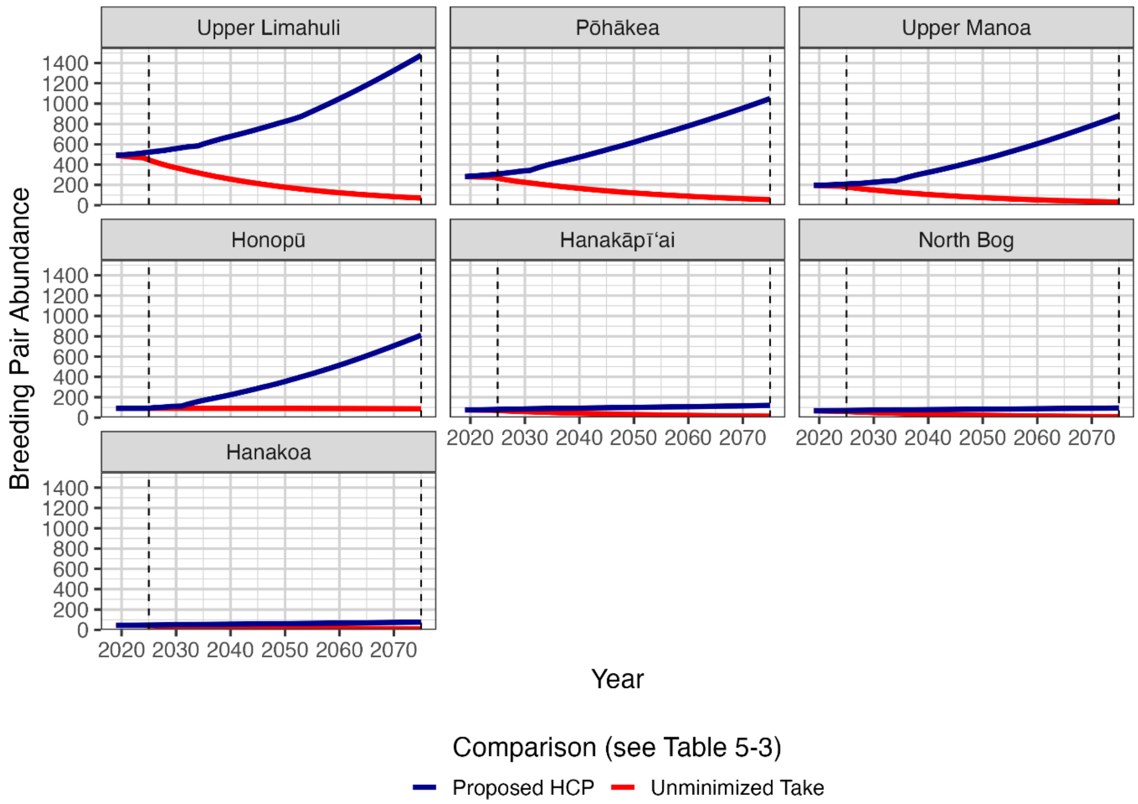


Figure 5-6a. Worse-Case Scenario: Beneficial Effects of Conservation Strategy at All Conservation Sites for Newell's Shearwaters ('a'o)

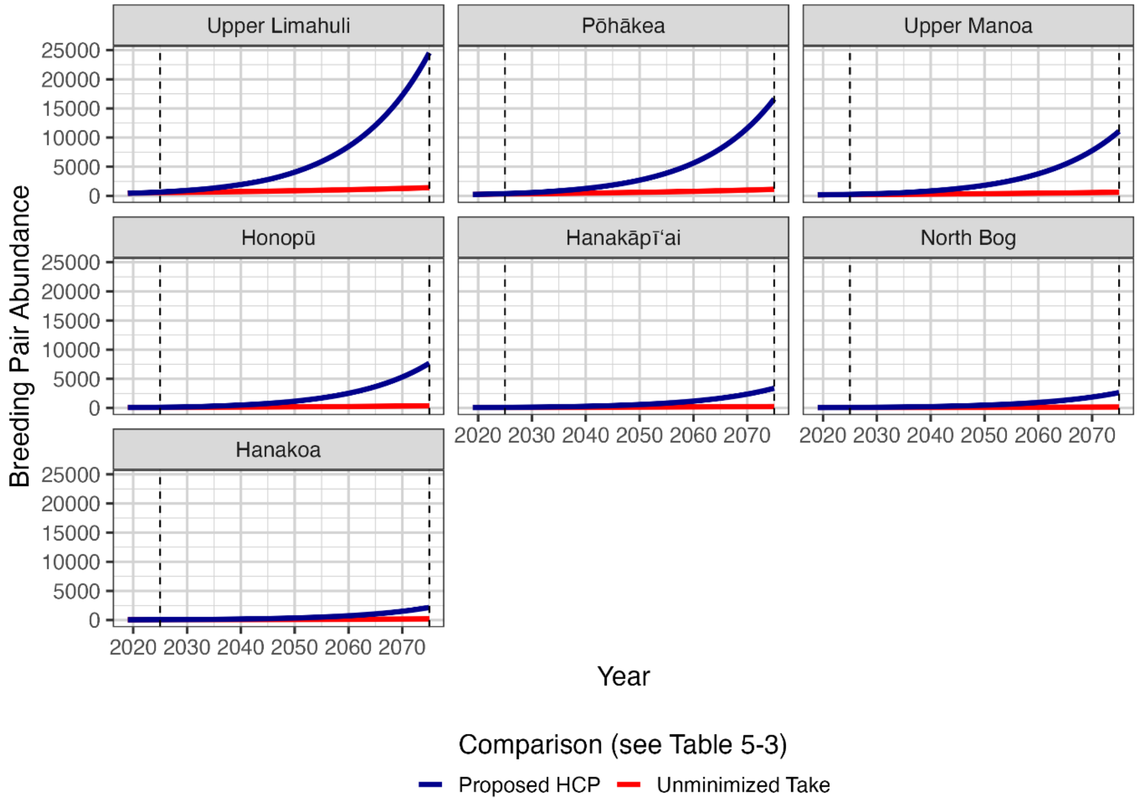


Figure 5-6b. Stable Trend Scenario: Beneficial Effects of Conservation Strategy at All Conservation Sites for Newell's Shearwaters (ʻaʻo)

Figure 5-6b shows the modeled abundance at each conservation site (or pairs of conservation sites) under the stable trend scenario. In this scenario, breeding pair abundance at the four conservation site locations for Newell's shearwater (ʻaʻo) with a PF (Upper Limahuli Preserve, Pōhākea, Honopū, and Upper Mānoa Valley) begins to increase immediately and shows dramatic increases by approximately 2050, halfway through the permit term. The other three conservation sites (Hanakāpiʻai, Hanakoa, and North Bog) show meaningful growth only in the last 5 to 10 years of the permit term. Without the HCP (red line), the abundance at all conservation sites remains nearly flat. Without the HCP under the stable trend scenario, the subpopulations at each conservation site would be at risk of local extirpation due to their low initial abundance.

As shown on Figures 5-6a and 5-6b, continued and expanded predator control combined with powerline collision minimization prevents substantial declines of existing subpopulations of Newell's shearwater (ʻaʻo) at the conservation sites and likely prevents local extirpation (red lines), consistent with biological objectives 1.1 and 1.3. Under the worse-case scenario, eight conservation sites (Upper Limahuli Preserve, Upper Limahuli Preserve PF, Pōhākea, Pōhākea PF, Honopū, Honopū PF, Upper Mānoa Valley, and Upper Mānoa Valley PF) contribute substantial numbers of new breeding pairs to the Kauaʻi metapopulation of Newell's shearwater (ʻaʻo) with the proposed HCP (blue lines) where the subpopulations would be subject to likely extirpation without the conservation measures (red lines; Figure 5-6a and 5-6b).

Figures 5-7a and 5-7b show the effects of the conservation strategy in the rest of suitable habitat for Newell's shearwater (ʻaʻo) on Kauaʻi, outside of the conservation sites. Under the worse-case scenario (Figure 5-7a), the conservation strategy would have little to no beneficial effects on the four smaller modeled subpopulations outside the conservation sites that are subject to relatively low risks of powerline collision or light attraction already because of their location in northwest Kauaʻi (Wainiha and Lumahaʻi Valleys, Kalalau East to Upper Mānoa, Nā Pali Coast, and Waimea Canyon). The Hanalei to Kekaha modeled subpopulation, with by far the largest subpopulation of Newell's shearwater (ʻaʻo), would continue to decline with the HCP (blue line) as compared to without the HCP (red line) (Figure 5-7a). However, the minimization provided by the HCP would slow the rate of decline considerably as compared to without the HCP. With the HCP, the Hanalei to Kekaha subpopulation is projected to be extirpated between about 2070 and the end of the permit term. Without the HCP, the Hanalei to Kekaha subpopulation is projected to be extirpated between about 2055 and 2060, approximately 15 to 20 years sooner than with the HCP.

Under the stable trend scenario, the minimization measures have a substantial influence on breeding pair abundance outside the conservation sites[26] in the Hanalei to Kekaha modeled subpopulation (Figure 5-7b). With the HCP (blue line), Newell's shearwater (ʻaʻo) breeding pairs steadily increase in abundance in the Hanalei to Kekaha modeled subpopulation. By the end of the permit term, the Hanalei to Kekaha modeled subpopulation is projected to more than double in abundance with the HCP, while without the HCP (red line) there is no change in the status quo stable trend, and abundance levels are projected to remain unchanged. Stated another way, in an island-wide metapopulation that has a stable growth trend (i.e., the stable trend scenario), the benefits of powerline minimization are substantial even in the absence of predator control.

[26] Predator control at the conservation sites is assumed in the model to have no effect on the vital rates of the covered seabirds in subpopulations outside the conservation sites. In reality, there may be spillover benefits of predator control to other subpopulations, particularly those adjacent to the conservation sites such as Nā Pali Coast and Kalalau East to Upper Mānoa for more wide-ranging predators such as feral cats and barn owls.

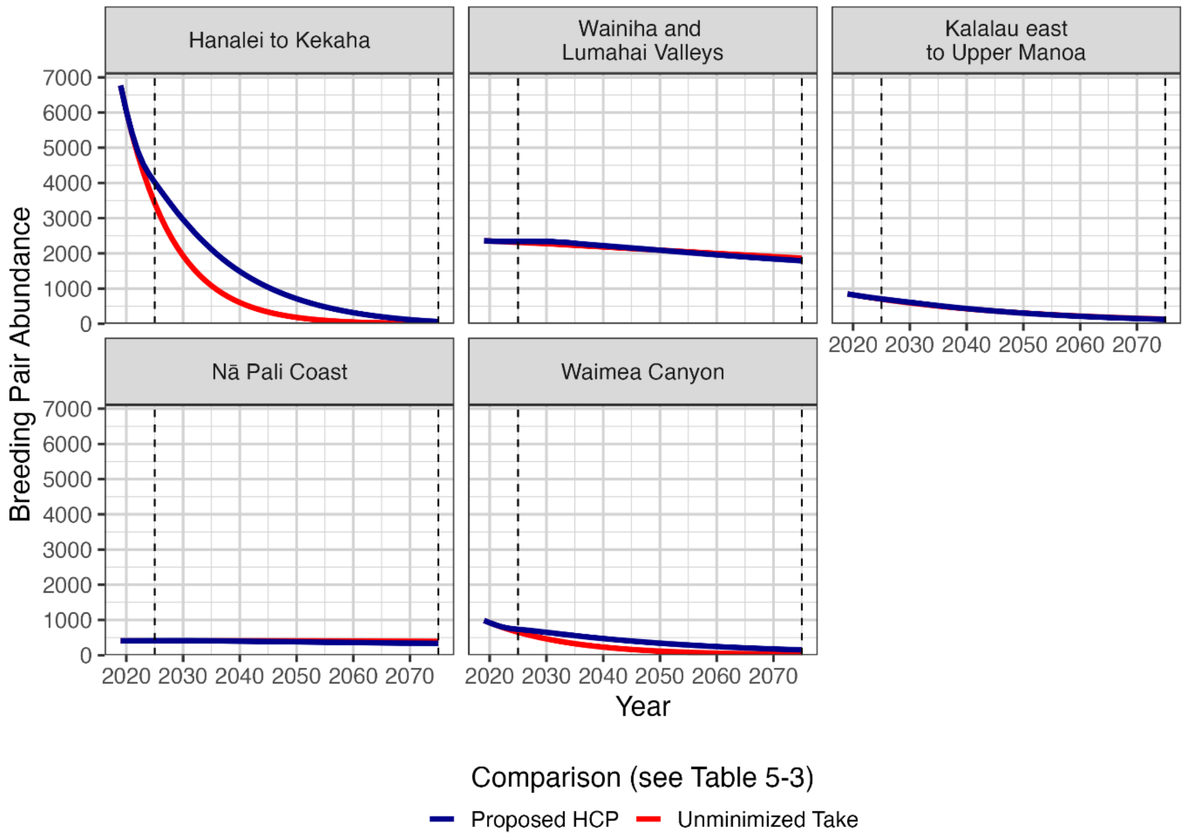


Figure 5-7a. Worse-Case Scenario: Beneficial Effects of Conservation Strategy Outside Conservation Sites for Newell's Shearwaters ('a'o)

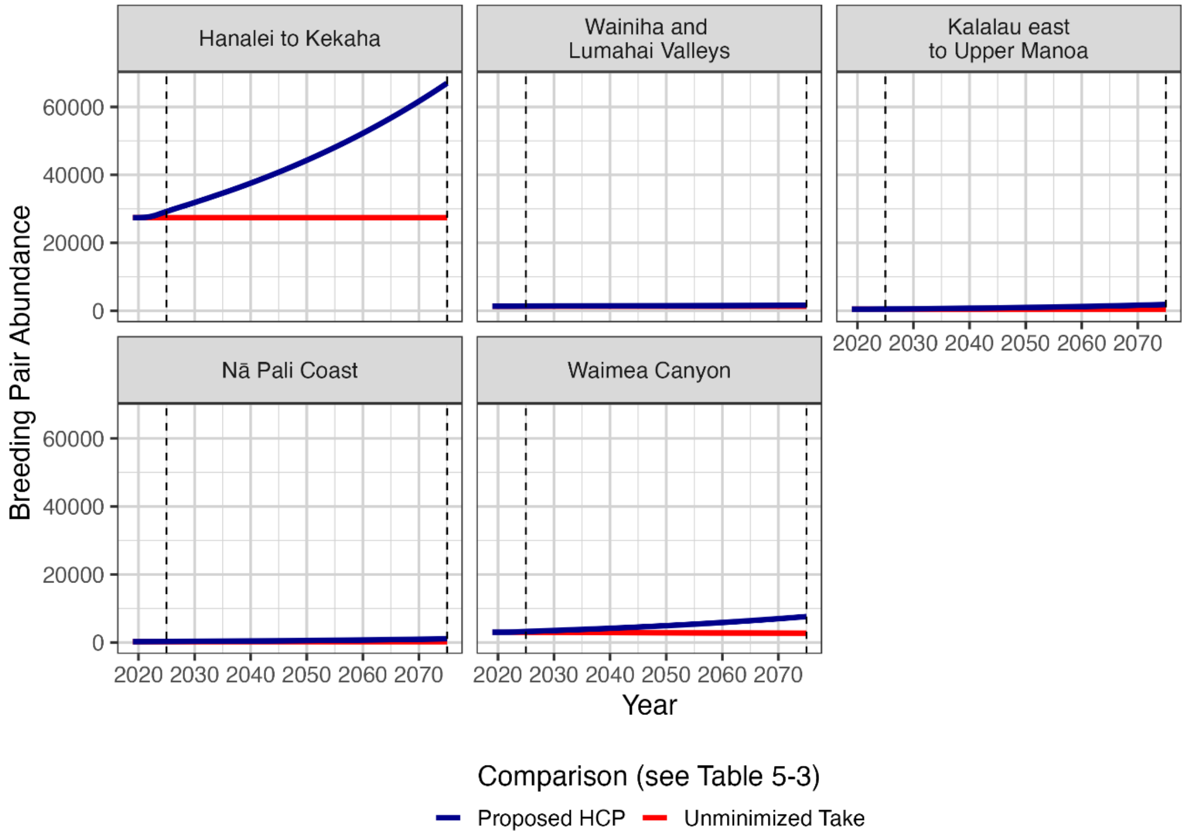


Figure 5-7b. Stable Trend Scenario: Beneficial Effects of Conservation Strategy Outside Conservation Sites for Newell's Shearwaters ('a'o)

Beneficial Effects of Conservation Measure 3, Provide Funding for the Save our Shearwaters Program

Starting at the beginning of the permit term, the HCP includes a $300,000 annual funding commitment to the SOS Program, adjusted annually for inflation, which is a sufficient level of funding to support KIUC's HCP commitments. The benefit of continuing this program to the covered seabirds is estimated in Table 5-9. Chapter 6, Table 6-3 outlines an adaptive management trigger to further ensure this funding is sufficient throughout the entire permit term.

The SOS Program has been active since 1979. However, in the early years of the program it operated with a limited budget and inconsistent staffing levels. Early in its history it also lacked the systematic and effective protocols for bird rescue, rehabilitation, and release that exist today and have been refined and tested over many years. As a consequence, data from the program's early years do not provide a reliable estimate of bird rescues expected during the permit term. To estimate benefits to the covered seabirds during the permit term, more recent and reliable SOS Program data was used, from 2009 to 2024. This range captures the period over which the SOS Program has used consistent, systematic protocols and staffing levels that are expected to continue throughout the permit term given the funding commitment by KIUC.

Table 5-9 provides the number of covered seabirds recovered or rehabilitated and released by the SOS Program from 2009 to 2024 and the estimated annual and 50-year recovery, rehabilitation, and release based on projections into the future of this historical data.

Table 5-9. Covered Seabirds Estimated to be Rehabilitated and Released through the SOS Program, by Species

Covered Seabird Species	No. of Individuals Recovered and Released 2009–2024	Average Annual Individuals Recovered and Released	Estimated 50-Year Recovery and Release[a]
Newell's shearwater (ʻaʻo)	2,240	140.0	7,000
Hawaiian petrel (ʻuaʻu)	79	4.9	247
Band-rumped storm-petrel (ʻakēʻakē)	10	0.6	31
Total	**2,329**	**145.5**	**7,278**

[a] Assumes the average historic rate of recovery and release from 2009 to 2024 would continue throughout the 50-year permit term. This table makes no assertions about rate of survival of recovered and released birds. SOS recoveries are an assumed benefit to the species but these benefits were not quantified and were not factored into the population dynamics models to calculate effects and offsets to the Kauaʻi metapopulation of either species.

The SOS Program recovered and released 2,329 of the covered seabirds from 2009 through 2024 (Table 5-9). Approximately 60 percent of the covered species that are handled by the SOS Program are rehabilitated and released back into the wild[27] (Bache 2019), with the expectation that they will successfully reproduce in future nesting seasons. There is evidence that rehabilitated and released fledglings of covered seabirds have reduced survivorship compared with wild fledglings. However, a substantial proportion of rehabilitated fledglings have been documented to successfully migrate to their wintering grounds (Raine et al. 2020a). Using satellite tags, Raine et al. (2020a) found that 21 days after release, 28.9 percent of 38 tagged SOS-rehabilitated fledglings were still transmitting in comparison with 50 percent of a similar sample of 12 wild fledglings. It is assumed that all of the rehabilitated seabirds would have died as a result of collision or grounding injuries, starvation, dehydration, predation, vehicle interactions, or other sources of mortality, if not retrieved, treated, and released by the SOS Program. Consequently, the SOS Program plays an important role in improving populations of the covered seabird species on Kauaʻi.

Because there is evidence that rehabilitated and released birds have reduced survivorship, the population dynamics model takes a conservative approach and does not reduce mortality to account for birds recovered and released. That is, the effects of rehabilitating and releasing covered seabirds are not factored into the population dynamics model for either species. Table 5-9 provides the anticipated number of birds to be rehabilitated and released during the 50-year permit term, rather than number of birds expected to survive after rehabilitation, because this is a quantifiable amount that can be tracked during HCP implementation.

Summary of Beneficial Effects

Figure 5-8 illustrates projected abundance trends by region under the worse-case and stable trend scenarios when the conservation strategy is implemented. Under the worse-case scenario, abundance trends remain negative along the Nā Pali Coast and the remaining island, with minimization measures reducing these downward trends on the remainder of the island. At the same time, there are strong positive trends with a high level of confidence projected at the conservation sites. Under the stable trend scenario, populations remain stable along the Nā Pali Coast and show a positive trend throughout the remainder of the island, with substantial benefits resulting from KIUC's minimization and mitigation measures.

[27] The remaining 40 percent are dead on arrival or their injuries are so severe they must be euthanized.

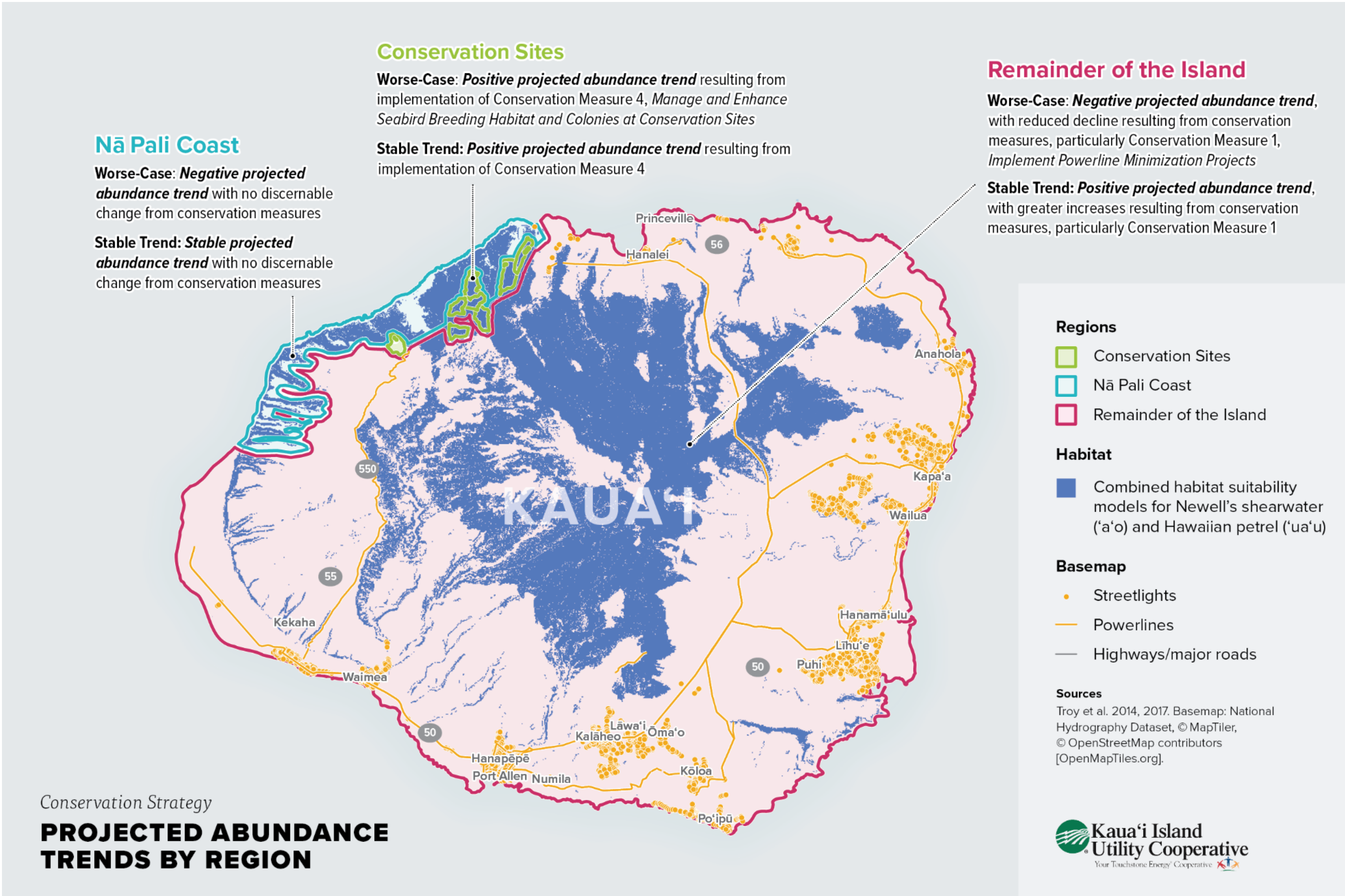


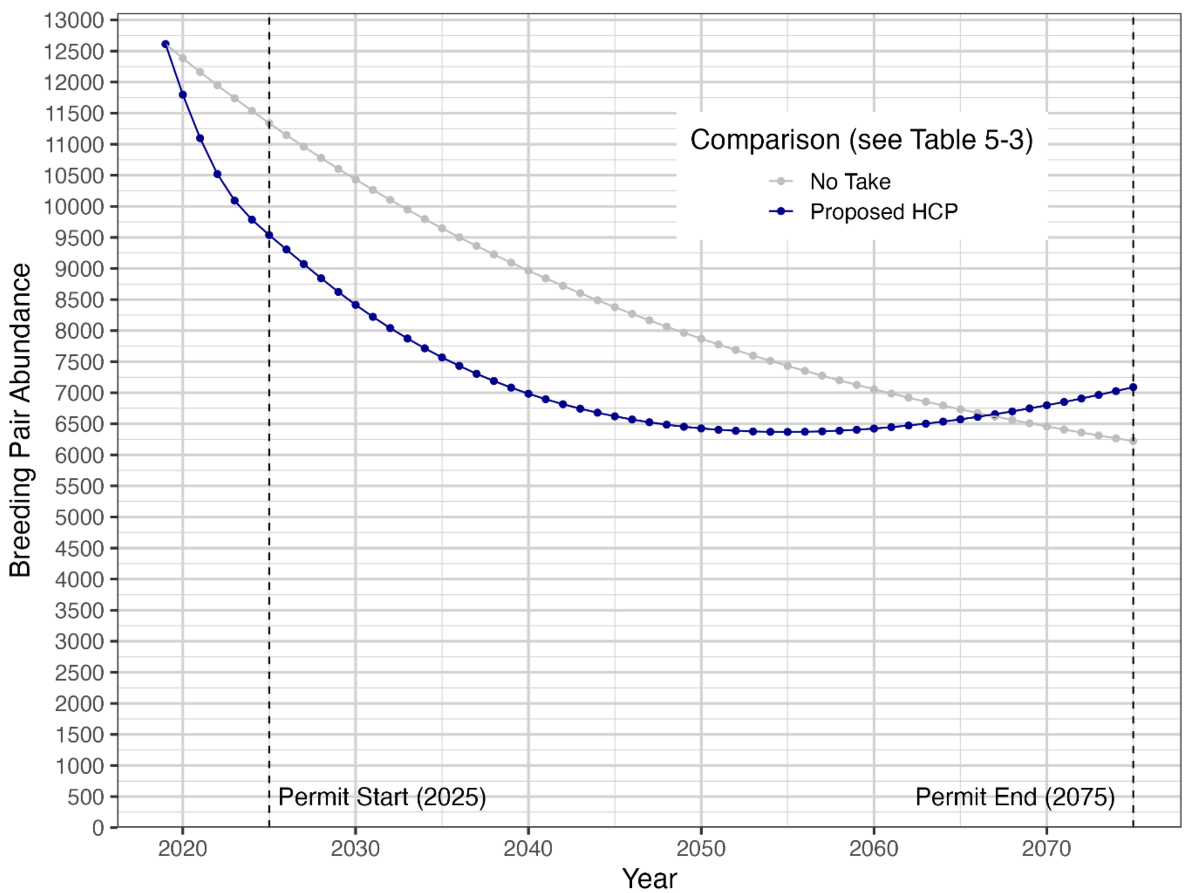
Figure 5-8. Conservation Strategy and Projected Abundance Trends Under Each Population Dynamics Model Scenario

Net Effects Based on Population Dynamics Model

As described in Section 5.3.1.6, *Benefits of the Conservation Strategy and Net Effects—Methods*, the difference between the no-take/no HCP comparison and the proposed HCP represents the net effects in terms of the projected abundance of Newell's shearwater ('a'o) breeding pairs in any year of the permit term and by the end of the permit term. These net effects include both the adverse effects of the proposed take and the beneficial effects of the proposed conservation strategy.

Worse-Case Scenario

The hypothetical comparison of no KIUC take and no HCP during the 50-year permit term for the worse-case scenario (Figure 5-9a, grey line) shows a persistent downward species decline resulting from factors other than KIUC's proposed take. In other words, even if KIUC was able to eliminate all take associated with its current and future facilities (i.e., 100 percent minimization), the Kaua'i metapopulation of Newell's shearwater ('a'o) is predicted to decline substantially and continue declining well after the 50-year permit term under the worse-case scenario.



Modeled Kaua'i metapopulation abundance for Newell's shearwater ('a'o) under a hypothetical situation with no KIUC-related take (grey line) vs. with the proposed HCP (blue line). The population growth rate with the proposed HCP exceeds that of the hypothetical situation with no KIUC-related take and no HCP by the end of the permit term.

Figure 5-9a. Worse-Case Scenario: Net Effects of the HCP for Newell's Shearwaters ('a'o)

In contrast, under the worse-case scenario the HCP conservation measures including minimization and conservation are projected by approximately 2056 (i.e., Year 32 of the permit term) to begin to reverse this decline (Figure 5-9a, blue line). It takes over half of the permit term to reach this point because of two primary factors. First, the worse-case scenario assumes a limited theoretical maximum growth rate of only 3.0 percent for the species. This theoretical maximum growth rate is what is assumed to occur in the absence of any anthropogenic threats, including predation by invasive species. In contrast, the stable trend scenario assumes a maximum theoretical growth rate of 8.0 percent annually. The second reason that it takes the model 32 years to begin to show positive metapopulation growth is due to assumed conditions of the Hanalei to Kekaha subpopulation. The Hanalei to Kekaha subpopulation, the largest in number and area on the island, dominates the metapopulation dynamics of the worse-case scenario for many years. Only when the Hanalei to Kekaha subpopulation is projected to decline to much lower levels than the conservation sites can the growth and abundance at the conservation sites begin to affect the island-wide metapopulation.

After 2056, the HCP results in a net benefit to the Kaua‘i metapopulation for approximately 18 years of the permit term (i.e., from 2056 until the end of the permit term; blue line) as compared to a scenario with no take and no KIUC conservation (Figure 5-9a, grey line). HCP conservation measures are projected to slow the metapopulation decline considerably between 2040 and 2050 and stabilize the island-wide metapopulation by approximately 2056. After this, the metapopulation is projected to increase gradually until the end of the permit term, with a net increase in numbers of breeding pairs (blue line) compared with a hypothetical scenario in which the proposed take did not occur (grey line). Hence, the HCP provides a net benefit to Newell’s shearwaters (‘a‘o) and offsets the impact of the taking even under the worse-case scenario by providing the following four outcomes:

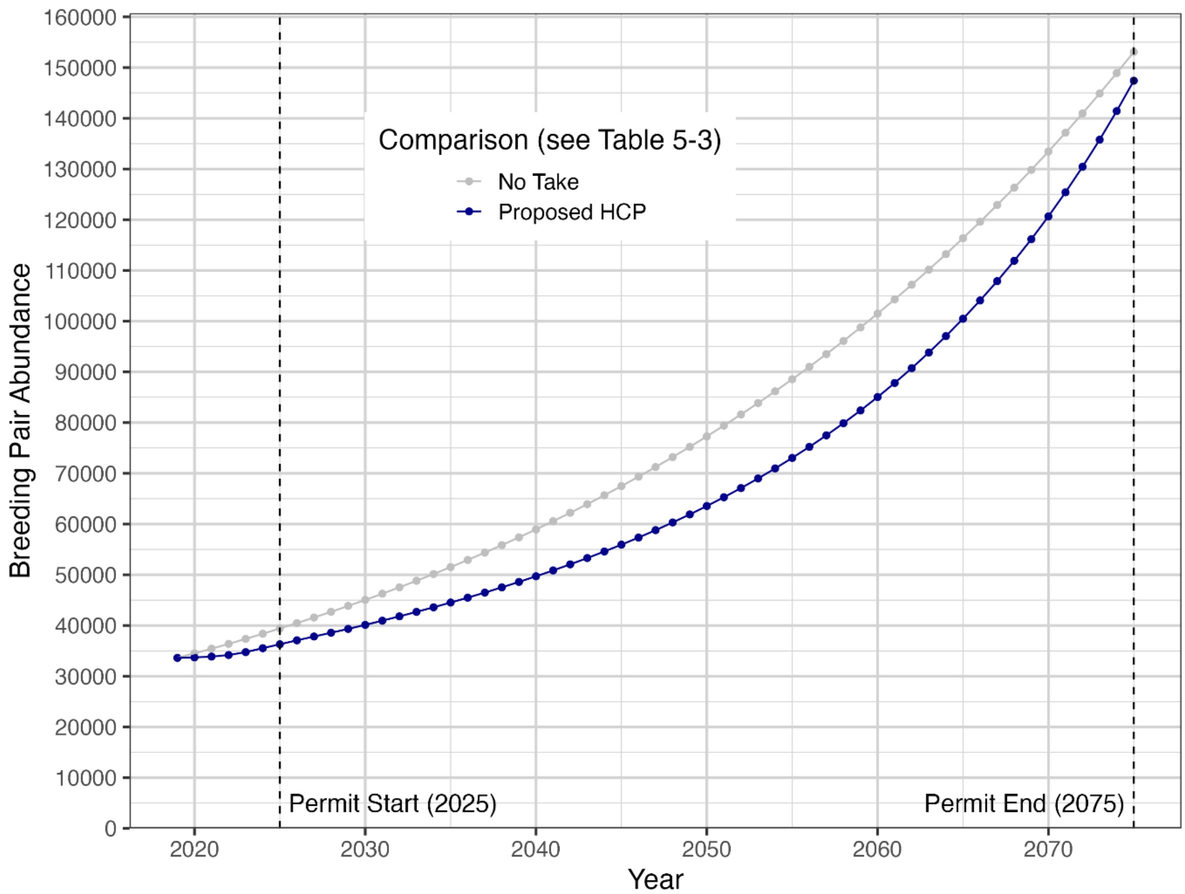
1. Reversing the decline of the Kaua‘i metapopulation and creating a consistently growing metapopulation, and the projected growth of the metapopulation is greater than the take during the permit term.
2. An increasing metapopulation abundance for at least 18 years of the permit term.
3. The Kaua‘i metapopulation does not fall below the threshold of 2,500 breeding pairs set by USFWS and DOFAW as the minimum viable metapopulation size, at any time during the permit term.
4. By the end of the permit term, the Kaua‘i metapopulation is growing steadily, greatly increasing metapopulation viability. Metapopulation viability is discussed in more detail below.

Stable Trend Scenario

The stable trend scenario shows an upward abundance trend for Newell’s shearwater (‘a‘o) throughout the permit term for both the proposed HCP and the hypothetical no take/no HCP comparison (Figure 5-9b). Under this scenario, the HCP provides a net benefit to Newell’s shearwaters (‘a‘o) and offsets the impact of the taking by providing the following outcomes:

1. Consistent growth in the Kaua‘i metapopulation in which the projected growth of the metapopulation is always greater than the take during the permit term.
2. An approximately four-fold increase in metapopulation abundance on Kaua‘i during the permit term (i.e., from an estimated 37,000 breeding pairs to 148,000 breeding pairs). By the end of the permit term, the population growth rate with the HCP exceeds the population growth rate without the HCP.

3. A Kaua'i metapopulation that never falls below the threshold of 2,500 breeding pairs set by USFWS and DOFAW as the minimum viable metapopulation size.
4. By the end of the permit term, the Kaua'i metapopulation is growing steadily, greatly increasing metapopulation viability. Metapopulation viability is discussed in more detail below.



Modeled metapopulation abundance of Newell's shearwater ('a'o) under a hypothetical situation with no KIUC-related take (grey line) vs. the proposed HCP (blue line). The population growth rate with the proposed HCP exceeds that of the hypothetical situation with no KIUC-related take and no HCP by the end of the permit term.

Figure 5-9b. Stable Trend Scenario: Net Effects of the HCP for Newell's Shearwaters ('a'o)

Addressing Uncertainty

KIUC addressed uncertainty associated with the population dynamics model by using conservative assumptions that err on the side of the species.[28] In other words, the assumptions under the worse-case scenario would tend to overestimate impacts, underestimate benefits, or both. For example, the initial modeled rate of decline without conservation measures under the worse-case scenario represents an island-wide metapopulation that is decreasing at -7.4 percent per year, which is faster than the long-term trend in radar data across monitoring sites during 1993–2020 (a -6.9 percent decline per year [lambda = 0.931]; Raine and Rossiter 2020). Also, the model only takes into account the benefits to the species of one other conservation action on Kaua'i, the KSHCP conservation site.

[28] Appendix 5D, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i*, provides a description of these sources of uncertainty.

Other conservation actions implemented by others or expected in the future by others are not included in the model.

As noted above, an example of a conservative model assumption is the initial rate of metapopulation decline. The model under the worse-case scenario assumes an initial rate of metapopulation decline under the take with no minimization or mitigation comparison of -7.4 percent per year. This estimate is conservative because it is greater than the -6.9 percent per year population decline from radar data (1993–2020). The radar trend, unlike the modeled metapopulation trend, only covers those areas of the island with breeding colonies most affected by powerlines and fallout. The radar survey estimate does not incorporate trends from breeding colonies in northwestern Kaua'i, including the conservation sites. Figure 5-2 illustrates the radar data sources under both the worse-case and stable trend scenarios.

Trends in abundance at the conservation sites have been positive (i.e., growing) since 2014–2015, as estimated through acoustic call rate monitoring data (Raine et al. 2022). Therefore, the modeled trend for the metapopulation is conservative under the worse-case scenario because it includes areas that are increasing in abundance, yet matches the long-term average radar site trend which only covers those areas of Kaua'i that have been most affected by powerline collisions and fallout. Moreover, trend data from independent data sources suggest that current trends may be less negative than they have been historically, and that abundance levels may have stabilized during the last decade for those areas of the island most affected by powerline collisions and fallout (Raine and Rossiter 2020; SOS unpublished data; Travers et al. 2023b).

Raine and Rossiter (2020) showed that the trends from systematic monitoring through radar surveys are consistent with a leveling out of abundance since about 2009. The radar data indicate that after a very large metapopulation decline before 2009, the metapopulation trend may now be relatively stable (a regression of radar data for the last decade [2010–2020] was flat with no significant change). Given the recent radar data that suggests a relatively consistent abundance of Newell's shearwater ('a'o), projections under the hypothetical situation of take with no minimization or mitigation are likely overestimating potential population declines in the future in the absence of predator control or powerline minimization. For a description of these assumption and additional examples of how the worse-case scenario is likely very conservative, see Appendix 5D, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i*.

In contrast, the modeled stable trend scenario is more reflective of current data and is consistent with the stable trend in island-wide metapopulation suggested by three independent data sources: KESRP radar data, SOS Program data, and KIUC powerline strike data. Model projections using the stable trend scenario with the HCP show substantial metapopulation growth throughout the permit term. See Appendix 5D, *Population Dynamics Model for Newell's Shearwater ('a'o) on Kaua'i*, for details of this model scenario, projected outcomes, and model limitations. The actual outcome of the HCP is likely to be in between the outcomes of the worse-case scenario and the stable trend scenario.

Ongoing monitoring will inform the extent to which each model reflects actual outcomes. The monitoring and adaptive management strategy described in Chapter 6, *Monitoring and Adaptive Management Program*, is designed to monitor the success of KIUC's minimization and conservation measures throughout the permit term and adjust measures as needed. This will provide additional safeguards around the uncertainties associated with the population dynamics model because ongoing monitoring data gathered during implementation will be compared against model projections, and conservation measures will be adaptively managed to ensure the species' biological goals and objectives are met.

Metapopulation Viability

Substantial subpopulation increases at the conservation sites and improved survival of the species on Kauaʻi outside the conservation sites, in combination with minimizing take, are expected to reverse the projected island-wide metapopulation decline under the worse-case scenario. Under both the worse-case and stable trend scenarios, the HCP would establish a viable and increasing Kauaʻi metapopulation of Newell's shearwater (ʻaʻo) consistent with Goal 1 in Chapter 4, *Conservation Strategy* (Figures 5-9a and 5-9b). Chapter 4, Section 4.3.1, *Newell's Shearwater (ʻaʻo)*, describes how *viable* is defined in the context of population dynamics modeling. The population dynamics model indicates that the KIUC HCP would achieve Goal 1 for Newell's shearwater (ʻaʻo), indicating a viable and increasing Kauaʻi metapopulation as represented by the following characteristics.

- Number of breeding pairs
- Population growth rate
- Age structure
- Spatial distribution

Each of these characteristics is described below in relation to the predictions of the population dynamics model.

Number of breeding pairs. Consistent with Objective 1.3, KIUC will (1) meet or exceed the minimum target breeding pairs defined in Table 6A-3 (lists the minimum breeding pairs per year), as measured by data collected at the conservation sites for all sites combined, (2) maintain a growth rate for breeding pairs annually of at least 1.0 percent as measured by a 5-year rolling average, and (3) maintain a 5-year rolling average 87.0 percent reproductive success rate. As described in Chapter 6, Section 6.4.4, *Conservation Site Monitoring and Adaptive Management*, and Table 6-3, KIUC will monitor the conservation sites and adaptively manage them to ensure these commitments are met.

The population dynamics model, under both the worse-case and stable trend scenarios, is consistent with a Kauaʻi metapopulation size for Newell's shearwater (ʻaʻo) of over 6,300 breeding pairs at the lowest point of forecasted abundance during the 50-year permit term (Appendix 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*). A metapopulation size at this abundance level is well within the range of what has been suggested in meta-analyses of minimum viable population sizes integrating a wide range of case studies for birds and other taxa (Trail et al. 2007; Reed 2003). These estimates take into account the roles of age structure, catastrophes, random demographic and environmental fluctuations (stochasticity), and inbreeding depression. The worse-case scenario projects that the Kauaʻi metapopulation size will consist of an estimated 4,324 breeding pairs within the conservation sites alone by the end of the permit term, with the metapopulation continuing to increase beyond the permit term based on the modeled metapopulation trajectory. This is well above 2022 estimates by USFWS and DOFAW that 10,000 individuals and 2,500 breeding pairs represent a minimum viable abundance level for the Kauaʻi metapopulation of Newell's shearwater (ʻaʻo).

Population growth rate. Consistent with Objective 1.3, KIUC will maintain an annual growth rate for breeding pairs of at least 1.0 percent as measured by a 5-year rolling average, and maintain a 5-

year rolling average of 87.0 percent reproductive success rate at reference burrows. As described in Chapter 6, Section 6.4.4, *Conservation Site Monitoring and Adaptive Management*, and Appendix 6A, *Adaptive Management Comparison Tables*, KIUC will monitor the conservation sites and adaptively manage them to ensure these commitments are met.

The results of KIUC's population dynamics model under the worse-case scenario indicates that after a period of decline in the Kauaʻi metapopulation, the conservation actions included in the HCP would result in a reversal of the modeled initial downward trend that would begin at approximately Year 32 of the permit (2056) (Figure 5-9a, blue line). This upward population growth trend is expected to continue for the remainder of the permit term, approximately 18 years. This positive rate of change in the Kauaʻi metapopulation before the end of the permit term is consistent with Kauaʻi metapopulation viability, meeting Goal 1 in this HCP, and exceeding USFWS' abundance threshold for this species' viability. Under the assumption of an initial stable abundance trend (Figure 5-9b), the positive rate of change in the Kauaʻi metapopulation throughout the permit term would result in a Kauaʻi metapopulation far exceeding USFWS' abundance threshold for this species' viability.

Age structure. Modeled metapopulation numbers for Newell's shearwater (ʻaʻo) that are increasing contribute to the viability of a population. An increase in the modeled metapopulation size can only occur when the total annual number of fledglings produced is greater than the number of deaths on an island-wide basis. When births are greater than deaths, the age structure of the metapopulation will be composed of a higher proportion of younger age classes. In other words, the age structure will contribute to higher levels of recruitment into the breeding colonies. Currently, evidence of a productive age structure is occuring at the conservation sites, where recruitment to breeding colonies has been observed from the uniformly positive trends (often a doubling) in call rates during the last decade (Raine et al. 2023). This positive productivity by approximately Year 32 of the HCP under the worse-case scenario (and throughout the permit term under the stable trend scenario) benefits the modeled Kauaʻi metapopulation of Newell's shearwater (ʻaʻo). This positive productivity is because reduced levels of predation in the conservation sites have resulted in ongoing recruitment from younger age classes into the breeding component of the metapopulation, which is expected to continue under the continued predator control measures of the HCP. Over time, this recruitment to breeding age classes is expected to be greater than reductions in survival and reproductive success resulting from future predicted levels of powerline strikes, light fallout from KIUC streetlights and covered facilities in the most affected areas of Kauaʻi (e.g., Hanelei to Kekaha).

Spatial distribution. Spatial distribution is an important component of many species' population viability. The more subpopulations present for a species, all else being equal, the greater the chance that the species can persist in the long term. Species with more subpopulations have a greater chance of withstanding stochastic events. For example, a species with 10 separate subpopulations might lose two of these subpopulations because of an episodic environmental event (e.g., a hurricane), but the remaining eight subpopulations can persist if they are distributed in a less affected area. A species with only two closely located subpopulations is at much greater risk of losing half or all of the subpopulations in an episodic environmental event.

As described in Chapter 4, *Conservation Strategy*, there are practical limitations precluding conservation efforts in areas of Kauaʻi outside the conservation sites; therefore, under the worse-case scenario of declining abundance trends outside the conservation sites, future subpopulations are likely to continue the current tendency of becoming spatially concentrated in remote locations with rugged terrain that are distant from most powerlines and lights, where there is less risk of predation, and where conservation efforts from this HCP, other HCPs, and other conservation and mitigation actions are focused. Figures 5-5 through 5-7 show the projected population trajectories for subpopulations inside and outside the conservation sites proposed by this HCP, respectively, under the worse-case and stable trend scenarios.

Spatial distribution is a component of a viable metapopulation for Newell's shearwater (ʻaʻo) (U.S. Fish and Wildlife Service 2019). The results of the population dynamics model under the assumption of an initial declining population suggest that the breeding distribution of Newell's shearwater (ʻaʻo) on Kauaʻi will become spatially more concentrated at the conservation sites, the Wainiha and Lumahaʻi Valleys, and the Nā Pali Coast in the future (i.e., areas close to the conservation sites) (Figure 5-2).

KIUC's proposed protection and maintenance of 12 conservation sites, however, is intended to maximize the potential for long-term survival of the Kauaʻi metapopulation. All the proposed conservation sites occur in the northwest portion of the island, where the largest sections of best remaining available habitat occurs for the species on Kauaʻi, meaning that the benefit from the conservation sites could promote successful expansion into areas outside of those sites. Additionally, the conservation sites are in areas farthest from threats such as powerlines and lights. The location of the conservation sites is also resilient to future land use changes on the island. The conservation sites are located on protected state-owned lands where development is not likely to occur, even while the rest of the island is experiencing high development pressure.

Greater spatial distribution for the conservation sites would be preferred for metapopulation viability, but no other areas on Kauaʻi are feasible for the long-term conservation of this species. Even though the conservation sites are located in one area of the island, they span a distance of approximately 7.1 mi (11.4 km) of topographically diverse land and are located in several different watersheds, spreading the risk of impacts from weather-related events.

Although the population dynamics model results suggest that some subpopulations outside of the conservation sites would not be considered viable[29] throughout the permit term under the worse-case scenario, this was based on the conservative biological assumptions that rates of decline are consistent with the largest estimated rate of decline observed across individual radar monitoring sites (Chapter 3, Section 3.2.1, *Covered Seabirds*). As described in Section 5.3.1.1, *Use of Population Dynamics Models*, KIUC therefore developed a second scenario assuming an initial stable population trend, which is more consistent with current data. Under the stable trend scenario, subpopulations are projected to persist and slowly grow outside the conservation sites. Therefore, under the stable trend scenario, the current spatial distribution of the species would be largely preserved.

The KIUC HCP focuses most conservation efforts in the northwest portion of Kauaʻi because this area has the highest long-term potential for conservation success (see Chapter 4, Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*). However, extensive conservation, with an emphasis on minimization, has been applied across the island and specifically in the Hanalei to Kekaha area, which had the highest strike numbers prior to minimization. As shown on Figure 5-3b, KIUC's minimization efforts would be expected to have a substantial positive effect on the Kauaʻi metapopulation by increasing abundance from a stable trend to an upward trend early in the permit term and continuing throughout the permit term under the assumption of a stable trend scenario. The KIUC HCP will provide a net benefit to Newell's shearwater (ʻaʻo) even under the worse-case model scenario in which subpopulations continue to decline at a high rate and do not persist outside the conservation sites (Figure 5-3a). Under the

[29] Chapter 4, Section 4.3.1, *Newell's Shearwater (ʻaʻo)*, describes how *viable* is defined in the context of population dynamics modeling.

worse-case scenario, modeled metapopulation abundance begins to increase by approximately Year 32 of the permit term and continues to grow for the remaining 18 years of the permit term. This worse-case result is consistent with a Kauaʻi viable metapopulation.

5.3.3 Requested Take and Effects on Hawaiian Petrel (ʻuaʻu)

5.3.3.1 Level of Take

Tables 5-10a and 5-10b provide the requested take for Hawaiian petrel (ʻuaʻu) and estimated amounts for each form of take for the 50-year permit term (Table 5-10a) and annual estimates (Table 5-10b). KIUC requests all forms of take of Hawaiian petrel (ʻuaʻu) that result from the following.

- Up to 106,500 strikes over 50 years of adults and subadults from existing powerlines resulting in indirect take of 11,353 eggs and chicks, for a total take of 117,853 from existing powerlines.
- Up to 4,584 strikes over 50 years of adults and subadults from new powerlines resulting in indirect take of 489 eggs and chicks, for a total take of 5,073 from new powerlines.
- Fallout of up to 200 individuals over 50 years from light attraction of new KIUC-owned and operated streetlights, resulting in indirect take of up to 8 eggs or chicks, for a total take request of 208.
- Fallout of up to 60 individuals over 50 years from light attraction of new KIUC-owned and operated streetlights, resulting in indirect take of up to 2 eggs or chicks, for a total take request of 62.
- Fallout of up to 15 individuals over 50 years from light attraction of existing KIUC-owned and operated facilities, resulting in indirect take of up to 1 egg or chick, for a total take request of 16.
- Injury or mortality of up to 108 individuals (mortality of 90 and injury of 18), and no observed injury of 539 birds over 50 years as a result of management actions at the conservation sites, resulting in indirect take of up to 108 eggs or chicks for a total take request of 755.

The estimates for amount of take associated with each form of take (Tables 5-10a and 5-10b) are a rough approximation based on the best available data. Because the fate of birds resulting from powerline collisions and fallout cannot be measured in the field (see explanation in Section 5.3.1, *Methods for Quantifying Take and Assessing Effects on the Covered Seabirds*), informed assumptions based on the best available data will be used to estimate outcomes of strikes and fallout, and the effect of take on the population. See Table 5-6 for a description on how the assumed outcomes of powerline strike are calculated and how the take request was determined and presented in Tables 5-10a and 5-10b.

Table 5-10a. Hawaiian Petrel ('ua'u) Requested Take Over Permit Term by Unit of Take (Powerline Strikes, Fallout, and Conservation Site Management), and Estimated Amount by Form of Take Based on Stable Trend Scenario

		Total Over 50 Years				
			Estimates by Form of Take[a, g]			
Source of Take	**Unit of Take**	**Request by Unit of Take[f, g]**	**Mortality[b]** (adults+sub-adults)	**Non-lethal Injury[c]** (adults+sub-adults)	**No Observed Injury[d]**	**Indirect Take of Eggs and Chicks[e]** (adult mortality + adult injury)
Existing powerlines	Powerline strikes[f]	117,853	30,672	26,093	49,736	11,353
New Powerlines	Powerline strikes[f]	5,073	1,320	1,123	2,141	489
Existing streetlights	Fallout (light attraction)	208	200	-	-	8
New streetlights	Fallout (light attraction)	62	60	-	-	2
Covered facilities	Fallout (light attraction)	16	15	-	-	1
Conservation program	Conservation site management[b]	755	90	18	539	108
Total		**123,967**	**32,357**	**27,234**	**52,415**	**11,961**

[a] These are rough estimates based on the best available data, although little to no data are available for some of these estimates, and it is not possible to track how many birds are injured or killed or how many eggs or chicks are lost due to powerline strikes and fallout. For details on how these were estimated, see Section 5.3.1.2, *Powerline Collisions—Methods*, subsection *Estimating the Form of Take.*

[b] For powerline strikes, 28.8% of strikes is a proxy for mortality based on proportion of birds grounded from Travers et al. (2021). The HCP assumes that 100% of fallout due to light attraction results in mortality. For conservation site management, based on data, KIUC assumed 13.9% of birds affected would be killed and that 2.8% would result in non-lethal injury, and the remaining would result in no observed injury.

[c] For powerline strikes, 24.5% of powerline strikes is a proxy for non-lethal injury based on proportion of birds that lose elevation but are not grounded from Travers et al. (2021). For fallout due to light attraction, KIUC assumes 100% of fallout results in mortality. Although some birds experiencing fallout will be rehabilitated by SOS, KIUC applied an assumption of 100% mortality for a conservative estimate of effects.

[d] For powerline strikes, assumes 46.7% of strikes may result in minor injuries (no observed injury) but not to the extent that an egg or chick is lost. Based on proportion of birds with powered flight, from Travers et al. (2021).

[e] For powerline strikes, assumes 20% of injuries and mortalities are breeding adults and one egg or chick is taken for every breeding adult injured or killed. For lights, as described in Section 5.3.1.3, *Light Attraction and Fallout—Methods*, 4% of fallout was assumed to consist of breeding adults; therefore, 4% of fallout was assumed to also result in indirect take of a chick or egg. For conservation site management, assumed conservatively that all affected birds are breeding adults.

[f] For powerline strikes, the number of strikes are a surrogate metric for take. KIUC requests take of covered seabirds in all forms (mortality, injury, no observed injury, and indirect take of eggs and chicks) associated with the requested take as measured by number of powerline strikes.

[g] All numbers are rounded to nearest whole number. Numbers less than 1 are shown as "<1" to signify a non-zero number, rather than rounding to zero. Numbers may not add up due to rounding.

Table 5-10b. Hawaiian Petrel ('ua'u) Estimated Average Annual Take by Unit of Take (Powerline Strikes, Fallout, and Conservation Site Management), and Estimated Amount by Form of Take based on Stable Trend Scenario

		Average Annual[a, h]				
			Estimates by Form of Take[b]			
Source of Take	**Unit of Take**	**Estimates by Unit of Take[g, h]**	**Mortality[c]** (adults+sub-adults)	**Non-lethal Injury[d]** (adults+sub-adults)	**No Observed Injury[e]**	**Indirect Take of Eggs and Chicks[f]** (adult mortality + adult injury)
Existing powerlines	Powerline strikes[g]	2,357	613	522	995	227
New Powerlines	Powerline strikes[g]	101	26	23	43	10
Existing streetlights	Fallout (light attraction)	4	4	-	-	<1
New streetlights	Fallout (light attraction)	1	1	-	-	<1
Covered facilities	Fallout (light attraction)	<1	<1	-	-	<1
Conservation program	Conservation site management[c]	15	2	<1	11	2
Total		**2,479**	**647**	**545**	**1,048**	**239**

[a] For powerline strikes, these numbers are expected to be highly variable from year to year. The average annual anticipated take is based on the 50-year take limit divided by 50. For annual take estimates based on 5-year rolling averages, see Appendix 6A, Table 6A-1.

[b] These are rough estimates based on the best available data, although little to no data are available for some of these estimates, and it is not possible to track how many birds are injured or killed or how many eggs or chicks are lost due to powerline strikes and fallout. For details on how these were estimated, see Section 5.3.1.2, *Powerline Collisions—Methods*, subsection titled *Estimating the Form of Take.*

[c] For powerline strikes, 28.8% of strikes is a proxy for mortality based on proportion of birds grounded from Travers et al. (2021). The HCP assumes that 100% of fallout due to light attraction results in mortality. For conservation site management, based on data, KIUC assumed 13.9% of birds affected would be killed and that 2.8% would result in non-lethal injury, and the remaining would result in no observed injury.

[d] For powerline strikes, 24.5% of powerline strikes is a proxy for non-lethal injury based on proportion of birds that lose elevation but are not grounded from Travers et al. (2021). For fallout due to light attraction, assumes 100% of fallout results in mortality. Although some birds experiencing fallout will be rehabilitated by SOS, KIUC applied an assumption of 100% mortality for a conservative estimate of effects.

[e] For powerline strikes, assumes 46.7% of strikes may result in minor injuries (no observed injury) but not to the extent that an egg or chick is lost. Based on proportion of birds with powered flight from Travers et al. (2021).

[f] For powerline strikes, assumes 20% of injuries and mortalities are breeding adults and one egg or chick is taken for every breeding adult injured or killed. For lights, as described in Section 5.3.1.3, *Light Attraction and Fallout—Methods*, 4% of fallout was assumed to consist of breeding adults; therefore, 4% of fallout was assumed to also result in indirect take of a chick or egg. For conservation site management, assumed conservatively that all affected birds are breeding adults.

[g] For powerline strikes, the number of strikes are a surrogate metric for take. KIUC requests take of covered seabirds in all forms (mortality, injury, no observed injury, and indirect take of eggs and chicks) associated with the requested take as measured by number of powerline strikes.

[h] All numbers are rounded to nearest whole number. Numbers less than 1 are shown as "<1" to signify a non-zero number, rather than rounding to zero. Numbers may not add up due to rounding.

5.3.3.2 Impacts of the Taking

This section describes the impact of the taking of Hawaiian petrel (ʻuaʻu) on the Kauaʻi metapopulation of this species and on the species as a whole, as required under Section 10(a)(2)(A)(i) of the federal ESA. Beneficial effects of measures to offset these impacts are described in Section 5.3.3.4, *Beneficial and Net Effects*.

This section provides a brief background on the species' status and trends and describes why and how the species is vulnerable as a result of ongoing mortalities. It describes the adverse effects KIUC covered activities have had on the metapopulation in the past, and the potential implications of ongoing unminimized take. This section then describes how KIUC's take minimization measures under the HCP are expected to improve outcomes for the metapopulation, under both the worse-case scenario and the stable trend scenario. It then describes the impacts of the proposed, minimized take under both scenarios. Finally, this section provides a conclusion on the impacts of the taking based on the supporting information herein.

Species Status and Trends

Breeding populations of the endangered Hawaiian petrel (ʻuaʻu) on Kauaʻi declined by an estimated 78 percent over a 20-year period from 1993 to 2013 (Raine et al. 2017). This decline was the result of the same factors as described above for Newell's shearwater (ʻaʻo) (Section 5.3.2, *Requested Take and Effects on Newell's Shearwater (ʻaʻo)*). As with Newell's shearwater (ʻaʻo), the Hawaiian petrel's (ʻuaʻu) reproductive strategy renders adult mortality particularly harmful to the species; high adult mortality may depress the population to a level that is vulnerable to extirpation.

Radar and SOS data indicate that Hawaiian petrel (ʻuaʻu) abundance in the eastern, southern, and portions of the northern regions of Kauaʻi sharply declined from 1993 to 2013, but subsequent radar data in addition to SOS and powerline strike data indicate that the abundance trends for these populations have been relatively flat over the last decade. Data sources substantiating a flat trend over the last decade are the same as described above for Newell's shearwater (ʻaʻo). Chapter 3, Section 3.2.1, *Covered Seabirds*, and Section 5.3.1.1, *Use of Population Dynamics Models*, provide additional background information on abundance trends for the Kauaʻi metapopulation of this species.

Effects of Covered Activities on Species Status and Trend

The effects of covered activities on the status and trends of Hawaiian petrel (ʻuaʻu) are similar to those described for Newell's shearwater (ʻaʻo) in Section 5.3.2, *Requested Take and Effects on Newell's shearwater (ʻaʻo).* In brief, the species' reproductive strategy, characterized by high adult survival and few offspring, makes it highly susceptible to extirpation resulting from adult mortalities. The Kauaʻi metapopulation of this species has experienced historic population declines due to multiple threats including powerline collisions and fallout from light attraction, although data suggests that the metapopulation has stabilized over the last 10 years (Chapter 3, Section 3.2.1, *Covered Seabirds*).

Effects of Minimization

Reduction of annual collisions of Hawaiian petrel (ʻuaʻu) with existing powerlines consistent with Objective 2.1 is a significant step toward reducing the decline of Hawaiian petrel (ʻuaʻu) on Kauaʻi, as described above for Newell's shearwater (ʻaʻo). The minimization measures will result in substantial ongoing reduction in take compared with the unminimized condition throughout the permit term. Chapter 4, Figures 4-5a and 4-5b show the amount of collision risk reduction expected throughout Kaua'i, both in terms of absolute risk reduction (Figure 4-5a) and proportional risk reduction (Figure 4-5b). As shown by comparing the unminimized take and proposed take with minimization only comparisons on Figure 5-10 (see Table 5-3 for description of each comparison), this estimated reduction in collisions is expected to improve the population rate of change. This is the anticipated result of retaining more adults and subadults, thereby improving demography, age class structure, and population size.

The differences between minimized and unminimized take are greater under the stable trend scenario (Figure 5-10b) than under the worse-case scenario (Figure 5-10a) because under the stable trend scenario there are more birds in areas vulnerable to powerline collisions. In contrast, under the worse-case scenario, the majority of birds will eventually be concentrated at the conservation sites, which are far less vulnerable to powerline collisions.

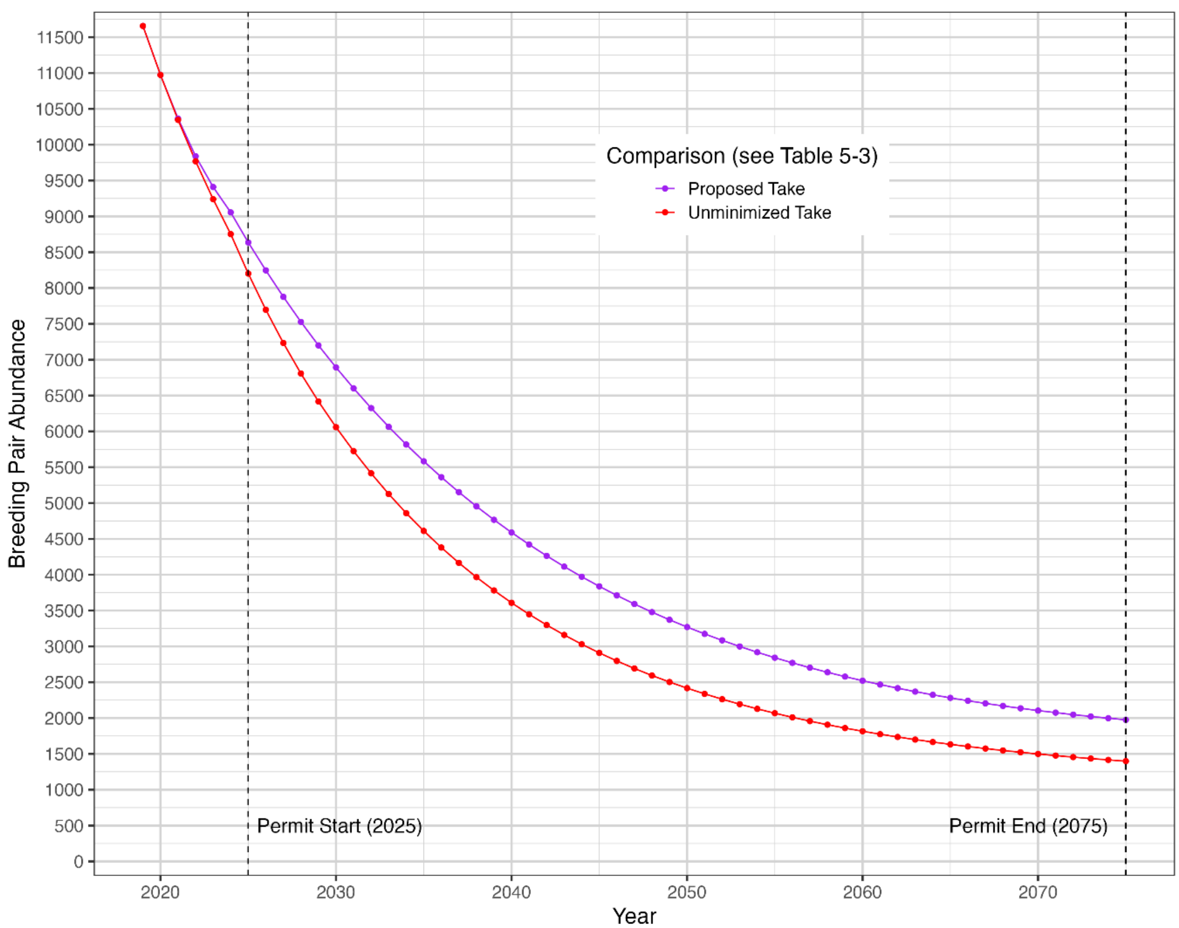


Figure 5-10a. Worse-Case Scenario: Effects of Minimization on Hawaiian Petrel ('ua'u) Kaua'i Metapopulation (All Subpopulations)

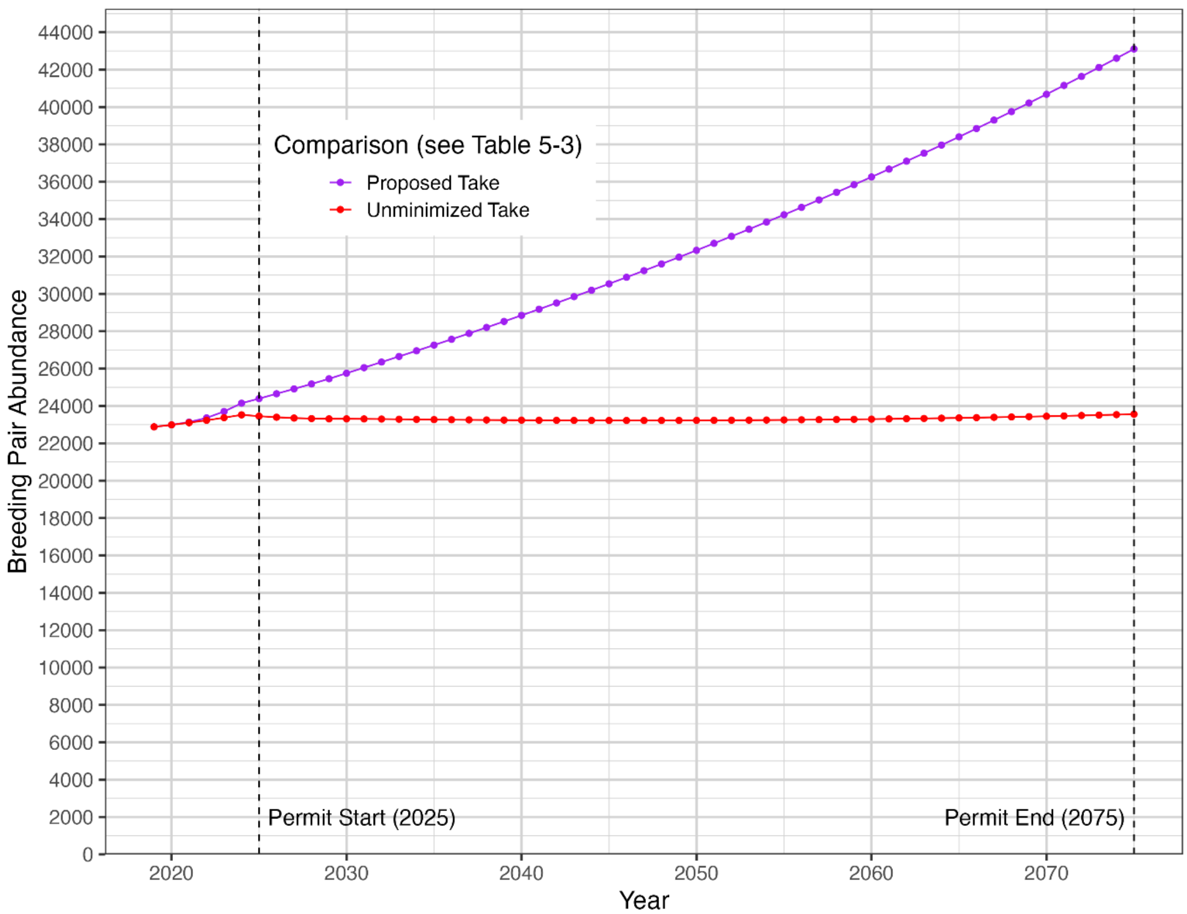


Figure 5-10b. Stable Trend Scenario: Effects of Minimization on Hawaiian Petrel (ʻuaʻu) Kauaʻi Metapopulation (All Subpopulations)

In addition to the powerline minimization described in the preceding paragraphs, KIUC has committed to minimizing light attraction consistent with Conservation Measure 2, *Implement Measures to Minimize Light Attraction.* The success of this measure is described in greater detail for Newell's shearwater (ʻaʻo) (Section 5.3.2, *Requested Take and Effects on Newell's Shearwater (ʻaʻo)*). These conservation actions will continue to be implemented during the permit term. Minimization of fallout from light attraction results in increased fledgling survival, which increases recruitment, which leads to more future breeding-age individuals in the Kauaʻi metapopulation. Because this species has very low reproductive productivity, increasing recruitment to the breeding-age population, and hence increasing the number of fledglings that can be produced by the metapopulation each year, will contribute to a stable age structure (increased amount of younger age classes in the population), population growth rate, and numbers for the Kauaʻi metapopulation of Hawaiian petrel (ʻuaʻu).

Impacts of the Taking based on Population Dynamics Model

The differences between the no take/no HCP and proposed take with minimization only comparisons in Figures 5-11a and 5-11b reflect the impact of KIUC's requested take on Hawaiian petrel (ʻuaʻu) throughout the permit term in the absence of Conservation Measure 4, *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*. Results are presented based on the worse-case model scenario (Figure 5-10a) and the stable trend model scenario (Figure 5-10b).

Population Dynamics Model Results

Table 5-11 compares model results between the worse-case scenario and the stable trend scenario for Hawaiian petrel (ʻuaʻu). The following sections describe model results as they pertain to the anticipated level of take, impacts of the taking on the species, beneficial effects of the conservation strategy, and net effects of the HCP (including both take and conservation).

Table 5-11. Hawaiian Petrel (ʻuaʻu) Model Results for each of Two Scenarios for the Kauaʻi Metapopulation.

	Model Scenario	
Model Result	**Worse Case**	**Stable Trend**
Metapopulation growth rate at end of permit term (2075)	1%	6%
Starting island-wide metapopulation size (total individuals, all ages) in 2025 (A)[a]	28,548	77,806
Ending island-wide metapopulation size in 2075 (B)	17,401	543,672
Starting abundance at all HCP conservation sites in 2021 (C)	7,078 [b]	Same
Ending total abundance at all HCP conservation sites in 2075 (D)	11,406	129,106[c]
Net gain at all HCP conservation sites (E = D – C)	4,319	122,019
Year when island-wide metapopulation growth becomes positive	2070	2021
Total number of predicted powerline collisions over the 50-year permit term (F)	18,858	111,084
Total injury and mortality resulting from powerline collisions over the 50-year permit term (G)	13,936 [d]	71,050[d]

[a] Initial abundance is estimated based on assumed trend, unminimized collision estimate, and R_{MAX} model

[b] Estimated from burrow monitoring, auditory surveys and habitat suitability modeling

[c] This is not a reasonable abundance level to expect for the conservation sites. It results because these provisional population model runs do not impose a carrying capacity (i.e., limit to the subpopulation size) outside the predator exclusion fences.

[d] Includes loss of chicks and eggs.

Worse-*Case Model Scenario*

As described in Appendix 5E, *Population Dynamics Model for Hawaiian Petrel (ʻuaʻu) on Kauaʻi*, in the hypothetical absence of take related to KIUC operations,[30] under the worse-case scenario the Kauaʻi metapopulation would continue to decline at an estimated annual rate of 2.4 percent per year (Lambda = 0.976[31]; Figure 5-11a, grey line). This is the modeled rate of decline that results from setting powerline and fallout take (from both direct take on individuals and indirect take of eggs and chicks resulting from killed or injured adults) to zero and applying the predation mortality and reproductive success rates estimated at conservation sites prior to KIUC's predator control measures. The trajectory under the no take/no HCP comparison suggests that the effects of predation and other threats remain substantial contributors to the species' decline even without the adverse effects of KIUC covered activities.

[30] Since KIUC powerlines are already in operation and their removal would be infeasible, this no-take scenario is hypothetical and used only as a basis for evaluating the impact of the taking.

[31] Lambda (λ) represents the annual population multiplier. A lambda of 1.0 indicates a population that is replacing itself but not growing or declining (i.e., a population with consistent numbers through time). A lambda above 1.0 indicates a growing population. A lambda below 1.0 indicates a declining population.

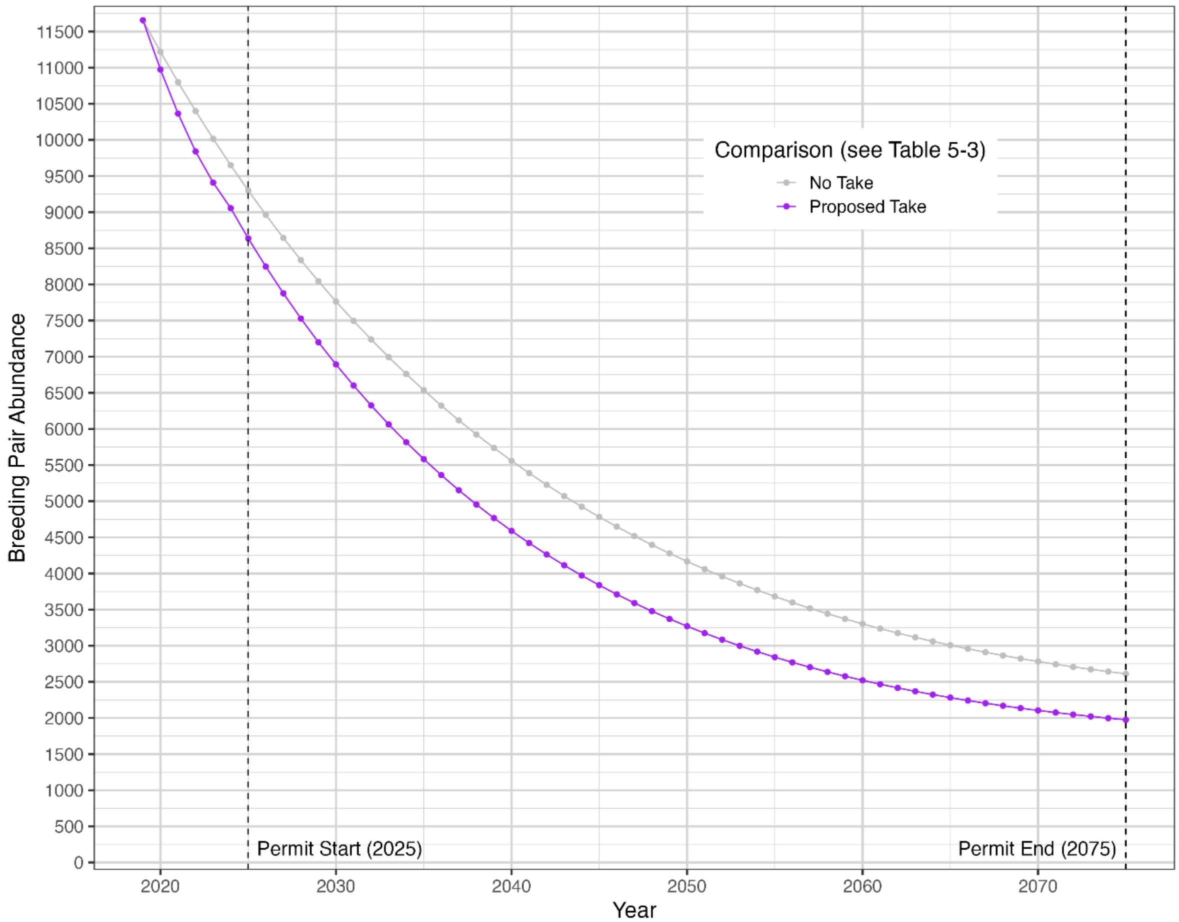


Figure 5-11a. Hawaiian Petrel (ʻuaʻu) Worse-Case Scenario: Impacts of the Taking on Breeding Pair Abundance and Trends Prior to Mitigation

As shown by the purple line on Figure 5-11a, even with powerline collision minimization, under the worse-case scenario, the continued loss of Hawaiian petrel (ʻuaʻu) as a result of KIUC covered activities could have an appreciable negative effect on the abundance of the metapopulation of Hawaiian petrel (ʻuaʻu) in the absence of mitigation to offset these effects (i.e., without Conservation Measure 4, *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*). Although both the purple line (proposed take) and grey line (no take/no HCP) indicate ongoing decline of the species, the Kauaʻi metapopulation size under the proposed take with minimization only comparison is well below the metapopulation size under the no-take comparison throughout the permit term. In the absence of mitigation, this population loss could render the species more vulnerable to extirpation on Kauaʻi due to random chance events such as catastrophic weather events, disease outbreaks, or genetic stochasticity. With unmitigated take, the metapopulation could fall to a level at which any future loss in abundance beyond the permit term would be unsustainable, because stressors on the species are likely to continue contributing to the species' decline. Once the population falls below a minimum size for sustaining a viable population, chances of extirpation are high. As described in Section 5.3.3.4, *Beneficial and Net Effects*, however, the proposed conservation strategy is expected to offset the impacts of the taking and result in a net benefit to the species, even under the worse-case scenario.

Stable Trend Scenario

Under the stable trend scenario, the Kauaʻi metapopulation would increase substantially under both the proposed take and no-take/no HCP comparisons, although the increases would be considerably greater for the no-take/no HCP comparison (Figure 5-11b). While the proposed take would substantially diminish projected abundance levels compared with no-take/no HCP (Figure 5-11b), the total metapopulation abundance would be considerably higher than under the worse-case scenario and the number of breeding pairs by the end of the permit term would be substantially higher than needed for a Kauaʻi viable metapopulation, even without conservation measures (see *Metapopulation Viability*, below).

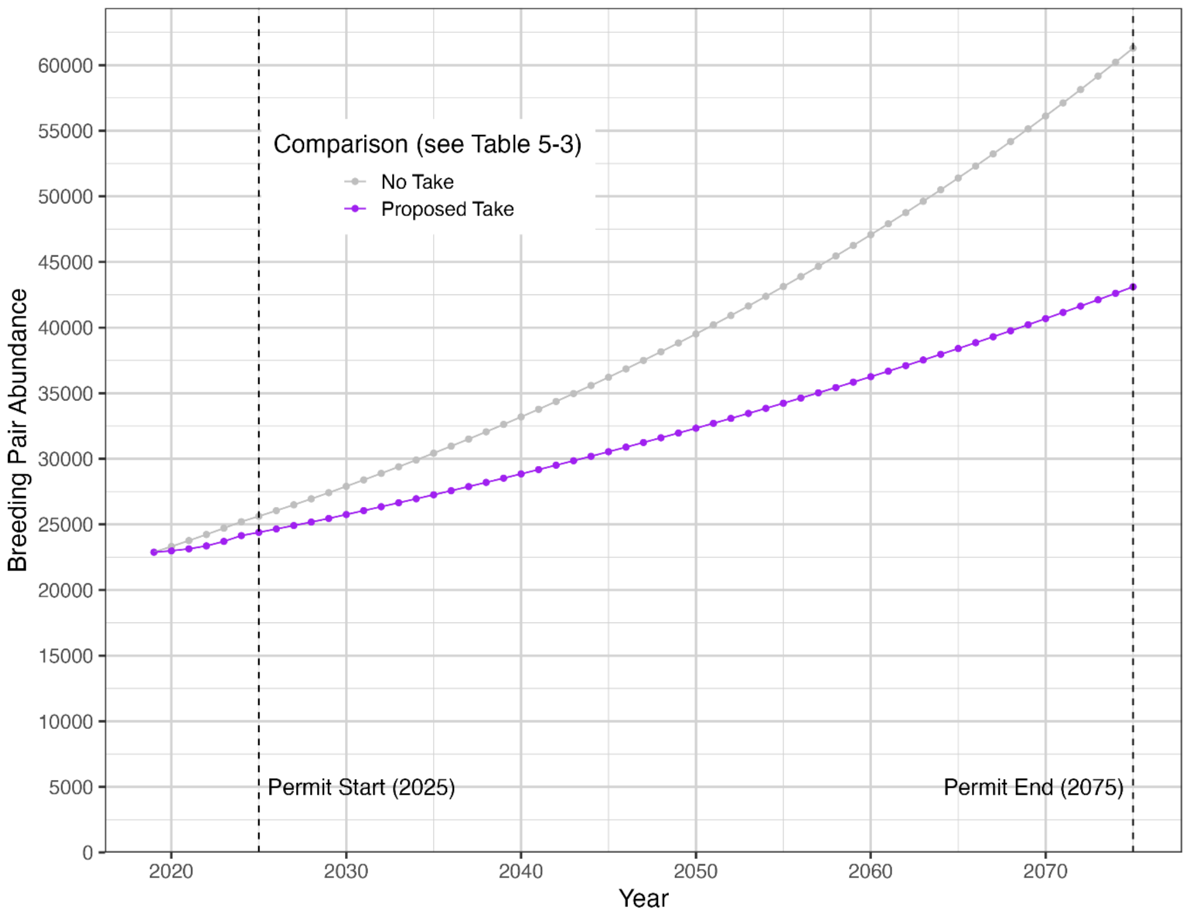


Figure 5-11b. Hawaiian Petrel (ʻuaʻu) Stable Trend Scenario: Impacts of the Taking on Breeding Pair Abundance and Trends Prior to Mitigation

Conclusion, Impacts of the Taking

Hawaiian petrel (ʻuaʻu) is highly vulnerable to ongoing mortalities from various sources, and KIUC's activities have contributed to the decline of the Kauaʻi metapopulation. KIUC's minimization measures (without additional compensatory measures) would reduce the downward trend under the worse-case scenario (Figure 5-10a), and contribute to a substantial metapopulation increase under the stable trend scenario (Figure 5-10b). Under both scenarios, the proposed, minimized take would considerably diminish the metapopulation abundance by the end of the permit term compared with a no-take/no HCP scenario (Figures 5-11a and 5-11b). For example, under the worse-case scenario, the proposed take would reduce the final metapopulation abundance by approximately 35 percent as compared to without take. Under the stable trend scenario, the proposed take would reduce the final metapopulation abundance by approximately 31 percent as compared to without take.

The reduced abundance resulting from take would be expected to have a greater effect on the species under the worse-case scenario (Figure 5-11a) than the stable trend scenario (Figure 5-11b) because the metapopulation numbers could dip to unsustainable levels under the worse-case scenario, as described above. Section 5.3.3.4, *Beneficial and Net Effects,* describes how KIUC will offset the impacts of the taking and result in net benefits to the species.

5.3.3.3 Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites,* is expected to mitigate Hawaiian petrel (ʻuaʻu) mortalities resulting from KIUC covered activities through management and enhancement of breeding colonies and reduction of predators (the same as Newell's shearwater [ʻaʻo] described in Section 5.3.2.3, *Beneficial Effects and Net Effects*).

Beneficial Effects of the Offset Measures

This section addresses beneficial effects of KIUC's measures to offset the minimized take of Hawaiian petrel (ʻuaʻu), focusing on Conservation Measure 4, *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites.* This section also provides additional information on the beneficial effects of Conservation Measure 3, *Provide Funding for the Save our Shearwaters Program*. The beneficial effects of conservation measures related to minimization (Conservation Measure 1, *Implement Powerline Minimization Projects* and Conservation Measure 2, *Implement Measures to Minimize Light Attraction*) have been described in Section 5.3.3.3, *Impacts of the Taking*.

The conservation measures to offset take are designed to result in early improvements in the viability of the Hawaiian petrel (ʻuaʻu) metapopulation on Kauaʻi by focusing conservation efforts in areas expected to have the greatest benefit to the species. The early nature of the beneficial effects is described further below, under *Population Dynamics Model Comparison.*

Beneficial Effects of Conservation Measure 4, Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites

As described in Chapter 4, *Conservation Strategy*, KIUC will offset the requested take of Hawaiian petrel (ʻuaʻu) primarily by managing and enhancing breeding colonies across conservation sites with suitable breeding habitat, and reducing the abundance and distribution of key seabird predators at these sites in northwestern Kauaʻi. Through these measures, KIUC will substantially increase the number of Hawaiian petrel (ʻuaʻu) breeding pairs and fledglings produced annually to reverse the historic downward trend of this species' Kauaʻi metapopulation (based on worse-case scenario) as determined by radar and acoustic call rates.

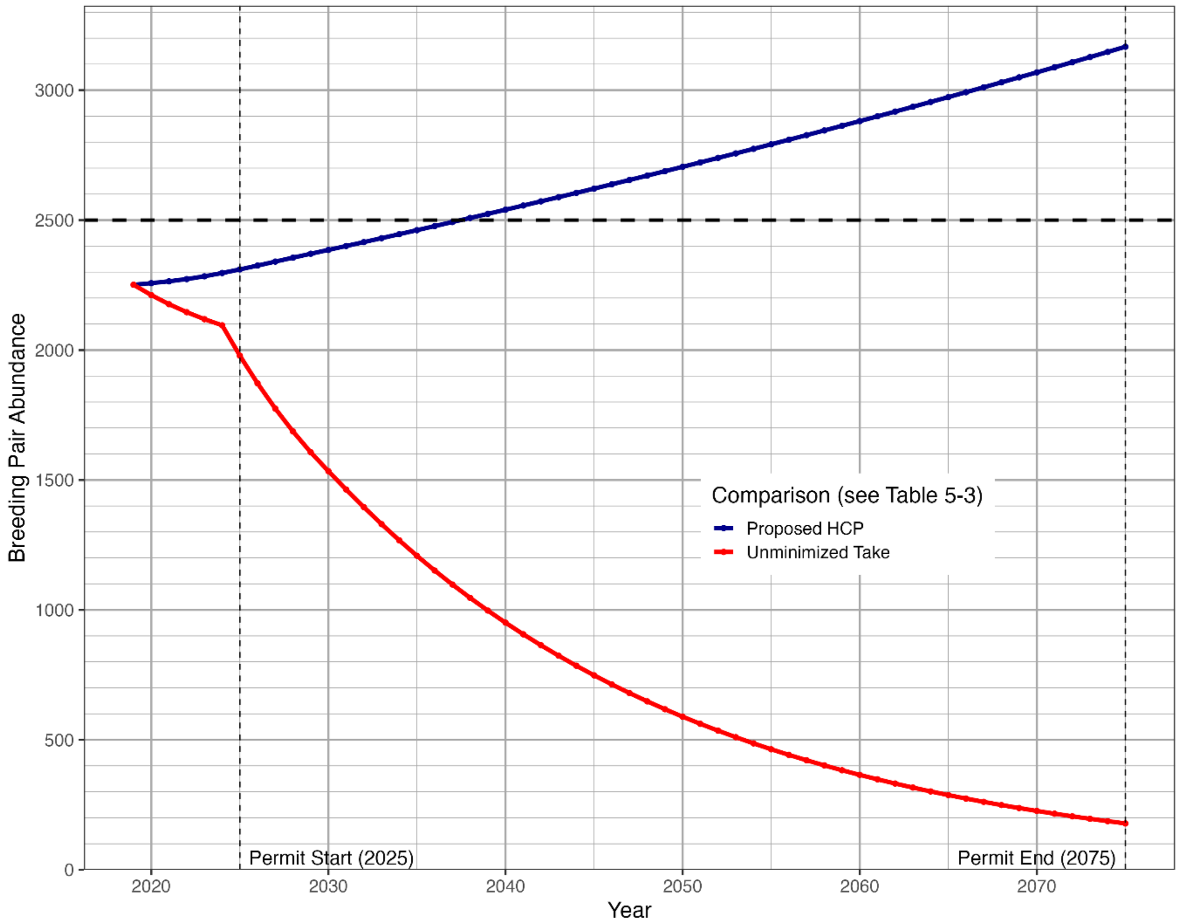
Management actions with demonstrated success at improving the reproductive success of Hawaiian petrel (ʻuaʻu) breeding colonies are ongoing and would continue and be expanded by the HCP for the duration of the permit term as described above for Newell's shearwater (ʻaʻo) in Section 5.3.2.4, *Beneficial Effects and Net Effects*). Substantial metapopulation increases and improved survival at the conservation sites, in combination with minimizing take island-wide, are expected to reverse the current island-wide population decline under the worse-case scenario and establish a Kauaʻi viable metapopulation that is increasing for Hawaiian petrel (ʻuaʻu) (as defined by meeting the HCP biological objectives associated with biological goals 1 and 2). Although numbers of breeding pairs are expected to decrease outside conservation sites under the worse-case scenario, redistribution of the metapopulation to the northwestern portion of the island will substantially reduce the vulnerability of Hawaiian petrel (ʻuaʻu) to predation, powerline collisions, and light attraction, stabilizing the metapopulation or reversing the downward metapopulation trend.

Population Dynamics Model Comparison

KIUC compared a hypothetical outcome without Conservation Measure 4, *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites* (i.e., the proposed take with minimization only comparison) with projected outcomes from the HCP to evaluate the beneficial effects of Conservation Measure 4, *Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*. Figures 5-12 through 5-14 provide relevant results from the population dynamics model as they relate to beneficial effects on subpopulations.

Figure 5-12a shows the metapopulation trajectory for Hawaiian petrel (ʻuaʻu) at all conservation sites combined under the worse-case scenario. Figure 5-12a (blue line) demonstrates substantial benefits resulting from the conservation strategy, and these benefits are seen early in the permit term. According to the model, the total breeding pair abundance of Hawaiian petrel (ʻuaʻu) at all of the conservation sites combined is expected to increase immediately, with the rate increasing continuously through the permit term (blue line). Under this worse-case scenario, the total abundance at the conservation sites alone combined is expected to reach the threshold of 2,500 breeding pairs by approximately 2051,[32] about halfway through the permit term. Conversely, without the conservation strategy, abundance declines throughout the permit term under the worse-case scenario.

[32] As described in Chapter 4, *Conservation Strategy*, 2,500 breeding pairs is the amount that USFWS and DOFAW consider to represent a minimum Kauaʻi viable metapopulation of Newell's shearwater (ʻaʻo).

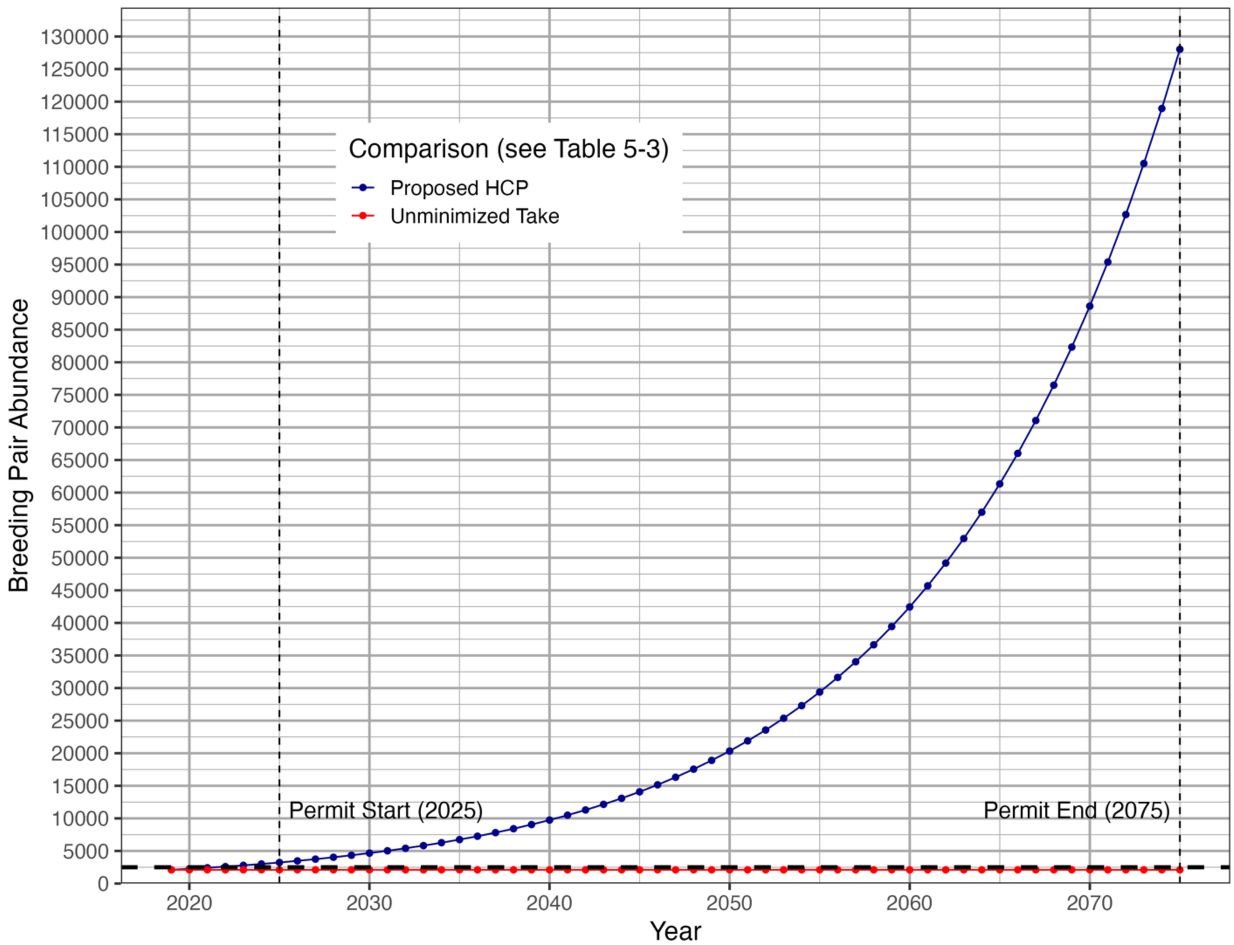


Abundance of Hawaiian petrel (ʻuaʻu) at all conservation sites combined without the HCP (no minimization or mitigation; red line) vs. with the minimization and mitigation proposed in the HCP (blue line). The difference between these two lines represents the beneficial effects of the combined minimization and mitigation under the worse-case scenario. The dashed black horizontal line indicates 2,500 breeding pairs, the point at which the Kauaʻi metapopulation reaches an abundance that USFWS and DOFAW consider to be a viable metapopulation.

Figure 5-12a. Worse-Case Scenario: Beneficial Effects of Conservation Strategy at Conservation Sites for Hawaiian Petrel (ʻuaʻu)

Figure 5-12b shows the modeled abundance for Hawaiian petrel (ʻuaʻu) at all conservation sites combined under the stable trend scenario. The red line in Figure 5-12b represents the modeled abundance without minimization or mitigation, indicating a slow rate of increase but nearly flat trajectory throughout the permit term. In this scenario, natural recruitment is able to slightly overcome the adverse effects of predators (without predator control) and the low risk of powerline collision and light attraction for birds leaving from or arriving at these sites.

The blue line on Figure 5-12b represents the modeled abundance with the proposed minimization and mitigation in place. With the HCP, growth at the conservation sites occurs immediately and continues to increase exponentially over time. The scenario does not assume a limit to the abundance (i.e., carrying capacity) of the species at the conservation sites. As discussed above, this assumption may or may not be accurate. Many of the conservation sites are several hundred acres in size (see Chapter 4, Table 4-8) and could theoretically support very large breeding colonies of birds at high densities observed at smaller sites. Furthermore, as the subpopulations at each conservation site increase, they may attract prospecting birds and new breeding pairs from outside the conservation sites, even after social attraction recordings cease within predator-proof fences. Although the assumption of no carrying capacity at the conservation sites is not meant to perfectly represent reality, under the stable trend scenario, abundance would be expected to increase in other larger areas of Kauaʻi outside the conservation sites, as a result of reducing a substantial source of take through powerline minimization measures. Hawaiian petrel (ʻuaʻu) abundance has been estimated to have been reduced by 78 percent during the observed decline in the 1990s and early 2000s (Raine et al. 2017). In other words, the metapopulation abundance has been estimated to be at approximately 22 percent of pre-decline abundance. This means that the Kauaʻi metapopulation would need to increase to almost five times its current size before abundance reached pre-decline levels. Hence, if the metapopulation reaches pre-decline levels of abundance under the HCP, that abundance level would still be five times higher than projected without the HCP under the stable trend scenario.



Modeled abundance for Hawaiian petrel (ʻuaʻu) if take without the HCP (red line) vs. with the HCP (blue line). The difference between these two lines represents the beneficial effects of the combined minimization and mitigation under the stable trend scenario. The dashed black horizontal line indicates 2,500 breeding pairs, the point at which the Kauaʻi metapopulation reaches an abundance that USFWS and DOFAW consider to be a viable metapopulation.

Figure 5-12b. Stable Trend Scenario: Beneficial Effects of Conservation Strategy at Conservation Sites for Hawaiian Petrel (ʻuaʻu)

Figures 5-13a and 5-13b provide estimates of abundance at each conservation site that currently supports Hawaiian petrel (‘ua‘u).[33] Figure 5-13a demonstrates that, under the worse-case scenario, conservation measures at all six of the conservation site locations will substantially benefit Hawaiian petrel (‘ua‘u), and do so relatively quickly. By comparison, Figure 5-13a illustrates that breeding pair abundance at every conservation site will decline almost immediately without the HCP (red line; i.e., without predator control and without minimization) and eventually become locally extirpated.

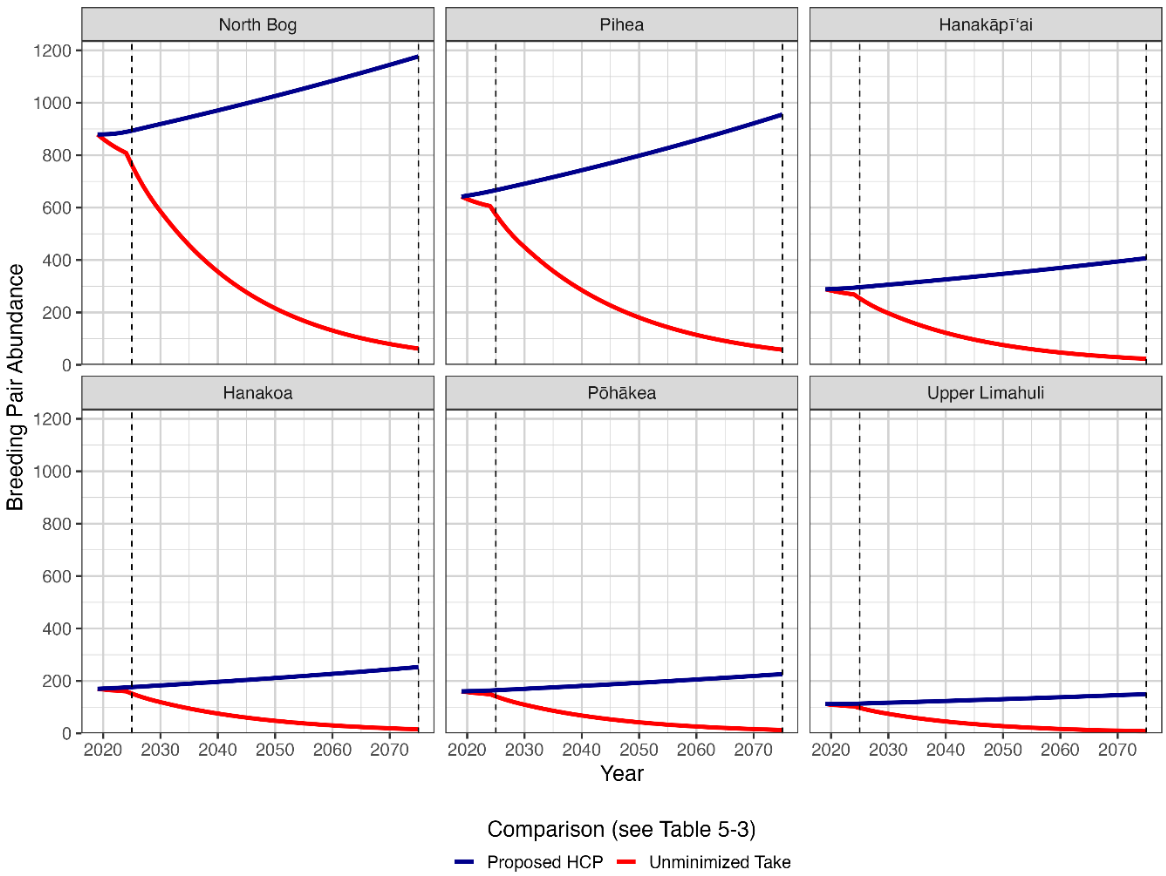


Figure 5-13a. Worse-Case Scenario: Beneficial Effects of Conservation Strategy at All Conservation Sites Combined for Hawaiian Petrel (‘ua‘u)

[33] Conservation sites are not shown that currently do not support the species and are not expected to support the species. See Appendix 4A, *Conservation Site Selection*, for details.

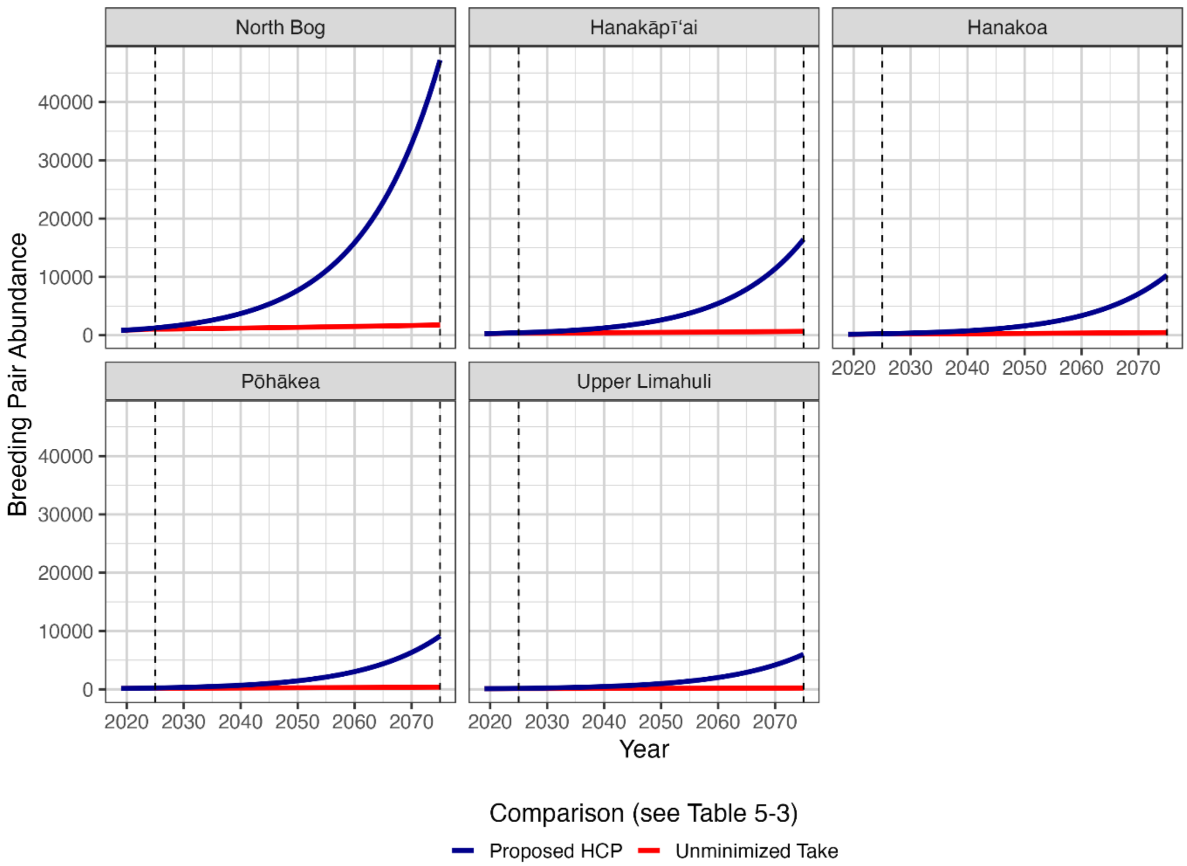


Figure 5-13b. Stable Trend Scenario: Beneficial Effects of Conservation Strategy at All Conservation Sites Combined for Hawaiian Petrel ('ua'u)

Figure 5-13b shows the modeled abundance at each conservation site under the stable trend scenario. In this scenario, breeding pair abundance at the conservation sites for Hawaiian petrel ('ua'u) shows substantial increases by approximately 2060. Without the HCP (red line), the abundance at all conservation sites remains nearly flat. Without the HCP under the stable trend scenario, the subpopulations at each conservation sites would be at risk of local extirpation due to their low initial abundance.

As shown on Figures 5-13a and 5-13b, continued and expanded predator control combined with powerline collision minimization prevents substantial declines of existing subpopulations of Hawaiian petrel ('ua'u) at the conservation sites and likely prevents local extirpation (red lines), consistent with biological objectives 2.1 and 2.3.

Figures 5-14a and 5-14b show the effects of the conservation strategy in the rest of suitable habitat for Hawaiian petrel ('ua'u) on Kaua'i, outside of the conservation sites. Under the worse-case scenario (Figure 5-14a), the conservation strategy would have little to no beneficial effects on the four smaller modeled subpopulations outside the conservation sites that are subject to relatively low risks of powerline collision or light attraction already because of their location in northwest Kaua'i (Wainiha and Lumaha'i Valleys, Kalalau East to Upper Mānoa, Nā Pali Coast, and Waimea Canyon). The Hanalei to Kekaha modeled subpopulation would continue to decline with the HCP (blue line) compared to without the HCP (red line) (Figure 5-14a). However, the minimization provided by the HCP would slow the rate of decline considerably as compared to without the HCP.

Without the HCP, the Hanalei to Kekaha subpopulation is projected to be extirpated around 2080. With the HCP, the Hanalei to Kekaha subpopulation is projected to continue to be extant beyond 2080.

Under the stable trend scenario, the minimization measures have a substantial influence on breeding pair abundance outside the conservation sites[34] in the Hanalei to Kekaha modeled subpopulation (Figure 5-14b). With the HCP (blue line), Hawaiian petrel (ʻuaʻu) breeding pairs steadily increase in abundance in the Hanalei to Kekaha modeled subpopulation. By the end of the permit term, the Hanalei to Kekaha modeled subpopulation is projected to nearly double in abundance with the HCP, while without the HCP it is projected to remain relatively unchanged. Stated another way, in an island-wide metapopulation that has a stable growth trend (i.e., the stable trend scenario), the benefits of powerline minimization are substantial even in the absence of predator control.

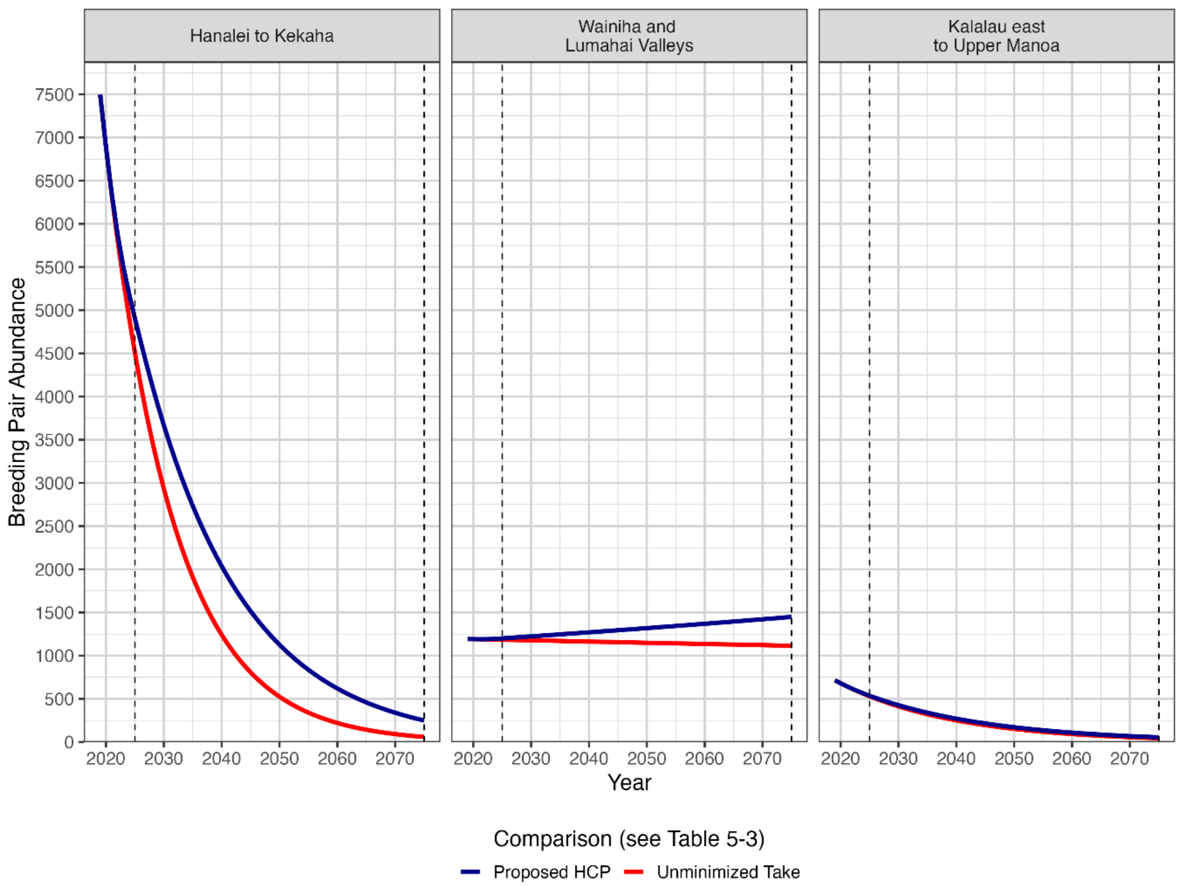


Figure 5-14a. Worse-Case Scenario: Beneficial Effects of Conservation Strategy Outside Conservation Sites for Hawaiian Petrel (ʻuaʻu)

[34] Predator control at the conservation sites is assumed in the model to have no effect on the vital rates of the covered seabirds in subpopulations outside the conservation sites. In reality, there may be "spillover" benefits of predator control to other subpopulations, particularly those adjacent to the conservation sites such as Nā Pali Coast and Kalalau East to Upper Mānoa and for more wide-ranging predators such as feral cats and barn owls.

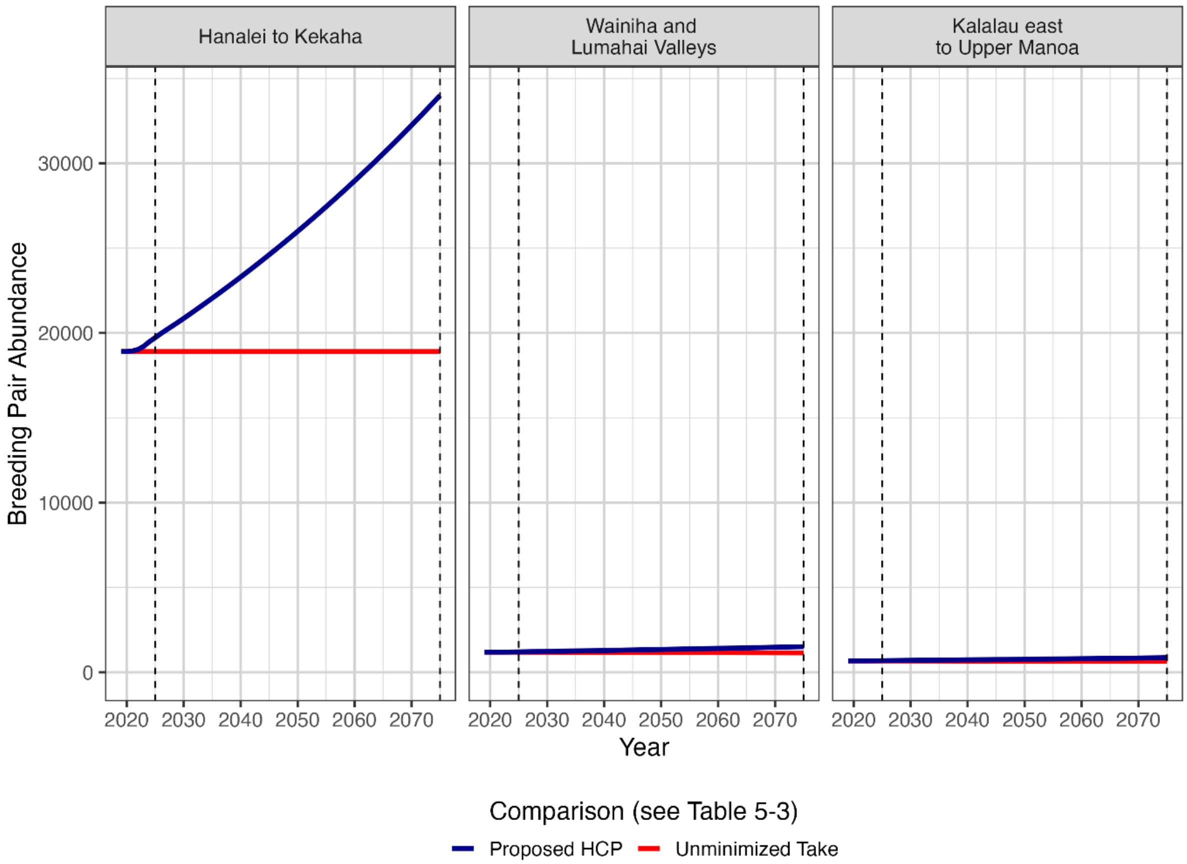


Figure 5-14b. Stable Trend Scenario: Beneficial Effects of Conservation Strategy Outside Conservation Sites for Hawaiian Petrel (ʻuaʻu)

Beneficial Effects of Conservation Measure 3, *Provide Funding for the Save our Shearwaters Program*

The beneficial effects of Conservation Measure 3 for Hawaiian petrel (ʻuaʻu) are as described above in Section 5.3.2, *Requested Take and Effects on Newell's shearwater (ʻaʻo).*

Summary of Beneficial Effects

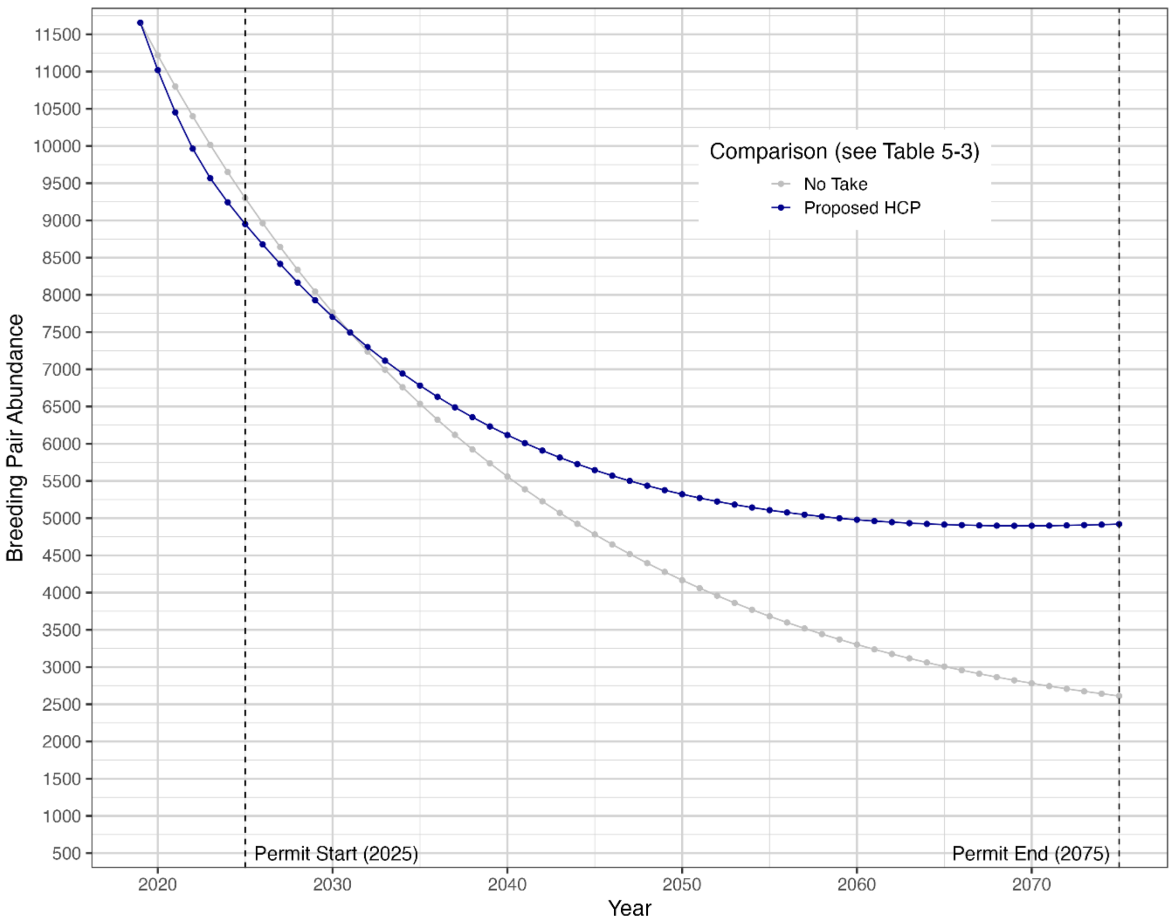
Figure 5-15 illustrates the primary benefits of KIUC's conservation strategy on Hawaiian petrel (ʻuaʻu), including summaries of the conservation actions, modeled abundance trends, and level of confidence for the Nā Pali Coast, the conservation sites, and the remaining island. Under the worse-case scenario, abundance trends remain negative along the Nā Pali Coast and the remaining island, with minimization measures reducing these downward trends on the remaining island, but strong positive trends with a high level of confidence at the conservation sites. Under the stable trend scenario, populations remain stable along the Nā Pali Coast and show a positive trend throughout the remainder of the island, with substantial benefits resulting from KIUC's minimization and mitigation measures.

Net Effects based on Population Dynamics Model

As described in Section 5.3.1.6, *Benefits of the Conservation Strategy and Net Effects—Methods*, the difference between the no-take comparison and the proposed HCP represents the net effects in terms of the projected abundance of Hawaiian petrel ('ua'u) breeding pairs in any year of the permit term and by the end of the permit term. These net effects include both the adverse effects of the proposed take and the beneficial effects of the proposed conservation strategy.

Worse-Case Scenario

The hypothetical comparison of no KIUC take during the 50-year permit term for the worse-case scenario (Figure 5-15a, grey line) shows a persistent downward species decline resulting from factors other than KIUC's proposed take. In other words, even if KIUC was able to eliminate all take associated with its current and future facilities (i.e., 100 percent minimization), the Kaua'i metapopulation of Hawaiian petrel ('ua'u) is predicted to decline substantially and continue declining well after the 50-year permit term under the worse-case scenario.



Modeled Kaua'i metapopulation abundance for Hawaiian petrel ('ua'u) under a hypothetical situation with no KIUC-related take (grey line) vs. with the proposed HCP (blue line). The population growth rate with the proposed HCP exceeds that of the hypothetical situation with no KIUC-related take and no HCP by the end of the permit term.

Figure 5-15a. Worse-Case Scenario: Net Effects of the HCP on Hawaiian Petrel ('ua'u)

Under the worse-case scenario the HCP conservation measures, including minimization and conservation, are projected by approximately 2070 (i.e., Year 45 of the permit term) to begin to reverse this decline. It takes most of the permit term to reach this point because of two primary factors. First, the worse-case scenario assumes a limited theoretical maximum growth rate of only 3.0 percent for the species. This theoretical maximum growth rate is what is assumed to occur in the absence of any anthropogenic threats, including predation by invasive species. In contrast, the stable trend scenario assumes a maximum theoretical growth rate of 8.0 percent annually. The second reason is that the Hanalei to Kekaha subpopulation dominates the metapopulation dynamics of the worse-case scenario for many years. Only when the Hanalei to Kekaha subpopulation is projected to decline to much lower levels than the conservation sites can the growth and abundance at the conservation sites begin to affect the island-wide metapopulation.

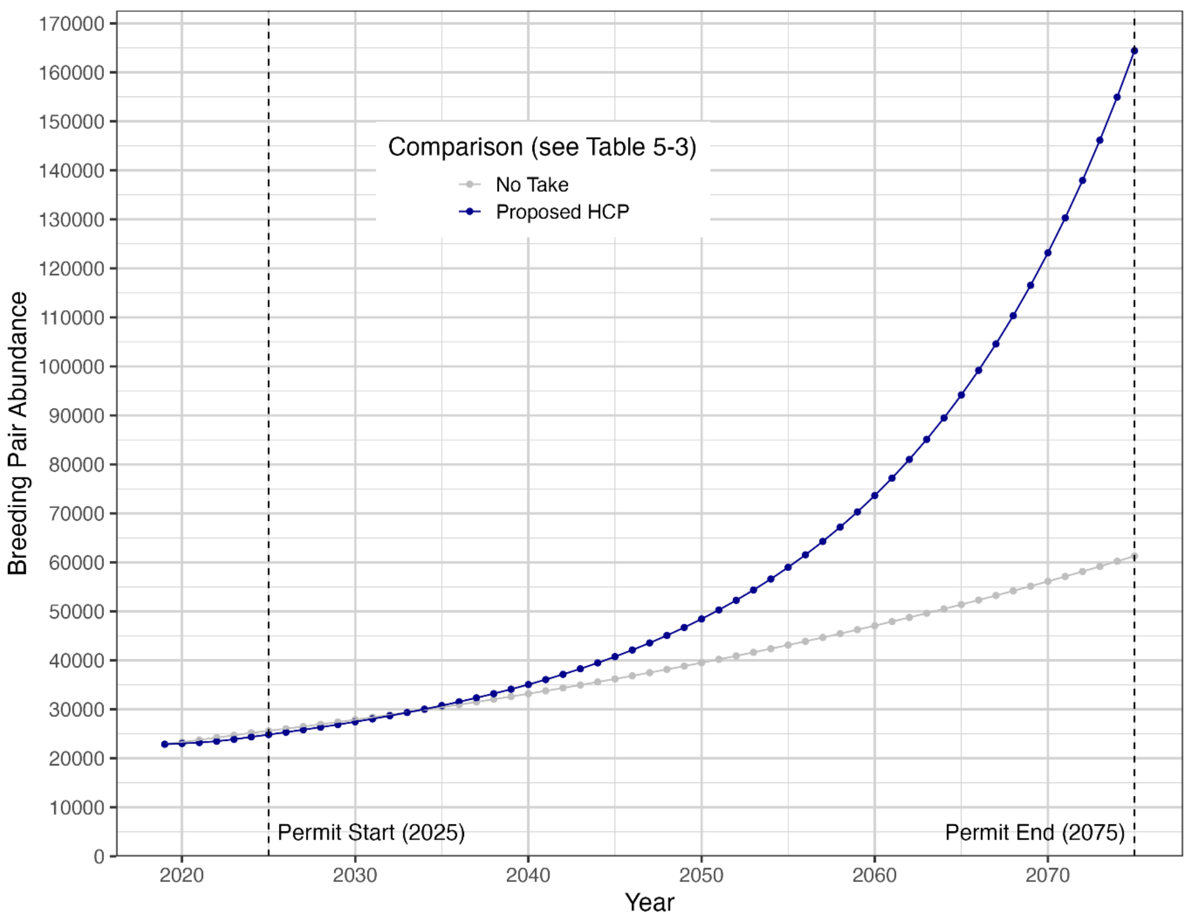
After 2030, the HCP results in a net benefit to the Kauaʻi metapopulation until the end of the permit term as compared to a scenario with no take and no KIUC conservation (Figure 5-15a). HCP conservation measures are projected to slow the metapopulation decline considerably between 2030 and 2060 and stabilize the island-wide metapopulation by approximately 2065. After this, the metapopulation is projected to increase gradually until the end of the permit term, with a net increase in numbers of breeding pairs (blue line) compared with a hypothetical scenario in which the proposed take did not occur (grey line). Hence, the HCP provides a net benefit to Hawaiian petrel (ʻuaʻu) even under the worse-case scenario by providing the following four outcomes:

1. Reversing the decline of the Kauaʻi metapopulation and creating a consistently growing metapopulation.
2. Increasing metapopulation abundance compared with the no-take scenario for most of the permit term.
3. The Kauaʻi metapopulation does not fall below the threshold of 2,500 breeding pairs set by USFWS and DOFAW as the minimum viable metapopulation size, at any time during the permit term.
4. By the end of the permit term, the Kauaʻi metapopulation is growing steadily, thus greatly increasing metapopulation viability. Metapopulation viability is discussed in more detail below.

Stable Trend Scenario

The stable trend scenario shows an upward abundance trend for Hawaiian petrel (ʻuaʻu) throughout the permit term for both the proposed HCP and the hypothetical no-take/no HCP comparison (Figure 5-15b). Under this scenario, the HCP provides a net benefit to Hawaiian petrel (ʻuaʻu) and offsets the impact of the taking by providing the following outcomes:

1. Consistent growth in the Kauaʻi metapopulation in which the projected growth of the metapopulation is always greater than the take during the permit term.
2. An approximately six-fold increase in metapopulation abundance on Kauaʻi during the permit term (i.e., from an estimated 25,000 breeding pairs to 165,000 breeding pairs).
3. A Kauaʻi metapopulation that never falls below the threshold of 2,500 breeding pairs set by USFWS and DOFAW as the minimum viable metapopulation size.
4. By the end of the permit term, the Kauaʻi metapopulation is growing steadily, greatly increasing metapopulation viability. Metapopulation viability is discussed in more detail below.



Modeled metapopulation abundance of Hawaiian petrel ('ua'u) under a hypothetical situation with no KIUC-related take (grey line) vs. the proposed HCP (blue line). The population growth rate with the proposed HCP exceeds that of the hypothetical situation with no KIUC-related take and no HCP by the end of the permit term.

Figure 5-15b. Stable Trend Scenario: Net Effects of the HCP on Hawaiian Petrel ('ua'u)

Addressing Uncertainty

KIUC addressed uncertainty associated with the population dynamics model by using conservative assumptions that err on the side of the species.[35] In other words, the assumptions under the worse-case scenario would tend to overestimate impacts, underestimate benefits, or both. For example, the initial modeled rate of decline without conservation measures under the worse-case scenario represents an island-wide metapopulation that is decreasing at -8.0 percent per year, which is faster than the long-term trend in radar data across all monitoring sites during 1993–2020 (a -4.6 percent decline per year [lambda = 0.954]; Raine and Rossiter 2020). Also, the model only takes into account the benefits to the species of one other conservation action on Kaua'i, the KSHCP conservation site. Other conservation actions implemented by others or expected in the future by others are not included in the model.

As noted above, an example of a conservative model assumption is the initial rate of metapopulation decline. The model under the worse-case scenario assumes an initial rate of metapopulation decline

[35] Appendix 5E, *Population Dynamics Model for Hawaiian Petrel ('ua'u) on Kaua'i*, provides a description of these sources of uncertainty.

under the take with no minimization or mitigation comparison of -8.0 percent per year. This estimate is conservative because it is greater than the -4.6 percent per year population decline from radar data from all sites (1993–2020). The radar trend, unlike the modeled metapopulation trend, only covers those areas of the island with breeding colonies most affected by powerlines and fallout. The radar survey estimate does not incorporate trends from breeding colonies in northwestern Kauaʻi, including the conservation sites.

Trends in abundance at the conservation sites have been positive (i.e., growing) since 2014–2015, as estimated through acoustic call rate monitoring data (Raine et al. 2022). Therefore, the modeled trend for the metapopulation is conservative under the worse-case scenario, because it includes areas which are increasing in abundance, yet matches the long-term average radar site trend which only covers those areas of Kauaʻi that have been most affected by powerline collisions and fallout. Moreover, trend data from independent data sources suggest that current trends may be less negative than they have been historically, and that abundance levels may have stabilized during the last decade for those areas of the island most affected by powerline collisions and fallout (Raine and Rossiter 2020).

Raine and Rossiter (2020) showed that the trends from systematic monitoring through radar surveys are consistent with a leveling out of abundance since about 2009. The radar data indicate that after a very large metapopulation decline before 2009, the metapopulation trend may now be relatively stable (a regression of radar data for the last decade [2010–2020] was flat with no significant change). Given the recent radar data that suggests a relatively consistent abundance of Hawaiian petrel (ʻuaʻu) projections under the hypothetical situation of unminimized take are likely overestimating potential population declines in the future in the absence of predator control or powerline minimization. For a description of these assumptions and additional examples of how the worse-case scenario is likely very conservative, see Appendix 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*.

In contrast, the modeled stable trend scenario is more reflective of current data and is consistent with the stable trend in island-wide metapopulation suggested by three independent data sources: DOFAW radar data, SOS Program data, and KIUC powerline strike data. Model projections using the stable trend scenario with the HCP show substantial metapopulation growth throughout the permit term. See Appendix 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi* for details of this model scenario, projected outcomes, and model limitations. The actual outcome of the HCP is expected to be in between the outcomes of the worse-case scenario and the stable trend scenario.

Ongoing monitoring will inform the extent to which each model reflects actual outcomes. The monitoring and adaptive management strategy described in Chapter 6, *Monitoring and Adaptive Management Program*, is designed to monitor the success of KIUC's minimization and conservation measures throughout the permit term and adjust measures as needed. This will provide additional safeguards around the uncertainties associated with the population dynamics model because ongoing monitoring data gathered during implementation will be compared against model projections, and conservation measures will be adaptively managed to ensure the species' biological goals and objectives are met.

Metapopulation Viability

Substantial population increases at the conservation sites and improved survival outside the conservation sites, in combination with minimizing take, are expected to eventually reverse the current island-wide population decline and establish a stable Kaua‘i viable metapopulation of Hawaiian petrel (‘ua‘u) consistent with Goal 2 in Chapter 4, *Conservation Strategy*. Chapter 4, Section 4.3.2, *Hawaiian Petrel (‘ua‘u)*, describes how *viable* is defined in the context of population dynamics modeling. The population dynamics model indicates that the KIUC HCP would meet Goal 2 for Hawaiian petrel (‘ua‘u) consistent with a Kaua‘i viable metapopulation as represented by the following characteristics.

- Number of breeding pairs
- Population growth rate
- Age structure
- Spatial distribution

Each of these characteristics is described below in relation to the output of the population dynamics model.

Number of breeding pairs. Consistent with Objective 2.3, KIUC will (1) meet or exceed the minimum target breeding pairs defined in Table 6A-4 (lists the minimum breeding pairs per year), as measured by auditory surveys, acoustic surveys, and burrow monitoring for all sites combined, (2) maintain a growth rate for breeding pairs annually of at least 1.0 percent as measured by a 5-year rolling average, and (3) maintain a 5-year rolling average 75.7 percent reproductive success rate. As described in Chapter 6, Section 6.4.4, *Conservation Site Monitoring and Adaptive Management*, and Appendix 6A, *Adaptive Management Comparison Tables*, KIUC will monitor the conservation sites and adaptively manage them to ensure these commitments are met.

The population dynamics model, under both the worse-case and stable trend scenarios, is consistent with a metapopulation size for Hawaiian petrel (‘ua‘u) on Kaua‘i of over 4,899 breeding pairs at the lowest point of forecasted abundance during the 50-year permit term (Appendix 5E, *Population Dynamics Model for Hawaiian Petrel (‘ua‘u) on Kaua‘i*). A metapopulation size at this abundance level is well within the range of what has been suggested in meta-analyses of minimum viable population sizes integrating a wide range of case studies for birds and other taxa (Trail et al. 2007; Reed 2003). These estimates take into account the roles of age structure, catastrophes, random demographic and environmental fluctuations (stochasticity), and inbreeding depression. The worse-case scenario projects that the Kaua‘i metapopulation size will consist of an estimated 3,128 breeding pairs within the conservation sites by the end of the permit term, with the metapopulation continuing to increase beyond the permit term based on the modeled metapopulation trajectory. This is well above estimates by USFWS and DOFAW that 10,000 individuals and 2,500 breeding pairs represent a minimum viable metapopulation level for the Kaua‘i metapopulation of Hawaiian petrel (‘ua‘u).

Population growth rate. Consistent with Objective 2.3, KIUC will maintain an annual growth rate for breeding pairs of at least 1.0 percent at all conservation sites combined as measured by a 5-year rolling average, and maintain a 5-year rolling average of 75.7 percent reproductive success rate at reference burrows. As described in Chapter 6, Section 6.4.4, *Conservation Site Monitoring and Adaptive Management*, and Appendix 6A, *Adaptive Management Comparison Tables*, KIUC will monitor the conservation sites and adaptively manage them to ensure these commitments are met. As shown on Figure 5-15, by the end of the permit term the amount of breeding pairs in the metapopulation of Hawaiian petrel (‘ua‘u) on Kaua‘i is modeled to be stable. Although difficult to see in the graph, the modeled metapopulation of Hawaiian petrel (‘ua‘u) begins to grow slightly starting in Year 45 of the permit term (2070). All else being equal (i.e., the HCP conservation measures remaining in place), this positive growth trajectory would continue after the permit term and continue to increase, similar to the result for Newell's shearwater (ʻaʻo).

Age structure. As shown on Figure 5-12, under predator control measures and social attraction efforts, the combined abundance of the conservation sites is expected to continue and extend ongoing positive trends in abundance, reflecting an age structure consistent with a viable population. In general, modeled metapopulation numbers that are stable or increasing are consistent with viability because a stable or increasing modeled metapopulation size occurs when the total annual number of fledglings produced is equal to or greater than the number of adults and number of deaths on an island-wide basis (which is the expected outcome of the conservation strategy). This stable or slightly positive productivity at the end of the HCP will result from achieving the biological objectives, resulting in a net benefit to the modeled metapopulation that overcomes the reductions in survival and reproductive success resulting from future levels of powerline strikes, light fallout, and introduced predators.

Spatial distribution. As described in Chapter 4, *Conservation Strategy*, there are practical limitations precluding conservation efforts in areas of Kauaʻi outside the conservation sites; therefore, under the worse-case scenario of declining abundance trends outside the conservation site, future populations are likely to become spatially concentrated in remote locations with rugged terrain that are distant from powerlines and lights, where conservation efforts are focused. The results of the population dynamics model are consistent with the future breeding distribution of Hawaiian petrel (ʻuaʻu) on Kauaʻi becoming spatially more concentrated towards the conservation sites and Wainiha and Lumahaʻi Valleys in the future. Figures 5-13 and 5-14 show the projected population trajectories for subpopulations inside and outside the conservation sites proposed by this HCP, respectively, under the worse-case and stable trend scenarios.

Although the population dynamics model results suggest that some subpopulations outside of the conservation sites would not be considered viable throughout the permit term under the worse-case scenario, this was based on the conservative biological assumptions that rates of decline are consistent with the largest estimated rate of decline observed across individual radar monitoring sites (Chapter 3, Section 3.2.1, *Covered Seabirds*). As described in Section 5.3.1.1, *Use of Population Dynamics Models*, KIUC therefore developed a second scenario assuming an initial stable population trend, which is more consistent with current data. Under the stable trend scenario, subpopulations are projected to persist and slowly grow outside the conservation sites. Therefore, under the stable trend scenario, the current spatial distribution of the species would be largely preserved.

The KIUC HCP focuses most conservation efforts in the northwest portion of Kauaʻi because this area has the highest long-term potential for conservation success (see Chapter 4, Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*). However, extensive conservation, with an emphasis on minimization, has been applied across the island and specifically in the Hanalei to Kekaha area, which had the highest strike numbers prior to minimization. As shown on Figure 5-12b, KIUC's minimization efforts would be expected to have a substantial positive effect on the Kauaʻi metapopulation by increasing abundance from a stable trend to an upward trend early in the permit term and continuing throughout the permit term under the assumption of a stable trend scenario. The KIUC HCP will provide a net benefit to Hawaiian petrel (ʻuaʻu) even under the worse-case model scenario in which subpopulations continue to decline at a high rate and do not persist outside the conservation sites (Figure 5-12a). Under the worse-case scenario, modeled metapopulation abundance begins to increase by approximately Year 45 of the permit term and continues to grow for the remaining years of the permit term and beyond. This worse-case result is consistent with a Kauaʻi viable metapopulation.

5.3.4 Requested Take and Effects on Band-Rumped Storm-Petrel (ʻakēʻakē)

5.3.4.1 Level of Take

Table 5-12 provides the requested take for band-rumped storm-petrel (ʻakēʻakē) and estimated amounts for each form of take.

There are no reliable estimates for take of band-rumped storm-petrel (ʻakēʻakē) resulting from powerline collisions because the species is relatively rare on Kauaʻi and powerline strikes are thought to be very rare (even relative to their low abundance). During powerline monitoring between 2012 and 2023, there were 193 observed threatened and endangered bird powerline collisions, none of which were band-rumped storm-petrel (ʻakēʻakē) (Travers et al. 2024). For the purpose of this analysis, KIUC assumed total strikes of 16 band-rumped storm-petrels (ʻakēʻakē) from existing powerlines and 6 from new powerlines over the 50-year permit term. Including indirect take, these numbers are 18 and 7, respectively. Ongoing monitoring will evaluate the levels of take (as measured by strikes) during implementation and provide measures to ensure the effects on the species do not exceed those limits, as described in Chapter 6, *Monitoring and Adaptive Management Program*.

Impacts on band-rumped storm-petrel (ʻakēʻakē) from light attraction are difficult to estimate because it is a very small and cryptic seabird that is difficult to find once grounded. Work in remote colonies of band-rumped storm-petrels (ʻakēʻakē) indicate this species is extremely susceptible to light attraction (Raine in litt.). Thus, light attraction of this species is likely underreported (Raine et al. 2017). The estimated annual band-rumped storm-petrel (ʻakēʻakē) take resulting from fallout is an average of 0.9 bird from new (0.2 bird) and existing (0.7 bird) streetlights and no birds from covered facility lighting (Appendix 5B, *Light Attraction Modeling for Covered Seabirds*), resulting in total take estimate from fallout of 46 birds over the 50-year permit term.

The estimates for amount of take associated with each form of take (Tables 5-12a and 5-12b) is a rough approximation based on the best available data. The only data available for this species are based on SOS data from 2009 through 2024 (Table 4-6), where 13 birds were turned in over a 16-year period, of which 10 were released and only three birds died during that period of time. There have been no documented powerline strikes associated with band-rumped storm-petrels (ʻakēʻakē), although observations of this species skimming over a section of powerlines in Waimea Canyon indicate that this species may also occasionally strike powerlines (Travers et al. 2021). Because powerline strikes for band-rumped storm-petrel (ʻakēʻakē) are rare, the likelihood of observation during implementation is also rare. For purposes of calculating take from powerline strikes, KIUC assumes take of 0.005 percent (22 band-rumped storm-petrel [ʻakēʻakē] strikes/404,118 total strikes over permit term) of modeled strikes resulting from new and existing powerlines are attributable to band-rumped storm-petrel (ʻakēʻakē). This small percentage was not deducted from the total estimated annual strikes of 15,847 based on the 2020 Bayesian acoustic strike model (Travers et al. 2020).

Table 5-12a. Band-Rumped Storm-Petrel (ʻakēʻakē) Requested Take Over Permit Term by Unit of Take (Powerline Strikes, Fallout, and Conservation Site Management), and Estimated Amount by Form of Take based on Stable Trend Scenario

		Total Over 50 Years				
			Estimates by Form of Take [a, g]			
Source of Take	**Unit of Take**	**Request by Unit of Take** [f, g]	**Mortality** [b] (adults+sub-adults)	**Non-lethal Injury** [c] **(adults+sub-adults)**	**No Observed Injury** [d] **(powered flight)**	**Indirect Take of Eggs and Chicks** [e] **(adult mortality + adult injury)**
Existing powerlines	Powerline strikes [f]	18	5	4	7	2
New Powerlines	Powerline strikes [f]	7	2	1	3	1
Existing streetlights	Fallout (light attraction)	36	35	-	-	1
New streetlights	Fallout (light attraction)	10	10	-	-	<1
Facilities	Fallout (light attraction)	-	-	-	-	-
Conservation program	Conservation site management	-	-	-	-	-
Total		**71**	**52**	**5**	**10**	**4**

[a] These are rough estimates based on the best available data, although little to no data are available for some of these estimates.

[b] For powerline strikes, 28.8% of strikes is a proxy for mortality based on proportion of birds grounded from Travers et al. (2021). The HCP assumes that 100% of fallout due to light attraction results in mortality.

[c] For powerline strikes, 24.5% of powerline strikes is a proxy for non-lethal injury based on proportion of birds that lose elevation but are not grounded, from Travers et al. (2021). For fallout due to light attraction, assumes 100% of fallout results in mortality. Although some birds experiencing fallout will be rehabilitated by SOS, KIUC applied an assumption of 100% mortality for a conservative estimate of effects.

[d] For powerline strikes, assumes 46.7% of strikes may result in minor injuries (no observed injury) but not to the extent that an egg or chick is lost. Based on proportion of birds with powered flight, from Travers et al. (2021).

[e] For powerline strikes, assumes 20% of injuries and mortalities are breeding adults and one egg or chick is taken for every breeding adult injured or killed. For lights, as described in Section 5.3.1.3, *Light Attraction and Fallout—Methods*, 4% of fallout was assumed to consist of breeding adults; therefore, 4% of fallout was assumed to also result in indirect take of a chick or egg.

[f] For powerline strikes, the number of strikes are a surrogate metric for take. KIUC requests take of covered seabirds in all forms (mortality, injury, no observed injury, and indirect take of eggs and chicks) associated with the requested take as measured by number of powerline strikes.

[g] All numbers are rounded to nearest whole number. Numbers less than 1 are shown as "<1" to signify a non-zero number, rather than rounding to zero. Numbers may not add up due to rounding.

Table 5-12b. Band-Rumped Storm-Petrel ('akē'akē) Estimated Average Annual Take by Unit of Take (Powerline Strikes, Fallout, and Conservation Site Management), and Estimated Amount by Form of Take based on Stable Trend Scenario

		Average Annual[a]				
			Estimates by Form of Take[b]			
Source of Take	**Unit of Take**	**Estimates by Unit of Take[g, h]**	**Mortality[c]** (adults+sub-adults)	**Non-lethal Injury[d]** (adults+sub-adults)	**No Observed Injury[e]** (powered flight)	**Indirect Take of Eggs and Chicks[f]** (adult mortality + adult injury)
Existing powerlines	Powerline strikes[g]	<1	<1	<1	<1	<1
New Powerlines	Powerline strikes[g]	<1	<1	<1	<1	<1
Existing streetlights	Fallout (light attraction)	<1	<1	-	-	<1
New streetlights	Fallout (light attraction)	<1	<1	-	-	<1
Facilities	Fallout (light attraction)	-	-	-	-	-
Conservation program	Conservation site management	-	-	-	-	-
Total		**1**	**1**	**<1**	**<1**	**<1**

[a] For powerline strikes, these numbers are expected to be highly variable from year to year. The average annual anticipated take is based on the 50-year take limit divided by 50.

[b] These are rough estimates based on the best available data, although little to no data are available for some of these estimates.

[c] For powerline strikes, 28.8% of strikes is a proxy for mortality based on proportion of birds grounded from Travers et al. (2021). The HCP assumes that 100% of fallout due to light attraction results in mortality.

[d] For powerline strikes, 24.5% of powerline strikes is a proxy for non-lethal injury based on proportion of birds that lose elevation but are not grounded, from Travers et al. (2021). For fallout due to light attraction, assumes 100% of fallout results in mortality. Although some birds experiencing fallout will be rehabilitated by SOS, KIUC applied an assumption of 100% mortality for a conservative estimate of effects.

[e] For powerline strikes, assumes 46.7% of strikes may result in minor injuries (no observed injury) but not to the extent that an egg or chick is lost. Based on proportion of birds with powered flight, from Travers et al. (2021).

[f] For powerline strikes, assumes 20% of injuries and mortalities are breeding adults and one egg or chick is taken for every breeding adult injured or killed. For lights, as described in Section 5.3.1.3, *Light Attraction and Fallout—Methods*, 4% of fallout was assumed to consist of breeding adults; therefore, 4% of fallout was assumed to also result in indirect take of a chick or egg.

[g] For powerline strikes, the number of strikes are a surrogate metric for take. KIUC requests take of covered seabirds in all forms (mortality, injury, no observed injury, and indirect take of eggs and chicks) associated with the requested take as measured by number of powerline strikes.

[h] All numbers are rounded to nearest whole number. Numbers less than 1 are shown as "<1" to signify a non-zero number, rather than rounding to zero. Numbers may not add up due to rounding.

5.3.4.2 Impacts of the Taking

The worldwide population size of the band-rumped storm-petrel (ʻakēʻakē) is uncertain, but is most likely around 150,000 birds (Appendix 3A, *Species Accounts*). The Hawaiʻi distinct population segment (DPS) of the band-rumped storm-petrel (ʻakēʻakē) represents a small, remnant population. In 2002, the number of breeding pairs on Kauaʻi was estimated to be 171 to 221 breeding pairs (Wood et al. 2002), and Pyle and Pyle (2017) estimated 250 breeding pairs in the mid-2010s. Based on the scarcity of known breeding sites in Hawaiʻi, the remote and inaccessible locations where they are suspected to occur today, and compared to prehistoric population levels and distribution, the Hawaiʻi DPS of band-rumped storm-petrel (ʻakēʻakē) appears to be significantly reduced in numbers and range following human occupation of the Hawaiian Islands (Appendix 3A, *Species Accounts*).

The take of an estimated 0.5 adult band-rumped storm-petrel (ʻakēʻakē) per year due to powerline strikes (25 over permit term/50 years) represents 0.1 percent of the estimated Hawaiʻi DPS (0.45/400[36]=0.0011 or 0.1 percent). Additionally, the take of <1 fledgling band-rumped storm-petrels (ʻakēʻakē) per year (Table 5-12) due to light attraction represents 0.5 percent of the estimated total fledglings produced annually by this species (221 breeding pairs; 1/211 = 0.0047 = 0.5 percent). The loss of 71 band-rumped storm-petrels (ʻakēʻakē) over the 50-year permit term, as described in the previous section, is not likely to have an appreciable effect on the survival and recovery of the Hawaiʻi DPS of band-rumped storm-petrel (ʻakēʻakē) because the estimated take from powerline strikes and light attraction of 71 birds over the permit term (1.4 birds per year) is expected to be fully offset and exceeded by the benefits provided by the conservation sites and the SOS Program. The net effects of the KIUC HCP on the band-rumped storm-petrel (ʻakēʻakē), taking both the adverse and beneficial effects into account, are described below.

5.3.4.3 Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program*, is expected to minimize and partially offset effects of powerline strikes for band-rumped storm-petrel (ʻakēʻakē). Based on SOS data from 2009 through 2024 (Table 5-9), an estimated 31 band-rumped storm-petrels (ʻakēʻakē) will be rescued and released over the 50-year permit term (10 birds released over 16 years equals 0.63 birds per year; 0.63 * 50 = 31 birds over the permit term), minimizing and partially offsetting the take of 71 birds from KIUC covered activities conservatively estimated for this species over the permit term. Also, powerline collision minimization is expected to benefit this species occurring in the areas of Hanalei to Kekaha, Waimea Canyon, Wainiha and Lumahaʻi. Another benefit to this species takes place at the Honopū PF site with social attraction for this species, where one bird was spotted on camera in the first year of social attraction (2022). In addition, the species is likely to benefit from predator control at the Honopū conservation site because of its proximity to the Nā Pali Coast where most band-rumped storm-petrel (ʻakēʻakē) are thought to occur on Kauaʻi. Barn owl control at all conservation sites is likely to benefit band-rumped storm-petrel (ʻakēʻakē) by reducing the presence of these wide-ranging predators in areas adjacent to conservation sites where band-rumped storm-petrels (ʻakēʻakē) are known to occur. KIUC expects funding of the SOS Program, in addition to the conservation measures for the other two covered species and the extensive minimization measures

[36] Conservatively assuming 200 breeding pairs, based on the range of estimates, which would mean at least 400 individual birds.

across the island, to be sufficient to offset the impact of the taking on band-rumped storm-petrel (ʻakēʻakē). Considering the take associated with KIUC activities, the effects of SOS recoveries, social attraction at Honopū PF, and the intensive predator control near occupied habitat for the species, the KIUC HCP will have a net benefit on band-rumped storm-petrels (ʻakēʻakē) on Kauaʻi.

5.4 Effects on Covered Waterbirds

5.4.1 Methods for Assessing Effects on Waterbirds

5.4.1.1 Powerlines

The covered waterbirds are susceptible to powerline strikes but there is no evidence that these species are adversely affected by light attraction on Kauaʻi. There are documented rare instances of two of the five covered waterbird species being affected by management actions at the conservation sites so the analysis focuses on estimating the effects of powerline strikes and conservation site management actions. For effects related to powerline strikes, the analysis for covered waterbirds is based on the estimated powerline strikes attributable to the covered waterbirds for spans with high risks to these species, an assessment of waterbird powerline strike risk first conducted by Marc Travers and André Raine in 2020 and later updated to include data through the end of 2024 (Travers and Raine in litt.). This section summarizes the methods of estimating take for the covered waterbirds. The high-risk areas for the covered waterbirds are in Mānā (spans 1–113) and Hanalei (spans 462–478 and 1297–1328), which are areas associated with the greatest amount of waterbird habitat and movement. For Hawaiian goose (nēnē) and Hawaiian duck (koloa maoli), incidental take is also expected from management activities conducted at the seabird conservation sites, including predator control, fence installation, and habitat maintenance. This take is considered in the effects analysis and included in the total take request for these species.

A combination of acoustic data of recorded strikes and observations of waterbird behavior around powerlines were used to inform powerline collision estimates for three of the covered waterbirds: Hawaiian stilt (aeʻo) (*Himantopus mexicanus knudseni*), Hawaiian duck (koloa maoli), and Hawaiian goose (nēnē).

There is a scarcity of data on Hawaiian common gallinule (ʻalae ʻula) (*Gallinula galeata sandvicensis*) and Hawaiian coot (ʻalae keʻokeʻo) (*Fulica alai*). There have been no observed collisions for either species during systematic surveys conducted over the observation period of 2011–2024. The only data available for these two species is collection of grounded birds determined to be grounded due to powerline collisions. Based on these data and the lack of powerline collision observations, we know that while there is collision risk, it is assumed to be low and widely distributed in both space and time. Furthermore, due to the scarcity of collision observations, it is assumed that any powerline collisions of Hawaiian coot (ʻalae keʻokeʻo) and Hawaiian common gallinule (ʻalae ʻula) would represent a very low proportion of strikes on the acoustic record for monitored spans. Because observational and acoustic data were not available for the Hawaiian common gallinule (ʻalae ʻula) and Hawaiian coot (ʻalae keʻokeʻo), the grounded bird detections from 2011 through 2024 were used to inform strike estimates for these species.

All waterbird collisions were assigned to one of three geographic areas: (i) Mānā, (ii) Hanalei wetlands, and (iii) all other areas (Figure 4-1). Acoustic monitoring data are available for Mānā (spans 1–113) and Hanalei (spans 462–478 and 1297–1328), but species cannot be determined through acoustic data alone. At the time of this analysis, Mānā is the only waterbird area with a full range of monitoring data including observation data, acoustic detections of strikes, and modeling of acoustic strike patterns across a season. The Hanalei wetlands (east of the town of Hanalei) include the Hanalei National Wildlife Refuge; this area has a large concentration of suitable breeding and foraging habitat for all of the covered waterbirds, is known to support a large share of the island's population of each species, and overlaps with powerlines. However, very little observation data are available for this area at the time of this analysis.

All other sites on Kauaʻi where covered waterbirds occur have (1) relatively low densities of occurrences, (2) are far from powerlines and therefore have low risks of collisions, or (3) both. For these reasons, all other sites on the island were combined into a single category. Observational data from Mānā were used as the basis for estimating the species proportion of covered waterbird powerline collisions for Hawaiian stilt (aeʻo), Hawaiian duck (koloa maoli), and Hawaiian goose (nēnē) for the spans at Mānā, Hanalei wetlands, and all other areas. The average grounded bird detections of Hawaiian common gallinule (ʻalae ʻula) and Hawaiian coot (ʻalae keʻokeʻo) over the 14-year period of available data (2011–2024) were used to estimate the proportion of powerline collisions for these two species for Mānā, Hanalei wetlands, and all other areas.

Take of covered waterbirds anticipated from future powerlines was estimated using the same methods as described for covered seabirds in Section 5.3.1.2, *Powerline Collisions—Methods.* The locations for future powerlines are currently unknown, but take limits were established based on an assumed 4.7 percent increase in strikes over the permit term.

As described for covered seabirds in Section 5.3.1.2, *Powerline Collisions—Methods,* the measurable units of take for covered waterbirds are powerline strikes. Requested take limits for the covered waterbirds were established based on the estimated proportion of all powerline collisions at Mānā (spans 1–113) and Hanalei (spans 462–478 and 1297–1328). The total annual strikes prior to minimization for these spans, based on the Bayesian model span by span acoustic strike estimate, is 1,018 for all avian species (Travers et al. 2020): 37 percent are attributed to covered waterbirds. The remaining strikes are attributed to other avian species including the covered seabird species and non-covered species (e.g., black-crowned night heron and nonnative avian species). Assuming 90 percent strike reduction resulting from minimization on these spans, the total estimated annual strikes post-minimization for all avian species on these spans is 102. Covered waterbird take will be tracked and reported over the permit term as 37 percent of all strikes at Mānā (spans 1–113) and Hanalei (spans 462–478 and 1297–1328), and it will be assumed that the proportion of injuries and mortalities by species as provided in Tables 5-13a and b remain constant throughout the 50-year permit term. Assuming a 4.7 percent increase in strikes with new powerlines, the total number of covered waterbird collisions estimated for the 50-year permit term is 1,972.

There are no published data available regarding the grounding rate of covered waterbirds (i.e., the rate at which waterbirds that collide with powerlines are grounded) on Kauaʻi or elsewhere. Similarly, no published data exist on the mortality rate of grounded waterbirds on Kauaʻi or elsewhere. In the absence of such data, for the purposes of this HCP, the same grounding rate assumption used for seabirds are used for waterbirds (28.8 percent). The analysis also assumes that 69.7 percent of grounded waterbirds die (Travers et al. 2021). While the seabird analysis assumes all grounded seabirds result in mortality, the waterbird analysis assumes that grounded waterbirds without severe injuries after an initial collision are likely to survive because they are primarily ground-dwelling species, are more mobile when grounded, and have greater capacity to regain flight than grounded seabirds. Therefore, waterbirds are less susceptible to dehydration, starvation, predation, or being hit by vehicles (Section 5.2.1.3, *Powerline Strike Effects Pathways for Covered Waterbird Species*).

For all covered waterbirds, KIUC expects to minimize strikes at powerlines where covered waterbirds are vulnerable by 90 percent by the end of 2025 (Shaw et al. 2021), prior to when the HCP is expected to take effect. As such, the number of estimated covered waterbird strikes was multiplied by 10 percent to estimate powerline strikes post-minimization.

This assessment is limited by the amount of data available for covered waterbirds. Despite these limitations, the analysis provides the best available information to conservatively estimate the effects of powerline collisions on the covered waterbirds, as described above and in Section 5.4.2, *Effects Common to All Covered Waterbirds*, and Section 5.4.3, *Species-Specific Waterbird Effects.*

5.4.1.2 Conservation Strategy Implementation

To estimate the number of covered waterbirds anticipated to be taken as a result of management at the conservation sites, KIUC evaluated data from 2015 through 2024 on birds affected by management actions for all of KIUC's conservation sites during that period. Based on these data, the two waterbird species likely to be affected by management actions at the conservation sites are the Hawaiian goose (nēnē) (*Branta sandvicensis*) and Hawaiian duck (koloa maoli) (*Anas wyvilliana*).

From 2015 through 2024, there were two recorded incidents involving covered waterbirds: one Hawaiian goose (nēnē) and one Hawaiian duck (koloa maoli). In both cases, the birds were caught in predator control traps. Notably, no mortalities of covered waterbirds have been documented as a result of these activities, and the single injured bird was successfully rehabilitated and released.

On average, these data indicate that fewer than one Hawaiian goose (nēnē) and fewer than one Hawaiian duck (koloa maoli) were affected by management activities annually. Given the low frequency of incidents—just two events in 10 years—KIUC estimates that take will be limited to 10 individuals for each species over the 50-year permit term, or less than one individual per year. No indirect take is anticipated for eggs or chicks, as no mortalities have occurred and no indirect impacts have been observed.

The estimated take for Hawaiian goose (nēnē) and Hawaiian duck (koloa maoli) resulting from conservation site management activities is included in the total authorized take for these species, as summarized in Tables 5-13a and 5-13b.

5.4.2 Effects Common to All Covered Waterbirds

Effects and Level of Take

KIUC requests take of the covered waterbirds associated with 37 percent of all KIUC powerline collisions along powerline spans in Mānā (spans 1–113) and Hanalei (spans 462–478 and 1297–1328) during the permit term. Before minimization, the total annual strikes for these spans based on the Bayesian model acoustic span by span strike estimate is 1,018 for all birds: 37 percent are attributed to covered waterbirds. The remaining strikes are attributed to other avian species including the covered seabird species and non-covered species (e.g., black-crowned night heron and nonnative avian species). Assuming 90 percent strike reduction resulting from minimization implemented at these spans, the total estimated annual strikes for all birds after minimization for these spans is 102. Because species identity cannot be determined using acoustic strike data, KIUC requests take authorization for all covered waterbirds combined as a constant proportion of 37 percent of all powerline strikes along these spans as determined from acoustic strike data, adjusted for minimization. KIUC will also apply this proportion to future lines associated with covered waterbirds. Tables 5-13a and 5-13b provide the estimated amount of take for each species associated with these strikes.

There will be an estimated 50,900 powerline collisions over the 50-year term (an estimated 1,018 annual collisions) along spans in Mānā (spans 1–113) and Hanalei (spans 462–478 and 1297–1328) (Travers et al. 2020) for all birds (covered and non-covered). After the assumed 90 percent minimization up to 5,090 powerline collisions may occur throughout the 50-year permit term (an estimated 102 annual collisions) for all bird species recorded along these spans. In these areas, 37 percent of all bird collisions are attributed to the covered waterbirds, for a total of 1,883 covered waterbird collisions over the 50-year permit term for all existing powerlines (i.e., available data at Mānā and Hanalei was used to estimate waterbird collisions across all three geographic areas). Assuming a 4.7 percent increase in collisions with new powerlines, an estimated 89 covered waterbird collisions will occur on new powerlines. A total take of 1,972 covered waterbirds is estimated over the 50-year permit term from powerline strikes. Chapter 6, *Monitoring and Adaptive Management Program*, describes how KIUC will monitor powerline collisions to ensure take does not exceed this level.

Section 5.2.1.3, *Powerline Strike Effects Pathways for Covered Waterbird Species*, describes the ways in which powerline strikes can adversely affect the covered waterbirds. Tables 5-13a and 5-13b provides the 50-year take request and annual take estimates for the covered waterbirds as well as the estimated number of powerline strikes and injury and mortality associated with powerline strikes based on the methods described above in Section 5.4.1, *Methods for Assessing Effects on Waterbirds*. These estimates are for the purpose of analyzing effects on the species and tracking take, as described in Chapter 6, *Monitoring and Adaptive Management Program*.

The estimated take for Hawaiian goose (nēnē) and Hawaiian duck (koloa maoli) resulting from conservation site management activities 10 individuals for each species over the 50-year permit term, or less than one individual per year, as summarized in Tables 5-13a and 5-13b.

Table 5-13a. Requested Take of Covered Waterbirds over the Permit Term from Powerline Strikes and Conservation Site Management

Species	Percent of Total Strikes	50-Year Projected SOS Program Rescues[b,h]	Total Take Request[c,h]	50-year Requested Take by Unit and Estimated Form of Take					
				Conservation Site Management[d]	Powerline Strikes, with Minimization[a,h]				
					Existing Powerlines[a]	Existing + New Powerlines (4.7% increase)	Grounding[e]	Injury[f]	Mortality[g]
Hawaiian stilt (ae'o)	1%	85	53	0	51	53	15	5	11
Hawaiian duck (koloa maoli)	9%	638	490	10	458	480	138	42	96
Hawaiian coot ('alae ke'oke'o)[f]	2%	173	107	0	102	107	31	9	21
Hawaiian common gallinule ('alae 'ula)[f]	2%	135	107	0	102	107	31	9	21
Hawaiian goose (nēnē)	23%	1,558	1,236	10	1,171	1,226	353	107	246
TOTAL	**37%**	**2,589**	**1,992**	**20**	**1,883**	**1,972**	**568**	**172**	**396**

[a] The total annual strikes prior to minimization for these spans based on the Bayesian model acoustic span by span strike estimate is 1,018 for all birds (Travers et al. 2020): 37% are attributed to covered waterbirds. Minimization is assumed to be 90%.

[b] Based on average annual number of SOS rescues from 2012 through 2024 (time span within which SOS consistently collected waterbird data).

[c] Based on conservation site management and strikes from existing and new powerlines.

[d] Conservation site management take is included only for Hawaiian goose (nēnē) and Hawaiian duck (koloa maoli). KIUC estimates up to 10 individuals per species over the 50-year permit term based on two observed incidents in 10 years. No take is expected for other covered waterbirds.

[e] Assumes 28.8% of strikes result in grounded birds. See Section 5.4.1, *Methods for Assessing Effects on Waterbirds.*

[f] Grounded birds that are not killed are assumed to be injured.

[g] Of grounded birds, 69.7% are assumed to be killed.

[h] All numbers are rounded to the nearest whole number. Numbers may not add up to the "Total" due to rounding.

Table 5-13b. Estimated Annual Take of Covered Waterbirds from Powerline Strikes and Conservation Site Management

Species	Percent of Total Strikes	Annual Projected SOS Program Rescues [b,h]	Total Estimated Take[c,h]	Annual Estimated Take by Unit and Estimated Form of Take					
					Powerline Strikes, with Minimization[a,h]				
				Conservation Site Management[d]	Existing Powerlines[a]	Existing + New Powerlines (4.7% increase)	Grounding[e]	Injury[f]	Mortality[g]
Hawaiian stilt (aeʻo)	1%	2	1	0	1	1	<1	<1	<1
Hawaiian duck (koloa maoli)	9%	13	10	<1	9	10	3	1	2
Hawaiian coot (ʻalae keʻokeʻo)[f]	2%	3	2	0	2	2	1	<1	<1
Hawaiian common gallinule (ʻalae ʻula)[f]	2%	3	2	0	2	2	1	<1	<1
Hawaiian goose (nēnē)	23%	31	25	<1	23	25	7	2	5
TOTAL	**37%**	**52**	**40**	**<1**	38	39	**11**	**3**	**8**

[a] The total annual strikes prior to minimization for these spans based on the Bayesian model acoustic span by span strike estimate is 1,018 for all birds (Travers et al. 2020): 37% are attributed to covered waterbirds. Minimization is assumed to be 90%.

[b] Based on average annual number of SOS rescues from 2012 through 2024 (time span within which SOS consistently collected waterbird data).

[c] Based on conservation site management and strikes from existing and new powerlines.

[d] Conservation site management take is included only for Hawaiian goose (nēnē) and Hawaiian duck (koloa maoli). KIUC estimates up to 10 individuals per species over the 50-year permit term based on two observed incidents in 10 years. No take is expected for other covered waterbirds.

[e] Assumes 28.8% of strikes result in grounded birds. See Section 5.4.1, *Methods for Assessing Effects on Waterbirds.*

[f] Grounded birds that are not killed are assumed to be injured.

[g] Of grounded birds, 69.7% are assumed to be killed.

[h] All numbers are rounded to the nearest whole number. Numbers less than 1 are shown as "<1" to signify a non-zero number, rather than rounding to zero. Numbers may not add up to the "Total" due to rounding.

Beneficial and Net Effects

As described in Chapter 4, *Conservation Strategy*, KIUC's funding of rescue and recovery efforts through the SOS Program will minimize and offset the take from powerline strikes. In addition, KIUC's funding of the SOS Program is expected to fully offset take and provide a net benefit for the covered waterbirds through the rescue, recovery, and release of waterbirds back into the wild that are affected by factors unrelated to KIUC's covered activities (e.g., botulism, vehicle collisions, other disease, illness, or injuries not related to powerline strikes). Rescuing, treating, and releasing covered waterbirds in this situation contributes to the species recovery by increasing their survival and reproduction. Section 5.4.3, *Species-Specific Waterbird Effects*, provides an analysis of the beneficial effects of the SOS Program on each covered waterbird species.

Table 5-14 summarizes the number of individuals of each covered waterbird species recovered or released from the SOS Program from 2012 through 2024, which is when SOS consistently collected data on waterbirds. This cumulative amount is converted to an average annual rate of recovery and release and multiplied by 50 to estimate the total number of waterbirds expected to be recovered and released during the permit term. This estimate is likely conservative since the earlier years of the SOS Program recovered fewer birds than in later years of the program because the program was smaller and less well known than it is today, with fewer volunteers or paid staff, and less visibility to the public.

Table 5-14. Covered Waterbird Species Recovered or Rehabilitated and Released by SOS Program

Species	No. of Individuals Recovered and Released 2012–2024 [a]	Average Annual Individuals Recovered and Released	Assumed 50-Year Recovery and Release (No. of Individuals) [b]
Hawaiian stilt (ae'o)	22	1.7	85
Hawaiian duck (koloa maoli)	166	12.8	638
Hawaiian coot ('alae ke'oke'o)	45	3.5	173
Hawaiian common gallinule ('alae 'ula)	35	2.7	135
Hawaiian goose (nēnē)	405	31.2	1,588
Total	673	51.8	2,588

[a] Source: SOS Program data.
[b] Rounded to nearest whole number.

5.4.3 Species-Specific Waterbird Effects

The effects and level of take for the covered waterbirds are described in Section 5.4.2, *Effects Common to All Covered Waterbirds*, and Table 5-13. The following subsections describe the impacts of the taking and the beneficial and net effects of the KIUC HCP on each species.

5.4.3.1 Hawaiian Stilt (ae'o)

Impacts of the Taking

This section describes the impact of the take of 53 Hawaiian stilts (ae'o) on the species' numbers, reproduction, and distribution at the population and species level.

<u>Numbers</u>. Long-term census data indicate that the statewide population of Hawaiian stilt (aeʻo) increased from 1985 to 2004 and have been roughly stable through 2023 with approximately 1,500 to 2,000 individuals statewide (U.S. Fish and Wildlife Service 2020; Paxton et al. 2021; Gorresen et al. 2024). The estimated average population on Kauaʻi from 2019 through 2023 was 229 to 483 birds (Gorresen et al. 2024). USFWS formally proposed downlisting the species from endangered to threatened in May 2021 (U.S. Fish and Wildlife Service 2021). Because the covered powerlines have been present throughout the census period, it is reasonable to assume that the population trajectory of Hawaiian stilt (aeʻo) has been stable or slightly increasing despite ongoing powerline collisions. The stable or increasing population even with this ongoing source of take indicates that the species' population is sustainable with current levels of powerline collisions (and with other sources of mortality unrelated to KIUC covered activities). Powerline collisions are estimated to be reduced by 90 percent through the minimization measures of this HCP (see Chapter 4, Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*). As such, the HCP is not anticipated to appreciably reduce the numbers of Hawaiian stilts (aeʻo) on Kauaʻi.

<u>Reproduction</u>. The mortality of adults affects reproduction by reducing the number of breeding adults. However, the HCP is not expected to appreciably reduce Hawaiian stilt (aeʻo) reproduction due to the relatively small portion (approximately 0.05 percent) of the population striking powerlines annually. Additionally, the stable or increasing numbers for this species with ongoing powerline unminimized collisions and other sources of mortality (e.g., predation, disease, vehicle collisions) indicate that reproduction will not be appreciably affected by minimized collisions.

<u>Distribution</u>. Hawaiian stilts (aeʻo) have continued to persist in the Mānā area, Hanalei National Wildlife Refuge, and other locations around Kauaʻi with continued collision risk from KIUC powerlines. The persistence of Hawaiian stilts (aeʻo) in these areas with ongoing unminimized powerline collisions indicates that the species' distribution will not be appreciably affected with substantially reduced collisions from powerline minimization.

Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program,* is expected to minimize and fully offset the effects of powerline strikes on Hawaiian stilts (aeʻo). Based on SOS data from 2012 through 2024, an estimated 85 Hawaiian stilts (aeʻo) will be rescued and released over the 50-year permit term, exceeding the take of 53 individuals from powerline strikes conservatively estimated for this species over the permit term (Table 5-13a). The percentage of rescued and released Hawaiian stilts (aeʻo) that survive post-release is unknown. However, the Hawaiian stilts (aeʻo) that survive will help to maintain population numbers, reproduction (continued survival of adults that reproduce), and the distribution of the species on Kauaʻi. With the proposed minimization and SOS rescues combined, the HCP is expected to result in a net benefit to Hawaiian stilts (aeʻo). The number of SOS Program rescues of Hawaiian stilt (aeʻo) exceeds the total take request by 32 individuals (60 percent) over the permit term, thus providing a net benefit. Because the take request is based on conservative assumptions, the actual difference may be greater.

5.4.3.2 Hawaiian Duck (koloa maoli)

Impacts of the Taking

This section describes the impact of the take of 490 Hawaiian ducks (koloa maoli) on the species' numbers, reproduction, and distribution at the population and species level.

Numbers. The Hawaiian duck (koloa maoli) population has been estimated by USFWS to be about 2,000 true Hawaiian ducks (koloa maoli) (i.e., not hybridized) on Kauaʻi and Niʻihau, and 200 on the Island of Hawaiʻi (U.S. Fish and Wildlife Service 2011). Gorresen et al. (2024) estimated a 5-year average population size between 2019 and 2023 on Kauaʻi of 516 to 854 individuals. Hawaiian duck (koloa maoli) survey counts on Oʻahu, Maui, and Hawaiʻi are confounded by the difficulty in distinguishing in the field Hawaiian duck (koloa maoli) from mallards and hybrids of mallards and Hawaiian duck (koloa maoli). Because of these issues, there is currently no credible population estimate for Hawaiian duck (koloa maoli) at any scale (U.S. Fish and Wildlife Service 2018a). Long-term (1986–2023) trends indicate increasing population sizes for the Hawaiian duck (koloa maoli) population on Kauaʻi (Gorresen et al. 2024).

Since its listing under the federal ESA in 1967, the Hawaiian duck (koloa maoli) population has increased on Kauaʻi, though it is declining on other Hawaiian Islands (U.S. Fish and Wildlife Service 2011). The Hawaiian duck (koloa maoli) population on Kauaʻi is substantially larger than the populations on all other Hawaiian Islands combined. This comparatively large population size is likely due to the lack of an established population of mongooses and very low occurrence of hybridization (U.S. Fish and Wildlife Service 2011). Because the population on Kauaʻi has been increasing even with the ongoing source of unminimized powerline strikes and other sources of mortality (e.g., predation, disease and vehicle collisions), the HCP is not anticipated to appreciably reduce the numbers of Hawaiian ducks (koloa maoli) on Kauaʻi.

Reproduction. The mortality of adults affects reproduction by reducing the number of breeding adults. However, the HCP is not expected to appreciably reduce Hawaiian duck (koloa maoli) reproduction due to the relatively high reproductive rate of the species and the relatively small portion (approximately 0.5 percent) of the population colliding with powerlines annually. Additionally, the increasing numbers for this species with ongoing unminimized powerline collisions indicate that reproduction will not be appreciably affected with substantially reduced collisions from powerline minimization.

Distribution. Hawaiian ducks (koloa maoli) have continued to persist in the Mānā area, Hanalei National Wildlife Refuge, and other locations around Kauaʻi with collision risk from KIUC powerlines. The persistence of Hawaiian ducks (koloa maoli) in these areas with ongoing unminimized powerline collisions indicates that the species' distribution will not be appreciably affected with substantially reduced collisions.

Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program*, is expected to minimize and fully offset effects of take on Hawaiian ducks (koloa maoli). Based on SOS data from 2012 through 2024, an estimated 638 Hawaiian ducks (koloa maoli) will be rescued and released over the 50-year permit term, exceeding the take of 480 individuals from powerline strikes conservatively estimated for this species over the permit term (Table 5-13a). The percentage of rescued and released Hawaiian ducks (koloa maoli) that survive post-release is unknown. However, the Hawaiian ducks (koloa maoli) that survive will help to maintain population numbers, reproduction (continued survival of adults that reproduce), and the distribution of the species on Kauaʻi.

In addition to powerline strike-related take, a small amount of incidental take is expected from management activities conducted at the seabird conservation sites. These activities, such as predator control, may occasionally affect Hawaiian ducks (koloa maoli). However, given that there have only been two known incidents involving covered waterbirds over a 10-year period of such management activities, KIUC estimates that take of Hawaiian ducks (koloa maoli) will be limited to 10 individuals over the 50-year permit term, averaging less than one individual per year. This take is included in the total authorized take for the species (490 total).

With the proposed powerline minimization and SOS rescues combined, the HCP is expected to result in a net benefit to Hawaiian ducks (koloa maoli). The number of SOS Program rescues of Hawaiian ducks (koloa maoli) exceeds the total take request by 148 individuals (30 percent) over the permit term, providing a net benefit. Because the take request is based on conservative assumptions, the actual difference may be greater.

5.4.3.3 Hawaiian Coot (ʻalae keʻokeʻo)

Impacts of the Taking

This section describes the impact of the take of 107 Hawaiian coots (ʻalae keʻokeʻo) on the species' numbers, reproduction, and distribution at the population and species level.

Numbers. The Hawaiian coot (ʻalae keʻokeʻo) population was estimated to be 1,306 to 1,858 birds across the state of Hawaiʻi as an annual average from 2019 to 2023, with an estimated population on Kauaʻi of 552 (400–735) (Gorresen et al. 2024). Survey data from biannual waterbird counts suggest that the population on Kauaʻi increased from 1986 to 2023 (Gorresen et al. 2024). Due to the relatively high reproductive rate of Hawaiian coot (ʻalae keʻokeʻo) and its upward population trend even with the ongoing mortality from unminimized powerline strikes, which will be substantially reduced through minimization, the HCP is not anticipated to appreciably reduce the numbers of Hawaiian coots (ʻalae keʻokeʻo) on Kauaʻi.

Reproduction. The mortality of adults affects reproduction by reducing the number of breeding adults. However, the HCP is not expected to appreciably reduce Hawaiian coot (ʻalae keʻokeʻo) reproduction due to the relatively high reproductive rate of the species and the relatively small portion (approximately 0.1 percent) of the population colliding with powerlines annually. Additionally, the increasing numbers for this species with ongoing unminimized powerline collisions and other sources of mortality (e.g., predation, disease and vehicle collisions) indicate that reproduction will not be appreciably affected by substantially reduced collisions resulting from minimization.

Distribution. Hawaiian coots (ʻalae keʻokeʻo) have continued to persist in the Mānā area, Hanalei National Wildlife Refuge, and other locations around Kauaʻi with unminimized collision risk from KIUC powerlines. The persistence of Hawaiian coots (ʻalae keʻokeʻo) in these areas with ongoing unminimized powerline collisions indicates that the species' distribution will not be appreciably affected with substantially reduced collisions resulting from minimization.

Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program,* is expected to mitigate and fully offset effects of powerline strikes on Hawaiian coots (ʻalae keʻokeʻo). Based on SOS data from 2012 through 2024, an estimated 173 Hawaiian coots (ʻalae keʻokeʻo) will be rescued and released over the 50-year permit term, exceeding the take from powerline strikes of 107 individuals conservatively estimated for this species over the permit term (Table 5-13a). The percentage of rescued and released Hawaiian coots (ʻalae keʻokeʻo) that survive post-release is unknown. However, the Hawaiian coots (ʻalae keʻokeʻo) that survive will help to maintain population numbers, reproduction (continued survival of adults that reproduce), and the distribution of the species on Kauaʻi. With the proposed minimization and SOS rescues combined, the HCP is expected to result in a net benefit to Hawaiian coots (ʻalae keʻokeʻo). The number of SOS Program rescues of Hawaiian coots (ʻalae keʻokeʻo) exceeds the total take request by 66 individuals (62 percent) over the permit term, providing a net benefit. Because the take request is based on conservative assumptions, the actual difference may be greater.

5.4.3.4 Hawaiian Common Gallinule (ʻalae ʻula)

Impacts of the Taking

This section describes the impact of the take of 107 Hawaiian common gallinules (ʻalae ʻula) on the species' numbers, reproduction, and distribution at the population and species level.

Numbers. Hawaiian common gallinule (ʻalae ʻula) counts indicate that the statewide population is small but relatively stable with an average of 712 birds (573–870) over 5 years (2019–2023), with an estimated 5-year average population on Kauaʻi of 485 (383–611) (Gorresen et al. 2024). Count totals are extremely variable between summer and winter surveys (U.S. Fish and Wildlife Service 2011). However, the annual surveys may be flawed; actual population size is thought to be greater because of the species' secretive behavior (U.S. Fish and Wildlife Service 2011). State long-term (1986–2023) trends indicate increasing population sizes for the Hawaiian common gallinule (ʻalae ʻula) population on Kauaʻi (Gorresen et al. 2024).

Research has shown that broadcasting calls increases the number of individuals counted by as much as 30 percent on Oʻahu and 56 percent on Kauaʻi (Desrochers et al. 2008). Based on a minimum population size of 631 birds (485 x 1.30), the loss of an average of two birds annually (0.3 percent) to powerline strikes could have an adverse effect on the long-term survival and recovery of the species. However, the measured stability of the Hawaiian common gallinule (ʻalae ʻula) population, despite the historic impacts of unminimized powerline strikes and other sources of mortality (e.g., vehicle strikes, predators), suggests that ongoing but substantially reduced powerline strikes are not anticipated to appreciably reduce the numbers of Hawaiian common gallinule (ʻalae ʻula).

Reproduction. The mortality of adults affects reproduction by reducing the number of breeding adults. However, the measured stability of the Hawaiian common gallinule (ʻalae ʻula) population, despite the historic impacts of unminimized powerline strikes and other sources of mortality (e.g., vehicle collisions, predators, disease), indicates that ongoing but substantially reduced powerline strikes of two birds annually will not appreciably affect the reproduction of Hawaiian common gallinule (ʻalae ʻula).

Distribution. Hawaiian common gallinules (ʻalae ʻula) have continued to persist in the Mānā area, Hanalei National Wildlife Refuge, and other locations around Kauaʻi with unminimized collision risk from KIUC powerlines. The persistence of Hawaiian common gallinule (ʻalae ʻula) in these areas with ongoing unminimized powerline collisions indicates that the species' distribution will not be appreciably affected with substantially reduced collisions resulting from powerline minimization.

Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program,* is expected to minimize and fully offset effects of powerline strikes on Hawaiian common gallinules (ʻalae ʻula). Based on SOS data from 2012 through 2024, an estimated 135 Hawaiian common gallinules (ʻalae ʻula) will be rescued and released over the 50-year permit term, exceeding the take of 107 birds from powerline strikes conservatively estimated for this species over the permit term (Table 5-13a). The percentage of rescued and released Hawaiian common gallinules (ʻalae ʻula) that survive post-release is unknown. However, the Hawaiian common gallinules (ʻalae ʻula) that survive will help to maintain population numbers, reproduction (continued survival of adults that reproduce), and the distribution of the species on Kauaʻi. With the proposed powerline minimization and SOS rescues combined, the HCP is expected to result in a net benefit to Hawaiian common gallinules (ʻalae ʻula). The number of SOS Program rescues of Hawaiian common gallinules (ʻalae ʻula) exceeds the total take request by 28 individuals (26 percent) over the permit term, providing a net benefit. Because the take request is based on conservative assumptions, the actual difference may be greater.

5.4.3.5 Hawaiian Goose (nēnē)

Impacts of the Taking

This section describes the impact of the take of 1,236 Hawaiian geese (nēnē) on the species' numbers, reproduction, and distribution at the population and species level.

<u>Numbers</u>. The Hawaiian goose (nēnē) population throughout Hawaiʻi is estimated as 3,797 individuals, with 2,314 on Kauaʻi (Nēnē Recovery Action Group 2025). Hawaiian geese (nēnē) appear to be increasing on Kauaʻi (U.S. Fish and Wildlife Service 2018b; Nēnē Recovery Action Group 2025), partially as a result of the release of captive breeding and translocation (U.S. Fish and Wildlife Service 2018b). The historic levels of powerline collision are estimated to be reduced substantially (90 percent) by the minimization measures of this HCP (Chapter 4, Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*). The growing population of this species with historical and ongoing take from KIUC powerlines suggests ongoing but substantially reduced powerline strikes are not anticipated to appreciably reduce the numbers of Hawaiian geese (nēnē) on Kauaʻi.

<u>Reproduction</u>. The mortality of adults affects reproduction by reducing the number of breeding adults. However, the HCP is not expected to appreciably reduce Hawaiian goose (nēnē) reproduction due to the relatively high reproductive rate of the species and the relatively small portion (approximately 0.6 percent) of the population colliding with powerlines annually. Additionally, the increasing numbers for this species on Kauaʻi with ongoing powerline collisions and other sources of mortality (e.g., predation, disease, vehicle collisions) indicate that reproduction will not be appreciably affected by substantially reduced collisions.

<u>Distribution</u>. Hawaiian geese (nēnē) have continued to persist in the Mānā area and other locations around Kauaʻi with collision risk from KIUC powerlines. The persistence of Hawaiian geese (nēnē) in these areas with ongoing powerline collisions indicates that the species' distribution will not be appreciably affected with substantially reduced powerline collisions.

Beneficial and Net Effects

The measure described in Chapter 4, Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program,* is expected to minimize and fully offset effects of take on Hawaiian geese (nēnē). Based on SOS data since 2012, an estimated 1,558 Hawaiian geese (nēnē) will be rescued and released over the 50-year permit term, exceeding the take of 1,226 individuals from powerline strikes conservatively estimated for this species over the permit term (Table 5-13a). The percentage of rescued and released Hawaiian geese (nēnē) that survive post-release is unknown. However, the Hawaiian geese (nēnē) that survive will help to maintain population numbers, reproduction (continued survival of adults that reproduce), and the distribution of the species on Kauaʻi.

In addition to powerline-related take, incidental take is also anticipated from management actions at the seabird conservation sites. These activities, such as predator control, may result in impacts on a limited number of Hawaiian geese (nēnē). However, based on only two known waterbird-related incidents over a 10-year period, KIUC conservatively estimates take of Hawaiian geese (nēnē) will total 10 individuals over the 50-year permit term, averaging less than one individual annually. This estimated take is included in the total authorized take for the species (1,236 total).

With the proposed powerline minimization and SOS rescues combined, the HCP is expected to result in a net benefit to Hawaiian geese (nēnē). The number of SOS Program rescues of Hawaiian geese (nēnē) exceeds the total take request by 322 individuals (26 percent) over the permit term, providing a net benefit. Because the take request is based on conservative assumptions, the actual difference may be greater.

5.5 Effects on Green Sea Turtle (honu)

5.5.1 Methods for Assessing Effects

There has been no systematic monitoring to assess effects of KIUC streetlights on green sea turtles (honu), and there are no records of KIUC streetlights affecting green sea turtle (honu) hatchlings until September 2020. There was an incident in September 2020 on Kauaʻi where green sea turtle (honu) hatchlings at night moved toward a KIUC streetlight and some of the hatchlings were crushed by vehicles before a concerned citizen rescued some and called local police to assist. However, adverse effects of lights on green sea turtle (honu) hatchlings are well documented in other areas (see Section 5.2.2.2, *Light Attraction Effects Pathways for Green Sea Turtle (honu)*) and are assumed to occur from KIUC streetlights near suitable green sea turtle (honu) nesting habitat.

KIUC conducted a field evaluation in 2020 to assess the extent to which KIUC streetlights might affect green sea turtles (honu), and to evaluate where additional minimization measures are needed. During the evaluation, all sandy beaches on Kauaʻi with KIUC streetlights that are potentially visible from the surface of beaches where suitable green sea turtle (honu) nesting habitat was present were evaluated. Suitable nesting habitat was considered regardless of whether or not turtles had been recorded nesting in those locations. The primary criterion for determining whether streetlights could affect green sea turtles (honu) was whether the streetlights were visible from the surface of sandy beaches. Seven beaches were determined to have streetlights that were visible from potentially suitable green sea turtle (honu) nesting habitat at the time of the evaluation: Keālia Beach (2 streetlights), Kapaʻa Shoreline (4 streetlights), Wailua Beach (7 streetlights), Poʻipū Shoreline (3 streetlights), Kukuiʻula Harbor (3 streetlights), Waimea Shoreline (3 streetlights), and Kekaha Shoreline (7 streetlights). KIUC will reevaluate all suitable beach habitat near KIUC streetlights on an annual basis to add or remove locations that may affect green sea turtle (honu) hatchlings as environmental conditions change (Section 4.4.5.2, *Shield Active Nests from Streetlights*).

5.5.2 Effects and Level of Take

As described in Appendix 3A, *Species Accounts*, average annual nesting densities of green sea turtles (honu) at all Kauaʻi beaches are very low, ranging from less than one (i.e., one nest every several years) to one to two nests per year between 2015 and 2020 (State of Hawaiʻi Division of Aquatic Resources 2020). Without minimization, the number of green sea turtle (honu) nests affected by KIUC streetlights is expected to be less than one per year due to limited extent of effects on suitable beaches. Although nesting density is low, observations of nesting did increase between 2015 and 2020 (State of Hawaiʻi Division of Aquatic Resources 2020), suggesting that effects of KIUC streetlights could increase slowly over time if no action is taken. This potential increase in nesting as well as the proposed minimization measures are taken into account in KIUC's take request.

KIUC assumes that with the monitoring and minimization measures to be conducted under Conservation Measure 5, *Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program*, in Chapter 4, *Conservation Strategy*, most or all take resulting from KIUC streetlights will be avoided. Despite this, KIUC requests take authorization of 50 green sea turtle (honu) nests over the 50-year permit term, which is equivalent to an average of one nest every year. This requested take accounts for the possibility of green sea turtle (honu) nests going undetected by monitors and not being shielded from a KIUC streetlight. Alternatively, shielding may be ineffective at some nest sites due to incorrect placement or vandalism, in which case hatchlings may be affected by KIUC streetlights.

Based on the methodology and assumptions described above, KIUC requests take of 50 green sea turtle (honu) nests over the 50-year permit term (an average of one nest per year), where take in the form of disorientation, injury, or mortality of any hatchlings in a nest counts as take of that nest. This approach was selected because of the difficulty of observing all hatchlings in any one nest since hatching occurs at night and its timing is unpredictable. KIUC believes that this take request is conservative. KIUC assumes that with the monitoring and minimization measures under Conservation Measure 5, *Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program* in Chapter 4, *Conservation Strategy*, most and potentially all take of green sea turtle (honu) from KIUC streetlights can be avoided.

5.5.3 Impacts of the Taking

This section describes the impact of the loss of portions of 50 green sea turtle (honu) nests on the species' numbers, reproduction, and distribution at the population and species level.

Numbers. As described in the species account (Appendix 3A, *Species Accounts*), the estimated number of female green sea turtles (honu) that nest in the Plan Area is 16, representing only 0.39 percent of the total of 3,864 breeding females estimated for the entire Central North Pacific DPS of green sea turtle (honu) (Seminoff et al. 2015). Of 20 nesting sites documented on Kauaʻi, all but two were described as having intermittent or indeterminate use (Parker and Balazs 2015). At the French

Frigate Shoals, the principal nesting site for the green sea turtle (honu) where approximately 95 percent of all nesting occurs, nesting green sea turtles (honu) increased by an estimated 4.8 percent annually from 1966 to 2006 (over 40 years) (Appendix 3A, *Species Accounts*; Balazs and Chaloupka 2006). Information on at-sea abundance trends has been consistent with the increase in nesting (Balazs et al. 1996, 2005; Balazs 2000; Seminoff et al. 2015), although Hurricane Walaka in 2018 resulted in substantial loss of nesting habitat and the long-term effects of this catastrophic event have not been fully analyzed. The take of up to 50 nests over a 50-year period resulting from KIUC streetlights, where most or all of the take is expected to consist of a small fraction of the hatchlings in each nest, is not expected to adversely affect the green sea turtle (honu) numbers. None of the approximately 3,864 breeding females in the Central North Pacific DPS of green sea turtle (honu) would be taken as a result of KIUC streetlights. Furthermore, the majority of hatchlings in any affected nest are not expected to be affected by streetlights, particularly with the minimization measures in place.

Reproduction. The anticipated take of green sea turtles (honu) is expected to affect a small fraction of the hatchlings from a nest, with the majority of hatchlings expected to survive and make it to the ocean. The HCP is not expected to appreciably reduce green sea turtle reproduction due to an anticipated small portion of one nest per year being impacted and the likelihood that the majority of the hatchlings will make it to the ocean.

Distribution. The anticipated take of green sea turtles (honu) is not expected to affect the species' distribution, as only a small fraction of hatchlings in each nest would be affected and the covered activities are not expected to adversely affect nest distribution on Kauaʻi.

5.5.4 Beneficial and Net Effects

The nest detection and nest shielding program for green sea turtle (honu) described in Conservation Measure 5, *Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program* in Chapter 4, *Conservation Strategy*, will minimize take resulting from KIUC streetlights (possibly to zero) and provide a net benefit to the species. The program is able to fully offset any take and provide a net benefit to the species because it will also reduce take of green sea turtle (honu) resulting from non-KIUC light sources.

In Chapter 4, KIUC identified seven beaches with suitable nesting habitat for green sea turtle (honu) from which KIUC-operated streetlights were visible and thus have the potential to cause light attraction for emerging hatchlings. KIUC streetlights were the primary light source on only two of the seven beaches identified. On five of the seven beaches identified in KIUC's 2020 streetlight assessment, most of the light on the beach is from sources other than KIUC streetlights, including residential buildings, commercial buildings (e.g., restaurants, resorts, shopping centers), and beach infrastructure (e.g., restrooms, parking lot lighting, walking path lighting).

To approximate where streetlights are visible from a beach location, a distance of 300 feet (91 meters) was used. As shown in Table 5-15, the total length of beaches under this program will be approximately 4.4 mi (7 km) across the seven sites (this length will vary depending on beach erosion or accretion). Of this total beach covered by the program, approximately 1.13 mi (1.82 km) (25 percent) is within 300 feet (91 meters) of a KIUC streetlight. This means that up to 25 percent of the beach length covered by the program may be affected by light attraction from KIUC streetlights. The remaining 75 percent of the beach length covered by the program (3.29 mi [5.29 km]) are more than 300 feet (91 meters) from any KIUC streetlight.

Table 5-15. Approximate Beach Length Covered by the Green Sea Turtle (honu) Nest Detection and Shielding Program

Beach with KIUC Streetlights[a]	Approximate Beach Length[b] and Total Beach Length in Nest Shielding Program (miles)	Beach Length with Potential for Light Attraction by KIUC Streetlights[c] (miles)	Beach Length with Primary Light Attraction from Non-KIUC Sources (miles)
Keālia Beach	0.73	0.12	0.61
Kapaʻa Shoreline	0.93	0.18	0.75
Wailua Beach	0.44	0.34	0.10
Poʻipū Shoreline	0.28	0.13	0.15
Kukuiʻula Harbor	0.16	0.11	0.05
Waimea Shoreline	1.68	0.19	1.49
Kekaha Shoreline	0.20	0.06	0.14
Total	**4.42**	**1.13**	**3.29**

[a] See Conservation Measure 4 for details. Entire length of beach is included in the nest detection and shielding program.

[b] As measured in Google Earth with aerial imagery dated May 13, 2024. Subject to change due to beach erosion or accretion over time.

[c] As defined by 300-foot (91-meter) distance from KIUC streetlights; assumed to be the distance beyond which the potential to adversely affect the behavior of hatchlings is negligible (see Chapter 4 for details).

As described in Chapter 4, *Conservation Strategy*, KIUC's nest shielding program will shield any nests that have even the smallest potential to be affected by KIUC streetlights, as well as any nests on the same beaches that are more than 300 feet (91 meters) from a KIUC streetlight. Therefore, nest shielding in these areas not subject to any light attraction from KIUC streetlights will provide a net benefit to green sea turtle (honu).

Assuming an even distribution of suitable habitat and the potential for nests throughout the 4.42 mi (7 km) of beaches, approximately three times as many nests shielded by this program will have light attraction primarily from non-KIUC sources as compared to the number of shielded nests affected by KIUC streetlights. As such, the take of hatchlings in up to 50 nests over 50 years from KIUC streetlights is expected to be fully offset through the reduction of take from non-KIUC light sources. The nest shielding program is also expected to provide a net conservation benefit to green sea turtle (honu) because over the 50-year permit term KIUC will be shielding more nests than would be affected by their own streetlights (approximately three times more by this analysis), and as such, will be reducing mortalities from non-KIUC sources and increasing the probability for more green sea turtles (honu) to survive and reproduce.

Chapter 6
Monitoring and Adaptive Management Program

Chapter 6 Highlights

Chapter Purpose: This chapter describes how KIUC will monitor whether the HCP is complying with all requirements of the HCP, federal permit, and state license and ensure that the HCP achieves its biological goals and objectives. The chapter also describes how adaptive management will be used to address uncertainty by adjusting conservation measures to improve their performance.

Context: Monitoring and adaptive management are essential tools to ensure (1) that KIUC remains in compliance with its requirements under the HCP, permit, and license; (2) that the amount of take of covered species does not exceed HCP limits; and (3) that the conservation measures are implemented effectively to achieve the HCP's biological goals and objectives.

Major Conclusions:	See the following for more information:
• KIUC will monitor HCP implementation, take of covered species, and the effectiveness of the conservation program throughout the permit term. In some cases, KIUC will monitor effects to covered species directly; in other cases, direct measurement is infeasible, so KIUC will estimate the effects on the covered species based on best available data sources.	Section 6.2
• Detailed monitoring methods are based on many years of ongoing monitoring.	
• KIUC will report monitoring results, issues that arise, and plan adjustments in Annual Reports which will be available to USFWS, DOFAW, and ESRC (and DAR for aspects related to the green sea turtle [honu]).	Sections 6.3 and 6.4
• Adaptive management is a method for addressing uncertainty and allows conservation measures proposed in Chapter 4, *Conservation Strategy*, to be adapted in response to new information.	
• The adaptive management program incorporates a collaborative decision-making process between KIUC, USFWS, and DOFAW (and DAR for aspects related to the green sea turtle [honu]) to adjust the conservation strategy as needed to meet the HCP's biological goals and objectives.	
• The chapter defines 58 metrics that, if approached or exceeded, would trigger the adaptive management process and specific responses by KIUC in collaboration with USFWS and DOFAW (and DAR for aspects related to the green sea turtle [honu]).	Table 6-2 Table 6-3
Data Sources: Seabird monitoring activities in the KIUC HCP have been occurring on Kauaʻi since at least 2017, in some cases much earlier. Due to the long history of these programs, monitoring protocols (1) have had extensive input from DOFAW, USFWS, and other experts; (2) have been refined and published; and (3) have high confidence in their feasibility and effectiveness:	
• Powerline monitoring (2011–2024)	
• Seabird colony monitoring (2017–2024)	
• Predator monitoring at seabird colonies (2011–2024)	
• Number of grounded birds handled by the Save Our Shearwaters Program (2009–2024)	

- Light attraction monitoring by KIUC at covered facilities (2002–2024)

KIUC started monitoring powerline collisions of waterbirds in 2021 as part of KIUC's system wide powerline monitoring program. Waterbird monitoring is informed by the many years of acoustic and observer seabird monitoring. However, because waterbird monitoring was started relatively recently and the data set only spans a few years, the data confidence is moderate. The monitoring program for green sea turtle (honu) would be new on Kauaʻi but it is based on similar monitoring programs elsewhere, so confidence is relatively high.

Related Chapters: The cost of monitoring and adaptive management and how it will be funded are described in Chapter 7, *Plan Implementation*.

6.1 Introduction

This chapter describes the monitoring and adaptive management program for the KIUC HCP. The goal of the monitoring component of the program is to evaluate on an ongoing basis whether the HCP is meeting or is likely to achieve the biological goals and objectives. The goal of the adaptive management component of the program is to outline a system for adjusting the KIUC HCP management strategy using the monitoring results. Specifically, the purposes of the monitoring and adaptive management program are to do the following.

- Ensure that KIUC remains in compliance with the HCP, the federal incidental take permit (ITP), and the state incidental take license (ITL).
- Ensure take of the covered species does not exceed the maximum limits set by the federal ITP and state ITL.
- Ensure the HCP biological goals and objectives are attained in a timely manner.
- Evaluate the effectiveness of the conservation measures (Chapter 4, *Conservation Strategy*) on an ongoing basis and identify when adaptive management must be applied to improve their effectiveness.

Adaptive management and monitoring will be integrated into one program. This chapter begins with an overview of the monitoring and adaptive management program. The chapter then provides details on the required monitoring and adaptive management actions. Finally, the chapter provides a description of all HCP data and reporting requirements (refer to Chapter 7, *Plan Implementation*, for details regarding data management and reporting).

6.1.1 Regulatory Context

As discussed in the *Habitat Conservation Planning and Incidental Take Permit Processing Handbook* (HCP Handbook) (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016), monitoring and reporting are mandatory elements of all HCPs.[1] When properly designed and implemented, monitoring programs should provide the information needed to answer the following questions.

- Is the permittee (KIUC) in compliance with its HCP, federal ITP, and state ITL?
- Is progress being made toward meeting the HCP's biological goals and objectives by the deadlines established in the HCP?
- Is the HCP's conservation strategy effective at minimizing and mitigating impacts as defined in the HCP?
- Is there a need to adjust conservation measures through adaptive management to improve the outcomes of the conservation strategy to meet established goals and objectives?

Adaptive management programs are recommended for HCPs to address data gaps or scientific uncertainty that could affect how species are managed during implementation. The HCP Handbook (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016) describes adaptive management as a method for addressing uncertainty in natural resource management and states that management must be linked to measurable biological goals and monitoring. Conservation

[1] See e.g., 50 CFR §§ 17.22(b)(1)(viii), 17.22(b)(3), 17.32(b)(1)(viii), 17.32(b)(3).

measures proposed in Chapter 4, *Conservation Strategy*, could be adapted in response to new information within an adaptive management framework if the commitments defined under the HCP's regulatory assurances (Chapter 7, *Plan Implementation*) are maintained.

The Hawaiʻi Endangered Species Act has similar requirements for HCP monitoring and adaptive management programs.[2] HCP monitoring programs must do the following.

- Include monitoring of the threatened and endangered species in the HCP.
- Include periodic monitoring by representatives of the Hawaiʻi Department of Land and Natural Resources or the Endangered Species Recovery Committee (ESRC), or both.
- Provide for an adaptive management strategy that specifies the actions to be taken periodically if the plan is not achieving its goals.

6.2 Overview of Monitoring and Adaptive Management Program

6.2.1 Types of Monitoring

KIUC will oversee and implement three types of monitoring: compliance monitoring, take monitoring, and effectiveness monitoring. A description of each of these elements is provided below.

6.2.1.1 Compliance Monitoring

Compliance monitoring tracks the status of HCP implementation and documents that HCP requirements are being met. Compliance monitoring verifies that KIUC is carrying out the terms of the HCP, the federal ITP, and the state ITL. KIUC conducted compliance monitoring during the active period of the 5-year Short-Term HCP (2011 to 2016) and has continued monitoring from 2016 to the present. Compliance monitoring will continue under the KIUC HCP, with the goals of (1) confirming implementation of the conservation measures, (2) confirming estimated strike reductions through minimization, and (3) tracking annual and cumulative take over the 50-year permit term. The components of compliance monitoring are as follows:

- Tracking implementation of the conservation measures, including commitments on location, extent, and schedule, as shown in Tables 6-1 and 6-2.
- Tracking KIUC's annual funding contribution to the Save Our Shearwaters (SOS) Program, as described in Chapter 7, Section 7.5, *Funding Assurances*.
- Tracking implementation of the monitoring and adaptive management program, as described in this chapter.
- Reporting implementation progress on an annual basis (see Chapter 7, Section 7.7.1, *Annual Reporting*, for details).

U.S. Fish and Wildlife Service (USFWS) staff, State of Hawaiʻi Department of Land and Natural Resources staff (including the State of Hawaiʻi Division of Forestry and Wildlife [DOFAW] and the State of Hawaiʻi Division of Aquatic Resources [DAR]), or members of the ESRC may visit any KIUC

[2] Hawaiʻi Revised Statutes Sections 195D-21(b)(2)(G) and 195D-21(b)(2)(H).

locations associated with this HCP[3] at any reasonable hour[4] to ensure that conservation measures are being implemented in accordance with the HCP, the federal ITP, and state ITL. For conservation sites that require helicopter transport, KIUC will coordinate access with USFWS or DOFAW staff as needed to comply with this provision. If, during any site visit, agency personnel note any apparent discrepancies and bring them to KIUC's attention, KIUC will investigate the apparent deviation and report its findings and recommended course of action to the agencies within 10 business days.

6.2.1.2 Take Monitoring

Take monitoring compares take that occurs during implementation to the take limit authorized by the federal ITP and state ITL. KIUC will track impacts on the covered species to ensure that take limits defined in Chapter 5, *Effects*, are not exceeded. Take will be estimated using the same methods that were developed to predict take by the covered activities. Take monitoring is a form of compliance monitoring but it is separated into its own category for the purposes of this HCP.

6.2.1.3 Effectiveness Monitoring

Effectiveness monitoring assesses the biological performance of the HCP. Specifically, effectiveness monitoring evaluates the implementation and success of the conservation strategy described in Chapter 4, *Conservation Strategy*. Effectiveness monitoring will determine the effectiveness of KIUC's minimization and conservation actions. For example, burrow monitoring at the conservation sites will determine whether the conservation actions at the sites are on track to achieve the biological goals and objectives of the HCP: specifically, whether reproductive success rates are consistent with metric 3 of Objective 1.3 for Newell's shearwater ('a'o) (*Puffinus newelli*) and Objective 2.3 for Hawaiian petrel ('ua'u) (*Pterodroma sandwichensis*) (Chapter 4, Section 4.3, *Biological Goals and Objectives*).

6.2.2 Adaptive Management

As described in Chapter 4, *Conservation Strategy,* based on the best scientific information currently available, KIUC believes that the HCP conservation measures will achieve the biological goals and objectives. Over time, however, conditions in the Plan Area or the status of the covered species may change in ways that could change the effectiveness of the conservation measures. It is also possible that new approaches or new technology will prove more effective at achieving the biological goals and objectives than what is currently described in the HCP. Finally, it may be found that conservation measures are less effective at achieving the biological goals and objectives than expected. The adaptive management process described here is intended to address all these situations.

Adaptive management is a structured approach to decision-making in the face of uncertainty that makes use of the experience of management and monitoring results in an embedded feedback loop of monitoring, evaluating, and adjusting management strategies. The kinds of uncertainties the KIUC

[3] For example, powerline minimization project areas, covered facilities, or any conservation sites established in furtherance of the HCP, regardless of ownership. Access to any KIUC-owned facility will require advance notice to secure proper access and escort to comply with safety and security requirements. DAR's involvement will be limited to green sea turtle (honu) facilities.
[4] 50 CFR § 13.47.

HCP adaptive management program is intended to address are related to data uncertainty and the causes and conditions affecting successful achievement of the HCP's biological goals and objectives.

Adaptive management under the KIUC HCP will incorporate a collaborative process between KIUC, USFWS, and DOFAW (and DAR for green sea turtles [honu] [*Chelonia mydas*]), for adjusting the conservation strategy as needed to meet the HCP's biological goals and objectives. KIUC will provide the agencies with monitoring results through annual reports and collaborate with the agencies at regular meetings to implement the adaptive management program described in this section.

Adaptive management is a required component of HCPs that allows for the incorporation of new information into conservation and mitigation measures during HCP implementation. Effective implementation of this approach requires explicit and measurable objectives, and identifies what actions are to be taken and when they are to occur. Adaptive management changes do not trigger the need for an amendment of the HCP or the associated federal ITP or state ITL.

The adaptive management process is often represented as a cycle of *plan*, *do*, *monitor*, *learn, and adjust* (Webb et al. 2017). Large programs and complex situations often contain multiple cycles of adaptive management operating simultaneously at different scales nested within the larger adaptive management framework (Bormann and Stankey 2009).

6.2.2.1 Minor Adjustments vs. Adaptive Management

As the HCP operator, KIUC will be making decisions daily about the best approaches to use in implementing the HCP. HCP implementation will involve many minor adjustments to the conservation measures described in Chapter 4, *Conservation Strategy*, to perform effectively and remain consistent with the HCP and any ITP or ITL terms and conditions.

KIUC has qualified authority to make minor adjustments that are related to day-to-day management and monitoring responsibilities for the sole purpose of implementing the conservation strategy and monitoring program. Throughout the year, KIUC will need to plan and implement simple adjustments to routine activities that are small in size or effect or that need to be implemented rapidly. These types of changes are not adaptive management and therefore do not require consultation with USFWS or DOFAW, provided that they would not: (1) individually or cumulatively result in material deviations from the requirements of the HCP, ITP, or ITL; or (2) impede timely attainment of biological goals and objectives. In no event will this qualified authority be relied on to reduce KIUC's commitment to fully and timely fund and implement all HCP obligations.

Day-to-day activities must fit within the framework of the HCP's conservation strategy and be implemented consistent with the text and intent of the HCP, ITP, and ITL, as applicable, and the timely attainment of the HCP's biological goals and objectives. Such changes will be reported in each Annual Report (Chapter 7, Section 7.7.1, *Annual Reporting*) and at regular coordination meetings. The following are examples of types of actions that are considered minor adjustments. However, this list does not encapsulate all minor adjustments that may occur during HCP implementation.

- Day-to-day conservation site management activities. Examples include the location or positioning of wildlife cameras or predator traps, predator control techniques like selection of predator traps, placement of traps, and frequency and intensity of trapping in view of covered species needs, fence repairs, debris removal, methods and timing of invasive predator removal, and methods and timing of the installation of artificial burrows.
- Methods and equipment to install bird flight diverters on new powerlines.

- Repair or replacement of existing and future powerline collision minimization infrastructure.
- Repair or replacement of existing and future light minimization infrastructure for the covered seabirds and green sea turtle (honu).
- Green sea turtle (honu) nest monitoring methods, locations,[5] and approaches that are consistent with the conservation measure (e.g., beach shielding locations, monitoring techniques)

If either USFWS or DOFAW determine, in writing, that actions described as a minor adjustment by KIUC are either individually or cumulatively not minor, KIUC will cease the adjustment, resume the HCP, ITP, and ITL requirement at issue, and coordinate with USFWS and DOFAW to reach resolution consistent with the adaptive management decision-making process described below.

6.2.2.2 Adaptive Management Decisions

It may become clear from monitoring results or from new external scientific information that certain conservation measures need to be adjusted in substantial ways that go beyond the day-to-day minor adjustments. Adaptive management actions are intended to capture substantial changes to the HCP that are needed to achieve a biological objective in the event the conservation measures are not working as intended. For example, monitoring may reveal that conservation measures, despite many minor adjustments, are not expected to meet a metric in a biological objective. Alternatively, new techniques may become available that have the potential to dramatically improve the performance of a conservation measure but are untested on Kauaʻi or with the covered species. Such substantial changes to conservation measures are considered adaptive management actions that require following the adaptive management decision-making process described in Section 6.2.2.3, *Adaptive Management Decision-Making Process*.

Adaptive management changes may require multiple years to assess, plan, and implement. Adaptive management actions require clear objectives, success criteria, and implementation schedules. The following actions are considered adaptive management actions and require consultation with and pre-approval from USFWS and DOFAW (and DAR for green sea turtle [honu]), following the decision-making process. Actions considered as adaptive management for the purposes of this HCP include, but are not limited to:

- Actions to address strike reductions below those forecast in Chapter 4, Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*.
- Any modifications to KIUC's streetlight or facility light minimization techniques (e.g., removing shields, changing the type of shields, changing dimming protocols, changing light type).
- Any modifications to SOS Program funding, other than annual adjustments for inflation.
- Any new techniques to minimize green sea turtle (honu) hatchling disorientation.
- Adding or discontinuing conservation sites.
- Adding, removing, or changing the location, size, or configuration of predator exclusion fences, ungulate fences, or social attraction sites.

[5] Changes to locations within beaches do not require agency consultation (e.g., moving fences from year to year depending on nest location) because these areas have already been reviewed and approved by USFWS and DOFAW in this HCP. Only new beach locations are considered an adaptive management action.

- Changes to any of the timelines in the HCP conservation strategy that delay completion of minimization or mitigation actions.
- Reducing the monitoring frequency for any conservation action.
- New technology pertaining to minimization measures, mitigation measures, or monitoring,

Strong adaptive management programs include pre-defined thresholds for adaptive management actions. When a threshold is crossed (or likely to be crossed) for a metric, the adaptive management decision-making process is triggered. This "automatic" trigger ensures that appropriate assessments are conducted and, if necessary, action is taken.

Thresholds can be defined as either qualitative or quantitative metrics. In either case, a threshold can be set so that it serves as an "early warning" for a conservation measure that may be off track but has not yet failed. In this way, the adaptive management process can function to improve performance well in advance of serious issues that may be difficult and expensive to address. In this HCP, these thresholds are called *adaptive management triggers*. The adaptive management triggers and responses for this HCP are defined in the following sections:

- Section 6.3, *Compliance Monitoring and Adaptive Management Triggers*
- Section 6.4, *Take and Effectiveness Monitoring and Adaptive Management Triggers*

6.2.2.3 Adaptive Management Decision-Making Process

KIUC will make recommendations regarding adaptive management actions as defined in Section 6.2.2.2*, Adaptive Management Decisions,* and KIUC will make any final adaptive management decisions in consultation with USFWS and DOFAW.[6] The adaptive management decision-making process consists of the following steps.

1. As part of their annual reporting requirements (Chapter 7, Section 7.7.1, *Annual Reporting*), KIUC will report the results of compliance monitoring, take monitoring, and effectiveness monitoring, including any other data necessary to determine whether the HCP is on track to meet the biological goals and objectives. As part of this assessment, KIUC will assess whether an adaptive management trigger is likely to be reached within the next reporting year, has already been reached, or has been exceeded (see the next sections for triggers).
2. If an adaptive management trigger has been reached or exceeded, this will trigger a mandatory collaborative process between KIUC, USFWS, and DOFAW[7,8], to define and implement an agreed-upon response. KIUC will identify a recommended approach after reviewing the appropriate adaptive management section and list of potential adaptive management changes in this chapter or will develop an approach for adaptive management if no pre-defined response exists. The potential need for adaptive management may also be identified by KIUC, USFWS, or DOFAW at any time if they reasonably conclude in writing that an adaptive management trigger has been reached or exceeded or biological objectives are not being met or are unlikely to be met. KIUC,

[6] DAR will be included when the adaptive management decision involves green sea turtle (honu).

[7] DAR will be included when the adaptive management trigger involves green sea turtle (honu).

[8] Consistent with Hawai'i Revised Statutes Chapter 195D, the ESRC will make adaptive management recommendations at their annual review meeting for this HCP.

USFWS, or DOFAW[9] may also identify the potential need for adaptive management if an adaptive management trigger is likely to be met.

3. KIUC will receive input from USFWS, DOFAW,[10] and in some cases the ESRC,[11] on the recommended adaptive management action or actions. USFWS or DOFAW may approve, approve with conditions, or disapprove of the proposed changes in accordance with the requirements and processes of applicable laws existing at that time. However, KIUC will make the final decision on the appropriate adaptive management action(s) after discussion with and input from USFWS and DOFAW. KIUC will remain responsible for permit compliance and meeting the biological objectives of the KIUC HCP. If an adaptive management action fails to address the identified issue, KIUC, USFWS, and DOFAW will repeat the adaptive management process as soon as reasonably possible with an alternative adaptive management action (Step 2).

4. USFWS and DOFAW independently will decide, as appropriate, whether an amendment to the HCP or federal ITP/state ITL is necessary, and if so, the necessary steps to follow (see Chapter 7, Section 7.6, *Revisions and Amendments*). They will further determine, as appropriate, whether the proposed adaptive management actions will result in physical changes to the environment that were not addressed in the original analyses, and if so, whether there is a need for updates to the Environmental Impact Statement, federal Endangered Species Act Section 7 Biological Opinion, or Findings documents.

5. KIUC will report to USFWS and DOFAW through the regular coordination meetings and the subsequent Annual Report regarding the implementation and preliminary outcomes, as they become available, of any USFWS- and DOFAW-approved adaptive management action.

Any adaptive management changes implemented by KIUC will be consistent with and support the achievement of the biological goals and objectives (Chapter 4, *Conservation Strategy*), and will consider, without limitation, the take limit (Chapter 5, *Effects*) and the commitments of the funding strategy (Chapter 7, *Plan Implementation*).

Most adaptive management actions are expected to either be cost neutral or funded by cost savings (e.g., reduction or cessation of ineffective conservation measures). If adaptive management actions result in additional costs, those costs will be funded by KIUC. KIUC's funding guarantee for adaptive management will be secured by a letter of credit (Chapter 7, Section 7.5, *Funding Assurances*). KIUC, USFWS, and DOFAW[12] will evaluate a range of adaptive management responses across a range of costs, and will, when possible, balance the action and the cost, but will ultimately select an adaptive management response based on its ability to support the biological goals and objectives.

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[9] DAR will be included when the adaptive management involves green sea turtle (honu).

[10] DAR will be included when the adaptive management involves green sea turtle (honu).

[11] Consistent with Hawai'i Revised Statutes Chapter 195D, the ESRC will make adaptive management recommendations at their annual review meeting for this HCP.

[12] DAR will be included when the adaptive management involves green sea turtle (honu).

6.3 Compliance Monitoring and Adaptive Management Triggers

As described above, compliance monitoring tracks the status of HCP implementation and documents that KIUC is implementing the conservation measures as described, including required methods and timing. KIUC will closely monitor all conservation measures to ensure that they are being implemented properly and on time. If there are delays in implementation, KIUC will report these delays in regular coordination meetings with USFWS and DOFAW and as part of the Annual Report (Chapter 7, Section 7.7.1, *Annual Reporting*). Compliance monitoring results will be the primary tool for USFWS and DOFAW to verify that KIUC remains in compliance with the HCP requirements, the federal ITP, and state ITL. As defined by this HCP, compliance monitoring is comprised of the components listed below.

Implementing conservation measures on schedule and to the specifications of the HCP is important therefore, KIUC has included two components: (1) a compliance schedule (Table 6-1) and (2) adaptive management triggers and responses for all relevant compliance monitoring actions (Table 6-2). Adaptive management triggers are often tied to HCP deadlines to ensure that key compliance actions are implemented according to the HCP schedule and if they are not, immediate responses are implemented. If an adaptive management trigger is reached or is likely to be reached as determined by KIUC, USFWS, or DOFAW,[13,14] these three entities will first jointly perform an assessment described in the column *Adaptive Management Response Step 1* in Tables 6-2 and 6-3. Based on the initial assessment, KIUC will implement a response with input from USFWS and DOFAW[15] as described in Section 6.2.2.3, *Adaptive Management Decision-Making Process*, identified in the last column as *Adaptive Management Response Step 2* in Tables 6-2 and 6-3. KIUC will designate or hire a compliance monitor to track and report on KIUC's compliance with the requirements identified in Table 6-1. It is likely that KIUC's Program Administrator will be assigned the duties of the compliance monitor. The designated compliance monitor will also assist with the adaptive management process, including the assessments identified in *Adaptive Management Response Step 1*.

Compliance monitoring and adaptive management will allow KIUC to document that all the requirements of the HCP are being met and will allow USFWS and DOFAW[16,17] to determine, using the success metrics in Table 6-2, whether the HCP is on track both in terms of scope and schedule.

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[13] DAR will be included when the adaptive management trigger involves green sea turtle (honu).

[14] Consistent with Hawai'i Revised Statutes Chapter 195D, the ESRC will make adaptive management recommendations at their annual review meeting for this HCP.

[15] DAR will be included when the adaptive management involves green sea turtle (honu).

[16] DAR will be included when the adaptive management involves green sea turtle (honu).

[17] Consistent with Hawai'i Revised Statutes Chapter 195D, the ESRC will make adaptive management recommendations at their annual review meeting for this HCP.

Table 6-1. Schedule for HCP Compliance

Key KIUC Tasks with Deadlines Tied to Permit Compliance	Deadline
Key Initial Deadlines [a]	
Initiate the green sea turtle nest detection and temporary shielding program	Within 6 months of permit and license issuance [b]
Complete installation of predator exclusion fencing at Upper Limahuli Preserve PF	End of 2025
Eradicate predators at Upper Limahuli Preserve PF	End of 2026
Initiate social attraction at Upper Limahuli Preserve PF	March 31, 2027
Complete installation of predator exclusion fencing at Upper Mānoa Valley PF	End of 2027
Eradicate predators at Upper Mānoa Valley PF	End of 2028
Initiate social attraction at Upper Mānoa Valley PF	March 31, 2029
Complete strike reduction monitoring for Powerline Minimization Plan (Appendix 4B, *KIUC Minimization Projects*) to determine final strike reduction percentage	End of 2027
Key Annual Deadlines (beginning immediately following permit and license issuance)	
Ensure automatic renewal of irrevocable letter of credit or other approved financial security occurs at the end of the annual coverage period.	January 31
Ensure annual renewal of contract with SOS to provide funding of $300,000 (increased annually to track inflation) to the SOS Program	January 31
Complete training program for green sea turtle (honu) nest monitoring	March 1
Submit Annual Report	July 1 target but no later than September 28
Complete training program for covered seabird facility monitoring	August 15
Dim external and turn off interior facility lights or close blinds at Port Allen Generating Station	September 15
Complete Annual Work Plan	December 31

[a] This table is only intended to identify key deadlines. Annual monitoring activities that will occur every year are not included in this table but described below in this chapter.
[b] Unless the permit and/or license is issued after October 1. For more details see Chapter 4, Section 4.4.5.1, *Nest Detection*.

Table 6-2. Compliance Monitoring Adaptative Management Triggers and Responses

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 1. Implement Powerline Collision Minimization Projects	No more than 16% (27.2 mi [43.8 km]) of total transmission wire length in 2025 will include wire height increases by the end of the 50-year permit term.	An average of more than 4.4 mi (7.1 km) of wire height increases of total transmission wire length in 2025 in any 5-year period.	KIUC compliance monitoring. Annual reporting.	Monitor powerlines with wire height increases and evaluate, in coordination with USFWS and DOFAW, whether powerline collisions may increase due to wire height and exceed the 5-year rolling average as predicted in Appendix 6A, *Adaptive Management Comparison Tables*, Table 6A-1a or 6A-2.	If the increase in powerline collisions likely due to wire height increases exceeds the 5-year rolling average in Table 6A-1 or 6A-2 in Appendix 6A, refer to the *Take Monitoring* section for Objectives 1.1 and 2.1 in Table 6-3 for the response.
Conservation Measure 1. Implement Powerline Collision Minimization Projects	No more than a 24% (360 mi [579 km]) increase in new powerlines within KIUC's approximate 1,500-mi (2,414-km) system over the 50-year permit term.	An average of more than 36 mi (58 km) of new wires in any 5-year period.	KIUC compliance monitoring. Annual reporting.	Monitor new powerlines and evaluate, in coordination with USFWS and DOFAW whether powerline collisions may increase due to new powerlines and exceed the 5-year rolling average as predicted in Appendix 6A, Table 6A-1 or 6A-2.	If the increase in powerline collisions likely due to new powerlines exceeds the 5-year rolling average in Table 6A-1 or 6A-2 in Appendix 6A, refer to the *Take Monitoring* section for Objectives 1.1 and 2.1 in Table 6-3 for the response.
Conservation Measure 1. Implement Powerline Collision Minimization Projects	In areas where vegetation management has exposed wires, KIUC determines using existing data that vegetation management has not increased risk of powerline collisions.	Minimization is not installed on newly exposed wires that have collision risk (due to vegetation management).	KIUC compliance monitoring. Annual reporting.	Monitor newly exposed wires (due to vegetation management) and evaluate, in coordination with USFWS and DOFAW whether powerline collisions may increase due to newly exposed wires and exceed the 5-year rolling average as predicted in Appendix 6A, Tables 6A-1 and 6A-2.	If the increase in powerline collisions likely due to newly exposed wires exceeds the 5-year rolling average in Table 6A-1 or 6A-2 in Appendix 6A, refer to the *Take Monitoring* section for Objectives 1.1 and 2.1 in Table 6-3 for the response.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 1. Implement Powerline Collision Minimization Projects	New distribution lines will be no more than 45 ft (13.7 m) above ground at pole.	New distribution lines are more than 45 ft (13.7 m) above ground at pole.	KIUC compliance monitoring. Annual reporting.	Monitor new distribution lines more than 45 ft (13.7 m) above ground at pole and evaluate, in coordination with USFWS and DOFAW, whether powerline collisions may increase due to height of line and exceed the 5-year rolling average as predicted in Appendix 6A, Table 6A-1 or 6A-2.	If the increase in powerline collisions likely due to height of line exceeds the 5-year rolling average in Tables 6A-1 or 6A-2 in Appendix 6A, refer to the *Take Monitoring* section for Objectives 1.1 and 2.1 in Table 6-3 for the response.
Conservation Measure 1. Implement Powerline Collision Minimization Projects	One vertical wire level each on new distribution and transmission lines where possible.	More than one vertical wire level on a new distribution and transmission lines.	KIUC compliance monitoring. Annual reporting.	Monitor new distribution and transmission lines with more than one vertical wire level and evaluate, in coordination with USFWS and DOFAW, whether powerline collisions may increase as a result of vertical layers from new lines and will exceed the 5-year rolling average as predicted in Appendix 6A, Table 6A-1.	If the increase in powerline collisions likely due to more than vertical layers exceeds the 5-year rolling average in Table 6A-1 in Appendix 6A, refer to the *Take Monitoring* section for Objectives 1.1 and 2.1 in Table 6-3 for the response.
Conservation Measure 1. Implement Powerline Collision Minimization Projects	New powerlines located in areas that reduce and minimize collision risk, where possible.	New powerlines are planned in a high-risk area, based on existing data, predictive modeling, and/or consultation with qualified avian biologist.[18]	KIUC compliance monitoring. Annual reporting.	Monitor new powerlines and evaluate, in coordination with USFWS and DOFAW whether powerline collisions may increase from new lines and exceed the 5-year rolling average as predicted in Appendix 6A, Table 6A-1 or 6A-2.	If the increase in powerline collisions likely due to new lines exceeds the 5-year rolling average in Table 6A-1 or 6A-2 in Appendix 6A, refer to the *Take Monitoring* section for Objectives 1.1 and 2.1 in Table 6-3 for the response.

[18] A qualified avian biologist is defined in this HCP as a biologist with knowledge of and experience with the covered seabirds and powerline collisions.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 1. Implement Powerline Collision Minimization Projects	Diverters installed on new powerlines, where practicable. Reflective diverters near roads and LED diverters away from roads.	During the planning and design phase for new powerlines that are expected to result in powerline collisions, diverters are not planned on new powerlines.	KIUC compliance monitoring. Annual reporting.	During the planning/design phase of the new powerlines the KIUC compliance monitor will consult with a qualified avian biologist to determine whether new powerline locations without diverters may increase powerline collisions and exceed the 5-year rolling average as predicted in Appendix 6A, Table 6A-1. Monitor take along these lines consistent with Table 6-3.	If the increase in powerline collisions likely due to lack of diverters exceeds the 5-year rolling average in Table 6A-1 or 6A-2 in Appendix 6A, refer to the *Take Monitoring* section for Objectives 1.1 and 2.1 in Table 6-3 for the response.
Conservation Measure 1. Implement Powerline Collision Minimization Projects	Diverters will be replaced according to the schedule outlined in this HCP.	Diverters are not replaced according to the schedule in this HCP.	KIUC compliance monitoring. Annual reporting.	KIUC will evaluate, in coordination with USFWS and DOFAW whether powerline collisions may increase from deferred diverter maintenance and exceed the 5-year rolling average as predicted in Appendix 6A, Table 6A-1 or 6A-2.	If the increase in powerline collisions likely due to lack of diverter maintenance exceeds the 5-year rolling average in Table 6A-1 or 6A-2 in Appendix 6A, KIUC will replace diverters, alternatively refer to the *Take Monitoring* section for Objectives 1.1 and 2.1 in Table 6-3 for the response.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Streetlights: Full-cutoff shields on all KIUC streetlights, so that light does not shine above 90-degree horizontal plane.	Full-cutoff shields are not installed on new streetlights (shields are installed on all existing streetlights) or shields that are damaged or removed prior to the seabird fallout season (September 15 to December 15).	KIUC compliance monitoring. Annual reporting.	KIUC will replace or repair shields on existing streetlights prior to the seabird fallout season. If damage occurs during the seabird fallout season, KIUC will repair shields as soon as possible following damage. Shields missing from new streetlights will be installed prior to the seabird nesting season.	N/A
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Streetlights: No more than 1,754 streetlights installed by the end of the 50-year permits.	More than 175 new streetlights installed over any 5-year period (the average expected over any 5-year period).	KIUC compliance monitoring. Annual reporting.	Assess, in coordination with USFWS and DOFAW[b], whether the rate of installation of new streetlights is expected to continue and would affect KIUC's 50-year take request.	If the increased rate of streetlight installation is likely to continue and is likely to result in an exceedance of the 50-year take request, KIUC will identify additional light minimization within 1 year to make up the difference, including where it will be implemented and a timeline for implementation. If this option is not possible, KIUC will discuss with the appropriate agencies whether KIUC should apply for a permit amendment.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Port Allen Generating Station: Dim/turn off the exterior lighting during the fledgling fallout season (September 15 to December 15).	Lights are not being dimmed/turned off at night during the seabird fledgling fallout season (September 15 to December 15).	KIUC compliance monitoring. Annual reporting.	KIUC will correct immediately to ensure lights are dimmed/turned off or shielded at night consistent with the HCP.	N/A
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Port Allen Generating Station and Kapaia Generating Station: Turn off interior lights at night, or use retractable screen or shades, during the fledgling fallout season (September 15 to December 15).	Lights are not compliant between September 15 and December 15.	KIUC compliance monitoring. Annual reporting.	KIUC will correct immediately to ensure interior lights are turned off at night or retractable screen or shades are used consistent with the HCP.	N/A
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Port Allen Generating Station: All exterior lights utilize full-cutoff white LED lights and shielded wall-mounted white LED box lighting (including new lights installed during the permit term) or other wildlife friendly options as described in Section 4.4.2.2, *Covered Facility Lights.*	Lights are not compliant.	KIUC compliance monitoring. Annual reporting and annual work plan.	KIUC will correct immediately during fallout seasons or, if not during seabird season, prior to the start of the next fallout season to ensure compliance.	N/A

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Kapaia Generating Station: All exterior lights are shielded to direct light downward, away from the sky.	Lights are not compliant.	KIUC compliance monitoring. Annual reporting and annual work plan.	KIUC will correct immediately during fallout seasons or, if not during seabird season, prior to the start of the next fallout season to ensure compliance.	N/A
Conservation Measure 2. Implement Measures to Minimize Light Attraction	No more than 85 cumulative hours of night lighting for restoration of power during the fledgling fallout season (September 15 to December 15).	An average of more than 8.5 hours of night lights during the fledgling fallout season (September 15 to December 15) in any 5-year period.	KIUC compliance monitoring. Annual reporting and annual work plan.	Assess, in coordination with USFWS and DOFAW, whether the rate of nighttime lighting for power restoration is expected to continue and would affect KIUC's 50-year take request.	If the increased rate of nighttime lighting for power restoration is likely to continue and is likely to result in an exceedance of the 50-year take request, KIUC will identify additional minimization within 1 year to make up the difference, including where it will be implemented and a timeline for implementation. If this option is not possible, KIUC will discuss with the appropriate agencies whether KIUC should apply for a permit amendment.
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Annual seabird training program prior to the start of the seabird fallout period (September 15 to December 15) using Appendix 6B, *KIUC Site Monitoring Protocols and Procedures for Protected Seabirds*.	Training has not occurred by August 15 of each year.	KIUC compliance monitoring. Annual reporting and annual work plan.	Compliance monitor ensures and documents that training occurs prior to September 15.	N/A

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program	KIUC funds SOS consistent with Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program*.	KIUC does not fund SOS consistent with Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program*.	KIUC compliance monitoring. Annual reporting.	KIUC will immediately remedy the SOS Program funding shortfall.	N/A
Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program	KIUC funds SOS consistent with Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program*.	The SOS Program is terminated.	KIUC compliance monitoring. Annual reporting.	KIUC will fund an equivalent program on Kaua'i or in Hawai'i focused on the rescue, rehabilitation, and release of covered seabird and waterbird species.	N/A
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will implement predator control consistent with Section 4.4.4.2, *Management Actions*.	KIUC does not implement predator control consistent with Section 4.4.4.2, *Management Actions*.	KIUC compliance monitoring. Annual reporting and annual work plan.	KIUC will evaluate why predator control is not consistent with Section 4.4.4.2, *Management Actions*. KIUC is permitted to make minor adjustments to the conservation strategy (Section 6.2.2.1, *Minor Adjustments vs. Adaptive Management*).	If for any reason predator control is not consistent with the HCP and the change is not due to a minor adjustment, meet and confer with USFWS and DOFAW to discuss cause and appropriate response to ensure Objectives 1.3, 2.3, and 3.3 are met.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will install (according to the implementation schedule) and maintain predator exclusion fencing consistent with Section 4.4.4.2, *Management Actions*.	KIUC's predator exclusion fencing is not consistent with Section 4.4.4.2, *Management Actions*.	KIUC compliance monitoring. Intra-annual coordination meetings. Annual reporting.	KIUC will evaluate and identify why predator exclusion fencing is not consistent with Section 4.4.4.2, *Management Actions*, and notify USFWS and DOFAW within 60 days of identifying trigger. KIUC is permitted to make minor adjustments to the conservation strategy (Section 6.2.2.1, *Minor Adjustments vs. Adaptive Management*).	KIUC will meet and confer with USFWS and DOFAW within 60 days of identifying trigger to discuss cause and appropriate response to ensure Objective 1.3 is met.
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will complete installation of predator exclusion fencing at Upper Limahuli Preserve PF by the end of 2025.	Predator exclusion fencing is not expected to be complete at Upper Limahuli Preserve PF by the end of 2025.	KIUC compliance monitoring. Annual reporting and annual work plan.	Notify USFWS and DOFAW by December 1, 2025, if the predator exclusion fencing is not expected to be complete by the end of 2025, and evaluate whether the delay will preclude KIUC from meeting Objective 1.3.	If the delay will impact KIUC's ability to meet Objective 1.3, KIUC will identify minimization and/or mitigation to ensure Objective 1.3 is met. If this option is not possible, KIUC will discuss with the appropriate agencies whether KIUC should apply for a permit amendment.
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will complete installation of predator exclusion fencing at Upper Mānoa Valley PF by the end of 2027.	Predator exclusion fencing is not expected to be complete at Upper Mānoa Valley PF by the end of 2027.	KIUC compliance monitoring. Annual reporting and annual work plan.	Notify USFWS and DOFAW by December 1, 2027 if the predator exclusion fencing is not expected to be complete by the end of 2027, and evaluate whether the delay will preclude KIUC from meeting Objective 1.3.	If the delay will impact KIUC's ability to meet the social attraction metric, KIUC will identify minimization and/or mitigation to ensure Objective 1.3 is met. If this option is not possible, KIUC will discuss with the appropriate agencies whether KIUC should apply for a permit amendment.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will eradicate all predators within Upper Limahuli Preserve PF, consistent with Section 4.4.4.2, *Management Actions*, no later than the end of 2026.	Predators are not expected to be eradicated in Upper Limahuli Preserve PF by the end of 2026.	KIUC compliance monitoring. Annual reporting and annual work plan.	Notify USFWS and DOFAW by December 1, 2026, if the predator eradication is not expected to be complete by the end of 2026, and evaluate whether the delay will preclude KIUC from meeting Objective 1.3	If the delay will impact KIUC's ability to meet Objective 1.3, KIUC will identify minimization and/or mitigation to ensure Objective 1.3 is met. If this option is not possible, KIUC will discuss with the appropriate agencies whether KIUC should apply for a permit amendment.
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will initiate social attraction within Upper Limahuli Preserve PF, consistent with Section 4.4.4.2, *Management Actions*, no later than March 31, 2027.	Social attraction has not been initiated in Upper Limahuli Preserve PF by March 31, 2027.	KIUC compliance monitoring. Annual reporting and annual work plan.	Notify USFWS and DOFAW by February 1, 2027, if the social attraction is not expected to be initiated by March 31, 2027, and evaluate whether the delay will preclude KIUC from meeting Objective 1.3.	If the delay will impact KIUC's ability to meet Objective 1.3, KIUC will identify minimization and/or mitigation to ensure Objective 1.3 is met. If this option is not possible, KIUC will discuss with the appropriate agencies whether KIUC should apply for a permit amendment.
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will eradicate all predators within Upper Mānoa Valley PF, consistent with Section 4.4.4.2, *Management Actions*, no later than the end of 2028.	Predators are not expected to be eradicated in Upper Mānoa Valley PF by the end of 2028.	KIUC compliance monitoring. Annual reporting and annual work plan.	Notify USFWS and DOFAW by December 1, 2028, if the predator eradication is not expected to be complete by the end of 2028, and evaluate whether the delay will preclude KIUC from meeting Objective 1.3.	If the delay will impact KIUC's ability to meet Objective 1.3, KIUC will identify minimization and/or mitigation to ensure Objective 1.3 is met. If this option is not possible, KIUC will discuss with the appropriate agencies whether KIUC should apply for a permit amendment.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will initiate social attraction in Upper Mānoa Valley PF, consistent with Section 4.4.4.2, *Management Actions*, no later than March 31, 2029.	Social attraction has not been initiated in Upper Mānoa Valley PF by March 31, 2029.	KIUC compliance monitoring. Annual reporting and annual work plan.	Notify USFWS and DOFAW by February 1, 2029, if the social attraction is not expected to be initiated by the end of March 31, 2029, and evaluate whether the delay will preclude KIUC from meeting Objective 1.3.	If the delay will impact KIUC's ability to meet Objective 1.3, KIUC will identify minimization and/or mitigation to ensure Objective 1.3 is met. If this option is not possible, KIUC will discuss with the appropriate agencies whether KIUC should apply for a permit amendment.
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	KIUC will implement invasive plant species management consistent with Section 4.4.4.2, *Management Actions*.	Invasive plant species management not implemented consistent with Section 4.4.4.2, *Management Actions*.	KIUC compliance monitoring. Annual reporting and annual work plan.	KIUC will evaluate why invasive plant species control is not consistent with Section 4.4.4.2, *Management Actions*. KIUC is permitted to make minor adjustments to the conservation strategy (Section 6.2.2.1, *Minor Adjustments vs. Adaptive Management*).	If for any reason invasive plant species control is not consistent with the HCP and the change is not due to a minor adjustment, meet and confer with USFWS and DOFAW to discuss cause and appropriate response to ensure Objectives 1.3 and 2.3 are met.
Conservation Measure 5. Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program	KIUC will implement nest detection and shielding program consistent with Section 4.4.5.1, *Nest Detection*.	Nest detection and shielding program not expected to be implemented by the start of a nesting season in any year.	KIUC compliance monitoring. Annual reporting and annual work plan.	As soon as it is anticipated the nest detection program will not be implemented by the start of a nesting season, notify USFWS, DOFAW, and DAR[19] and provide the reasons for the delay.	KIUC will implement the nest detection and shielding program as soon as possible.

[19] KIUC will coordinate with Division of Aquatic Resources when green sea turtle (honu) is potentially affected.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 5. Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program	KIUC will shield active nests from streetlights consistent with Section 4.4.5.2, *Shield Active Nests from Streetlights*.	Nests not shielded from streetlights consistent with Section 4.4.5.2, *Shield Active Nests from Streetlights*.	KIUC compliance monitoring. Annual reporting and annual work plan.	KIUC will correct the issue immediately to ensure compliance. If, for any reason, the nest detection program cannot be implemented consistent with specifications and the change is not due to a minor adjustment, meet and confer with USFWS, DOFAW, and DAR to discuss the cause and appropriate response to ensure Objective 5.1 is met. KIUC is permitted to make minor adjustments to the conservation strategy (Section 6.2.2.1, *Minor Adjustments vs. Adaptive Management*).	N/A
Conservation Measure 5. Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program	KIUC will conduct annual training and reporting consistent with Section 4.4.5.5, *Annual Training and Reporting*.	Annual training not anticipated to be completed 1 month prior to the start of the green sea turtle (honu) nesting season or reporting is not consistent with Section 4.4.5.5, *Annual Training and Reporting*.	KIUC compliance monitoring. Annual reporting and annual work plan.	KIUC will correct the issue immediately to ensure compliance. KIUC is permitted to make minor adjustments to the conservation strategy (Section 6.2.2.1, *Minor Adjustments vs. Adaptive Management*).	N/A

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle (honu)	If an agreement is reached with the County and State on practicable streetlight minimization, KIUC will install practicable light minimization techniques within a timeframe agreed upon by USFWS, DOFAW, and DAR, consistent with Section 4.4.6.1, *Identify and Install Practicable Light Minimization Techniques*.	If an agreement is reached with the County and State on practicable streetlight minimization, and it is not installed within the agreed upon timeframe.	KIUC compliance monitoring. Annual reporting and annual work plan.	KIUC will notify USFWS, DOFAW, and DAR and provide the reason for non-compliance.	KIUC will correct the issue immediately to ensure compliance.

ft = feet; km = kilometer; LED = light-emitting diode; m = meter; mi = mile; N/A = not applicable

6.4 Take and Effectiveness Monitoring and Adaptive Management Triggers

As described above, take monitoring is a component of compliance monitoring that compares the take that occurs during implementation to the take limit authorized by the federal ITP and state ITL. Effectiveness monitoring assesses the biological performance of the HCP.

This section describes methods and protocols to monitor take levels (take monitoring) and the effectiveness of conservation measures (effectiveness monitoring). The section also describes the adaptive management triggers and responses relevant to each of the six conservation measures and their associated biological objectives identified in Chapter 4, *Conservation Strategy*. Table 6-3 summarizes the adaptive management triggers and responses for take monitoring and effectiveness monitoring. The format for Table 6-3 is the same as for Table 6-2. The one exception is that the relevant biological objectives are also included in Table 6-3 to help organize the monitoring actions. Each section after Table 6-3 describes take monitoring, effectiveness monitoring, and adaptive management associated with each conservation measure. For details and explanations of the metrics of success, the adaptive management triggers, the monitoring strategy, and the response steps, see the text following Table 6-3.

Table 6-3. Adaptive Management Triggers for Take and Effectiveness Monitoring

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Take Monitoring					
Objective 1.1 (Newell's shearwater (ʻaʻo)), Objective 2.1 (Hawaiian petrel (ʻuaʻu))					
Conservation Measure 1. Implement Powerline Collision Minimization Projects	No more than the predicted annual powerline strikes of Newell's shearwater (ʻaʻo) as shown in Appendix 6A, *Adaptive Management Comparison Tables*, Table 6A-1 (based on a 5-year rolling average) for each year of the permit term.	Strikes higher than predicted as shown in Appendix 6A, Table 6A-1 based on 5-year rolling average.	Annual monitoring of high-risk spans. Rover acoustic monitoring and Bayesian model. Proportion by species will be constant and assumed.	Notify USFWS and DOFAW within 30 days of receiving the Annual Report for powerline monitoring and meet and confer to determine whether modifications to minimization or monitoring are needed. KIUC will evaluate the cause of the increase above the predicted strikes (Table 6A-1).	Reduce strikes through additional powerline minimization. KIUC will evaluate the span(s) to determine what minimization technique(s) already identified in the HCP are practicable. KIUC may also test novel minimization techniques that incorporate new technology. KIUC will identify a practicable plan of action within 6 months of annual reporting. The timeline for minimization installation will depend on the technique (i.e., reconfiguration requires more planning and permitting than diverter installation).
Conservation Measure 1. Implement Powerline Collision Minimization Projects	No more than the predicted annual powerline strikes of Hawaiian petrel (ʻuaʻu) as shown in Appendix 6A, Table 6A-2 (based on a 5-year rolling average) for each year of the permit term.	Strikes higher than predicted as shown in Appendix 6A, Table 6A-2 based on 5-year rolling average.	Annual monitoring of high-risk spans. Rover acoustic monitoring and Bayesian model. Proportion by species will be constant and assumed.	Notify USFWS and DOFAW within 30 days of receiving the Annual Report for powerline monitoring and meet and confer to determine whether modifications to minimization or monitoring are needed. KIUC will evaluate the cause of the increase above the	Reduce strikes through additional powerline minimization. KIUC will evaluate the span(s) to determine what minimization technique(s) already identified in the HCP are practicable. KIUC may also test novel minimization techniques that incorporate new technology. KIUC will identify a practicable plan of action within 6 months of annual reporting. The timeline for minimization installation will depend on the technique (i.e., reconfiguration requires more

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
				predicted strikes (Table 6A-2).	planning and permitting than diverter installation).
Objective 4.1 (Waterbirds)					
Conservation Measure 1. Implement Powerline Collision Minimization Projects	No more than 53 Hawaiian stilt (aeʻo) strikes, 480 Hawaiian duck (koloa maoli) strikes, 107 Hawaiian coot (ʻalae keʻokeʻo) strikes, 107 Hawaiian common gallinule (ʻalae ʻula) strikes, or 1,226 Hawaiian goose (nēnē) strikes by the end of permit term.	Occurrence of any of the following: more than 1 Hawaiian stilt (aeʻo) strike, 10 Hawaiian duck (koloa maoli) strikes, 2 Hawaiian coot (ʻalae keʻokeʻo) strikes, 2 Hawaiian common gallinule (ʻalae ʻula) strikes, and 25 Hawaiian goose (nēnē) strikes in any year, based on a 5-year rolling average.	Annual monitoring of high-risk spans in Mānā and Hanalei. Rover acoustic monitoring and Bayesian model. Proportion of strikes attributed to waterbirds will be constant and assumed.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to minimization or monitoring are needed.	Reduce strikes through additional powerline minimization. KIUC will evaluate the span(s) to determine what minimization technique(s) already identified in the HCP are practicable. KIUC may also test novel minimization techniques that incorporate new technology. KIUC will identify a practicable plan of action within 6 months of annual reporting. The timeline for minimization installation will depend on the technique (i.e., reconfiguration requires more planning and permitting than diverter installation).
Objective 1.2 (Newell's shearwater (ʻaʻo)), Objective 2.2 (Hawaiian petrel (ʻuaʻu)), Objective 3.2 (band-rumped storm-petrel (ʻakēʻakē))					
Conservation Measure 2. Implement Measures to Minimize Light Attraction	No more than 650 groundings (alive or dead) of Newell's shearwater (ʻaʻo), 15 groundings of Hawaiian petrel (ʻuaʻu), and no groundings of band-rumped storm-petrel (ʻakēʻakē) by the end of the permit term at the covered facilities (Port Allen and Kapaia Generating Stations).	Groundings (alive or dead) of 13 or more Newell's shearwater (ʻaʻo) annually, based on a 5-year rolling average. Any incidents of Hawaiian petrel (ʻuaʻu) or band-rumped storm-petrel (ʻakēʻakē) also trigger adaptive management.	Facility monitoring (Section 6.4.2, *Light Attraction Monitoring and Adaptive Management*).	By January 15, notify USFWS and DOFAW and meet and confer to determine whether modifications to management or monitoring are needed. If needed, go to Step 2.	KIUC will investigate causes and evaluate whether further minimization is practicable to reduce fallout or if additional monitoring is needed to reduce mortality. Implement further minimization or monitoring if feasible and appropriate based on causes. See Section 6.4.2.3, *Adaptive Management for Light Attraction*.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Conservation Measure 2. Implement Measures to Minimize Light Attraction	Groundings from construction night lighting for the restoration of power are 5 or fewer Newell's shearwaters (‘a‘o), and 0 Hawaiian petrel (‘ua‘u) or band-rumped storm-petrel (‘akē‘akē), based on a 5-year rolling average.	Groundings from construction night lighting for the restoration of power are 6 or more Newell's shearwater (‘a‘o), and 1 or more Hawaiian petrel (‘ua‘u) or band-rumped storm-petrel (‘akē‘akē), based on a 5-year rolling average.	KIUC compliance monitoring. Annual reporting and annual work plan.	Notify USFWS and DOFAW and meet and confer to determine if the number of grounded birds due to night lighting could result in KIUC exceeding its combined take estimate for light attraction (Chapter 5, *Effects*, Tables 5-7a and 10a). If the answer is yes, proceed to Step 2.	KIUC will investigate whether additional minimization is practicable to reduce fallout or if additional monitoring is needed to reduce mortality. Implement further minimization or monitoring if feasible and appropriate. KIUC, USFWS, and DOFAW may also consider additional powerline minimization to make up the difference if additional light attraction minimization is not practicable.
Objective 1.3 (Newell's shearwater (‘a‘o)), Objective 2.3 (Hawaiian petrel (‘ua‘u))					
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	No more than 39 Newell's shearwater (‘a‘o) or 108 Hawaiian petrel (‘ua‘u) injured or killed from conservation site management over the permit term.	More than 1 Newell's shearwater (‘a‘o) or more than 2 Hawaiian petrel (‘ua‘u) injured or killed from conservation site management per year, based on a 5-year rolling average.	Conservation site monitoring (Section 6.4.4, *Conservation Site Monitoring and Adaptive Management*).	Notify USFWS and DOFAW by January 15 if the 5-year rolling average annual trigger is exceeded, and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will investigate causes and implement modifications as needed based on the best available technology to minimize mortalities.
Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	No more than 10 Hawaiian duck (koloa maoli) or 10 Hawaiian goose (nēnē) injured from conservation site management over the permit term.	More than 1 Hawaiian duck (koloa maoli) or Hawaiian goose (nēnē) injured from conservation site management per	Conservation site monitoring (Section 6.4.4, *Conservation Site Monitoring and Adaptive Management*).	Notify USFWS and DOFAW by January 15 if the 5-year rolling average annual trigger is exceeded, and meet and confer to	KIUC will investigate causes and implement modifications as needed based on the best available technology to minimize mortalities.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
		year, based on a 5-year rolling average.		determine whether modifications to management are needed. If needed, go to Step 2.	
Objective 5.1 and 5.2 (green sea turtle (honu))					
Conservation Measure 5. Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program	No more than 50 nests taken over the permit term	Number of nests taken in any year is 2 or greater, or take of any number of hatchlings from undocumented nests.	Nest monitoring (see Chapter 4, Section 4.4.5, *Conservation Measure 5. Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program*).	Notify USFWS, DOFAW, and DAR and meet and confer to determine whether modifications to management or monitoring are needed. If needed, go to Step 2.	KIUC will evaluate potential additional minimization and monitoring measures and implement if practicable. See Section 6.4.5.3, *Adaptive Management for Green Sea Turtle (honu)*
Effectiveness Monitoring					
Objective 1.1 (Newell's shearwater ('a'o)), Objective 2.1 (Hawaiian petrel ('ua'u))					
Conservation Measure 1. Implement Powerline Collision Minimization Projects	66.4% reduction in seabird strikes on existing powerlines.	Island-wide seabird annual take over a 3-year average (2025, 2026, 2027) after all minimization is completed (May 5, 2024) is higher than expected with 66.4% reduction of strikes as determined by the Bayesian model (Appendix 5C, *Bayesian Acoustic Strike Model*).	Acoustic data from acoustic sensors located on powerlines as measured over 3 years after minimization is completed. Reduction of strikes is measured through take monitoring.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management or monitoring are needed. See Step 2 if management or monitoring is needed. KIUC will evaluate whether the cause is due to strike reduction issues or population increases	If annual strikes exceed what is expected with 66.4% strike reduction, by the end of 2028 identify additional minimization (this may also include the same amount/location using a technique with a higher strike reduction) to make up the difference, where it will be implemented, and timeline for implementation. If minimization cannot make up the difference, and annual strikes are exceeding what is expected with 66.4% reduction in strikes, by the end of 2028 evaluate whether the take limit is likely to be exceeded. If so,

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
				as measured by radar data. If the difference is likely due to strike reduction issues, see Step 2. If difference is due to population increases, coordinate with USFWS and DOFAW to assess whether permit amendment will be needed.	a permit amendment may be needed.
Objective 4.2 (Waterbirds)					
Conservation Measure 1. Implement Powerline Collision Minimization Projects	90% reduction of waterbird strikes.	If annual take as measured and calculated at Mānā and Hanalei spans over a 3-year average (2025, 2026, 2027) after all minimization is completed is higher than expected with 90% reduction of waterbird strikes.	Acoustic data from acoustic sensors located on powerlines as measured over 3 years after minimization is complete deduction of strikes is measured through take monitoring.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management or monitoring are needed. KIUC will evaluate whether the cause is due to strike reduction issues If difference is likely due to strike reduction issues, see Step 2.	If minimization is not effective and annual waterbird strikes exceed what is expected with 90% strike reduction, by the end of 2028 identify additional minimization (this may also include the same amount/location using a technique with a higher strike reduction) to make up the difference, where it will be implemented, and timeline for implementation. If minimization cannot make up the difference, and annual strikes are exceeding what is expected with 90% reduction in strikes, by the end of 2028 evaluate whether the take limit is likely to be exceeded. If so, a permit amendment may be needed.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Objective 1.2 (Newell's shearwater (ʻaʻo)), Objective 2.2 (Hawaiian petrel (ʻuaʻu)), Objective 3.2 (band-rumped storm-petrel (ʻakēʻakē)), Objective 4.2 (Waterbirds)					
Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program	Fund SOS or another rehabilitation facility at the level needed to provide rehabilitation care for covered avian species as described in Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save our Shearwaters Program.*	10% or greater combined increases in intakes of covered avian species 3 years in a row.	SOS tracking of data and annual reporting of numbers of birds handled for each species.	Work with SOS, USFWS, and DOFAW to determine if the current level of funding is sufficient to rehabilitate the increased number of covered species. If the funding level is determined to be insufficient, see Step 2.	KIUC will increase funding by at least 50% of the proportional increase in covered species intakes (e.g., a 10% increase in covered species intake equals at least a 5% increase in funding; a 20% increase in covered species intakes equals at least a 10% increase in funding).
Objective 1.3 (Newell's shearwater (ʻaʻo)), Objective 2.3 (Hawaiian petrel (ʻuaʻu))					
All 12 conservation sites combined Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Growth rate for Newell's shearwater (ʻaʻo) breeding pairs annually of at least 1% to reach the annual target of breeding pairs.	Newell's shearwater (ʻaʻo) breeding pairs in any year is lower than Appendix 6A, *Adaptive Management Comparison Tables*, Table 6A-3 based on 5-year rolling average to account for annual variability.	Auditory surveys and comparison with projected numbers from modeling (Appendix 6A, *Adaptive Management Comparison Tables*).	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
All 12 conservation sites combined[a] Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and	Maintain an 87.2% reproductive success rate based on a 5-year rolling average for Newell's shearwater (ʻaʻo).	Less than 87.2% reproductive success rate for Newell's shearwater (ʻaʻo) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, and fledgling success.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Colonies at Conservation Sites					
Upper Limahuli Preserve Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain an 87.0% reproductive success rate based on a 5-year rolling average for Newell's shearwater ('a'o).	Less than 87.0% reproductive success rate for Newell's shearwater ('a'o) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
Pōhākea Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain an 87.0% reproductive success rate based on a 5-year rolling average for Newell's shearwater ('a'o).	Less than 87.0% reproductive success rate for Newell's shearwater ('a'o) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
All 8 conservation sites combined[a] Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Growth rate for Hawaiian petrel ('ua'u) breeding pairs annually of at least 1% to reach annual targets of breeding pairs.	Hawaiian petrel ('ua'u) breeding pairs in any year is lower than Appendix 6A, Table 6A-4 based on 5-year rolling average to account for annual variability.	Auditory surveys and modeling.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
All 12 conservation sites combined Conservation Measure 4. Manage and Enhance Seabird	Maintain a 78.7% reproductive success rate on a 5-year rolling average for Hawaiian petrel ('ua'u).	Less than 78.7% reproductive success rate for Hawaiian petrel ('ua'u) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks,	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are	Evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Breeding Habitat and Colonies at Conservation Sites			predation/loss, fledgling success.	needed. If needed, go to Step 2.	
Upper Limahuli Preserve Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain a 66.7% reproductive success rate on a 5-year rolling average for Hawaiian petrel (ʻuaʻu).	Less than 66.7% reproductive success rate for Hawaiian petrel (ʻuaʻu) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
Pihea Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain a 78.0% reproductive success rate on a 5-year rolling average for Hawaiian petrel (ʻuaʻu).	Less than 78.0% reproductive success rate for Hawaiian petrel (ʻuaʻu) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
North Bog Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain a 78.0% reproductive success rate on a 5-year rolling average for Hawaiian petrel (ʻuaʻu).	Less than 78.0% reproductive success rate Hawaiian petrel (ʻuaʻu) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
Pōhākea Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and	Maintain a 75.5% reproductive success rate on a 5-year rolling average for Hawaiian petrel (ʻuaʻu).	Less than 75.5% reproductive success rate for Hawaiian petrel (ʻuaʻu) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks,	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Colonies at Conservation Sites			predation/loss, fledgling success.	needed. If needed, go to Step 2.	
Hanakoa Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain an 78.0% reproductive success rate on a 5-year rolling average for Hawaiian petrel (ʻuaʻu).	Less than 78.0% reproductive success rate for Hawaiian petrel (ʻuaʻu) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
Hanakāpīʻai Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Maintain an 78.0% reproductive success rate on a 5-year rolling average for Hawaiian petrel (ʻuaʻu).	Less than 78.0% reproductive success rate for Hawaiian petrel (ʻuaʻu) based on a 5-year rolling average.	Annual colony monitoring at reference burrows: estimate of burrows, chicks, predation/loss, fledgling success.	Notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology.
Social attraction Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Produce at least one Newell's shearwater (ʻaʻo) breeding pair within each of the four social attraction sites by year 5 of completion of predator eradication within the fenced area at each site.	One or more social attraction sites without a breeding pair by year 5 of the completion of predator eradication within the fenced area at each site.	Annual colony monitoring within social attraction sites: estimate of burrows, chicks, predation/loss, fledgling success.	KIUC will evaluate causes, notify USFWS and DOFAW, and meet/confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will develop an appropriate approach. Options may include modifying the broadcasted calls or other methods based on available information and technology.
Social attraction Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and	Demonstrate positive growth within each social attraction site during the portion of the permit term when social	One or more of the social attraction sites not meeting the projected amount of breeding pairs during the portion of the	Annual colony monitoring within social attraction sites: estimate of burrows, chicks,	KIUC will evaluate whether Metric 1 is being met, and if not, is it likely due to the social attraction sites not meeting the	KIUC will develop an appropriate approach. Options may include modifications to broadcasted calls or other methods based on available information and

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
Colonies at Conservation Sites	attraction is occurring.	permit term when social attraction is occurring and the total number of breeding pairs from all sites cumulatively are not meeting the targeted number of breeding pairs in Table 6A-3.	predation/loss, reproductive success.	projected amount of breeding pairs. If so, notify USFWS and DOFAW and meet and confer to determine whether modifications to management are needed at the social attraction sites. If needed, go to Step 2.	technology, or adding a new conservation site.
Predator control and invasive plant species control Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	Growth rate for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) breeding pairs annually of at least 1% to reach target breeding pairs for each year of the permit term.	Newell's shearwater (ʻaʻo) or Hawaiian petrel (ʻuaʻu) breeding pairs in any year is lower than Appendix 6A, Table 6A-3 or Table 6A-4.	Predator control monitoring and invasive species control monitoring.	Notify USFWS and DOFAW and meet and confer to determine if the trigger is due to predator control or invasive plant species issues and whether modifications to management are needed. If needed, go to Step 2.	KIUC will develop an appropriate approach. Options may include modifying predator control strategy, implementing additional invasive plant control, or other methods based on available information and technology.
Site occupancy Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites	At least four conservation sites will be occupied annually by breeding pairs for years 1–10 and at least 9 conservation sites occupied by breeding pairs or prospecting birds for remainder of the permit term by Newell's shearwater	Fewer conservation sites than specified are occupied annually by respective seabird species.	Burrow monitoring, call rates, and/or auditory surveys.	KIUC will evaluate causes, notify USFWS and DOFAW, and meet/confer to determine whether modifications to management are needed. If needed, go to Step 2.	KIUC will evaluate causes and develop an appropriate approach. Options may include modifying predator control strategy or other methods based on available information and technology, or adding a new conservation site.

Conservation Measure	Metric of Success	Adaptive Management Triggers	Monitoring Strategy	Adaptive Management Response Step 1	Adaptive Management Response Step 2
	(ʻaʻo), and at least six sites will be occupied annually by breeding pairs of Hawaiian petrel (ʻuaʻu).				

[a] A minimum sample size of 30 burrows is needed to reliably estimate reproductive success at each site separately for the purpose of an adaptive management trigger.

6.4.1 Powerline Strike Monitoring and Adaptive Management

6.4.1.1 Effectiveness Monitoring of Powerline Minimization

Biological Objectives 1.1, 2.1, 3.1, and 4.1 (Table 4-1) require that KIUC substantially reduce the extent and effect of collisions of covered seabirds and waterbirds in accordance with the location, extent, and schedule outlined in Chapter 4, Section 4.3, *Biological Goals and Objectives*. To meet these objectives, KIUC has been implementing powerline collision minimization projects (Conservation Measure 1) since 2020 as early implementation for the HCP.[20] While this reduces powerline collisions prior to finalization of the HCP, the measures will continue to be in place and continue to minimize powerline collisions throughout the HCP permit term. Also, replacement or repair of early implementation minimization measures such as bird diverters is a component of the HCP. Early implementation of minimization measures ensures that the measures are in place from day one after the HCP is in place and allows for the resulting benefits to be effective immediately at the time minimization is implemented.

KIUC monitors the effectiveness of powerline minimization by monitoring powerline strikes along existing powerlines before and after minimization projects are implemented. The goal of this monitoring is to verify and measure the reductions in covered species collisions, evaluating each modification span-by-span. Based on current strike reduction estimates (Travers et al. 2020), KIUC is expected to achieve a 66.4 percent reduction in covered seabird collisions from existing powerlines systemwide.[21] KIUC also expects to achieve a 90 percent reduction in powerline collisions of covered waterbirds (Shaw et al. 2021) using the techniques described under Chapter 4, Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*.

KIUC completed implementation of an extensive island-wide minimization plan on May 5, 2024. Minimization effectiveness monitoring will occur for 3 years after completion of minimization projects to account for annual and seasonal variation. As such, KIUC expects that effectiveness monitoring will be completed by the end of 2027.

All new powerlines will be monitored for 3 years post installation since minimization will be applied, as appropriate. However, KIUC cannot evaluate minimization effectiveness for new powerlines because there is no baseline (i.e., collision data prior to the installation of minimization techniques) against which to evaluate the percent strike reduction. As stated in Chapter 4, Section 4.4.1.2, *Future Transmission and Distribution Lines*, new powerlines will be installed in a way to reduce strike risk as much as practicable. KIUC is estimating reduction of strike risks on new lines by comparing previous powerline designs (vertical profile and static wire) that have no minimization to HCP new line design parameters (siting in low risk areas, horizontal configuration, no static wire and bird flight diverters to the extent practicable) with minimization. Using this method and based on strike and minimization data for existing powerlines, KIUC estimates 80 percent reduction in powerline collision risks on new lines for the covered seabirds based and a 90

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[20] Some minimization actions also happened before 2020, during KIUC's Short-Term HCP (2011–2016), as described in Chapter 4, Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*.

[21] KIUC is also estimated to achieve an 80 percent reduction in risk of powerline collisions associated with new powerlines installed during the permit term, compared with the level of risk that would occur without minimization, through a combination of sighting in low-risk areas, utilizing horizontal versus vertical configurations, no static wire and installing bird flight diverters, to the maximum extent practicable.

percent reduction for the covered waterbirds. These estimated strike reductions are assumed for the purpose of this HCP and cannot be included as a specific adaptive management trigger because there is no way to measure it during the permit term. However, KIUC's estimated amount of future powerline buildout (see Chapter 2, *Covered Activities*) is included in KIUC's population dynamics model, and therefore in the modeled future strike projections (Chapter 5, *Effects*). If KIUC's actual strikes are higher than predicted by the population dynamics model in any year based on a 5-year rolling average (and powerline strike reduction is determined to be the issue), KIUC will evaluate its entire powerline system, including new lines installed during implementation of the HCP to identify high strike zones and potential minimization measures to reduce strikes in those areas.

6.4.1.2 Take Monitoring of Powerline Strikes

KIUC will use acoustic sensors as described in Section 6.4.1.3, *Covered Seabirds Monitoring Protocol for Powerline Collisions*, and Section 6.4.1.4, *Covered Waterbird Monitoring Protocol for Powerline Collisions*, to continue monitoring the annual number of powerline collisions of the covered seabirds and waterbirds. Annual acoustic sensor data will be modeled through the Bayesian Acoustic Strike Model (Bayesian Model) (as described in Appendix 5C, *Bayesian Acoustic Strike Model*) and KIUC will compare those results with the strike projections from the population dynamics model for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) to confirm that the number of powerline collisions attributed to the covered seabirds is not higher than predicted, and therefore is not at risk of exceeding the take limit established in Chapter 5, *Effects*. The results of this comparison will trigger adaptive management if strikes are higher than predicted in any year, based on a 5-year rolling average (Appendix 6A, Tables 6A-1 and 6A-2).

The Bayesian Acoustic Strike Model will be applied to the data obtained through acoustic take monitoring to estimate annual powerline strikes during HCP implementation. During implementation, the processed acoustic data from powerline monitoring will be run through the Bayesian Acoustic Strike Model, which incorporates variables such as (i) potential geographic predictor variables such as mean slope of the landscape between adjacent poles and mean gradient of the landscape in the area surrounding the span, (ii) potential environmental variables such as mean annual windspeed within 328 feet (ft) (100 meters [m]) of the span, and (iii) potential structural predictor variables such as the number of wire layers and mean exposure. The rationale for variables included in the Bayesian Acoustic Strike Model is provided in Travers et al. (2020) in Appendix 5C, *Bayesian Acoustic Strike Model*. The resulting outputs are provided on a span-by-span basis.

Model parameters related to estimates in terms of partitioning collision numbers to species breakdown and different components of take (e.g., mortality versus injury) will be held constant to facilitate comparisons across years, and to evaluate whether biological goals and objectives are being met. New information may suggest that model assumptions should be adjusted. Any adjustments to model parameters must be mutually agreed to by KIUC, USFWS, and DOFAW and would be documented in the next annual report along with a justification for the change.

During the 50-year permit term, a new model may become available that estimates powerline collisions more accurately than the Bayesian Acoustic Strike Model available today. If mutually agreed to by KIUC, USFWS, and DOFAW that a new model is appropriate, KIUC will adopt this model for the remainder of the permit term.

Powerline strike monitoring will continue to be performed annually during HCP implementation for the duration of the permit term. However, the scope of the monitoring will be narrowed to the following high-risk locations once strike reduction monitoring is complete.

- Powerline Trail
- Mānā (Kekaha)
- Waimea Canyon Drive
- East Kīlauea
- Līhuʻe and Central Region

KIUC will sample spans in these locations that contain both minimized and unminimized spans to infer trends over its entire powerline system. KIUC specifically chose to minimize all locations in its powerline system with significant levels of take, and thus these areas will be the best indicator of whether take limits are likely to be exceeded. Areas within KIUC's powerline system that are unminimized are estimated to have low take; in many cases, these spans are estimated to have zero strikes.

Given that the high-risk locations contribute most of the collisions within KIUC's power grid, take estimates in these areas that exceed forecasts could lead to KIUC exceeding its take limit. In addition, because these areas have the most collisions, it is expected that any changes in these areas (whether negative or positive) will be the most apparent over time (i.e., the most quickly detectable). KIUC will track collisions at these spans annually during the permit term and implement adaptive management, if necessary. Trends at these high-risk locations may also result in adaptive management being implemented at non-monitored spans (e.g., if KIUC finds that light-emitting diodes [LEDs] are an issue at a high-risk span, they may implement adaptive management for LEDs systemwide).

As stated in Chapter 5, Section 5.4.2, *Effects Common to All Covered Waterbirds*, KIUC is requesting take of the covered waterbirds based on 37 percent of all KIUC powerline strikes recorded through acoustic monitoring along powerline spans in Mānā (spans 1–113) and Hanalei (spans 462–478 and 1297–1328), and for each species based on the proportion of strikes by species provided in Tables 5-13a and 5-13b (1 percent Hawaiian stilt [aeʻo] [*Himantopus mexicanus knudseni*], 9 percent Hawaiian duck [koloa maoli] [*Anas wyvilliana*], 2 percent Hawaiian coot [ʻalae keʻokeʻo] [*Fulica alai*], 2 percent Hawaiian common gallinule [ʻalae ʻula] [*Gallinula galeata sandvicensis*], 23 percent Hawaiian goose [nēnē] [*Branta sandvicensis*]). The number of strikes will be estimated annually during HCP implementation by applying the above percentages to acoustic data from the acoustic monitoring units at Mānā and Hanalei to the Bayesian Model.

KIUC may also choose to monitor additional powerline spans if needed to accomplish the following. In these cases, observational monitoring may also be employed, at the discretion of KIUC in coordination with USFWS and DOFAW.

- Estimate powerline collisions in areas where conditions have changed (e.g., new line installation, after line replacements due to weather events and other factors, large-scale tree felling, or tree growth leading to line shielding).
- Estimate powerline collisions before and after testing a new minimization approach.
- Document improved minimization beyond the commitments in the HCP and for the purposes of adaptive management (see Section 6.2.2, *Adaptive Management*).

- Confirm take and/or identify issues in other areas not identified above.
- The data will be applied to the 2020 Bayesian Model to verify that powerline collisions at these high-risk spans have not increased beyond what is forecast in the HCP. The modeling results will be included in the following year's Annual Report (see Chapter 7, *Plan Implementation*).

KIUC will determine if the number of collisions identified in the Bayesian Model is higher than predicted (Appendix 6A, *Adaptive Management Comparison Tables*, Tables 6A-1 and 6A-2) using a 5-year rolling average, according to the following timelines, as long as trends are as expected (or better than expected). The first evaluation will occur in Year 1 of the permit term.

- Annual for Years 1 to 10 of the permit term (10 years)
- Every 2 years for Years 10 to 20 (10 years), unless strikes are higher than predicted, in which case the adaptive management process identified in Table 6-3 would be triggered, and annual evaluations would be required until strikes were no longer higher than predicted using a 5-year rolling average.
- Every 5 years after Year 20 of the permit term unless strikes are higher than predicted, in which case the adaptive management process identified in Table 6-3 would be triggered, and annual evaluations would be required until strikes were no longer higher than predicted using a 5-year rolling average.

KIUC expects the annual number of strikes will not exceed KIUC's estimated average annual take (Chapter 5, *Effects*) due to significant early implementation of extensive minimization and monitoring prior to the start of the permit term, as well as a robust adaptive management process.

6.4.1.3 Covered Seabirds Monitoring Protocol for Powerline Collisions

Powerline collision monitoring[22] for covered seabirds during the permit term will serve the following purposes:

- Monitoring the effectiveness of minimization measures completed through May 5, 2024, by comparing pre-2020 strike data with post-May 5, 2024 strike data (3 years of monitoring, through 2027).
- Monitoring annual powerline collisions as described below and comparing with projected powerline collisions (based on 5-year rolling average) as shown in Appendix 6A, *Adaptive Management Comparison Tables*, to ensure take limits are not exceeded.

As stated in Chapter 5, *Effects*, KIUC based its island-wide strike estimate for the covered seabirds on a 2020 Bayesian acoustic strike model using data from 2013 to 2019 (Travers et al. 2020). In summary, the model is based on data gathered from acoustic sensors placed on power poles throughout the island to record powerline strikes. The sensors were either (1) placed at the base of power poles in quiet soundscapes (typically higher-elevation sites) or (2) mounted on the power pole just below the lowest transmission lines when the pole was near traffic sounds. The complete data collection methods of the Infrastructure Monitoring and Minimization Project can be found in Appendix 5C, *Bayesian Acoustic Strike Model,* and are summarized below.

[22] The Bayesian Acoustic Strike Model will be applied to the data obtained through powerline collision monitoring to estimate powerline strikes.

Using the results from the Bayesian acoustic strike model, KIUC began early implementation of powerline minimization projects in 2020, targeting high-strike powerline spans to reduce collisions. Following the completion of each powerline minimization project on existing powerlines, the modified spans are monitored for three full seabird seasons using the same sampling methodology described above. This data is used to update the Bayesian acoustic strike model to quantify the change in the number of strikes per span after minimization to determine the effectiveness of KIUC's minimization actions. The strike reduction for each modified span is summed for all the spans thus modified when the island-wide strike models are run to estimate the number of systemwide collisions experienced in any given year.

There are three types of acoustic monitoring (static, rover, and check) that have been used by KIUC since 2011. All three types of acoustic monitoring are used to collectively document the total number of strikes across KIUC's powerline systems and the strike reduction (i.e., effectiveness of minimization measures) for both existing and new powerlines[23].

- **Static Site Acoustic Monitoring.** This type of acoustic monitoring uses acoustic sensors that are maintained at the same location over the entire seabird season (March through December) and from year to year. Static site acoustic monitoring typically has two acoustic sensor units at each location; one for peak time (i.e., sunset to 3.5 hours after and 3.5 hours prior to sunrise to sunrise) recording and one for off-peak (i.e., gap in peak time) recording. The static locations are used to determine the seasonal and annual variation in seabird powerline collision and the increase or decrease in the strike rate. Static acoustic sensors must be put in high-strike locations (not random) to be able to detect seasonal and long-term patterns robustly.

  Static locations were originally selected to monitor areas with the highest strike rates based on rover site monitoring (see below). Once minimization is implemented by KIUC, the static locations will remain the same to determine the resulting strike reduction. If an area does not have static sites, then rover site acoustic monitoring is used to determine the strike reduction.

- **Rover Site Acoustic Monitoring.** Rover site acoustic monitoring uses acoustic sensors that are moved from location to location roughly every 30 days to ensure there is equal monitoring across KIUC's powerline system. They record strikes during the peak time (i.e., sunset to 3.5 hours after and 3.5 hours prior to sunrise to sunrise). This type of acoustic sensor is deployed based on random stratified design using vegetation height (exposure) and region of the island. Acoustic sensors are randomly assigned to spans, in proportion to the number of spans within each stratum. It ensures that there is sufficient and equal sampling across KIUC's entire system. This strategy ensures that acoustic sensors are sampling powerlines without human influence.

  Originally, rover site acoustic monitoring allowed KIUC to identify collision hot spots across its system, but now that those locations are known, this type of monitoring is KIUC's primary tool to determine the amount of strike reduction as a result of minimization. Each minimized section receives random stratified monitoring at a minimum of 25 percent spatial coverage for a minimum of 28 days.

  Rover site acoustic monitoring is always utilized following minimization, even if some static sites are present in the area. Up to 12 roving acoustic sensors will be operated at locations that have been minimized. Rover acoustic sensors will be operated between May 15 and September 15 and will be relocated monthly, for a total of up to 48 unique monitoring locations each year. The rover units will be placed at systematic randomly selected locations such that each of the

[23] All new powerlines will be acoustically monitored for three years after installation, regardless of location.

four types of minimization (i.e., reconfiguration, static wire, LED diverters, and reflective diverters), will be monitored.

- **Check Site Acoustic Monitoring.** Check site acoustic monitoring is predominantly random rover sites that previously detected strike sounds. Check units are deployed typically in the following season to resample the random rover site and record all night from sunset to sunrise (rather than during the peak period) to provide strike variation across the night and across seasons. Each minimized section receives at least one check site.

In addition, observational monitoring is concurrently employed for powerlines with acoustic monitoring devices using night vision. Observational surveys are used to estimate species-specific passage rates at elevations with powerline collision risk, and record seabird behavioral responses following each observed powerline interaction. The observational data is used to validate the acoustic monitoring system by (1) observing post-strike behavior to ascertain injury or mortality; and (2) determining if there are issues with the acoustic monitoring system (i.e., acoustic sensors) in terms of the numbers of strikes versus observations of birds in the vicinity of the recording devices.

To facilitate detection of nocturnal collisions and observe post-collision impacts, night vision goggles in combination with near-infrared illuminators are used to enhance the capabilities of night vision and facilitate better visual tracking of individual seabirds pre- and post-collision. When conducting the surveys, observers are positioned to monitor the wires between two power poles with their field of view oriented from the first pole to the second pole, ensuring that powerlines were always in their view. Monitoring begins near to or following astronomical twilight (i.e., full darkness), requiring the optical equipment described above. The surveys cover approximately 1.5- to 3-hour time windows, depending on location. Typically, each staff member conducts two surveys per night, totaling 4 to 5 hours a night of observations. The overall observation effort is focused during darkness and the varying light levels that occur at the edge of night. Most observations occur between 15 minutes prior to sunset and 15 minutes after sunrise, and as such most survey effort is concentrated in the 3-hour windows around sunset and sunrise.

Given that minimization on new powerlines will be employed at the time the new lines are installed, new powerlines will be monitored in the same ways as other minimized spans on existing lines within KIUC's powerline system, except that there will be no baseline (i.e., no unminimized data) against which to measure the strike reduction. KIUC will only be able to determine the number of strikes resulting from the span or spans with new, minimized powerlines, but there will be no estimate of the strike reduction (i.e., amount of change from an unminimized state).

6.4.1.4 Covered Waterbird Monitoring Protocol for Powerline Collisions

Waterbird monitoring also uses acoustic sensors and observations of waterbird movement to quantify powerline collisions before and after minimization and to estimate the change in total strikes as a result of minimization activities. Effectiveness monitoring for the covered waterbird species is similar to that conducted for the covered seabirds, except that the monitoring effort will be focused on KIUC's powerline spans with the greatest waterbird habitat and movement in the Plan Area (Mānā [spans 1–113] and Hanalei [spans 462–478 and 1297–1328]). For take monitoring, KIUC applies a constant value (see Chapter 5, Section 5.4.2, *Effects Common to All Covered Waterbirds*) to estimate the proportion of all bird strikes assumed to be covered waterbirds for the 113 spans in Mānā and the 49 spans in Hanalei where covered waterbirds predominantly occur. As of 2021, KIUC has been collecting data in Mānā to determine the effectiveness of bird flight diverters and transmission line removal implemented at that location.

6.4.1.5 Adaptive Management for Powerline Minimization

Based on the current strike reduction estimates and KIUC's pre-HCP minimization plan (Appendix 4B, *KIUC Minimization Projects*), KIUC expects to have reduced covered seabird strikes by 66.4 percent and covered waterbird strikes by 90 percent by May 5, 2024. KIUC will monitor the minimized spans for a 3-year period to assess whether these targets have been reached. KIUC will finish this 3-year period of minimization monitoring at the end of 2027, to evaluate its strike reduction as a result of minimization completed by May 5, 2024. Because KIUC has invested substantial effort into early implementation of powerline minimization, it can implement any necessary adaptive management changes very early in the permit term (as soon as 2027). If KIUC finds that the strike reduction for the covered seabirds is less than 66.4 percent or the strike reduction for the covered waterbirds is less than 90 percent, adaptive management will be triggered and KIUC will implement a response, in consultation with USFWS and DOFAW, as identified in Table 6-3.

KIUC will also implement adaptive management if they find that powerline collisions are higher than predicted in any year as identified in Appendix 6A, *Adaptive Management Comparison Tables*, Tables 6A-1 and 6A-2, based on a 5-year rolling average. KIUC will work in close collaboration with its contractors, USFWS, and DOFAW to determine the cause for increased collisions and identify possible solutions.

KIUC will follow the process outlined in Section 6.2.2.3, *Adaptive Management Decision-Making Process*, to determine the appropriate adaptive management response in close coordination with USFWS and DOFAW. The adaptive management response for covered seabirds and covered waterbirds is the same (i.e., additional minimization), although the trigger for waterbirds is based on the specific waterbird spans. Adaptive management changes for powerline collisions consist of implementing additional minimization to reduce the numbers of strikes in order to meet biological Objectives 1.1, 2.1, and 4.1 (Chapter 4, Section 4.3, *Biological Goals and Objectives*) and to limit the potential for exceedance of the permitted take limit (as described in Section 6.4.1.2, *Take Monitoring of Powerline Strikes*). Adaptive management changes for powerline strike minimization may include the following:

- Minimization on unminimized spans.
- Additional minimization on previously minimized spans (e.g., adding bird flight diverters on reconfigured spans).
- Novel minimization techniques that incorporate new technology.
- Replacing less effective techniques with those expected to result in greater strike reductions.

KIUC will work in conjunction with USFWS and DOFAW consistent with Section 6.2.2.3, *Adaptive Management Decision-Making Process*, regarding new strategies and technologies, as well as any changes (other than minor adjustments) to the monitoring protocols to measure powerlines collisions.

6.4.2 Light Attraction Monitoring and Adaptive Management

Biological Objectives 1.2, 2.2, and 3.2 require that KIUC minimize artificial light attraction on the covered seabird fledglings from all existing and future KIUC streetlights and existing covered facilities. KIUC will achieve this by continuing to implement practicable conservation measures through the permit term (Chapter 4, Section 4.4.2, *Conservation Measure 2. Implement Measures to Minimize Light Attraction*).

6.4.2.1 Effectiveness Monitoring for Light Attraction

Streetlights

As stated in Chapter 4, Section 4.3.1, *Newell's Shearwater (‘a‘o)*, KIUC, in partnership with the County of Kaua‘i and State of Hawai‘i, installed full-cutoff shields on all its streetlights within the Plan Area in 2017. Although KIUC owns and operates the streetlights, KIUC is not able to modify them without County and State approval. As stated above, biological Objectives 1.2, 2.2, and 3.2 require that KIUC continue to implement practicable conservation measures throughout the permit term. Accordingly, KIUC will maintain full-cutoff shields on all existing streetlights and install full-cutoff shields on all new streetlights throughout the permit term.

Effectiveness monitoring for KIUC streetlights is not needed to meet the biological objectives. Monitoring KIUC streetlights for light attraction of covered seabirds is not feasible or practicable given the wide distribution of streetlights across the island and their locations. In most cases, streetlights occur in areas with other (often many other) light sources from residences, vehicles, or commercial operations. In these cases, it is often impossible to determine if a seabird became grounded due to a KIUC streetlight or a non-KIUC light source nearby. KIUC streetlights in residential and more remote areas that are the only light source are often surrounded by private land for which access is often not possible. Full-cutoff shields on streetlights have been determined by KIUC, USFWS, and DOFAW, to be the best practicable minimization measure and for the purposes of this HCP are assumed to be effective. Full-cutoff shields direct all light toward the ground and minimize the amount of light directed outward or upward toward the sky which minimizes light visible to seabirds flying overhead. Chapter 4, Section 4.3.1, *Newell's Shearwater (‘a‘o)*, discusses the effectiveness of full-cutoff shields in more detail.

Covered Facilities

The number of grounded seabirds found at KIUC's covered facilities will determine the efficacy of Conservation Measure 2. *Implement Measures to Minimize Light Attraction*. KIUC monitors its covered facilities (Port Allen Generating Station and Kapaia Power Generating Station) according to the *KIUC Site Monitoring Protocols and Procedures for Protected Seabirds* (Appendix 6B). During the seabird fallout season (September 15–December 15), responsible KIUC staff at the covered facilities conduct twice daily dedicated searches targeted specifically at finding grounded seabirds—once 1 hour prior to sunrise and once 3 to 4 hours after sunset.

The following steps will be taken when any downed seabird is discovered alive, as described in Appendix 6B, *KIUC Site Monitoring Protocols and Procedures for Protected Seabirds*.

- At least one photograph will be taken of the scene showing the bird as it was found.
- The location where the seabird was found will be marked on a satellite image.
- KIUC staff will deploy the KIUC Oppenheimer Seabird Recovery Kit, put on protective gloves, carefully wrap the bird in the clean towel from the kit, and gently place it in the recovery box.
- The KIUC Seabird Recovery Reporting Form (Appendix 6B, *KIUC Site Monitoring Protocols and Procedures for Protected Seabirds*) will be completed.

- The bird will be placed in the nearest SOS Aid Station, and SOS will be called to report that the seabird has been placed there. KIUC staff will then ensure that the retrieved bird receives prompt attention by SOS staff or volunteers.
- Within 24 hours of finding a seabird, KIUC will inform USFWS and DOFAW via email and include the completed KIUC Seabird Recovery Reporting Form and information concerning the bird's disposition.

If a dead bird is found the protocol is similar except that KIUC staff must place the bird in the refrigerator in two plastic storage bags and contact SOS for retrieval. The KIUC Seabird Recovery Reporting Form (Appendix 6B, *KIUC Site Monitoring Protocols and Procedures for Protected Seabirds*) will be completed and USFWS and DOFAW will be contacted within 24 hours.

To determine the effectiveness of light attraction minimization at KIUC's covered facilities, KIUC will review the monitoring results from the previous year to determine how many seabirds were grounded with the implementation of KIUC's conservation actions. The results of the covered facility monitoring will also be included in KIUC's annual report (see Chapter 7, Section 7.7.1, *Annual Reporting*).

6.4.2.2 Take Monitoring for Light Attraction

Streetlights

Take of covered seabirds from KIUC streetlights was estimated based on inferences used in the light attraction model that is described in Appendix 5B, *Light Attraction Modeling for Covered Seabirds*. Because take from KIUC streetlights cannot be measured in the field, ongoing take from streetlight attraction will continue to be assumed throughout the permit term to be consistent with the model estimate.

Covered Facilities

The facility monitoring described under Section 6.4.2.1, *Effectiveness Monitoring for Light Attraction*, will allow KIUC to compare the number of covered seabirds found in the covered facilities during the permit term to the amount estimated in Tables 5-7 and 5-10. If take at both covered facilities combined is higher than estimated in the HCP as measured by a rolling 5-year average, KIUC will implement an adaptive management change as shown in Table 6-3.

Night Lighting for the Restoration of Power

As stated in Chapter 5, Section 5.3.1.3, *Light Attraction and Fallout—Methods*, subsection *Fallout from Night Lighting for Restoration of Power*, the take estimate for streetlights is conservative (i.e., likely overestimates take). Fallout during the seabird fledging season (September 15 to December 15) from lighting at temporary work areas is expected to be rare given that the lighting event is short in duration (typically 0.5 hour on average; see Chapter 2, Section 2.2.2, *Night Lighting for Repair of Facilities*). In addition, nighttime work is only associated with emergency power outages that happen in the evening hours. Based on these factors, the HCP assumes the operation of temporary lighting for restoring power does not change the overall estimated take of covered seabirds from light attraction. KIUC staff will search for grounded and circling seabirds within 0.1 mile (0.16 kilometer) of the construction site in accessible areas (e.g., public land) according to the same methodologies as the covered facilities (Appendix 6B, *KIUC Site Monitoring Protocols and*

Procedures for Protected Seabirds), except that only one search event will be performed following completion of the emergency work.

6.4.2.3 Adaptive Management for Light Attraction

As described above, KIUC will continue to implement practicable conservation measures related to covered streetlights throughout the permit term. Because KIUC is already implementing these streetlight minimization measures to the maximum extent practicable, no additional measures or adaptive management changes are required for streetlights. Adaptive management is triggered if KIUC finds that the number of grounded covered species in the two covered facilities combined in any year (as measured by a 5-year rolling average) is greater than what is expected at the covered facilities (see Chapter 5, Tables 5-7 and 5-10) (13 or more groundings of Newell's shearwater [ʻaʻo], and 1 or more grounding of Hawaiian petrel [ʻuaʻu] or band-rumped storm-petrel [ʻakēʻakē] [*Hydrobates castro*]). KIUC will follow the process outlined in Section 6.2.2, *Adaptive Management*, to determine the appropriate adaptive management response in close coordination with USFWS and DOFAW. The adaptive management trigger for take and effectiveness monitoring are the same (i.e., number of grounded birds), and they would result in the same response, depending on the cause. Adaptive management changes for light attraction at the covered facilities may include the following.

- Improved or more frequent training for KIUC facility staff to promptly attend to (i.e., improve detectability) and properly handle downed seabirds (i.e., improve survivorship).
- Reassessment of light intensity and light shielding at either or both covered facilities.
- Improved predator control at either or both covered facilities.
- Changing the light type if research shows a different light type is more bird-friendly.
- Novel technology to improve light shielding or otherwise further reduce light attraction.

For night lighting used for power restoration, KIUC will search for grounded birds at work sites and count birds found against its take limit. If KIUC finds that the number of grounded birds due to night lighting is significantly greater than anticipated and could result in KIUC exceeding its combined take estimate for light attraction (Chapter 5, *Effects*, Tables 5-7 and 5-10), KIUC will work with USFWS and DOFAW to find a solution. This may include, but is not limited to, increased minimization of facility lighting or of KIUC powerlines, if practicable (see Section 6.4.3, *SOS Program Monitoring and Adaptive Management*).

6.4.3 SOS Program Monitoring and Adaptive Management

6.4.3.1 Effectiveness Monitoring for SOS Program

KIUC is required to fund the rescue, rehabilitation, and release of the covered seabirds and the covered waterbirds through the SOS Program. Conservation Measure 3 requires KIUC to fund the SOS Program at $300,000 annually for the duration of the permit and license terms, adjusted annually for inflation increases, to treat covered seabirds and covered waterbirds that are provided to the facility. Funding of the SOS Program will be tracked as noted in Section 6.2.1.1, *Compliance Monitoring.* SOS staff funded through Conservation Measure 3 are required to have the qualifications stipulated in Chapter 4, Section 4.4.3.1, *SOS Staff Qualifications*, to ensure an effective standard of rehabilitation services.

The SOS Program is based on opportunistic findings of grounded birds by the public and volunteers. As such, there are no monitoring protocols for this program. To determine the effectiveness of KIUC's funding of the program, KIUC will review and evaluate the SOS Program annual report, which is submitted to KIUC each spring for the previous calendar year. Through the SOS annual report and by closely coordinating with SOS Program staff, KIUC will track the number of covered seabirds and covered waterbirds that are handled by SOS each year. KIUC will review data on the numbers of rescues and releases of covered seabirds and covered waterbirds to compare the results with previous years, which will inform adaptive management. The assumption is that KIUC's funding of the SOS Program during HCP implementation (see Chapter 7, *Plan Implementation*, for funding commitments) will be sufficient for SOS to handle at least the average amount of covered seabirds and covered waterbirds (based on data from 2022–2024, Table 6-4) and some small amount of increase during the HCP permit term. However, the HCP also acknowledges that significant increases in the number of covered seabirds and covered waterbirds handled by SOS could necessitate increased funding beyond the funding commitment of the HCP. Annual assessments of the SOS Program will inform adaptive management, as described below (see Section 6.4.3.2, *Adaptive Management for SOS Program*). In addition, the results of the SOS Program relevant to the covered species will be included in KIUC's Annual Report (see Chapter 7, Section 7.7.1, *Annual Reporting*).

Table 6-4. Average Number of Covered Species Rehabilitated by the SOS Program

Year	Number of Covered Seabirds[a,b]	Number of Covered Waterbirds[a,b]
2022	169	105
2023	188	107
2024	131	141
3-Year Average	163	118

[a] Totals do not include birds dead on arrival.
[b] Source: Bache 2023, 2024, 2025.

6.4.3.2 Adaptive Management for SOS Program

As described in Section 6.4.3.1, *Effectiveness Monitoring for SOS Program*, KIUC will evaluate the SOS Program's annual reports and coordinate with SOS Program staff. If for 3 years in a row the number of individuals of the covered species turned in to SOS increases by 10 percent or greater as compared to the previous 3-year average, adaptive management will be triggered. KIUC will coordinate with SOS, USFWS, and DOFAW to identify the reason for the change and determine whether the current level of SOS funding is sufficient to process the increased level of covered seabirds and waterbirds coming to SOS. If it is determined that the current level of SOS funding is not sufficient to rehabilitate the increased number of individuals of covered species, KIUC will increase its level of funding by 50 percent of the increase in covered species.[24] Additionally, if the number of birds turned in later drops back to the 3-year historic average (Table 6-4), KIUC will consult with SOS, USFWS, and DOFAW to determine if funding can be reduced back to the original level.

[24] For example, a 10 percent increase in covered species turned in to SOS = a 5 percent increase in KIUC funding; a 20 percent increase in covered species turned in to SOS = a 10 percent increase in KIUC funding.

6.4.4 Conservation Site Monitoring and Adaptive Management

6.4.4.1 Effectiveness Monitoring at the Conservation Sites

KIUC will continue to use the same monitoring protocols that have been used and refined for more than 10 years through the Short-Term HCP and early implementation of this HCP to evaluate management effectiveness at the conservation sites to meet the above biological objectives. Each of the following sections describes how KIUC will monitor and collect data from the conservation sites that will allow them to determine the effectiveness of site management. This, in turn, will allow KIUC to determine when biological Objectives 1.3 and 2.3 are met.

Monitor Status of Covered Seabird Colonies in the Conservation Sites

KIUC will monitor the covered seabird colonies within the 12 conservation sites annually according to the monitoring protocols in the following sections. The purpose of this monitoring is to ensure that the number of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) breeding pairs and new fledglings produced annually are increasing, as described in Objective 1.3 for Newell's shearwater (ʻaʻo) and Objective 2.3 for Hawaiian petrel (ʻuaʻu). KIUC will conduct six types of monitoring at each relevant conservation site, each of which is described below:

- Burrow monitoring
- Call rate monitoring
- Auditory surveys
- Social attraction monitoring
- Invasive plant monitoring[25]
- Predator monitoring

Specifically, KIUC will determine whether the conservation sites are collectively achieving the desired metrics under Objective 1.3 and Objective 2.3, which are repeated below. For each metric, the relevant monitoring method is bolded.

- Metric 1. Meet the minimum target breeding pairs defined in Tables 6A-3 and 6A-4 (lists the minimum breeding pairs per year), as determined by population estimates derived through **auditory surveys, acoustic surveys, and burrow monitoring** for the combined sites.
- Metric 2. Growth rate for breeding pairs annually of at least 1 percent for both Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu). Absolute numerical growth rate cannot be measured directly but will be inferred from data collection at the conservation sites and determined by using a 5-year rolling average.
- Metric 3. Maintain a 5-year rolling average 87.2 percent reproductive success rate for Newell's shearwater (ʻaʻo) and 78.7 percent reproductive success rate for Hawaiian petrel (ʻuaʻu), as measured through **burrow monitoring**.

[25] Invasive species plant management will be continual at the four social attraction sites and at Upper Limahuli Preserve. At the other conservation sites invasive plant species control will be performed on an as-needed basis, as described in Chapter 4, *Conservation Strategy*, Section 4.4.4.2, *Management Actions.*

- Metric 4. For Newell's shearwater (ʻaʻo) only as there is no social attraction for Hawaiian petrel (ʻuaʻu). Eradication of any terrestrial predators within predator exclusion fencing within one year of fence construction completion, and prior to initiating social attraction, as determined based on use of camera traps, burrow monitoring cameras, and opportunistic observations of predator signs (**predator monitoring, burrow monitoring**). Eradication may need to occur again as a result of a fence breach.
- Metric 5. Produce at least one Newell's shearwater (ʻaʻo) breeding pair within each of the four social attraction sites, as determined based on **burrow monitoring**, by year 5 after the completion of predator eradication within the fenced area at each site (**social attraction monitoring**).
- Metric 6 in Objective 1.3 for Newell's shearwater (ʻaʻo) and Metric 4 in Objective 2.3 for Hawaiian petrel (ʻuaʻu). Ensure that invasive plant and animal species do not preclude meeting the objective metrics above. If metrics 1, 2, and 3 as determined from **auditory surveys, call rates and burrow monitoring** are all successfully being met, this metric is being met as well.
- Metric 7 in Objective 1.3 for Newell's shearwater (ʻaʻo) and Metric 5 in Objective 2.3 for Hawaiian petrel (ʻuaʻu). At least four conservation sites will be occupied annually by breeding pairs for years 1 through 10 and at least nine conservation sites occupied by breeding pairs or prosecting birds for remainder of the permit term by Newell's shearwater (ʻaʻo), and at least six conservation sites will be occupied by Hawaiian petrel (ʻuaʻu) breeding pairs annually, as measured by **burrow monitoring**, **call rates**, and/or **auditory surveys**.

The monitoring protocols described below were developed by Raine and Travers and is the current method used to document and monitor the covered seabird colonies (Archipelago Research and Conservation 2022).

Burrow Monitoring

Burrows identified as those of either Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) will be monitored at each of the 12 conservation sites to evaluate the effectiveness of the management actions at meeting metrics 1 through 6 above. In addition, burrows with unidentified seabirds will also be monitored. Burrow monitoring will track the nesting outcomes (i.e., reproductive success). A subset of up to 30 burrows[26] at each conservation site will be monitored using cameras that support documentation of breeding probability and success, and predation events (which is relevant to metrics 3 and 6).

Eight seabird monitoring visits are conducted annually at each conservation site based on the following schedule, which has been refined over the last decade by Raine et al. The schedule is somewhat flexible each breeding season by necessity due to logistical considerations and weather conditions.

- February (prior to covered species arrival)—Remote wildlife cameras and acoustic sensors deployed for the season.
- April (covered species arrival)—Burrow checks, equipment maintenance.
- June (incubation)—Burrow checks, equipment maintenance.

[26] A minimum sample size of 30 burrows is needed to reliably estimate reproductive success at each site separately for the purpose of an adaptive management trigger.

- July (chicks hatching)—Auditory surveys
- August (early chick rearing)—Burrow checks, equipment maintenance.
- October (beginning of Newell's shearwater [ʻaʻo] fledging)—Burrow checks, equipment maintenance.
- November (end of Newell's shearwater [ʻaʻo] fledging, beginning of Hawaiian petrel [ʻuaʻu] fledging)—Burrow checks, equipment maintenance.
- December (end of Hawaiian petrel [ʻuaʻu] fledging)—Final burrow checks, remove remote wildlife cameras.

Each previously located burrow has been marked with a unique identification tag[27] and its location recorded using a handheld global positioning system (GPS) unit. Wherever possible, each burrow had also been identified to species, although in some cases where nest chambers are too convoluted to see the bird, the species is listed as 'UNPE-Unidentified Procellariid' until species confirmation is possible.

Searches are also undertaken to locate new nest sites and new nesting areas within each management area. Searches in each management area employ two methods:

- Evening and dawn auditory surveys supplemented with night-vision equipment, during which birds are observed in flight and their burrow location estimated by where they landed. Those areas were then searched.
- Diurnal cold searches, during which personnel actively search the vegetation for nest sites in areas identified as having high levels of seabird activity, particularly ground activity indicative of breeding birds, during recent auditory surveys.

During burrow checks, each burrow is inspected to assess breeding status. For deep burrows where direct visual inspection is not possible, a hand-held camera is used to take photos into the back of the burrow. At all times, care is taken to minimize damage to surrounding vegetation and burrow structure.

During each burrow check, data is collected via specially designed apps to record the following signs of activity within or around the nest.

- The presence of adult, egg, or chick
- Scent, signs of digging or trampling
- Presence of feathers, guano, or eggshell

A note is also made as to whether it was possible to see to the back of the burrow (e.g., was the burrow fully inspected, or was there a possibility that something was missed). Any signs of depredation (e.g., a dead adult or chick in front of burrow or inside burrow, chewed feathers or egg) or the presence of scat/droppings/prints that indicate a predator has been in the vicinity of the nest are also recorded. In instances where a seabird carcass is located, it is photographed, collected, and removed for further inspection. Data collected on depredations include a GPS point, the species of predator involved (if known), and species and age of the bird that has been depredated.

[27] Red-colored cattle tags with black numbering for all burrows in Hono O Nā Pali Natural Area Reserve and orange-colored cattle tags with black numbering for all burrows in Upper Limahuli Preserve are currently used. Types of tags and colors may change over the course of the permit term.

At the end of the season, a final status is assigned to each nest using the following categories.

- Active, breeding confirmed, success—Breeding was confirmed as having been initiated during the season through the presence of (i) an adult during the day in June or July, apparently incubating, (ii) an egg, (iii) down, or (iv) chick. Nest successfully fledged a chick. As the site is remote and not visited regularly enough to see the chick fledge, a successful fledging is considered in the following scenario: A chick was confirmed in burrow up until typical fledging month (October for Newell's shearwater ['a'o], November/early December for Hawaiian petrel ['ua'u]) and on the following check the presence of small amounts of down outside the nest site indicate that the chick was active outside the burrow and subsequently fledged. No signs of depredation or predator presence were noted. Burrows with cameras provide information on exact fledging date and time.
- Active, breeding confirmed, failure—Breeding was confirmed as having been initiated during the season through the presence of (i) an adult during the day in June or July, apparently incubating, (ii) an egg, (iii) down, or (iv) chick. Nest did not fledge a chick. The failure stage (egg or chick) and cause of failure (e.g., depredation of chick or egg, abandonment, depredation of breeding adult) is recorded where known. Burrows with cameras can provide information on depredation events and predator visitations pertinent to nest failure.
- Active, breeding confirmed, outcome unknown—Breeding was confirmed as having been initiated during the season through the presence of (i) an adult during the day in June or July, apparently incubating, (ii) an egg, (iii) down, or (iv) chick. Breeding was confirmed at the site; however, no subsequent visits were made, no visits were made late enough in the season to confirm fledging, or signs were inconclusive. A very small number of burrows fit into this category as every effort is made to assess the final status of all burrows.
- Active, unknown—The presence of an adult bird, or signs of an adult bird (e.g., guano, feathers, trampling) indicate that a bird was present during the breeding season, but it was not possible to confirm whether breeding occurred and failed or breeding was never initiated. Either way no chick fledged. Situations like this arise in instances where (i) it was not possible to examine the back of the nesting chamber due to the structure of the burrow or (ii) the burrow is discovered late in the breeding season and, as it was not monitored during the egg-laying period, it is not clear if breeding had been initiated.
- Active, not productive—The presence of an adult bird, or signs of an adult bird (e.g., guano, feathers, trampling) indicate that a bird was present during the breeding season, but burrow inspections reveal that no breeding took place (i.e., no egg was ever laid).
- Active, prospecting—Bird(s) recorded visiting nest, but signs are indicative that these are prospecting and not breeding birds. Examples would be new excavations within a previously inactive burrow, a single visit during the breeding season to a previously inactive burrow, a visit to a burrow where both adults had been confirmed killed the year before, or the preliminary excavation of a burrow-like structure combined with the confirmed presence of a seabird.
- Inactive—No sign (e.g., bird presence, feathers, guano, digging) that the burrow has been visited in that breeding season.
- Status unknown—There was no way to assess what had happened in the burrow during the year (i.e., burrow found at the end of the season with seabird sign but no indication of what happened, or burrow monitored at points during the season but breeding status and outcome unknown).

- Did not monitor—Burrow not checked at all in the year (due to safety reasons, or they could not be located in the following monitoring season).

During colony monitoring visits, surveyors continue to look for any sign of breeding activity (e.g., guano, feathers, scent). If any sign is noticed the surveyors search the area for new burrows. Newly identified burrows are then included in future burrow monitoring efforts as outlined above. The addition of new burrows to the overall colony monitoring effort provides a larger sample size to assess breeding probability and breeding success, as well as the impact of introduced predators (which cannot be adequately assessed if only a small number of burrows in a restricted area of the site are monitored). Ultimately, the number of burrows known within each conservation site is used to understand the minimum number of breeding pairs present within each management site, as well as being one of the factors needed in the estimation of site-specific population estimates.

Incidences of depredation (or signs of introduced predators) either at known nesting burrows or along trails are also recorded when they are observed during trips to each area, with locations logged using a handheld GPS. Any depredated seabird bodies or predator scat/pellets are photographed *in situ* and then bagged and removed for further analysis if necessary (i.e., if the cause of depredation is not immediately apparent). If scat is located, it is subsequently examined for the presence of seabird feathers/bones indicative of a depredation event. When instances of depredation or fresh predator sign are recorded, the appropriate predator control team (depending on the conservation site) is notified immediately to ensure that predator control efforts occur in the area as soon as possible to minimize further depredation events. This is particularly important for barn owl, feral pig, and feral cat sightings, as these predators can cause significant damage to the colony in a relatively short time and need to be removed before they become established.

A subset of up to 30 burrows are monitored at each site by remote wildlife cameras[28] each month from March to December, with the exact number depending upon availability of camera units and the number of burrows that are active. These cameras are mounted on poles located 3 to 5 feet (0.9 to 1.5 meters) away from the burrow entrance, with the camera pointed directly at the burrow mouth. Cameras are set on a "rapidfire" setting (motion sensor activated, with a trigger speed of ≤ 1.5 seconds), and are tested at the time of deployment and during battery changes to ensure that the camera would fire when something moved in front of the burrow mouth. These camera stations are useful in identifying individual feral cats to help inform predator control staff whether there is more than one animal in the area and/or the key areas in which the individual animal is concentrating its hunting activities.

Memory cards used to record photographs are switched out on each visit to minimize risk of data loss. Batteries are replaced as needed to ensure continuous coverage over the season. Data cards are reviewed while in the field to assess activity levels and presence/absence of seabird predators at the burrow. If any predator is observed, monitoring personnel inform predator control personnel as soon as possible.

If a burrow fails during the season or the chick successfully fledged, then the camera is moved to a new active burrow on the next check, with burrows chosen based on ease of camera placement and field of view. At each check, data are collected via specially designed apps to record battery power, percentage of memory card storage usage, and whether there are any issues with the unit. If a camera is malfunctioning in the field, it is brought back to the office and sent back to the

[28] Current model used is the Reconyx Hyperfire HP2X. Other similar models may be used in the future.

manufacturer for repair; where possible, defective cameras are replaced immediately in the field with a functioning unit.

Call Rate Monitoring

Call rate monitoring is undertaken using acoustic sensors.[29] Call rate monitoring using acoustic sensors is a critical tool for evaluating trends in abundance. Call rates for both Newell's shearwater ('a'o) and Hawaiian petrel ('ua'u) are significantly correlated to the number of breeding birds in an area (Raine et al. 2019). Therefore, estimating the change in call rates allows researchers to assess whether the colony is responding to management actions (Raine et al. 2023). This approach allows a larger scale of assessment of management that is not possible through burrow monitoring alone. Acoustic sensors in conjunction with burrow monitoring data will be used to evaluate the effectiveness of the management actions at meeting metrics 1, 2, 5, and 6 above.

Acoustic sensors are attached to poles and elevated 1 foot (0.3 meter) above the ground. One acoustic sensor will be placed at each of the previously established static monitoring points (14 static units deployed at Upper Limahuli Preserve, 10 each at Pōhākea, Hanakāpi'ai, Hanakoa, North Bog, Honopū, and Pihea, and 8 units at Upper Mānoa Valley) at each of the conservation sites. Annual monitoring since 2015 has demonstrated that the number and distribution of acoustic sensors at the conservation sites is sufficient to correlate call rates with the number of breeding birds and detect changes in call rates to allow researchers to assess whether the colony in its entirety is responding to management actions (Raine et al. 2023). Permanent static locations were selected such that sensor microphones were sheltered from prevailing winds and were well away from moving vegetation such as branches, grasses, or ferns.

Five months of data are collected annually between May and September to cover both the recruitment phase (May to early June) and incubation through early chick rearing (June to September). Five months of data collection allows for a more robust analysis by reducing the potential impact of data loss due to weather or malfunctioning equipment (units are maintained, and thus problems are detected, once per month). Five months also covers the peak vocal period for the two target species.

Acoustic sensors are powered by batteries and recordings are stored on memory cards. All sensors are fitted with two omnidirectional microphones that have water repellent applied to them to improve waterproofing. Microphones are arrayed horizontally to the ground and one on each unit had an additional wind screen installed over it. All units also have plastic rain guards erected above them to help waterproof the units.

The acoustic sensors record on two channels at a sampling rate of 22 kilohertz and are programmed to record 1 minute out of every 5 minutes for 5 hours after sunset, and 1 minute out of every 10 minutes for 5 hours before sunrise. Acoustic sensor recordings will be analyzed for (a) first arrival dates, and (b) calling rates during the recruitment stage and breeding stage (5 months: May through September). Acoustic sensors will be analyzed to detect call rates of Newell's shearwater ('a'o), Hawaiian petrel ('ua'u), and barn owls.[30]

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[29] Acoustic sensor data are currently analyzed by an outside vendor, Conservation Metrics, Inc., although this may change in the future.

[30] Band-rumped storm-petrels ('akē'akē) are not included because they do not breed in the conservation sites, with the exception of Honopū PF where band-rumped storm-petrels ('akē'akē) may breed in the future due to social attraction efforts at that site. If this occurs, breeding will be monitored through burrow monitoring.

At each check, data are collected via specially designed apps to record memory card percentage and functionality of the two microphones. SD cards and batteries were also swapped out regularly (memory cards on every visit and batteries every two visits). If a microphone is malfunctioning, it is immediately replaced with a new microphone in the field. Even if both microphones are functioning properly, one is switched with a new microphone to decrease the likelihood of microphone failure. Habitat, topography, and vegetation data are also collected on the iPad Mini around all deployed acoustic sensors the first year the units are deployed.

It is possible that call rate saturation may occur during the 50-year permit term if the number of covered birds increases within the conservation sites more quickly than is predicted in the worse-case trend modeled scenario. If call rate saturation occurs, it would not be possible to detect trends in calls rates. The Population Dynamic Model worst case scenario projects that both species will increase at the conservation sites at a 1 percent annual growth rate. If call rate saturation does occur, it is expected to happen much later in the permit term because call rates would need to exceed 30 calls per minute[31] on average at each conservation site. If growth at the conservation sites exceeds the projected 1 percent growth rate and call rate saturation becomes a possibility within the permit term, it would be addressed through adaptive management. KIUC would work with USFWS, DOFAW, and the colony monitoring team when estimated populations indicate call rate saturation may become an issue and prior to reaching call rate saturation to adjust or revise the monitoring protocol to ensure that call rate saturation does not affect data collection necessary to determine the effectiveness of KIUC's management with the conservation sites to meet Objectives 1.3 and 2.3.

Call rate monitoring is also used to track abundance trends along Nā Pali Coast outside of the KIUC conservation sites where numerous covered seabirds nest in cliffs. Call rate monitoring is currently the only feasible method of monitoring the covered seabirds nesting in this remote area. KIUC started funding call rate monitoring along the Nā Pali Coast in 2022. Starting in 2023 acoustic sensors have been deployed annually at 18 to 20 sites stretching across the Nā Pali Coast. KIUC will continue to fund long-term systematic call rate monitoring in this area during the permit term for the purpose of tracking abundance trends of the colonies nesting along the cliffs on the shoreline.

Auditory Surveys

While call rate monitoring uses acoustic sensors installed at the sites to measure call rates, auditory surveys involve biologists visiting each of the sites and listening for seabird calls. An auditory survey will be undertaken at each of the conservation sites in July of each year, following standardized survey protocol as described in Raine et al. (2024:Section 2.3.2). Data from auditory surveys will be used to develop population estimates and to inform seabird distribution mapping (metric 1). Data from auditory surveys will also help surveyors to locate new burrow clusters.

The focus of each survey will be dependent on management priorities (e.g., attempting to locate new Newell's shearwater [ʻaʻo] breeding sites, updating auditory survey polygons to assess population size changes and assisting with real-time barn owl monitoring). Data collected on barn owl activity during the auditory surveys is also passed on to predator control teams to help inform predator control operations.

Auditory surveys are not conducted during the week of the full moon, as birds are not vocal during full moon nights. During auditory survey trips, surveys are undertaken in the evening and the early

[31] In 2021, calls per minute were lowest at Pihea (6.13 calls/min) and highest at Upper Limahuli Preserve (17.59 calls/min) (Archipelago Research and Conservation 2022).

morning, which are the peak periods of seabird movement to and from the sea and breeding colonies. Evening surveys start at sunset and last for 2 hours. Morning surveys start 2 hours before dawn and last for 1.5 hours.

Surveys are split into 30-minute sessions, with 5 minutes allotted for the collection of weather data, 25 minutes for auditory surveying, and 5 to 10 minutes for concurrent night vision. Surveyors record all seabird calls (classified as a single unbroken note or series of notes) heard during the survey period and any bird actually seen during each period (either by eye or through night-vision equipment). For each record, data are collected on time of observation, species, direction from observer, distance from observer, and the behavior of bird (with particular attention paid to circling behavior and ground-calling).

At the end of the survey trip, observers create polygons on maps of the survey area identifying where seabird activity is recorded. These are categorized using detections such as the following.

- Birds in transient flight between inland nesting areas and the sea.
- Birds circling to gain altitude before flying further inland or out toward the sea.
- Birds persistently circling and calling within a restricted area over an extended period.
- Birds calling from the ground.

Detections are then translated into polygons on the maps (where applicable), which are defined as hotspot-heavy and hotspot-light. Hotspot-heavy and hotspot-light are defined as polygons where there is aerial calling activity only, with heavy denoting localized aerial activity with continuous calling and light denoting localized aerial activity (i.e., sporadic calling). Hotspot-heavy and ground-calling polygons are the best indicators of actual breeding activity in any given area. These polygons and the definition of the polygons have been the standard protocol since endangered seabird surveys started on Kauaʻi in 2006 and as such are directly comparable with each other across years.

All ground-calling locations are individually recorded on a map in the field and later added to ArcGIS. Ground-calling locations are those where birds are confirmed calling from the ground (as opposed to from the air), as this is indicative of breeding activity and is arguably the most important record of seabird activity in any area. At the end of the season, ground-calling locations from auditory surveys in all years are combined. Any locations that are within 82 ft (25 m) of each other are removed (to be conservative, as they may have related to the same bird and this helped prevent double counting) as well as any ground-calling locations within 82 ft (25 m) of a known burrow. All others are included on the distribution maps.

Social Attraction Monitoring

Social attraction monitoring is the primary means of determining the effectiveness of the social attraction management action and whether metric 5 in Objective 1.3 is met. Social attraction monitoring will be a combination of burrow monitoring and auditory surveys conducted at each social attraction site. Burrow monitoring will be used to determine the number of burrows occupied, the number of burrows with breeding pairs, the number of chicks fledged and reproductive success rates. This information will inform whether metric 5 is met as well as informing the growth in breeding pairs over time at the social attraction site (metric 1). However, this information cannot be used as a direct measure of growth rate at the social attraction site. Auditory surveys conducted at social attraction sites will inform the level of seabird activity at the site and help locate new natural burrows through pinpointing ground calling. Monitoring the level of seabird activity through auditory surveys will be particularly helpful in the early years of social attraction because it will provide a gauge on the level of interest and attraction to the site. Auditory surveys conducted at social attraction sites will also be used to assess whether the social attraction sound system is properly working, and to identify the presence of barn owls at the site that will help inform predator control efforts.

Burrow monitoring at the social attraction sites will involve the contents of all artificial burrows (and any identified natural burrows) within the predator exclusion fence being checked during the monthly trips to each social attraction site to document and record any seabird sign at each burrow. Data collected will be the same as that collected at natural burrows at other conservation sites and will be used to document the presence of breeding pairs, eggs and chicks as well as any other seabird sign (i.e. guano, feathers) at each burrow.

Twenty cameras will also be used to monitor a subset of the artificial burrow entrances and trails within the social attraction site. Camera data will be used to document burrow occupancy, as well as the presence of predators, should they occur within a fenced area. At the beginning of the season, cameras are deployed on the entrances of artificial burrows and natural burrows (once located) that are deemed most likely to have seabird activity (these include burrows where activity was recorded in previous years and burrows near the social attraction speakers) or areas where a well-positioned camera could cover multiple burrow entrances. As the season progresses, cameras will be moved from non-active burrows to any burrow where seabird activity is noted (e.g., presence of guano, feathers, nest material).

Additional Monitoring Activities

In addition to the activities outlined above, during each monitoring trip the following activities will also be performed.

- Data will be collected on any sign of predators (e.g., rats, cats, pigs, barn owls) or predation events (e.g., a dead covered seabird or predator-damaged eggs). In instances where a seabird carcass is located, it will be photographed, collected, and removed for further inspection. If possible, the age of the carcass will be determined.[32] Breeding status of predated adults will also be assessed by looking for evidence of a brood patch.
- Monitoring staff will immediately contact the predator control team to coordinate efforts to locate and remove the predator when (a) a fresh predation event is found; (b) fresh sign of cats, dogs, or barn owl activity is observed; or (c) cats, dogs or barn owls are observed on photographs captured by burrow monitoring cameras.
- If time allows, searches will also be undertaken to locate new burrows and new breeding areas within the conservation sites. Any new burrows found will be tagged and incorporated into the burrow monitoring program unless, as described above, burrow abundance exceeds monitoring capacity, in which case the survey team will design their burrow monitoring to represent the spatial distribution of the targeted population using a subset of burrows, rather than monitoring each burrow. If possible, staff will note any banded birds occupying monitored burrows or otherwise being present at the sites. If any birds are observed on camera or by direct observation to be banded, personnel will attempt to document the band number if it does not interfere with the bird's safety or the day's work plan.

[32] Age can be determined generally by the wear of primary and secondary feathers and evidence of sun bleaching on the wing coverts or head feathers.

- If HCP field teams note the spread or prevalence of invasive plant species in the field they will alert KIUC's vegetation control team, who will address this issue through the provisions of Conservation Measure 4. The potential spread of invasive plants at the social attraction sites is monitored visually by the vegetation control team through regularly occurring trips to each site. Monitoring of invasive plants at all sites occurs incidentally during other activities at the conservation site (e.g., colony monitoring, predator control). There is no specific monitoring protocol or adaptive management triggers for invasive plant species included in this HCP. However, adaptive management responses related to the conservation sites and the covered seabird breeding pairs will evaluate invasive plant species as one possible cause of reduced success.

This additional monitoring activity will be used to help determine if the management actions have been effective at meeting the metrics for biological Objectives 1.3 and 2.3 for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu), and to provide more information on actions that may or may not be contributing to not meeting the metrics, if that occurs, and to inform appropriate adaptive management responses.

Kauaʻi metapopulation trends of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) will be evaluated by updating the population dynamics model (Appendix 5D, *Population Dynamics Model for Newell's Shearwater (ʻaʻo) on Kauaʻi*) utilizing annual monitoring data from all conservation sites, the Nā Pali Coast, and radar surveys (conducted by DOFAW).

Model parameters other than the performance at the conservation sites will be held constant to facilitate comparisons across years and to assess progress towards meeting biological Objectives 1.3 and 2.3. However, new information may suggest that model assumptions should be adjusted. Any adjustments to model parameters must be mutually agreed to by KIUC, USFWS, and DOFAW and be documented in the next annual report along with a justification for the change.

During the 50-year permit term, a new model may become available that estimates Kauaʻi metapopulation trends of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) more accurately than the population dynamics model available today. If mutually agreed to by KIUC, USFWS, and DOFAW that a new model is appropriate, KIUC will adopt this model for the remainder of the permit term.

Monitoring of the conservation sites will continue annually, according to the monitoring protocols above, throughout the permit term.

Evaluate the Effectiveness of Predator Control in the Conservation Sites

KIUC has been funding monitoring for the presence of pigs, cats, mice, rats, and barn owls in many of the conservation sites since 2011. Biological Objectives 1.3 and 2.3 require that invasive animal species do not preclude meeting the other metrics related to covered seabird population abundance and population growth in the conservation sites. Predator monitoring at each conservation site, outside of areas with predator exclusion fencing, will consist of the following measures.

- Operate up to 10 camera traps (game cameras) at locations chosen to give a breadth of spatial coverage at each conservation site. The images will be reviewed every 4 to 6 weeks for evidence of predators.
- Review burrow monitoring camera (up to 30 at each site) images every 4 to 6 weeks for evidence of predators.

- Opportunistically observe predator signs (e.g., carcasses, sightings, tracks, scat, fur, wallows) while working in the colonies on other tasks. Any predated seabird bodies or predator scat/pellets will be photographed *in situ* and then bagged and removed for further analysis if necessary. If scat is located, it will be subsequently examined for the presence of seabird feathers indicative of a predation event. Locations of predator evidence will be logged using a handheld GPS and observations recorded.
- Record the location, number, and species of predators trapped or otherwise removed.

For areas within predator exclusion fencing, once the terrestrial predator exclusion fences are complete and predators are eradicated from Upper Limahuli Preserve PF, Upper Mānoa Valley PF, Pōhākea PF, and Honopū PF (as determined by monitoring, using the above protocol), predator monitoring at those sites will be modified as follows.

- The trail camera traps (up to 10 at each site[33]) will be repositioned to selectively monitor the fenced area (Chapter 4, Section 4.4.4.2, *Management Actions*), weatherports, helicopter landing zones, and other areas suspected to be or confirmed to be areas where predator incursions are more likely to occur or be detected. The fence perimeter will be monitored with cameras inside the fence.
- Perimeter walks will occur on a monthly interval and any damage to the fence will be immediately reported and addressed. Monitoring of the fenceline will include searching for any signs of barn owl use or presence.

The results of the monitoring outlined above will be used throughout the year to make minor adjustments to the predator control efforts and methods to be as effective and efficient as possible (Section 6.2.2.1, *Minor Adjustments vs. Adaptive Management*). The effectiveness of predator control and the trigger for adaptive management will be determined based on the outcomes for the covered species metrics under Objectives 1.3 and 2.3. For example, if the number of Newell's shearwaters (ʻaʻo) or Hawaiian petrels (ʻuaʻu) is below the number of breeding pairs projected in any year, KIUC would evaluate the cause, which would include an evaluation of the predator control program to determine its effectiveness. Similar evaluations would occur for growth rates and reproductive success rates if those metrics of success are not achieved (Table 6-3).

The following data, collected by the predator control team, will be used to adaptively refine and adjust predator management in the conservation sites (Pias and Dutcher 2020).

- Average daily animal removal rates (animals removed per trap per day) by species and conservation site examined across all trap types per year.
- Number of animals (by species) captured by trap type.
- Presence of animals (by species) detected at camera locations by site.
- Number of individual cats by site.
- Daily and monthly modeled probability (i.e., likelihood) of animal presence (by species) by site and year.
- Change in call rate of barn owls at each site, as measured using acoustic monitoring.

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[33] Determined by predator control experts to be a sufficient minimum number to cover all major trails and movement corridors within each conservation site (Pias and Dutcher 2021).

Additional data collection methods may be added in the future if predator control techniques or technology changes.

Monitoring to assess whether predators are being controlled at the conservation sites as intended will serve as the effectiveness monitoring for band-rumped storm-petrel (ʻakēʻakē, Objective 3.4). If predator control is occurring at the conservation sites, and the breeding pair numbers, growth rate, and reproductive success rates for the other covered seabirds are met, Objective 3.4 is assumed to be met. Any minor adjustments or adaptive management changes to predator control for the other covered seabird species is assumed to benefit band-rumped storm-petrel (ʻakēʻakē).

6.4.4.2 Take Monitoring at the Conservation Sites

Conservation site management actions may result in take of covered seabirds and two of the covered waterbirds, with the primary cause being predator trapping. Predator traps will be monitored as described in Section 6.4.4.1, *Effectiveness Monitoring at the Conservation Sites*, and any covered birds injured or killed in predator traps will be detected during trap monitoring and reported to USFWS and DOFAW within 24 hours of detection, see Appendix 4C, *Protocols for Seabird Trap Interactions at Conservation Sites*. A written report will be delivered to USFWS and DOFAW within 1 week of the detection and will include date of incident, species, photos of the bird *in situ*, type of trap and location (GPS coordinates), condition of bird, and actions taken. This information will also be included in annual reports. Onsite evaluations by trained staff will determine the condition of the birds, and birds found to not be in good condition will be delivered to SOS for rehabilitation as soon as possible. Table 6-3 includes adaptive management triggers and responses associated with the results of this take monitoring.

6.4.4.3 Adaptive Management for the Conservation Sites

The conservation measures proposed in the conservation sites have been implemented and refined for over 10 years and have proven to be highly effective at reducing the abundance of predators and increasing the abundance of the covered seabirds within the conservation sites (Raine et al. 2020). As such, KIUC does not expect that the conservation measures within the conservation sites will require significant refinement during the permit term.

As stated in Chapter 5, Section 5.3.2, *Requested Take and Effects on Newell's Shearwater (ʻaʻo)*, and Section 5.3.3, *Requested Take and Effects on Hawaiian Petrel (ʻuaʻu)*, the data analysis and modeling used to estimate adverse, beneficial, and net effects on these species required the application of assumptions that in some cases have a high level of uncertainty. KIUC addressed this uncertainty, in part, by using conservative assumptions that err on the side of likely overestimating adverse effects on the species and likely underestimating the benefits. Despite these assumptions, adaptive management at the conservation sites will be necessary if the biological objectives are not likely to be met.

Specific adaptive management triggers have been developed for each conservation site or combinations of conservation sites that are relevant to either Newell's shearwater (ʻaʻo) or Hawaiian petrel (ʻuaʻu). These adaptive management triggers were designed with the following goals and constraints in mind:

- Each trigger serves as an early warning to detect potential performance problems at individual conservation sites.
- Utilize metrics that are measured annually in the field at each conservation site.

- Utilize measures such as rolling averages that "smooth" out annual variability but still allow annual assessments of performance.

With these concepts in mind, adaptive management would be triggered if any of the criteria listed in Table 6-3 (metrics associated with Objectives 1.3 and 2.3) are not met.

Appendix 6A, *Adaptive Management Comparison Tables*, Tables 6A-3 and 6A-4, provide projected annual rolling averages for the Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) breeding pair growth at all conservation sites combined during the 50-year permit term, using the outputs from the population dynamics models worst case modeling scenario. These tables will be used on an annual basis during the permit term to evaluate whether the covered seabird populations in the conservation sites collectively are on track to meeting or exceeding the biological goals and objectives or are underperforming (in which case adaptive management would be triggered, as stated above).

In another example, early warning triggers are established in Table 6-3 for reproductive success rates for Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) at each of the conservation sites where they consistently occur. Site-specific adaptive management triggers are defined for each conservation site that take into account the expected average reproductive success at each site needed to achieve the reproductive success rate across all sites combined (i.e., Metric 3 in biological objectives 1.3 and 2.3).

If any of the triggers listed in Table 6-3 occur, an adaptive management change will be triggered. KIUC will follow the process outlined in Section 6.2.2, *Adaptive Management*, and Table 6-3 to determine the appropriate adaptive management responses in close coordination with and in agreement from USFWS and DOFAW. Adaptive management changes at the conservation sites may include, but are not limited to, the following.

- Alter the timing, intensity, or type of predator control.
- Increase the number of conservation sites or install additional predator exclusion fencing.
- Increase the number, type, location, or attraction methods for social attraction sites.
- Initiate social attraction within predator exclusion fences for Hawaiian petrel (ʻuaʻu).
- At Upper Limahuli Preserve, cat-proofing the existing ungulate exclusion fence.

These options are in addition to minor adjustments that are made on a regular basis and do not require coordination with USFWS or DOFAW, such as moving predator trap locations or altering the timing, location, intensity or methods for invasive plant control (Section 6.2.2.1, *Minor Adjustments vs. Adaptive Management*. If adaptive management changes in the conservation sites prove ineffective or infeasible, KIUC may choose to enhance or expand minimization measures to further reduce take of the covered species (i.e., increase strike reduction beyond 66.4 percent).

6.4.5 Green Sea Turtle (honu) Monitoring and Adaptive Management

6.4.5.1 Effectiveness Monitoring for Green Sea Turtle (honu)

The effectiveness of the green sea turtle (honu) nest detection and shielding program will be evaluated based on the outcomes of the annual monitoring program described under Conservation

Measure 5, *Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program*, described in Chapter 4, *Conservation Strategy*. The goal of the green sea turtle (honu) monitoring program is to detect nests and determine the outcome of shielded nests. At the start of each season, the monitoring program initially would be focused on detecting nests and documenting those locations. Once nests were detected, the monitoring program would endeavor to have monitors present at or near the time of emergence to verify shielding is effective at preventing (or substantially reducing) light disorientation of hatchlings. If any hatchlings are disoriented due to KIUC streetlights, this could indicate that the temporary light shields are not as effective as assumed in this HCP. Please see Chapter 4, Section 4.4.5, *Conservation Measure 5. Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program*, for the green sea turtle (honu) monitoring requirements for the KIUC HCP.

6.4.5.2 Take Monitoring for Green Sea Turtle (honu)

Minimization of green sea turtle (honu) hatchling disorientation will require systematic, intensive surveys that not only locate active nests but also document the fate of every green sea turtle (honu) nest that has the potential to be affected by KIUC streetlights. Take of green sea turtle (honu) nests for the KIUC HCP is defined as a nest (documented or undocumented by the monitoring program) with at least one hatchling disoriented by KIUC streetlights. As described in Chapter 4, Section 4.4.5, *Conservation Measure 5. Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program*, the green sea turtle (honu) monitoring program consists of drone surveys, a monitoring program, and shielding the nest with shade cloth fencing. This monitoring approach has been adapted from the Kauaʻi Seabird HCP (State of Hawaiʻi Division of Forestry and Wildlife 2020). The complete monitoring methods can be found in the conservation measure in Section 4.4.5, *Conservation Measure 5. Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program*.

6.4.5.3 Adaptive Management for Green Sea Turtle (honu)

The KIUC HCP assumes that the nest detection and nest shielding program will be highly effective. As a result, very few green sea turtle (honu) hatchlings are expected to be disoriented during the 50-year permit term. As such, the KIUC HCP estimates that no more than one nest will be taken per year. To ensure that this goal is achieved, if there is more than one green sea turtle (honu) nest taken in any year or any hatchlings in an undocumented nest are taken due to KIUC streetlight attraction, adaptive management will be triggered (Table 6-3). If a nest is taken at the start of the nesting season, KIUC will implement adaptive management changes to prevent further take for the remainder of the nesting season if practicable. Otherwise, adaptive management changes will be implemented during the next green sea turtle (honu) nesting season. KIUC will follow the process outlined in Section 6.2.2, *Adaptive Management*, and Table 6-3 to determine the appropriate adaptive management change in close coordination with USFWS, DOFAW, and DAR.

KIUC will begin the adaptive management process by investigating the conditions that may have led to the hatchling disorientation, evaluating the following factors.

- Was the beach monitored by drone or on foot?
- Was the nest located during monitoring?
- Was the nest shielded?
- Was the shielding effective at preventing hatchling disorientation?
- Were monitors present at the time of nest hatching?

- Were there any other factors that may have contributed to the taking?

Depending on the answers to these questions, KIUC's adaptive management response will address the specific issue that occurred. For example, if the nest was not located during monitoring, KIUC may need to increase the monitoring frequency, change the monitoring methods, or may need to increase the number of beaches that are monitored on foot. If the issue was that the shielding was not effective, KIUC may need to change the type of shielding material, shield height, or add additional protective mechanisms (e.g., fences around the shields). If the shield was vandalized, KIUC may need to have the monitor visit the shielded nest more frequently prior to hatching.

If take occurs, KIUC will email USFWS, DOFAW, and DAR as soon as possible with the details of the event. KIUC will solicit input from USFWS, DOFAW, and DAR, on possible adaptive management responses according to the procedure described in Section 6.2.2, *Adaptive Management*. KIUC will also describe in the Annual Report the taking and any adaptive management changes implemented.

Minor Changes to Avoid Impacts on Hawaiian Monk Seal

KIUC will coordinate with Kaua'i DAR, the National Oceanic and Atmospheric Administration, and USFWS as outlined in Chapter 4, *Conservation Strategy*, to avoid affecting Hawaiian monk seals ('ilio holo i ka uaua) (*Neomonachus schauinslandi*) present and/or pupping on beaches where the green sea turtle (honu) nest detection and shielding program will be implemented and a green sea turtle nest is located within 50 ft of a monk seal adult and within 150 ft of a monk seal mother and pup. Coordination and avoidance measures that occur for this purpose will be summarized in annual reports. Minor adjustments may be made to the green sea turtle (honu) nest detection and shielding program through these coordinated efforts, but these minor changes are not expected to trigger adaptive management or impact effectiveness or take monitoring.

6.4.6 Adjusting Monitoring Methods

KIUC's current monitoring efforts are considered the best available science (Chapter 5, *Effects*). However, monitoring methodologies are constantly evolving and becoming more effective and efficient with new technologies. Hence, improved monitoring methodologies (e.g., better microphones, improved vibration sensors, enhanced analysis software) are expected to become available. KIUC will utilize new technology to the maximum extent practicable and may adopt them into its program under the following circumstances.

- Species experts believe that the newer technology provides more accurate or more reliable results that can be integrated into the pre-existing dataset.
- Data obtained through the updated technology is sufficiently compatible with that collected in earlier years of the monitoring program to allow long-term trend analysis.
- The improved technology does not substantially increase the cost of the monitoring.

KIUC will make changes to monitoring methods after discussing them with USFWS and DOFAW and gaining their concurrence on the proposed change.[34]

[34] KIUC will seek input from DAR on any desired modifications to monitoring methods for green sea turtle (honu).

Chapter 7
Plan Implementation

Chapter 7 Highlights

Chapter Purpose: This chapter describes the responsibilities of the parties involved in implementing the HCP; changed and unforeseen circumstances for which state and federal regulatory assurances are requested; and the estimated cost and funding assurances to implement the HCP. This chapter also includes the process to revise or amend the HCP and the requirements to report on implementation progress annually.

Context: Changed circumstances are described based on the environmental setting (Chapter 3, *Environmental Setting*), conservation measures described in the conservation strategy (Chapter 4, *Conservation Strategy*), and forecasts of climate change effects on extreme weather events. Plan costs are estimated based on the actions described in the conservation strategy (Chapter 4), changed circumstances, and monitoring and adaptive management program (Chapter 6, *Monitoring and Adaptive Management Program*).

Major Conclusions:	**See the following for more information:**
• **Implementation responsibilities.** KIUC is solely responsible for implementing the HCP. USFWS and State of Hawaiʻi Department of Land and Natural Resources (DLNR) will support HCP implementation by reviewing annual reports and participating in the adaptive management process. ESRC has special responsibility to review annual reports and provide recommendations for adaptive management.	Section 7.2
• **Regulatory assurances and changed circumstances.** USFWS and DLNR will provide No Surprises assurances to KIUC as long as KIUC addresses the changed circumstances forecasted by the HCP: severe weather and effects of climate change, new invasive species, disease outbreak in covered species, vandalism, population declines due to issues at sea, or listing of new species.	Section 7.3
• **HCP costs.** The HCP is estimated to cost $431 million over 50 years, or an average of $8.6 million annually in 2024 dollars. Expected costs are relatively consistent over the permit term but are expected to increase due to inflation.	Section 7.4, Table 7-3 (Cost Summary)
• **HCP funding assurances.** KIUC commits to fully funding the HCP through a combination of its annual operating budget and capital funding through debt financing or lines of credit. KIUC has requested from the Hawaiʻi Public Utilities Commission a rate increase to cover HCP operational costs. KIUC would also provide a funding guarantee for remedial actions and adaptive management actions through a letter of credit issued by a third-party organization, that can be drawn upon if KIUC does not meet its financial obligations.	Section 7.5, Table 7-8 (Funding Sources)
• **Revisions and amendments.** The HCP includes procedures to adjust the HCP in the case of minor changes and to formally amend the plan and permits in the event of more substantive changes.	Section 7.6
• **Annual and other reporting.** The HCP includes a list of the required contents and data for the annual report that will be submitted by a target date of July 1 for the previous calendar year. The HCP also lists other reporting necessary upon specific events occurring.	Section 7.7

- **Data Sources:** Forecasts of changes in frequency of extreme weather events came from downscaled global climate models from the National Aeronautics and Space Administration. To address a high level of uncertainty in these models, an ensemble of models was used with two scenarios of future greenhouse gas emissions. Data for cost estimating came from KIUC's early HCP implementation actions for all conservation measures, except for green sea turtle (honu), and from the long-term monitoring already in place. The cost estimate to implement the green sea turtle (honu) conservation measure, in the absence of enough volunteers, was based on estimates from technical experts and costs incurred by other agencies.

7.1 Overview

This chapter describes how KIUC will implement the HCP. The chapter describes the following implementation topics.

- Implementation structure of the HCP, including the responsibilities of KIUC, U.S. Fish and Wildlife Service (USFWS), and the State of Hawaiʻi Division of Forestry and Wildlife (DOFAW) (Section 7.2, *Implementation Responsibilities*).
- Regulatory assurances requested for this HCP under the federal Endangered Species Act (ESA) and Hawaiʻi Revised Statutes (HRS) (Section 7.3, *Regulatory Assurances*).
- Estimated costs of HCP implementation (Section 7.4, *Costs of KIUC HCP Implementation*) funding assurances (Section 7.5, *Funding Assurances*).
- The process to revise or amend the HCP during implementation (Section 7.6, *Revisions and Amendments*).
- Requirements for annual reporting to USFWS and DOFAW (Section 7.7, *Reporting*).

7.2 Implementation Responsibilities

This section describes the implementation responsibilities of KIUC as the permittee and the responsibilities of USFWS and DOFAW in supporting and overseeing HCP implementation.

7.2.1 Responsibilities of Kauaʻi Island Utility Cooperative

The KIUC Board will approve and adopt the HCP after the Public Draft HCP has been released for public review and after a final HCP has been prepared in response to those public comments. After the KIUC Board adopts the HCP, USFWS will determine whether to issue the federal incidental take permit (ITP) and the Board of Land and Natural Resources (BLNR) will decide whether to issue the state incidental take license (ITL). Immediately following the first issuance (either the ITP or the ITL), KIUC would fully undertake HCP implementation. KIUC has been conducting early implementation during the HCP preparation phase and in transition from the Short-Term HCP to this HCP. Management actions that have already been implemented for many years will continue (e.g., conservation site management and monitoring). Additionally, some new conservation measures and management actions will be implemented as a part of this HCP. A KIUC HCP Program Manager will be responsible for day-to-day administration and implementation of the KIUC HCP during the 50-year permit term, including acting as the compliance monitor. KIUC will be responsible for implementing the conservation strategy (Chapter 4, *Conservation Strategy*) to achieve the biological goals and objectives of the HCP. KIUC will implement all the actions described in the HCP, including the following.

- Implementing the HCP conservation measures.
- Implementing the monitoring and adaptive management program.
- Providing oversight and coordination of HCP administration of program funding and resources.
- Preparing annual reports, work plans, and budgets.

- Fulfillment of compliance monitoring, effectiveness monitoring, and HCP reporting requirements.

A summary of all HCP commitments and their timing is provided in Table 7-1.

The following sections describe how KIUC will implement the HCP. Some of these job functions may be performed by KIUC staff. KIUC will also hire contractors to provide many services under the direction and oversight of the HCP Program Manager. As the sole permittee, KIUC is ultimately responsible for the implementation of all HCP conservation measures and other commitments. The HCP Program Manager will be responsible for tracking the status of HCP implementation and documenting implementation of the conservation measures as described in Chapter 4, including required methods and timing.

7.2.1.1 Conservation Measures and Monitoring Actions

KIUC will implement all the conservation measures described in Chapter 4, *Conservation Strategy*, and the monitoring and adaptive management actions described in Chapter 6, *Monitoring and Adaptive Management Program*. KIUC is also responsible for monitoring for changed circumstances identified in Section 7.3.1, *Changed Circumstances*, that might arise. If any changed circumstances do arise, KIUC must follow the procedures outlined in this chapter to identify and implement the appropriate remedial measure to address the specific changed circumstance.

7.2.1.2 Oversight and Coordination

KIUC is responsible for executing the requirements of the HCP, the federal ITP, and state ITL. Implementation tasks include support of permanent and seasonal administrative and technical staff who will be responsible for overseeing and ensuring the day to-day tasks of implementing the HCP "on the ground." Implementation tasks will also address activities such as managing program funding and resources, ensuring minimization actions are implemented according to the location and schedule identified in the HCP, maintaining a database of relevant information, tracking impacts and conservation, and reporting all relevant information to USFWS, DOFAW, and DAR[1] annually (Section 7.7.1, *Annual Reporting*).

KIUC will also prepare an Annual Work Plan to identify ongoing and project-specific actions for the following year. Each year KIUC will develop a budget that is sufficient to meet all KIUC HCP, federal ITP, and state ITL obligations and a schedule for HCP implementation and assign staffing responsibilities using the cost estimate (Section 7.4, *Costs of KIUC HCP Implementation*) and schedule (Chapter 6, Table 6-1) identified in this HCP. All of the HCP conservation measures will be implemented as described in the HCP (unless USFWS and DOFAW approve, in writing, a reduced frequency during the permit term) to achieve the HCP biological objectives. The specific techniques that will be used to implement the conservation measures are described in Chapter 4, *Conservation Strategy*. These techniques may change based on HCP monitoring results, adaptive management (see Chapter 6, *Monitoring and Adaptive Management Program*), and changed circumstances, which could have budget and schedule implications.

[1] DAR has jurisdiction over the green sea turtle (honu).

Table 7-1. HCP Commitments and Timing

Commitment	Timing	Section
Minimize Powerline Collisions for Covered Seabirds and Waterbirds.		
Various minimization methods will be used singularly or in combination including reconfiguration projects, removing static wire, and/or adding bird flight diverters on powerlines. An extensive minimization plan has been completed as of May 2024, but minimization will be employed throughout the permit term on all new lines and on existing lines as appropriate and applicable based on monitoring and adaptive management.	Installation of new lines and whenever triggered	4.4.1
All new transmission and distribution lines on Kauaʻi with collision risks will be minimized by applying the standards listed in Section 4.4.1.2. Examples include not installing any new static wire, minimizing powerline height, and installing new lines in a horizontal plane.	Whenever triggered	4.4.1.2
KIUC will notify USFWS and DOFAW of new powerlines proposed in a specifically defined area of northwestern Kauaʻi called the *Area of Additional Conservation Commitments* (see Figure 4E-1 in Appendix 4E) and subject to the review criteria in Appendix 4E. USFWS and DOFAW will review and approve the new powerlines proposed in this specifically defined area to ensure that new powerlines will not inhibit the ability of the HCP to achieve the biological goals and objectives.	Whenever triggered	4.4.1.2 and Appendix 4E
Minimize Light Attraction for Seabirds		
Minimization of light attraction from streetlights. Full-cutoff shielded fixtures will be utilized on new lights when installed.	Whenever new lights are installed	4.4.2
KIUC will notify USFWS and DOFAW of any new streetlights proposed in a specifically defined area of northwestern Kauaʻi called the *Area of Additional Conservation Commitments* (see Figure 4E-1 in Appendix 4E). USFWS and DOFAW will review and approve any new streetlights proposed in this specifically defined area to ensure that new streetlights will not inhibit the ability of the HCP to achieve the biological goals and objectives.	Whenever triggered	4.4.2.1 and Appendix 4E
Minimization of light attraction at KIUC facilities. Exterior lighting at Port Allen Generating Station will be dimmed during the fledgling fallout.	Annually from Sept. 15 to Dec. 15	4.4.2.2
Minimization of light attraction at KIUC facilities. Interior building lights at covered facilities will be turned off at night or shades/blinds drawn during the fledgling fallout season.	Annually from Sept. 15 to Dec. 15	4.4.2.2
Minimization of light attraction at KIUC facilities. The ongoing annual seabird training program will be conducted prior to the start of the seabird fallout period (September 15) using the KIUC Site Monitoring Protocols and Procedures for Protected Seabirds (Appendix 6B, *KIUC Site Monitoring Protocols and Procedures for Protected Seabirds*).	Annually prior to Sept. 15	4.4.2.4
Minimization of light attraction at KIUC facilities. A formal predator control program will not be implemented at KIUC's covered facilities. Rather, KIUC staff will maintain rodent traps on a consistent basis to remove rats and mice, and KIUC staff will trap and remove on an as-needed basis feral cats and dogs observed within the fenced facilities and transfer them to a suitable animal shelter or sanctuary.	Annually from Sept. 15 to Dec. 15	4.4.2.5
Minimization of light attraction from nighttime repairs restoring power outages. Searches for grounded birds will be conducted after the work is	Annually from Sept. 15 to Dec. 15	4.4.2.3

Commitment	Timing	Section
completed according to the same protocol used at the covered facilities (Section 4.4.2.2, *Covered Facility Lights*).		
SOS for Covered Seabirds and Waterbirds		
SOS funding. Starting the first year of the permit term, KIUC will fund the SOS Program at $300,000 annually for the duration of the permit term. This amount will increase annually to account for inflation.	Annually	4.4.3
SOS outreach. KIUC will continue to conduct its own public outreach and education in coordination with the SOS Program.	Ongoing	4.4.3.2
Conservation Sites for Covered Seabirds		
KIUC will implement management actions at 12 conservation sites, of which four are social attraction sites, to increase the abundance and reproductive success of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) breeding colonies, and to benefit band-rumped storm-petrel (ʻakēʻakē) occurring in the region.	Ongoing	4.4.4.1
Predator control. Intensive monitoring and predator control will be conducted at the conservation sites to remove cats, ungulates, rats, barn owls, and feral bees.	Ongoing	4.4.4.2
Predator exclusion fencing. At two sites (Upper Limahuli Preserve PF and Upper Mānoa Valley PF), predator exclusion fences will be constructed, terrestrial predators will be eradicated, invasive plants will be removed and replaced with native vegetation conducive to suitable seabird habitat as appropriate, and artificial burrows and social attraction equipment will be installed.	By March 2027 at ULP PF, and by March 2029 at UMV PF	4.4.4.2
Predator exclusion fencing. At four sites, in cases of a fence breach or damage, rapid response will be initiated to repair the fence breach or damage and to eradicate terrestrial predators within the fenced area in order to remove any predators that may have entered the breach and to re-establish predator-free habitat.	When triggered	4.4.4.2
Predator exclusion fencing. The condition of the predator exclusion fencing at four sites will be maintained and segments of the predator exclusion fencing will be replaced and/or repaired as needed during the permit term.	As needed	4.4.4.2
Invasive vegetation control. Invasive vegetation management focused on the list of species in Appendix 4D, *Best Management Practices for Invasive Plant Species Control*, will be conducted at the four social attraction sites (including a 30-foot perimeter around the outside of the predator exclusion fences). Invasive vegetation control will occur in the other conservation sites on an as-needed basis, when observed and documented during monitoring and determined to be spreading or otherwise problematic for seabird habitat suitability (Chapter 6, *Monitoring and Adaptive Management Program*).	Ongoing	4.4.4.2
Minimization of impacts on covered seabirds. For management actions that have the potential to affect the covered seabirds such as construction of predator exclusion fencing, the timing will be outside of the breeding season unless it is determined it will not disturb a breeding colony. For management actions that have the potential to affect the covered seabirds, and that need to occur during the breeding season such as cat trapping and invasive vegetation control, protocols will be used to minimize the risk of impacts.	Ongoing	4.4.4.2

Commitment	Timing	Section
Green Sea Turtle (honu)	**Annually**	**4.4.5**
A nest detection and shielding program will minimize and offset the effects of light attraction from KIUC streetlights on green sea turtle (honu). This conservation measure will be implemented throughout the permit term until KIUC modifies all the streetlights potentially affecting nesting green sea turtle (honu) habitat to eliminate these effects.	Annually	4.4.5
On an annual basis, all beaches in the Plan Area with suitable green sea turtle (honu) nesting habitat and KIUC streetlights will be surveyed to identify locations where KIUC streetlights are visible from the surface of the beach. Once identified, nest detection surveys will be conducted in those locations between May 15 and December 15.	Annually	4.4.5.1
Active green sea turtle (honu) nests on beaches with any potential of light impacts from KIUC streetlights will be shielded using light-proof fences. These will be erected around the nest after approximately 45 days of incubation and removed after the green sea turtle (honu) hatchlings have emerged and entered the ocean.	Annually	4.4.5.2
The nests identified through annual nest detection surveys will be monitored until the hatchlings emerge. Evidence of emergence and take (if any occurs) will be reported to USFWS, DOFAW, and DAR within 24 hours.	Annually	4.4.5.3
All staff, and volunteers if any, of the nest detection and shielding program will be required to complete annual training 1 month prior to the start of the green sea turtle (honu) nesting season, provided by USFWS or DAR, or trainers approved by USFWS and DAR.	Annually	4.4.5.5
A standardized data collection form will be developed for use during green sea turtle (honu) monitoring that will ensure that all necessary information is collected by green sea turtle (honu) monitors, so that it can be reported accurately in the Annual Report.	First year of program	4.4.5.5
Additional minimization of streetlights, will be explored to the extent practicable and agreed to by the County and State. KIUC will work with the County and State to determine the range of available practicable minimization measures and their timeline for implementation. All KIUC streetlight modifications require County and State agreement prior to implementation.	Ongoing	4.4.6
If new locations are identified where beach conditions change that expose additional green sea turtle (honu) nesting habitat to light from streetlights, light minimization techniques will be installed on those non-minimized streetlights as soon as practicable (and if practicable based on the site-specific considerations), regardless of historic or current green sea turtle (honu) nesting activity.	As needed	4.4.6.1

7.2.1.3 Budget Administration

KIUC will develop, propose, and administer budgets for general plan administration. Specific responsibilities will include developing and monitoring budgets, processing invoices, managing financial reserves, identifying cost savings, and managing administrative contracts (e.g., liability insurance). KIUC is governed by a nine-member board. KIUC Board approval will be required for the HCP. KIUC Board approval will also be required for the Annual Work Plans and the associated estimated HCP budget as part of their annual operational budget approval process. KIUC will establish processes to ensure timely implementation and proper oversight of annual budgets and related HCP expenditures. Notwithstanding KIUC's internal budgeting process, the failure of KIUC to

(1) fund expenditures necessary to fully comply with HCP, federal ITP, or state ITL requirements, or (2) maintain financial assurance mechanisms required by this HCP, federal ITP, or state ITL, may result in suspension or termination of the federal ITP or state ITL.

7.2.1.4 Data Maintenance

KIUC will collect, store, and use the relevant data necessary to analyze and report on HCP implementation. KIUC will work with its implementation partners to collect relevant data, compile it, and synthesize it to satisfy the reporting requirements of the HCP described in Section 7.7.1, *Annual Reporting*. KIUC will maintain the data to track compliance as well as monitoring and adaptive management programs. KIUC will use the data to summarize take and conservation by year and cumulatively, as well as track the spatial location of take, management actions, and monitoring to demonstrate progress of meeting the HCP biological goals and objectives (see Section 7.7.1, *Annual Reporting*, for details). KIUC may also hire contractors to provide these functions. Data will be made accessible to USFWS and DOFAW.

7.2.1.5 Consultants and Contractors

KIUC will retain consultants to meet any technical, scientific, or other staffing needs that cannot be effectively or efficiently addressed through in-house staff. It is expected that KIUC will use consultants more heavily for administrative tasks during the early stages of HCP implementation, becoming less necessary as KIUC develops systems and processes for HCP implementation. It is expected that consultants and contractors will be used throughout the life of the HCP for management and monitoring of the covered species.

7.2.2 Responsibilities of U.S. Fish and Wildlife Service

Consistent with its authority and responsibilities under the applicable federal law, USFWS will have responsibility to monitor and ensure compliance with the terms and conditions of the federal ITP and HCP. Specifically, USFWS will, without limitation, have responsibility during HCP implementation to do the following.

- Review and verify HCP Annual Reports submitted by KIUC for completeness and compliance (see Section 7.7.1, *Annual Reporting*, for Annual Report requirements) and to determine whether KIUC is making progress towards achieving the biological goals and objectives of the HCP and implementing all applicable requirements of the HCP and any ITP terms and conditions.
- After consultation with DOFAW and the Endangered Species Recovery Committee (ESRC),[2] make recommendations to KIUC regarding adaptive management changes according to the adaptive management process described in Chapter 6, Section 6.2.2, *Adaptive Management*.
- Receive and review reports from KIUC regarding observations of injury or mortality of the covered species.
- Review and verify monitoring reports provided by KIUC.

[2] USFWS is also a member of the ESRC.

- Participate in periodic HCP coordination meetings with KIUC and DOFAW as necessary to stay informed about HCP implementation and to provide technical advice to KIUC, as necessary or requested.
- Visit mitigation sites and KIUC facilities as needed to observe the progress and results of HCP conservation measures, which will be coordinated with the KIUC HCP Program Manager.
- Coordinate with the KIUC HCP Program Manager and DOFAW regarding any potential compliance issues and work cooperatively to resolve these issues. If compliance issues cannot be resolved, take enforcement action as necessary and appropriate.
- Provide technical assistance if KIUC requests a minor modification or major amendment to the HCP (see Section 7.6, *Revisions and Amendments*, for details on these procedures).

7.2.3 Responsibilities of the State of Hawai‘i Department of Land and Natural Resources

The State of Hawai‘i Department of Land and Natural Resources (DLNR) provides regulatory oversight for the State of Hawai‘i, as authorized by statute, to ensure that all HCPs and state ITLs issued by BLNR comply with the provisions of applicable State of Hawai‘i regulations. The DLNR through DOFAW will have the following responsibilities during HCP implementation.

- Review HCP Annual Reports submitted by KIUC for completeness, accuracy, and compliance (see Section 7.7.1, *Annual Reporting*, for Annual Report requirements) and to determine whether KIUC is making progress towards achieving the biological goals and objectives of the HCP and implementing all applicable requirements of the HCP.
- Provide HCP Annual Reports to the ESRC for their review and recommendations for adaptive management.
- Consider recommendations from the ESRC regarding adaptive management or other changes to the HCP to improve its effectiveness and coordinate with USFWS and KIUC regarding these recommendations.
- With USFWS, make recommendations to KIUC regarding adaptive management changes according to the adaptive management process described in Chapter 6, Section 6.2.2.3, *Adaptive Management Decision-Making Process*.
- Receive and review reports from KIUC regarding observations of injury or mortality of the covered species.
- Review and verify monitoring reports provided by KIUC.
- Participate in HCP coordination meetings with KIUC and USFWS as necessary to stay informed about HCP implementation and to provide technical advice to KIUC, as necessary or requested.
- Coordinate with the KIUC HCP Program Manager and USFWS regarding any potential compliance issues and work cooperatively to resolve these issues. If compliance issues cannot be resolved, take enforcement action as necessary and appropriate.
- Visit conservation sites and KIUC infrastructure and facilities as needed to observe the progress and results of HCP conservation measures, which will be coordinated with the KIUC HCP Program Manager.

- Provide technical assistance if KIUC requests a minor modification or major amendment to the HCP (see Section 7.6, *Revisions and Amendments*, for details on these procedures).

7.2.4 Responsibilities of the Endangered Species Recovery Committee

The Hawaiʻi Revised Statutes (HRS) require the ESRC to review all HCPs annually "to ensure compliance with agreed to activities and, on the basis of any available monitoring reports, and scientific and other reliable data, make recommendations for any changes."[3] To fulfill this requirement, the ESRC will review the KIUC Annual Report (see Section 7.7.1, *Annual Reporting*, for details on the Annual Report) and any other relevant reports and data to determine whether the KIUC HCP is in compliance with the terms of the HCP and state ITL. The ESRC (and/or DOFAW staff as ESRC representative) may conduct an annual site visit on the Island of Kauaʻi to fulfill its statutory duty,[4] which would be coordinated with the KIUC HCP Program Manager. The ESRC is supported and advised by DOFAW and the DLNR as described in the section above. Site visits are required prior to ESRC making HCP recommendation to the BLNR.

7.3 Regulatory Assurances

No Surprises assurances are provided by the federal ESA through the "No Surprises" rule (50 Code of Federal Regulations [CFR] Section 17.22.32). This rule provides assurances to federal ITP holders that USFWS will not require the commitment of additional land, water, or financial compensation; or additional restrictions on the use of land, water, or other natural resources beyond the level otherwise agreed to in the HCP without the consent of the permittee. HCP permittees may provide additional mitigation, but only voluntarily. No Surprises assurances remain in place if the HCP is being properly implemented. For example, the No Surprises assurances would not apply to situations where authorized take levels are exceeded, or the minimization or mitigation measures are not meeting success measure targets.

As part of the No Surprises assurances, an HCP must identify and analyze reasonably foreseeable changed circumstances that could affect a species or geographic area during its term (50 CFR Section 17.3). Should such a changed circumstance occur, the permittee is required to implement the measures specified in the HCP to respond to this change. HCP permittees are not required to implement remedial actions for any unforeseen circumstances. These terms are defined and explained below.

The HRS provides for regulatory "incentives" in Section 195D-23 that are similar to the regulatory assurances provided by the federal ESA. The State cannot, in order to protect a threatened or endangered species, "impose additional requirements or conditions, or modify any existing requirements or conditions to mitigate or compensate for changes in the conditions or circumstances of any species or ecosystem, natural community, or habitat covered by the [HCP]." Allowable exceptions are as follows (any single item alone is an exception).

- KIUC consents to the changes.

[3] Section 195D-25(b)(2).

[4] The ESRC may not conduct more than one site visit per year to each property that is the subject of an HCP (HRS Section 195D-25(b)(6)).

- BLNR finds that the changes would not impose new restrictions on land available for development and would not increase cost to HCP parties.
- BLNR pays for any additional cost and KIUC consents to the changes.
- Extraordinary new circumstances or information indicates failure to change plan would appreciably reduce likelihood of survival or recovery of any threatened or endangered species. If additional mitigation measures are subsequently deemed necessary to provide for the conservation of a species that was otherwise adequately covered under the terms of the HCP as a result of extraordinary circumstances, the obligation for executing mitigation measures shall rest with the State, or the federal government with its consent, and not with KIUC.

7.3.1 Changed Circumstances

The federal No Surprises regulation defines changed circumstances as those circumstances affecting a species or geographic area covered by the HCP that can be reasonably anticipated by the applicant or USFWS and that can be planned for. Accordingly, this regulation requires that changed circumstances be identified in the HCP along with remedial measures that would be implemented by the permittee to address these changes. The changed circumstances that could arise in the Plan Area have been identified and are described in Section 7.3.3, *Changed Circumstances Addressed by this HCP*.

Changed circumstances are defined by federal regulation as follows.

> *Changed circumstances* are changes in circumstances affecting a species or geographic area covered by a conservation plan that can reasonably be anticipated by plan's developers and the Service for which responses can be identified in a conservation plan (e.g., the listing of new species, or a fire or other natural catastrophic event in areas prone to those events) (50 CFR Section 17.3).

If a changed circumstance occurs within the Plan Area, KIUC will notify USFWS and DOFAW within 30 days of this changed circumstance. KIUC will evaluate the extent of the changed circumstance and identify and implement an appropriate response based on the remedial measures described in Section 7.3.3, *Changed Circumstances Addressed by this HCP*, to the extent necessary to address the effects of the changed circumstances on the HCP's conservation strategy. KIUC will also notify both agencies of their plans to implement remedial measures to address a changed circumstance. USFWS and DOFAW will not require any additional conservation or mitigation to address changed circumstances that are not identified in the HCP, without the consent of KIUC, if the KIUC HCP is found to be properly implemented. Properly implemented means that the commitments and the provisions of the HCP, federal ITP, and state ITL have been or are being fully implemented and the biological goals and objectives are being met.

7.3.2 Unforeseen Circumstances

Unforeseen circumstances are defined by federal regulation as follows.

> [Unforeseen circumstances are] changes in circumstances affecting a species or geographic area covered by a conservation plan or agreement that could not reasonably have been anticipated by plan or agreement developers and the Service at the time of the conservation plan's or agreement's negotiation and development, and that result in a substantial and adverse change in the status of the covered species (50 CFR Section 17.3).

In the event of unforeseen circumstances during the permit term, USFWS, DOFAW, and KIUC will work together to identify opportunities to redirect existing resources to address unforeseen circumstances, as needed to maintain the benefits of the HCP. However, the HCP provides regulatory assurances to KIUC consistent with the federal No Surprises regulation and the HRS Section 195D-23 that USFWS and DOFAW will not do the following:

- Require the commitment of additional land, water, or financial compensation by KIUC in response to unforeseen circumstances above and beyond those agreed to elsewhere in the HCP.
- Impose additional restrictions on the use of land, water, or natural resources otherwise available for use by KIUC under the original terms of the HCP in response to unforeseen circumstances.

As described in the No Surprises regulation, it is USFWS' responsibility to demonstrate the existence of unforeseen circumstances using the best scientific and commercial data available. KIUC as the permittee is only responsible for the changed circumstances as defined and described in the HCP. Unforeseen circumstances are circumstances that are highly unlikely and not reasonably foreseeable to occur during the permit term and, as determined by the federal No Surprises regulations, are not the management, monitoring, or funding responsibility of KIUC as the permittee.

The federal No Surprises regulation does not limit or constrain USFWS or any federal, state, local, or tribal government agency, or private entity, from taking additional actions at its own expense to protect or conserve covered species. The federal No Surprises regulation also does not prevent USFWS from asking KIUC to voluntarily undertake additional mitigation on behalf of the affected species.

As described above, an allowable exception to the State's regulatory assurances includes "extraordinary new circumstances or information indicates that failure to modify the plan or agreement is likely to appreciably reduce likelihood of survival or recovery of any threatened or endangered species".[5] Under the Hawai'i ESA (HRS Section 195D-23(a)(5)), "extraordinary new circumstances" represent circumstances that indicate that failure to modify the plan or agreement is likely to appreciably reduce the likelihood of the survival or recovery of any threatened or endangered species in its natural habitat. If additional mitigation measures are subsequently deemed necessary to provide for the conservation of a species that was otherwise adequately covered under the terms of an HCP, safe harbor agreement, or state ITL because of extraordinary circumstances, the primary obligation for executing mitigation measures rests with the State, or the federal government with its consent, and not with KIUC.

The following describes the procedures to deal with unforeseen circumstances that arise during implementation of the HCP. The procedure begins with identifying any such circumstances as part of ongoing compliance reporting and coordination with USFWS and DOFAW. USFWS, DOFAW, or KIUC may initiate the process for declaring and documenting unforeseen circumstances. Once initiated, KIUC will provide available information to the agencies regarding the circumstances and associated adverse changes to covered species in the Plan Area. If applicable, KIUC will identify specific biological goals and objectives of the HCP that are or will be affected by the circumstances.

Upon determining that unforeseen circumstances exist, USFWS and DOFAW will inform KIUC of any additional avoidance, minimization, or mitigation measures that may be warranted. While KIUC will

[5] HRS Section 195D-23(a)(5).

not be required to provide additional resources or funds to remedy unforeseen circumstances, KIUC will work with USFWS and DOFAW to determine an appropriate response within the original resource commitments identified in the HCP. Responses may include additional mitigation, which may be implemented at the option of KIUC or by third-party stakeholders under the direction of KIUC. KIUC will document and track any unforeseen circumstances—and associated metrics and mitigation—as part of the HCP monitoring and reporting program.

7.3.3 Changed Circumstances Addressed by this HCP

The changed circumstances in this section are recognized by this HCP. The descriptions in this section also discuss the risk of these changed circumstances along with remedial actions that would be funded and implemented to address impacts of changed circumstances on the covered species. KIUC will maintain sufficient financial reserves to fund any remedial action described in this section, as they arise (see Section 7.5, *Funding Assurances*, for details). The following changed circumstances are recognized by this HCP and described in the following subsections.

- Severe weather and the effects of climate change (e.g., hurricanes, flooding, landslides, heat waves, sea level rise, fire)
- New invasive species
- Disease outbreak in covered species
- Vandalism
- Population declines due to issues at sea
- Listing of a new species

The following information is provided for each identified changed circumstance.

- A brief overview
- A risk assessment that summarizes historical data to estimate the frequency and intensity of foreseeable impacts over the duration of the HCP
- A process for coordinating with the agencies for evaluation prior to implementing actions
- Preventive measures that KIUC has committed to in the HCP that will help reduce the potential for impacts on covered species from the changed circumstance
- Foreseeable rates of occurrence and magnitude derived from the risk assessment
- Remedial measures that KIUC will implement to address foreseeable impacts on the covered species
- Thresholds for unforeseeable rates of occurrence and magnitude derived from the risk assessment.

7.3.3.1 Severe Weather, Natural Hazards, and the Effects of Climate Change

Severe weather, natural hazards, and ongoing climate change can reasonably be anticipated to affect covered species or the geographic area covered by this HCP (Table 7-2). Severe weather may include hurricanes, flooding caused by tropical storms, and heavy rain events such as Kona storms. Natural hazards include tsunamis, landslides triggered by heavy precipitation, and wildfire triggered by drying (a combination of reduced moisture and higher temperature in conjunction with flammable invasive grasses). Many of these weather and hazard events may be intensified by climate change. For example, tsunamis deposit large amounts of water ashore and the reach of that water may be exacerbated by sea level rise. Rising temperatures are causing new stressors such as heat waves. Some of these situations are at the scale of the entire Plan Area and may affect all covered species (e.g., hurricanes, heat waves), whereas other severe weather events or natural hazards are expected to only affect a subset of the covered species (Table 7-2).

Risk Assessment

Climate models offer insights into future trajectories of temperature, precipitation, and related variables, as well as sea level rise. However, projections often exhibit considerable variability across models and may even differ on the direction of a future climate change, such as whether a location will become wetter or drier. Different greenhouse gas scenarios or pathways also introduce variability into how models perform and can result in large differences in the projected magnitude of climate change. Appendix 7C, *Summary of Supplementary Climate Projections*, provides details on climate projections for key climate hazards relevant to this plan.

Changes in the climate of the Hawaiian Islands are already evident. Since 1950, temperatures across the Hawaiian Islands have risen by about 2 degrees Fahrenheit (°F) (1.1 degrees Celsius [°C]), with a sharp increase in warming over the last decade. The number of hot days and very warm nights increased dramatically during the 2015–2020 period compared to the 1951–1980 average, with 58 days of maximum temperature of 90°F (32°C) or higher during 2019 as opposed to the long-term average of about 8, and over 80 nights that year at 75°F (24°C) or higher compared to the long-term average of 27. The rate of temperature increase has been the greatest at high elevations (Stevens et al. 2022).

Under a higher emissions pathway, historically unprecedented warming is projected through 2100. Even under a lower emissions pathway, annual average temperatures are projected to most likely exceed historical levels by the middle of the century (i.e., about halfway through the HCP permit term). However, a large range of temperature increases is projected under both pathways, and under the lower pathway, a few projections are only slightly warmer than historical records. Rising temperatures will cause future heat waves to be more intense. Warming, accompanied by reduced rainfall in some areas, will stress native plants and animals, especially in high-elevation ecosystems.

Precipitation varies greatly across individual islands and the island chain. Nonetheless, precipitation trends are also apparent. Hawai'i has historically experienced drier than normal conditions during the El Niño wet season (November to April) and greater than normal rainfall during the La Niña wet season. Since the early 1980s, Hawai'i has experienced drier conditions during the wet season of La Niña years. In fact, a drying trend in La Niña years has been evident since 1956. Moreover, El Niño events have occurred more frequently over the last two decades, resulting in more drying (Stevens et al. 2022). Both El Niño and La Niña episodes are projected to increase in frequency and magnitude as the world warms (Keener et al. 2018). Larger total acres burned by wildfires are more likely to occur in the year following an El Niño event (Stevens et al. 2022).

Overall, annual rainfall has decreased throughout the island chain since the 1920s and the decrease is particularly evident during recent years in the wet season (Frazier et al. 2022). A 500-year historical reconstruction of winter precipitation concluded that a general drying trend, though with substantial decadal and longer-term variability, goes back 160 years (Díaz et al. 2016). In 10 of the 15 years since 2007, wet-season precipitation was below average, with 4 of the remaining 5 years being very near average. All of the 17 significantly above-average wet years occurred prior to 2006. The changing La Niña rainfall pattern and the increasing frequency of El Niño seem to have contributed to a long-term drought that started in 1980. An increase in the frequency of the trade wind inversion is also linked to a decrease in precipitation at high elevations. The number of consecutive dry days across the Hawaiian Islands has increased since the 1950s. An increase in drought conditions has been detected on Kauaʻi in recent years, particularly on the windward side of the island and at high elevations. Such conditions lead to a lack of usable water and an increased risk of fire (Stevens et al. 2022).

Drought increases the risk of wildfire ignition and the overall size of a wildfire, while wind enhances the speed and severity of the fire. Droughts are projected to worsen due to climate change on Kauaʻi over the next 50 years, which could lead to greater wildfire risk. Models projecting future wind speeds are more uncertain, although maximum wind speeds are projected to increase, potentially exacerbating the likelihood and intensity of wildfires (Appendix 7C, *Summary of Supplementary Climate Projections*).

Increasing trends in extreme 30-day rainfall and the lengths of consecutive dry-day and consecutive wet-day periods indicate that Hawaiʻi's rainfall is becoming more extreme and suggest that both droughts and floods are becoming more frequent in Hawaiʻi (Keener et al. 2018). Nonetheless, the most recent analysis by the National Oceanic and Atmospheric Administration (NOAA) states that extreme precipitation events have become less frequent on Kauaʻi (Stevens et al. 2022). This is one area in which there appears to be conflicting reports. Any seemingly contradictory information may stem from different time frames of analysis or the lack of weather stations from which to extract data. In revising the Precipitation-frequency Atlas of the United States for the Hawaiian Islands (Volume 4 of its continental Atlas 14 project), NOAA also revised downward the magnitude of 100-year, 60-minute and 24-hour flood events. Over most of Kauaʻi, the 100-year flood has diminished as much as 50 percent since the last atlas was published in the 1960s (Perica et al. 2011).

Precipitation projections for Hawaiʻi are particularly challenging to estimate due to the state's high and steep topography, which leads to pronounced variability in climate over distances much smaller than climate model grid cells. Moreover, natural year-to-year variability in rainfall is much larger than the small changes in precipitation being projected even under higher emissions scenarios for the middle of the century. Hawaiʻi appears to straddle the transition between wetter conditions in the tropics and drier conditions in the subtropics that arises from climate models. It is likely that the currently wet windward sides of the major islands will see an increase in rainfall, while the currently dry leeward sides will experience a decrease. The occurrence of extreme precipitation events are projected to increase across Kauaʻi. The heaviest precipitation totals are projected to increase in intensity and the frequency of these events are projected to become more common during the 50-year permit term. This will likely lead to increased flood risk across the island, particularly in areas exposed to the present-day 100- and 500-year FEMA floodplains. Appendix 7C, *Summary of Supplementary Climate Projections*, provides more detail regarding extreme rainfall projections.

Kona storms yield disproportionately large amounts of rainfall. Kona storms are cool winter storms associated with a southward shift in the mid-latitude jet stream. They usually affect the state for a week or less and occur, on average, two to three times per year. Kona storms often result in flash flooding and may trigger landslides. Kona storms can produce additional hazards such as hail, heavy mountain snows, waterspouts, and high surf events. Storm tracks are shifting northward due to climate change, which could result in more "noncrossing" (i.e., those that do not cross an island) cold fronts in the future. In addition, warming may also produce fewer cold fronts. On the island of O'ahu, a study found that Kona storms represent almost 50 percent of total annual precipitation, and that cold fronts that approach but ultimately do not cross the island actually have a drying effect and result in reduced overall rainfall. Because leeward regions are dependent on storm events for much of their rainfall, those areas may be even drier as climate change progresses (Longman et al. 2021).

Hawai'i is also susceptible to tropical storms, most often occurring between June and November. Such storms bring heavy rains, high winds, and high waves to the islands. Hurricanes rarely affect the state, with many dissipating into tropical storms or tropical depressions as they approach the islands. Since 1950, 25 hurricanes have affected Hawai'i (passing within 200 miles [mi] [322 kilometers {km}]), with only two making landfall. The annual number of tropical cyclones observed in the Central North Pacific has varied over time, with a greater number forming during El Niño years. The most active hurricane season on record in the Central Pacific was 2015, with eight hurricanes and six additional tropical storms. Future tropical cyclone activity remains uncertain. Projections indicate that the likelihood of both a hurricane landfall and near-landfall on Kaua'i will increase slightly during the 21st century, from a historic landfall record of 1-in-35 years to 1-in-30 years at the end of the century (Appendix 7C, *Summary of Supplementary Climate Projections*, Table 7C-1). Additionally, the likelihood of the most intense hurricanes may increase at a faster rate than the frequency of overall hurricane frequency due to projected increases in maximum sustained winds speeds. Appendix 7C provides more detail on future tropical cyclone projections.

Sea level rise is another concern. Rates of sea level rise in Hawai'i vary among the islands; it has been 0.6 inch (1.5 centimeters) per decade for Kaua'i (Keener et al. 2018). By 2100, increases of 1–4 feet (ft) (0.3–1.2 meters [m]) in global sea level are very likely, with even higher levels than the global average projected for Pacific Islands including Hawai'i. In fact, the Pacific Basin is likely to experience the highest rates of sea level rise on the planet. A Hawaiian assessment of sea level rise concluded that at least 1 ft (0.3 m) of rise could be reached by mid-century (Hawai'i Climate Change Mitigation and Adaptation Commission 2017). That same assessment chose 3.2 ft (1 m) of rise as its high-end planning scenario for the latter half of the 21st century because models suggest an acceleration in sea level rise by the end of the century. The Fourth U.S. National Climate Assessment found that 3.2 ft (1 m) was an intermediate scenario and one that could be reached as soon as 2060 (Keener et al. 2018). Sea level science is dynamic and rapidly evolving, and modeling results rapidly become outdated. Sea level rise is projected to cause an increase in tidal floods associated with nuisance-level impacts. Nuisance floods are events in which water levels exceed the local threshold (set by NOAA's National Weather Service [NWS]) for minor impacts on infrastructure, cause road closures, and overwhelm storm drains. Continued sea level rise will also present major challenges to Hawai'i's coastline through coastal inundation and erosion (Stevens et al. 2022).

Pacific climate variability is a governing element that amplifies many aspects of global climate change, such as drought, sea level, storminess, and ocean warming. Overall, there is great uncertainty about how Pacific variability occurring on short timescales, such as El Niño and La Niña, will combine with multidecadal changes in temperature, waves, rainfall, and other physical factors to influence future patterns of climate change (Keener et al. 2018).

Foreseeable Frequencies for Extreme Weather Events and Natural Hazards

For the purposes of this HCP, foreseeable frequencies for severe weather events have been estimated based on historic and projected rates of each type of severe weather. Current scientific understanding of the projected future frequency and intensity of severe weather events in the vicinity of Kauaʻi in a warming climate are provided in each subsection below and summarized in Table 7-2. Appendix 7C, *Summary of Supplementary Climate Projections*, provides more detail on methods and results for projections regarding hurricanes, flooding, sea level rise, and wildfire.

Table 7-2. Foreseeable Frequency of and Covered Species Affected by Severe Weather and Natural Hazards (see text for details)

Severe Weather[a]	Historic Annual Average	Foreseeable Frequency During 50-year Permit Term	Foreseeable Occurrences During 50-year Permit Term	Dataset Length	Temporal Trend	Likely Extent of Damage	Covered Species Affected
Hurricane (Landfall)	0.028	1 per 31 years	1.6 times	70 years	Slightly Increasing	Widespread, maximum	Seabirds, waterbirds, green sea turtle (honu)
Hurricane (Close approach[b])	0.028	1 per 31 years	1.6 times	70 years	Slightly Increasing	Regional, moderate	Seabirds, waterbirds, green sea turtle (honu)
Hurricane (Distant approach[b])	0.056	1 per 16 years	3.1 times	70 years	Slightly Increasing	Regional, minimal	Seabirds, waterbirds, green sea turtle (honu)
Tsunami	0.07	1 per 14 years	3.5 times	70 years	Stable	Coastlines, maximum	Waterbirds, green sea turtle (honu)
Flooding	see text	see text	see text	17 years	Increasing	Localized or regional	Waterbirds, seabirds, green sea turtle (honu)
Landslide	see text	see text	see text	15 years[c]	Unknown	Localized or regional	Seabirds
Sea Level Rise	see text	see text	Gradually accelerating over the permit term	see text	Increasing	Coastlines, maximum	Waterbirds, green sea turtle (honu)
Wildfire	See text	See text	See text	50 years	Increasing	Regional, moderate	Seabirds, waterbirds, green sea turtle (honu)

[a] For each type of severe weather event or natural hazard that could result in a changed circumstance (i.e., affect the Plan's operating conservation program), the average rate of occurrence per year is provided (annual average) along with foreseeable frequencies of each event. Dataset length indicates the duration of records used to derived annual historic averages. See section below for dataset sources. Foreseeable frequencies are based on model projections to the 2070s.

[b] Close approach is defined as 0–50 miles (0–81 kilometers) offshore, distant approach is defined as 50–150 miles (82–241 kilometers) offshore. Hurricanes have been divided into these categories due to the differences in the potential damage, in terms of extent and magnitude, that may be expected at conservation sites associated with this HCP. Specifically, damage resulting from hurricanes making landfall or closely approaching the island is presumed to be more severe relative to hurricanes whose center remains at a distance from the island. "Distant" is synonymous with "less severe damage expected", and these distances were based on the extent of damage that resulted from various hurricanes passing at various distances from Kauaʻi.

[c] The dataset for landslide frequency was anecdotal, rather than authoritative, and the annual average and foreseeable frequency should be considered minimum estimates. Given the regularity of landslides as well as uncertainty in the exact rate, any landslide that has occurred and is deemed to affect conservation site infrastructure, will be considered foreseeable and addressed with remedial measures.

Frequency calculations for different types of severe weather and hazards are based on various lengths of timeseries, in part due to the rarity of some events and also due to the limitations of historical record keeping. Frequency calculations also used forward-looking climate projections, where appropriate (Appendix 7C, *Summary of Supplementary Climate Projections*). Summarized here is justification for the duration chosen for each type of event (Table 7-2):

- **Hurricanes:** an historical timeseries of 70 years (1950–2020) is used for determining the frequency of historic hurricanes with moderate (i.e., distant approach) to extensive (i.e., close approach and landfalls) damage, due to the infrequent, irregular intervals between such events, as well as the differences in how hurricanes track across the Pacific, causing variation in the frequency and severity of hurricane impacts on different islands. The frequency of hurricanes approaching or hitting Kauaʻi is based on historical return intervals adjusted using basin-wide projections of hurricane frequency derived from the literature to extrapolate mid-to-late century hurricane frequencies.
- **Tsunamis:** a historical timeseries of 70 years (1950–2020) is used for determining the frequency of major tsunamis, again due to rarity and the irregular intervals between such events. For example, if the analysis considered only the previous 30 years, then the calculated frequency would be one tsunami expected per 30 years rather than one per 14 years.
- **Flooding:** a timeseries of 17 years (2004–2021) of flash flood warnings issued by the NWS is used for this assessment because reliable tracking of flash flood warnings did not occur prior to 2004. Also, since flash flooding is frequent on Kauaʻi, a shorter timeseries still provides sufficient information to calculate expected frequencies. Forward-looking climate projections of inland flooding are not readily available. Given the high foreseeable frequency, any flash flood warning issued by the NWS in the Plan Area would be considered foreseen and addressed with remedial measures if the HCP's minimization measures or conservation measures are compromised.

  Flooding is also evaluated using present-day Federal Emergency Management Agency (FEMA) flood zones and projections of return period precipitation intensities and annual likelihoods of high-intensity precipitation events. FEMA floodplains provide representations of present-day risk in terms of 100-year and 500-year floodplains (1 and 0.2 percent annual probability, respectively). Present-day FEMA floodplains represent a strong indicator of areas which may be at heightened riverine flood risk under climate change, as precipitation increases maximum flood stages, as well as FEMA-assessed risk of coastal flooding. In general, increases in heavy precipitation under climate change could increase flood flows and the severity of flooding within these floodplains.
- **Landslides:** Landslides typically occur with heavy precipitation events. There is no authoritative database detailing landslide events on Kauaʻi at the time of writing. Instead, anecdotal information on landslides for the period 2006–2012—derived from the County of Kauaʻi Multi-hazard Mitigation and Resilience Plan (County of Kauaʻi 2015)—and for the period 2013–2021—derived from online news outlets—is used to calculate the frequency of known landslides from 2006 to 2021. As noted, this represents a minimum because many areas in the plan area, including remote areas where conservation sites are located, are not currently monitored for landslides; an exact rate for landslides cannot be determined, primarily due to a lack of information.

  It is foreseeable that increasing precipitation or storm events could increase the frequency of landslides on Kauaʻi, particularly when coupled with increasing wildfire risk to nonnative vegetation (LaRosa et al. 2008). Therefore, given the already high foreseeable frequency combined with an uncertainty in baseline landslide risk at the conservation sites, any landslide detected in or immediately adjacent to seabird conservation sites should be considered foreseen and addressed with remedial measures if the HCP minimization measures or conservation measures are compromised.

- **Sea Level Rise:** Sea level rise projections used the Intermediate-High and Intermediate-Low scenarios developed by NOAA to bracket future coastal change (Sweet et al. 2022). NOAA sea level rise projections are frequently used in city, state, and federal reports, scientific assessments, and guidance documents across the country. The Intermediate-High scenario aligns approximately with the very high-end range of a Shared Socioeconomic Pathways (SSP) SSP5-8.5 and represents a low risk tolerance scenario.[6] In contrast, the Intermediate-Low scenario aligns approximately with the middle range of SSP2-4.5 and represents a higher risk tolerance scenario.
- **Wildfires:** Global Climate Models are limited in their ability to simulate wildfire frequency and intensity absent effects of urbanization, land fragmentation and land use change, and spatiotemporal ignition frequency. Global Climate Models, however, can simulate fire weather conditions, which include measures of drought or dry spells. The HCP used quantitative geospatial projections of annual maximum number of consecutive dry days to represent changes in dry spell length across Kaua'i during the next 50 years.

The frequency estimates in Table 7-2 are calculated as the likelihood of an event happening over a certain amount of time based on multi-year averages, which is not an absolute time-to-event interval. For extreme weather events, there can be great variation in the interval between events and they may not be regularly spaced across the permit term. As an example, if hurricanes may foreseeably make landfall on Kaua'i once every 31 years, then a maximum of two hurricane landfalls would be foreseen over a 50-year permit term. Frequency estimates are not provided for flooding, landslides, or fire because of the difficulty of predicting frequency at a scale meaningful to the conservation sites. See the text below for details.

Hurricanes

Hurricanes are large weather systems. Hurricane-force winds (i.e., 74 miles per hour [mph] or 119 kilometers per hour [kph]) may extend outward to more than 150 mi (241 km) from the center of large (Category 3+) hurricanes (National Oceanic and Atmospheric Administration 1999). At that scale, hurricanes can affect the entirety of Kaua'i even when they do not make landfall. In the central Pacific, hurricanes generally move from east to west but may also swing northward. As a result, all regions of the island have the potential to be affected by the damaging winds and heavy rains associated with hurricanes.

The National Hurricane Center's Hurricane Database (National Hurricane Center 2021; National Oceanic and Atmospheric Administration 2021a) contains data from 1950 when record-keeping began. Based on the previous 70 years, an average of five hurricanes form in the central Pacific annually, with two of these being Category 3 or greater.

[6] A low risk tolerance scenario represents a planning scenario that considers the potential for higher impact, worse-case climate change outcomes. Higher-impact scenarios, such as SSP5-8.5, help establish a low risk tolerance for planning and, in turn, increase resiliency to climate change. SSPs represent potential socioeconomic trajectories related to energy and land use, resource use, and governance, all of which affect greenhouse gas emissions.

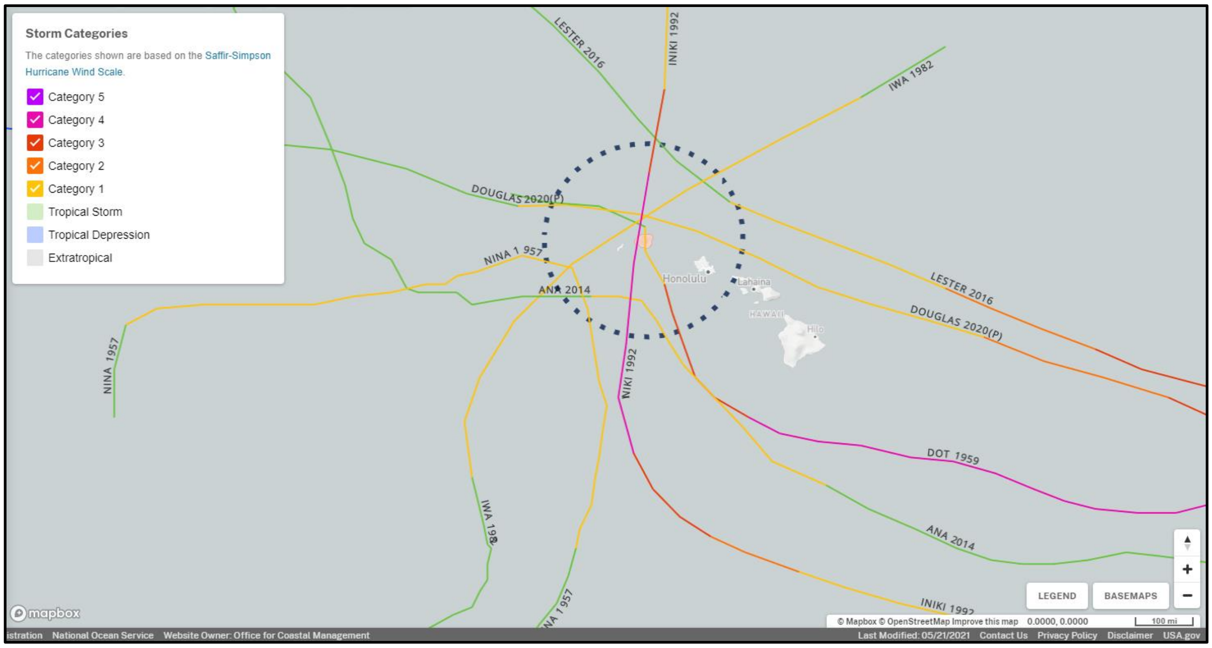
Rarely do hurricanes make landfall on the Hawaiian Islands (Thompson 2014). However, the extent of hurricane damage is a function of the size of the hurricane and the distance between the hurricane and the island, not whether it makes landfall. To estimate the potential for hurricanes damaging Kauaʻi, historical hurricane records were partitioned into three categories: (1) landfall, (2) close approach (0–50 mi [0–81 km] offshore), and (3) distant approach (51–150 mi [82–241 km] offshore).

Of all the islands, Kauaʻi has experienced the most direct hits of hurricanes in recorded history (National Oceanic and Atmospheric Administration 2021a; Figure 7-1). Over the last 70 years, two hurricanes have made landfall on Kauaʻi—Hurricane Dot in August 1959 (Category 1 at time of landfall) and Hurricane ʻIniki in September 1992 (Category 4 at time of landfall). Basin-wide tropical hurricanes are anticipated to increase slightly in frequency over the permit term (Appendix 7C, *Summary of Supplementary Climate Projections*). This equates to a foreseeable rate of one landfall every 31 years, or up to two landfalls during the 50-year permit term.

Over this same period, an additional two hurricanes made close approaches—Hurricane ʻIwa in 1982 (Category 3) and Hurricane Douglas in 2020 (Category 1). When adjusted for projected frequency increases, this also equates to a rate of one close approach every 31 years, or up to two close approaches during the 50-year permit term.

Four additional hurricanes have made distant approaches to Kauaʻi (Figure 7-1). Adjusted for increased frequencies, this would equate to a rate of one distant approach every 16 years, or up to three distant approaches during the 50-year permit term. Tropical storms are more frequent and can also have damaging impacts (e.g., rain, flash flooding, storm surge) but with more modest winds that remain below 74 mph (119 kph).

The rate of hurricane formation including formation of major hurricanes has been stable over the last 40 years (1980–2020; Figure 7-2 generated from National Hurricane Center 2021 data using R package HURDAT by Trice 2020). During this more recent period, one hurricane has made landfall and an additional five hurricanes passed within 150 mi (241 km) of Kauaʻi, which equates to a rate of one hurricane making landfall every 40 years and one hurricane passing close enough to potentially cause damage to isolated parts of the island every 6 years. These more recent rates of occurrence are similar to the 70-year average indicating that the frequency of impacts due to climate change is difficult to detect at this point in time. Quantitative projections, however, indicate that the likelihood of both a hurricane landfall and near-landfall on Kauaʻi will increase slightly during the 21st century (Appendix 7C, *Summary of Supplementary Climate Projections*).



Source: National Oceanic and Atmospheric Administration 2021a

Figure 7-1. A map of the tracks of all hurricanes within 150 mi (241 km) of Kauaʻi (as depicted by the dashed circular outline) between 1950 and 2020, generated using NOAA's Historical Hurricane Tracks Mapbox interface

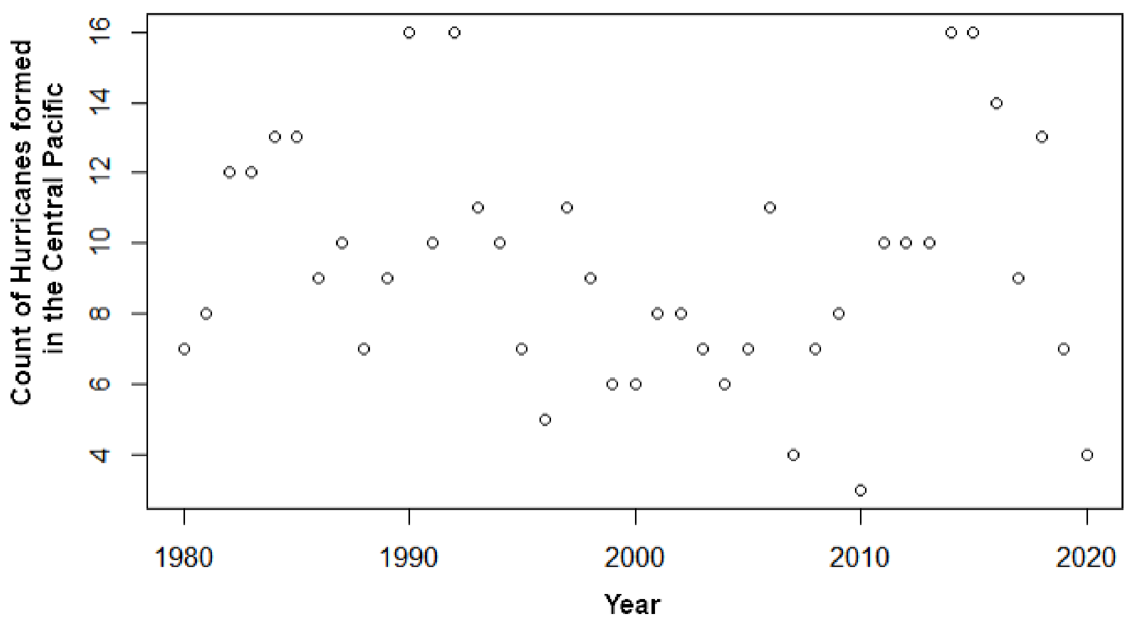


Figure 7-2. Annual count of the hurricanes formed in the central Pacific Ocean based on the National Hurricane Center's Hurricane Database (National Hurricane Center 2021), which shows no evidence of a directed trend in either increasing or decreasing directions.

Hurricane 'Iniki was the most powerful hurricane to strike the state in recorded history (Central Pacific Hurricane Center 1993). Hurricane 'Iniki made landfall on the south-central portion of Kaua'i at peak intensity and moved across the island in 40 minutes (Central Pacific Hurricane Center 1993). Much of the island experienced sustained winds of 100 to 120 mph (161 to 193 kph), with gusts of 175 mph (282 kph) at landfall along with localized microbursts, sudden downdrafts of wind capable of reaching 200 mph (320 kph). In addition to intense winds, Hurricane 'Iniki created a 13- to 20-ft (4- to 6-m) storm surge on top of a 17-ft (5.2-m) swell along the southern Kaua'i coastline. Because the hurricane moved quickly through the island, there were no reports of significant rainfall (National Oceanic and Atmospheric Administration 1993).

Marked declines in populations of the covered seabirds were documented because of Hurricane 'Iniki. "While it is unlikely that the hurricane itself caused direct mortality of adults [on land] given that it struck the island during the day while adults were out at sea" (Raine et al. 2017), it is likely that chicks were still in burrows when Hurricane 'Iniki made landfall. However, the hurricane may have displaced adults at sea, affecting foraging success and chick provisioning (Schreiber 2002). Additionally, damages resulting from this hurricane likely "increased impacts of introduced predators (by opening ingress routes that act as movement corridors), habitat modification (due to erosion and native vegetation removal), and powerline collisions (the removal of considerable vegetation shielding powerlines after large trees were blown over)" (Raine et al. 2017).

Smaller hurricanes that fail to make landfall can also pose threats but have historically resulted in considerably less damage than Hurricane 'Iniki. Hurricane 'Iwa was the second most damaging hurricane to affect Kaua'i, passing within 25 mi (40 km) of the shoreline as a Category 3 hurricane. The right semicircle of this hurricane extended across Kaua'i and produced 30-ft (9-m) swells, an 8-ft (2.4-m) storm surge, and wind gusts up to 120 mph (193 kph) (Rosendal 1983). The worst damage from Hurricane 'Iwa occurred along the south side of the island, where the rough surf destroyed or severely damaged several exposed luxury hotels, condominiums, and boats (Rosendal 1983). Like Hurricane 'Iwa, the center of Hurricane Douglas passed within 43 mi (69 km) of Kaua'i's north shore but, unlike Hurricane 'Iwa, it was a much smaller storm and hurricane-force winds remained offshore. Overall damage was relatively minor with some moderate flooding on Kaua'i due to storm surge and rainfall (Brackett 2020).

In certain situations, described above, hurricanes are expected to have the greatest likelihood of affecting the covered seabirds. In some instances, however, hurricanes may also affect the covered waterbirds and green sea turtle (honu) depending on the severity of the event. Hurricanes may result in life-threatening impacts on adults, juveniles, chicks, and eggs, both on land and at sea, of the covered species, and by severely altering vegetation and damaging or destroying nests. Hurricanes have the potential to alter the environment in areas important to the life history of covered species, including altering vegetation in breeding areas and other habitats that affect the ability of covered species to survive and reproduce.

Considerable damage or destruction of conservation structures (e.g., powerline collision deterrent devices, predator and ungulate exclusion fences, Save Our Shearwaters [SOS] facilities and operations) because of hurricanes may temporarily reduce the effectiveness of the conservation measures. Additionally, damage resulting from hurricanes may temporarily impede access to the conservation sites to implement remedial measures.

Tsunamis

Tsunamis are potentially destructive waves caused by the displacement of a large volume of water resulting from earthquakes, volcanic eruptions, submarine landslides and other underwater explosions. Tsunamis can travel across the Pacific Ocean basin from the point of origin to remote points of impact in a matter of hours.

Terrestrial areas affected by tsunamis may experience widespread inundation by seawater at otherwise unprecedented distances inland. Tsunamis are life threatening to all life forms that are unable to rapidly relocate and/or tolerate long periods of inundation by rushing seawater. Any structures (e.g., houses, bridges, roads) and sensitive habitats in their pathway are at risk of being destroyed.

Due to the sheer size and destruction that can result from tsunamis, frequencies of these events can be reconstructed from paleotsunami (i.e., tsunami occurring prior to the historical record) deposits. Although there is evidence that Hawaiʻi was affected by locally generated tsunamis in the distant past (e.g., Moore and Moore 1984; Satake et al. 2002; McMurtry et al. 2004), the most recent event occurred over 10,000 years ago (McMurtry et al. 2004). All recent tsunamis affecting Hawaiʻi have been generated by remote earthquakes; the Hawaiian Islands' location in the middle of the Pacific Ocean predisposes them to be threatened by tsunamis from great earthquakes in nearly all directions (Butler et al. 2014). Paleotsunami deposits laid down in the in the Makauwahi Sinkhole on the southwest side of Kauaʻi between 350 and 575 years ago provide evidence of the largest tsunami to hit the island in geologic history, with seawater traveling 328 ft (100 m) inland and rising 24 ft (7.3 m) above sea level (Butler et al. 2014).

In the last 70 years, five major tsunamis have affected Kauaʻi. During the 1960 Chilean tsunami, seawater rose a maximum of 10 ft (3 m) above sea level as measured at the Makauwahi Sinkhole (Butler et al. 2014). The other four major tsunamis that affected Kauaʻi occurred in 1952, 1957, 1964, and 2011 (Butler et al. 2014). This equates to an average impact rate of one major tsunami every 14 years, or a foreseeable rate of up to four tsunamis during the 50-year permit term.

Because the frequency of earthquake-generated tsunamis is unrelated to climate change and the scale needed to encompass the full range of potential impacts is on the order of centuries, rather than decades, only the 70-year frequencies will be used to set thresholds for what can be reasonably anticipated over the duration of the federal ITP and state ITL for tsunamis.

Tsunami impacts are restricted to lower-elevation coastal areas, most frequently below 10 ft (3 m) in elevation based on the last 70 years of data from Kauaʻi. Conservative estimates of sea level rise could add 1–3 or more ft of height to a tsunami. As a result, green sea turtle (honu) and covered waterbird habitat are at risk of being affected by this type of event. Tsunamis that result in significant coastal flooding may temporarily disturb or destroy active waterbird nests and wetland breeding habitat due to inundation. Green sea turtle (honu) nesting habitat and active nests may be affected by tsunamis that inundate or destroy nesting beach habitat. Furthermore, these events could remove coastal vegetation, coastal beach habitat, or structures near nesting habitat that have the potential to increase the impacts of artificial lights on hatchlings trying to make their way to the ocean. A tsunami that struck a green sea turtle (honu) nesting beach could wash away eggs prior to hatching.

Of all the severe weather and natural hazards accounted for, tsunamis are the least likely to affect the covered seabirds because they do not occur near coastal habitat. Perhaps if a tsunami was powerful enough to trigger landslides in the steep cliff nesting areas high above the ocean then seabirds might be affected.

Flooding

Flooding can result from a body of water overflowing onto land, from heavy rainfall that accumulates on the land surface, and, more recently, from sea level rise that causes "sunny day" tidal flooding associated with "king tides," or the highest tides of the year. Flooding may result from other severe weather events already summarized above (e.g., hurricanes) or may be associated with less severe weather systems (e.g., heavy rainfall events, Kona storms, tropical storms). Rapid rise in water can endanger lives, destroy structures, wash out roads and trails, and promote the occurrence of rainfall-triggered landslides that may impede access by blocking roads and trails.

Flooding risks can be assessed various ways. For planning purposes, NOAA calculates precipitation frequency based on historic data (now through 2010 for Hawaiʻi). The U.S. Geological Survey (USGS) uses its network of streamflow gauges to monitor the flood stage of rivers in real time. The NWS issues flash flood (sudden, violent flooding) warnings using hydrologic tools that are informed by radar-based rainfall rates to forecast the severity, timing, and magnitude of flash flooding.

USGS published updated flood frequency estimates for Hawaiian streams with data through the 2008 water year (Oki et al. 2010). Using 235 gauging stations in unimpacted areas, a trend was detected in only 37 and of those, 27 were downward and 10 were upward. In general, estimated 100-year peak discharges from this study were lower than those from previous studies across all the islands including Kauaʻi. These data are consistent with NOAA's Atlas 14 findings. It should be noted that hydrologic data can be highly variable and the inclusion or exclusion of periods of time can change the outcomes of analysis, sometimes quite significantly.

Unlike the previously described severe weather events, the database that has archived all NWS flash flood warnings issued on Kauaʻi only begins in 1986 and appears unreliable prior to 2004 due to a marked increase in the frequency of warnings issued starting in 2004 (Iowa Environmental Mesonet 2021). According to the NWS, a flash flood warning is "issued when flash flooding is imminent or occurring;" therefore, warnings represent a reliable proxy for the actualized frequency of flooding events that have occurred over the last 17 years (2004–2021) across the entire island. Due to a lack of records for flash flooding events prior to 2004, an assessment of increased flash flooding due to climate change was not possible.

Since 2004, there have been 244 flash flood warnings issued on Kauaʻi, which equates to an average of between 12 and 13 flash floods on the island each year. There is significant interannual variability in flooding, however, and the number of flash flood warnings range from as few as 4 to as many as 58. Within a year, flash flooding can occur in any month but 82.6 percent (n=185) of flash flood warnings issued since 2004 occurred between October and February.

Spatially, some areas are more prone to damage caused by flash flooding due to sloped topography that works to funnel runoff, creating a temporary watercourse or adding to the flow rate of existing watercourses. Areas with this sort of topography are more likely to experience erosion in events of flooding due to fast-moving water flows. Based on the Special Flood Hazard Areas depicted on the Flood Hazard Assessment Tool (State of Hawaiʻi Department of Land and Natural Resources 2021), areas with the greatest risk of flooding are associated with existing watercourses (i.e., rivers, streams, and marshes) and low-lying areas (e.g., Mānā, Hanalei Valley). Although all areas subject to flooding are not identified on this map, and the lack of Special Flood Hazard Areas in the remote interior and along the northwestern coastline are likely because people do not reside in these areas. Given the steep topography and abundant existing watercourses in the remote, uninhabited areas of the island where the seabird conservation sites are located, localized damage caused by flash flooding, particularly in steep valleys and existing waterways, should be anticipated.

Present-day FEMA flood maps are commonly used to estimate areas potentially exposed to future flooding. Although these flood maps represent present day risks, the flood zones indicate which areas are most likely to flood first, or more frequently, as the climate changes. The frequency, magnitude, and duration of flooding are expected to increase as a result of climate change, which is evaluated using projections of return period precipitation intensities and annual likelihoods of high-intensity precipitation events (Appendix 7C, *Summary of Supplementary Climate Projections*). Return period precipitation intensities are an imperfect but reasonable proxy for future flood exposure to the heaviest 1-day precipitation totals that occur during a set period of time (e.g., 5, 10, 20 years) given projected precipitation totals in the future. Short-duration and high-intensity rainfall events can lead to significant localized inland flooding. Climate models (see Appendix 7C) project larger increases for less-frequent, higher-intensity precipitation totals, particularly under the SSP5-8.5 scenario. For example, the models indicate that a 4-inch (10-centimeter) precipitation total (averaged over 10 x 10 km grid cell) would occur once every 15–21 years. By 2070, climate models indicate that frequency could increase to once every 9–12 years (i.e., 39 to 58 percent more often). Combining the heavy precipitation projections with present-day FEMA floodplains, flood risk will likely increase for areas exposed to riverine and coastal flooding, particularly along the eastern portion of the island.

On Kauaʻi there have been a few instances in recent history where extensive flooding has occurred in populated areas and has resulted in significant damage to human infrastructure. Four such flooding events have occurred since 1991 (December 1991, October 2006, April 2018, and March 2020; Tetra Tech 2021). The Hanalei National Wildlife Refuge (NWR), which is located on the north side of Kauaʻi, has the potential to be affected by extensive damage due to flooding as frequently as once every 10 years if all these storm events are considered. However, locational details provided for three of the four events indicate that worst impacts were at a distance from Hanalei NWR (e.g., Hanalei Bridge, Anahola), so the realized frequency of events causing extensive damage at Hanalei NWR may be more on the order of once every 40 years. In the southern portion of Kauaʻi flooding near the Waimea River mouth and Mānā have been documented in the last 40 years. However, flood events expected to cause extensive damage to Mānā are expected to be relatively rare and are not anticipated at anything less than a 40-year interval.

The covered seabirds and covered waterbirds could be affected by localized flooding that occurs during the nesting season. Large rain events that result in flooding cause the most risk to seabirds. In 2021, a Hawaiian petrel (ʻuaʻu) chick was found in a flooded burrow in the Hono O Nā Pali Natural Area Reserve in late September; the chick was found covered in mud, soaked, and sitting in an inch of water (Archipelago Research and Conservation 2021). Covered seabird eggs and fledglings could also be affected by large rain events. Flooding may also affect the covered waterbird species. It is unlikely that flooding of waterbird wetland and river habitats, even in extreme cases, will result in a mass mortality event of adult waterbirds. However, if it happens to be nesting season for waterbirds when flooding occurs and their nests become inundated, these events could result in temporary reductions in reproductive outputs of affected species (Byrd and Zeillemaker 1981). In April 2018, an historic rain event resulted in 50 inches (127 centimeters) of rain falling on Kauaʻi in 24 hours, causing the Hanalei River to flood its banks and inundate surrounding low-lying areas, including the wetlands in the Hanalei NWR. Despite this historic flooding, intensive efforts to document impacts on waterbirds located only seven carcasses (based on an interview of K. Uyehara reported by Rogers 2018). Moreover, flooding can create new suitable habitat for the covered waterbird species when properly managed, but these events can also make habitat less suitable or unusable, depending on the water depth and season in which the events occur. Flash flooding can submerge or wash away nests in wetland habitat and can remove nesting substrate. Green sea turtles (honu) do not occur in areas where they are expected to be adversely affected by flooding.

Landslides

Landslides are defined by the USGS as the movement of a mass of rock, debris, or earth down a slope. Slope movement occurs when forces acting downslope due to gravity exceed the strength of the earth materials that compose the slope. Landslides can be initiated in slopes already on the verge of movement by rainfall, snowmelt, changes in water level, stream erosion, changes in groundwater, earthquakes, volcanic activity, disturbance by human activities, or any combination of these factors. On land, landslides can endanger lives, destroy structures, and block access to roads and trails. Underwater landslides can generate tsunamis.

Kauaʻi primarily experiences rainfall-triggered landslides (County of Kauaʻi 2015) due to its steep mountainous topography, which focuses rain onto mountain slopes, causing landslides. There is no authoritative database detailing landslide events on Kauaʻi, so generating a robust and long-term average for this type of extreme event and assessing changes in frequency in recent years is not possible. However, the County of Kauaʻi Multi-hazard Mitigation and Resilience Plan (2015) does provide some anecdotal information on landslides. Specifically, this plan notes that flooding and storm events caused landslides affecting highway and coastal roads in 2006, 2008, and 2012. News articles since 2012 indicate additional weather-related landslides occurred in 2014 at Wailua River (Hawaii News Now 2014), in 2018 along the north shore (Parachini 2018), and again in 2021 along the north shore (Bigley 2021). Thus, anecdotal reporting from 2006 to 2021 indicates that landslides are common and landslide-generating events occur at least once every 2.7 years. However, not all landslides are reported, particularly in the uninhabited interior regions of the island, and this is a minimum estimate of landslide frequency rather than an average estimate. Although very little is known about the exact rate of landslides in the uninhabited northwest portions of Kauaʻi where seabird conservation sites are located, landslides do occur frequently in the steep terrain along the Nā Pali Coast and may frequently affect the conservation sites. There are records of landslides affecting the covered seabirds in the Upper Limahuli Preserve, Hanakāpīʻai, and North Bog conservation sites.

The USGS Preliminary Landslide Susceptibility Map for Hawaiʻi depicts areas of steep slopes with moderate, high, and very high risk of landslides across Kauaʻi. These risk categories are based on expert judgement and a slope-stability model applied to digital topography following the methods of Harp et al. (2009). While this information is preliminary or provisional and is subject to revision, it indicates there a risk of landslides throughout the Nā Pali Coast. Each conservation site is primarily designated as the lowest risk category (moderate) with small areas considered to be high risk (Figure 7-3). Generally, areas of very high risk, which are the very steep slopes of the Nā Pali Coast, are outside of the conservation sites, but can overlap slightly with the conservation site boundary, such as is the case along the eastern edge of North Bog.

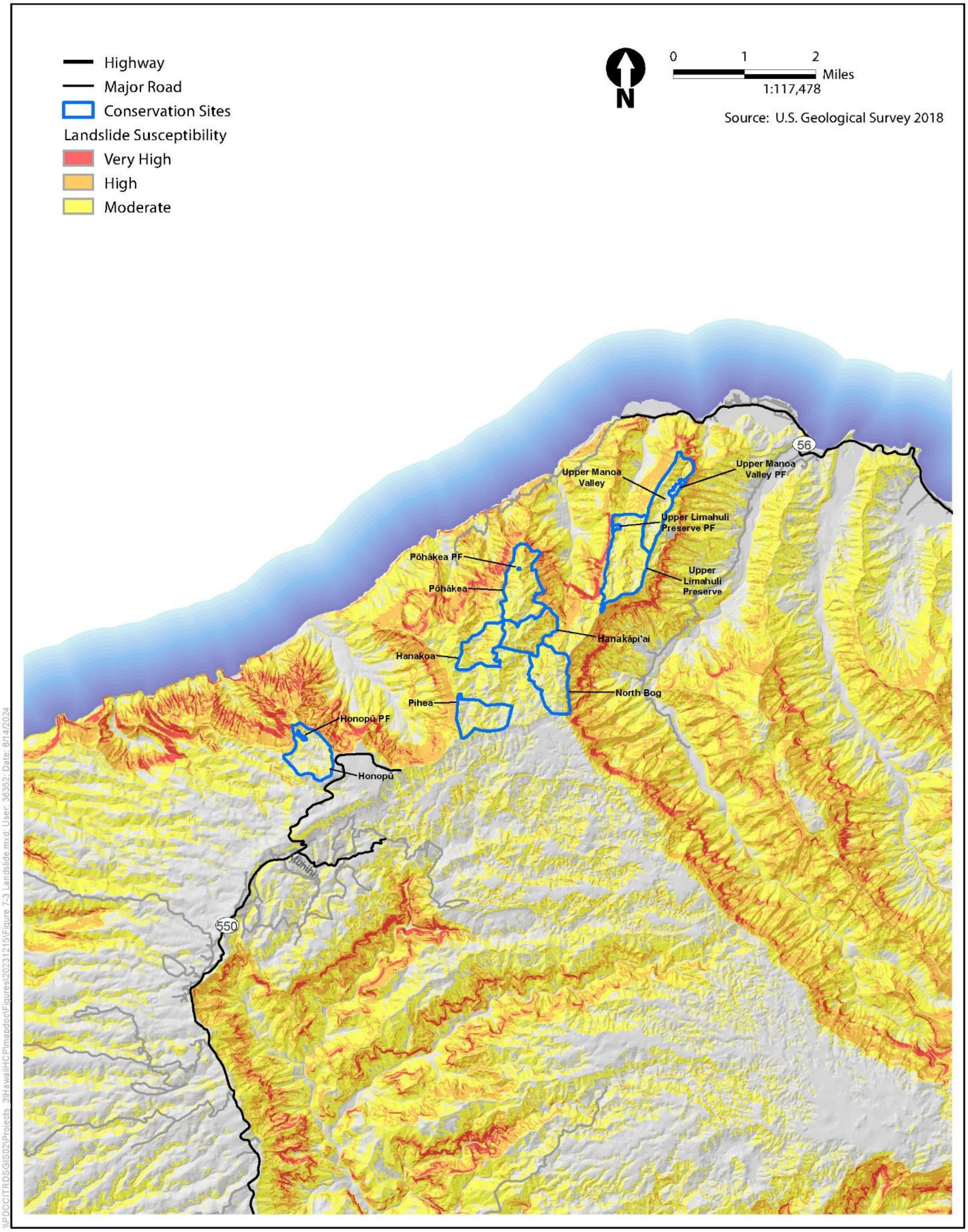


Figure 7-3. Landslide Susceptibility Map for the Conservation Sites

The location and design of all 12 selected conservation sites was informed, in part, by landslide risk. Site locations were chosen, and boundaries were designed to mostly avoid areas with high and very high landslide risk (Figure 7-3). However, a moderate risk of landslides remains throughout all or most of the Nā Pali Coast where all the KIUC HCP conservation sites are located. Therefore, landslides are expected to affect the covered seabirds directly and indirectly during the 50-year permit term. Landslides can bury active burrows (including the chicks and any incubating adults inside), remove vegetation and soil, or result in large areas of land breaking off and falling into the ocean. Landslides can also damage or destroy predator fencing, which increases the susceptibility of covered seabirds to predator mortality until the fence can be repaired. Landslides are not expected to affect the covered waterbirds or green sea turtle (honu) because they do not occur in areas susceptible to landslides.

Sea Level Rise

Rising sea levels will both directly inundate areas near shorelines and cause low-lying areas to flood due to the upward displacement of shallow aquifers. Rising sea levels also increase the tendency of large waves to wash inland and flood areas with saltwater, making the soil unsuitable for many plants (Keener et al. 2018).

In addition to water pushing further inland during high tide events, event-based coastal flooding of low-lying areas arising from tropical storms, hurricanes, and tsunamis waves will also be exacerbated by sea level rise. In addition, El Niño and La Niña events affect wave action and model projections indicate changing future wave conditions that will vary in complex ways spatially, by season, and with shoreline exposure and orientation (Keener et al. 2018).

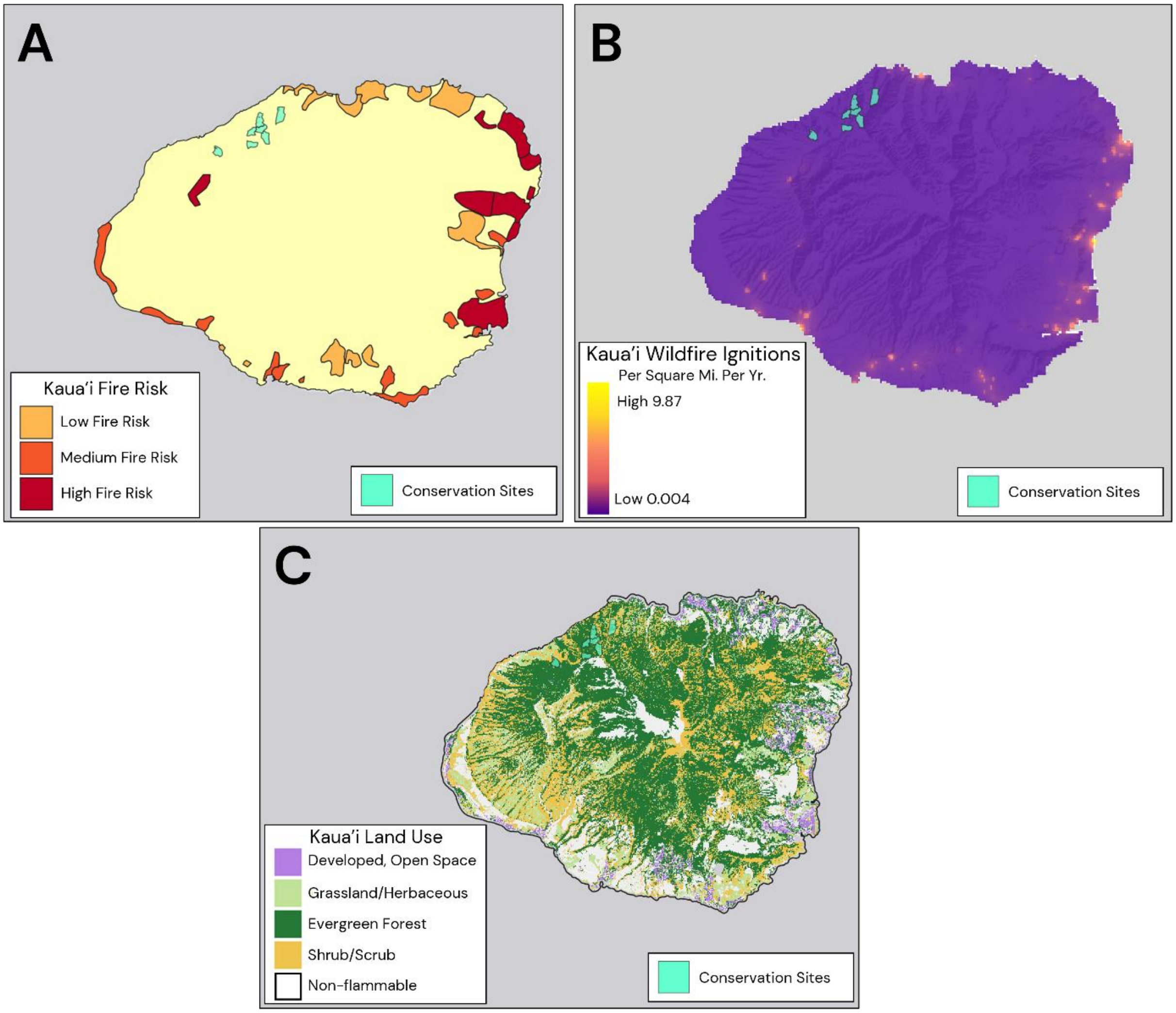
Sea level rise projections using the National Aeronautics and Space Administration and NOAA Interagency Sea Level Rise intermediate-low and intermediate-high scenarios at the Nāwiliwili Bay tide gauge on Kaua'i suggest sea level rise could exceed 1 ft (0.3 m) and 2.5 ft (0.8 m) by 2070 under each scenario, respectively. Sea level rise accelerates into the future, particularly after 2050 during the second half of the permit term under the more risk-averse Intermediate-High scenario (Appendix 7C, *Summary of Supplementary Climate Projections*).

Sea level rise projections provide geospatial floodplain and inundation levels under a range of climate change scenarios, but do not include the potential impacts from future storm surge. Given uncertainty intrinsic to sea level rise projections and the adaptations or physical responses of coastal habitats, it is uncertain if sea level rise will affect the lowland covered species during the permit term. If sea level rise does occur there is no response possible for the loss of nesting waterbirds or green sea turtle (honu) nests due to sea level rise. If nesting habitat is lost on the island of Kaua'i, KIUC has no control over these areas, and thus no way to recover nesting habitat.

Low-lying coastal areas around the island may become chronically flooded within the mid- to latter-half of this century. This land will become submerged by coastal erosion, direct marine flooding from tides and waves, or become new wetlands behind the shoreline from rising water tables and reduced drainage. Some examples of areas that would be exposed to chronic flooding include: the Mānā Plain northwest of Kekaha, Kē'ē Beach, Kīlauea, Polihale Beach, and Nāwiliwili Harbor. Seventy percent of Kaua'i's beaches are subject to chronic erosion and Kaua'i has lost almost 4 mi (6 km) of beaches to erosion fronting seawalls and other shoreline armoring (Hawai'i Climate Change Mitigation and Adaptation Commission 2017). Nesting waterbirds, turtles and seals, and coastal plants in low-lying areas are expected to experience some of the most severe impacts of sea level rise (Keener et al. 2018).

Wildfire

Each year, Hawaiʻi averages over 1,000 fires and over 20,000 acres (8,094 hectares) burned (Trauernicht et al. 2015). This has primarily affected forested, shrub, and grassland areas near developed communities, which are most vulnerable to wildfire during periods of drought or prolonged dry conditions. Figure 7-4 highlights the areas across Kauaʻi that are historically most susceptible to wildfire risk. Regions designated as "high fire risk" areas include a large area north of Nāwiliwili Bay, surrounding areas of Kapaʻa, the shoreline east of Wailua, and the coastal area north of Anahola. Notably, there is also a designated high-risk area inland over the northwestern portion of the island toward the headwaters of Waimea Canyon. These are all located along the more drought-prone east and northeast coast of Kauaʻi. Medium fire risk areas are primarily located along the south and southwest coast, and low risk areas are primarily located along the north coast. Current and proposed conservation sites are located in the northwestern portion of Kauaʻi and do not intersect with any low, medium, or high fire risk area assigned by the Hawaiʻi GIS Fire Risk Program. Historical fire ignition densities coincide with many of the fire risk areas, particularly near more developed population centers. Wildfire ignition is primarily driven by human ignitions (both arson and accidental), with more isolated ignitions from lightning. Over the next 50 years, drought and dry spell length is projected to increase across Kauaʻi, although the increase is relatively small in magnitude—increases on the order of 0.2–0.4 day (1–2 percent increase) in the mid-range SSP2-4.5 and 0.7–0.9 day (3–4 percent) in the high-end SSP5-8.5 scenario (Appendix 7C, *Summary of Supplementary Climate Projections*).



Land cover data highlights developed land, grass, shrubs, and forest. Developed land poses increased ignition risk and forest, shrub, and grassland represents fuel for wildfire development under drought conditions. Current conservation sites shown in the northwest of each panel in areas of no assigned fire risk.

Figure 7-4. Present-day Hawaiʻi GIS Program (a) Fire Risk Areas and (b) Ignition Density, as well as (c) USGS National Land Cover Database maps for Kauaʻi

Preventive Measures

Through the HCP conservation measures, KIUC will construct and maintain structures in the conservation sites to minimize risks to the covered species and successful implementation of the conservation strategy from severe weather events and natural hazards. For example, strong fence construction at the conservation sites will minimize the risk of damage during storm events (Chapter 4, Section 4.4.4.2, *Management Actions*, subsection *Predator Exclusion Fencing*). In addition, KIUC will proactively clear vegetation and trim trees along a buffer on either side of the fence to protect fences from falling vegetation in strong winds. Remote cameras along the fence line will serve as an early detection monitoring tool to detect fence damage or landslides immediately after storms. For green sea turtle (honu), contracted or volunteer monitors will remove shields during a storm to ensure that they are not blown away or damage nests and will visit all potentially suitable habitat on an annual basis to track changes over time (Chapter 4, Section 4.4.5.1*, Nest Detection*).

Changed Circumstances and Remedial Measures

KIUC will notify USFWS and DOFAW as indicated in Table 7-3 when a severe weather changed circumstance has occurred. Following the occurrence of a severe weather event, KIUC will evaluate the extent of the damage as it pertains to the conservation measures of this HCP, and the resulting impacts on the covered species based on the best available information at that time. Once the extent of the damage has been assessed, KIUC will identify and implement appropriate remedial measures as described below as soon as possible and will notify both agencies of their plans.

Damage from severe weather has the potential to be widespread across the island and may affect the success of conservation measures proposed by this HCP. Because of the uncertainty in frequency, intensity, and location of severe weather events, the HCP identifies changed circumstances in terms of effects of severe weather relevant to the HCP conservation strategy. The damage that could result from severe weather types may take various forms that are summarized in Table 7-3. Damages that may affect the success of HCP conservation measures will be remedied using the potential responses in Table 7-3. In most cases of a changed circumstance from severe weather, KIUC will respond to any foreseeable damage to the conservation sites or replacement of minimization devices on powerlines through repair or replacement.

Table 7-3. Changed Circumstances Resulting from Severe Weather (e.g., hurricanes, flooding, heavy rain events) or Catastrophic Events (e.g., tsunamis, landslides, wildfires) and Potential Responses

Changed Circumstance Due to Severe Weather or Catastrophic Events	Response	Unforeseen Circumstance Threshold
Damage to powerline minimization devices (e.g., diverters)	Within 30 days of a severe weather or catastrophic event or as soon as it is safe or logistically feasible, KIUC will take the following steps: (1) Conduct surveys to assess damages that may have occurred to powerline minimization devices to determine if repairs/replacement are necessary; (2) Notify the agencies of damage to powerline minimization devices; and (3) Replace damaged or missing diverters as soon as practicably feasible[7]. Repair or replacement of minimization devices of like kind will be determined by KIUC without consultation. If KIUC cannot replace or repair the minimization devices with like kind or KIUC analysis indicates that replacement is not in the best interest of the species (e.g., the timing of full replacement/repair occurs during the breeding season and the work may affect the species), KIUC will notify and consult with USFWS and DOFAW within 30 days of the severe weather or catastrophic event and determine an alternative response.	No set limit, response will be implemented each time a severe weather or catastrophic event occurs and results in damage to minimization devices.

[7] The timing of replacement will be driven by the level of damage and power outages, with first priority being given to restoring power. Power outages from severe weather are often associated with powerlines being down so the potential for take from downed lines is non-existent.

Changed Circumstance Due to Severe Weather or Catastrophic Events	Response	Unforeseen Circumstance Threshold
Damage, loss, or destruction, to a portion of or the entire predator exclusion fence	The need to repair or replace predator exclusion fences in part or in whole during the 50-year permit term is reasonably foreseeable. KIUC will take the following steps after a severe weather or catastrophic event to ensure each predator exclusion fence remains fully operational during the permit term: (1) Within 30 days of a severe weather or catastrophic event, or as soon as it is safe or logistically feasible, KIUC will evaluate damage to the fence and site and determine whether portions of or the entire fence is replaceable, what portion of colonies remain, extent to which suitable habitat remains, and other resulting impacts on the covered species. KIUC will also notify USFWS and DOFAW and present the evaluation to them; (2) KIUC will repair or replace any fence segments that are not fully functional or are otherwise damaged or destroyed due to severe weather or catastrophic event during the permit term, regardless of the number of times a segment is repaired or replaced. Repair and replacement work must be complete as soon as practically feasible within identification of need, but at the most within 2 years, unless otherwise agreed to in writing by the agencies; (3) In the unlikely scenario that severe weather or a catastrophic event results in the destruction of an entire fence, KIUC will replace the fence in its entirety. Fence replacements must be complete within 2 years of identification of need, unless otherwise agreed to in writing by the agencies; and (4) Notwithstanding items (1) and (2) above, if in the judgment of KIUC, the USFWS, and/or DOFAW, a severe weather or a catastrophic event eliminates or substantially reduces the ability of that site to contribute towards meeting biological goals and objectives (e.g., due to colony destruction, loss of habitat, or creation on unstable slopes) fence replacement may be impossible or impractical. In this event, KIUC will follow the response regarding temporary or permanent impacts to a conservation site set out below.	Each predator exclusion fence repaired as needed (unlimited) and replaced up to two times due to severe weather or catastrophic events during the permit term.
Temporary loss of accessibility to conservation sites (e.g., damaged helicopters, landing pads, or roads)	Should there be a temporary loss of accessibility to conservation sites, KIUC will take the following steps within 30 days of the loss of accessibility, or as soon as it is safe or logistically feasible if the site is inaccessible: (1) Conduct surveys and confer with appropriate parties (e.g., helicopter operator, Hawaiʻi Department of Transportation) to determine the extent of access damages; (2) Notify the agencies within 30 days of losing accessibility; and (3)	No set limit, response will be implemented each time a severe weather or catastrophic event occurs and results in temporary loss of accessibility to conservation sites.

Changed Circumstance Due to Severe Weather or Catastrophic Events	Response	Unforeseen Circumstance Threshold
	Provide USFWS and DOFAW with an approximate timeline for clearing trails well enough to gain access to conservation sites and repair fences, weatherports, and landing zones. For other damage, KIUC will work with the appropriate party to determine a strategy and timeline for repair.	
Temporary impacts to a portion of a conservation site	Should there be temporary impacts to a conservation site (e.g., moderate landslide), KIUC will take the following steps within 30 days of the temporary damage, or as soon as it is safe or logistically feasible: (1) Assess the site to determine the extent of damage and implement remedial measures that quickly restores habitat value (e.g., remove soil and vegetation blocking access to burrow areas) and (2) initiate consultation with the agencies within 45 days of temporary impacts to a conservation site regarding specific and timely KIUC-proposed remedial measures, which may include, without limitation, resumption of conservation measures, enhanced predator control, and restoration measures.	No set limit, response will be implemented each time a severe weather or catastrophic event occurs and results in temporary impacts to a portion of a conservation site.
Permanent impacts to all or a portion of a conservation site	Should a portion of or an entire conservation site be permanently impacted, KIUC will take the following steps within 30 days of the event or as soon as it is safe or logistically feasible, or timeframe agreed to by the agencies: (1) Evaluate the damage to the site and determine whether portions of colonies are remaining, whether or not suitable habitat remains, and, whether or not fences are replaceable; (2) Notify USFWS and DOFAW and present the assessment of the permanent destruction of a portion or entire conservation site; (3) Propose actions to maintain remaining colonies or suitable habitat, and adjustments to ensure HCP goals and objectives are met, which may include expanding a conservation site or adding a conservation site; (4) Discuss proposed actions with USFWS and DOFAW to verify approach and establish a timeline for KIUC's implementation; and (5) Upon approval by the agencies KIUC will begin implementing remedial actions.	No set limit, response will be implemented each time a severe weather or catastrophic event occurs and results in permanent impacts to all or a portion of a conservation site.
Increased accessibility of predators within the conservation sites.	Following a severe weather or catastrophic event, KIUC will take the following steps within 30 days or as soon as it is safe or logistically feasible: (1) Conduct surveys within the conservation sites to determine if increased accessibility (e.g., vegetation removal, erosion) has occurred; (2) Immediately implement remedial measures depending on the type of damage. Measures may include an increased	No set limit, response will be implemented each time a severe weather or catastrophic event occurs and results in increased accessibility

Changed Circumstance Due to Severe Weather or Catastrophic Events	Response	Unforeseen Circumstance Threshold
	trapping effort, replanting, and/or temporary fencing; (3) Notify the agencies within 15 days of increased predator presence being detected at the conservation sites; and (4) Discuss the actions taken (or proposed actions) with USFWS and DOFAW to determine any appropriate response and timeline for implementation.	of predators within the conservation sites.
Destruction of green sea turtle (honu) nests	Within 24 hours or as soon as practically possible following a severe weather or catastrophic event that may damage habitat containing active green sea turtle (honu) nests, KIUC will take the following steps: (1) Have KIUC monitors visit the site to assess if any nests remain or if anything may obstruct hatchlings from reaching the ocean. KIUC's monitor will document the number and condition of remaining nests and eggs and whether there are obstructions for hatchlings; (2) Consult with DOFAW, DAR, and USFWS within 24 hours of finding a nest with eggs to determine if they are viable. If they are determined to be viable, KIUC will (a) propose remedial actions on a case-by-case basis (e.g., reinstate KIUC's monitoring and temporary shielding program, collect the eggs for artificial incubation) and (b) discuss proposed action(s) and implementation schedule with USFWS, DAR, and DOFAW prior to implementation; and (3) Remove obstructions from path of hatchlings from the nest to the ocean prior to hatching.	No set limit, response will be implemented each time a severe weather or catastrophic event occurs and results in destruction of green sea turtle (honu) nests.
Loss of green sea turtle (honu) habitat due to sea level rise	Every five years during the permit term, KIUC will evaluate, in coordination with USFWS, DAR, and DOFAW, where green sea turtle (honu) habitat has been lost due to sea level rise through the HCP's annual nest monitoring program. Where habitat loss or expansion has occurred, KIUC will adjust the nest detection and temporary shielding program to focus on available suitable habitat.	No set limit, response will be implemented as needed per every 5-year evaluation to address loss of green sea turtle (honu) habitat due to sea level rise.

It is foreseeable that complete replacement of predator exclusion fences and other conservation infrastructure and equipment may be required up to twice during the permit term given the expected frequency of widespread hurricane damage (e.g., when hurricanes either make landfall or when their trajectory brings them into close proximity of the island as defined above). At least one landfall hurricane is expected every 31 years and at least one close pass hurricane is expected every 31 years (see Table 7-2). This equates to the likelihood that up to two hurricanes with widespread damage, and one hurricane with moderate damage will affect Kaua'i at any point during the 50-year permit term. Minor repairs to infrastructure may be required in any areas that experience severe weather, and infrastructure required for full implementation of the conservation strategy should be inspected as soon as possible following such events.

Unforeseen Circumstance

Given the data regarding annual averages and frequency of occurrence presented in the Risk Assessment subsection, for one (i.e., loss or destruction of an entire predator exclusion fence) of the changed circumstances associated with severe weather and catastrophic events, a threshold has been set beyond which the circumstance would be considered unforeseen (Table 7-3). These thresholds indicate the limit of what can be reasonably anticipated in terms of the frequency of occurrence over the 50-year HCP permit term given historical data and long-term trends identified in Table 7-2.

7.3.3.2 New Invasive Species

New invasive species can reasonably be anticipated to become established within the Plan Area over the course of the 50-year permit term. There are many invasive plant and animal species that are already established on Kauaʻi that are known to be significant threats to the covered species, as described in Chapter 3, *Environmental Setting,* and addressed in the conservation strategy for the covered seabird species, as described in Chapter 4, *Conservation Strategy*. In particular, conservation measures for the covered seabirds include monitoring and evaluation of conservation sites for invasive plants and feral honeybees and these monitoring efforts will facilitate detection of additional harmful invasive species if they become established at or near these conservation sites. There is potential that new invasive species, especially those that occur on the other Hawaiian Islands, could become established on Kauaʻi.

Risk Assessment

Invasive species can harm the covered seabirds, covered waterbirds, and possibly green sea turtles (honu). Both lethal and sublethal effects may occur through various pathways—predation (mammals, birds, reptiles), micro-predation (insects), spread of novel pathogens (mammals, insects), and habitat loss (plants). Based on observations from Kauaʻi, other Hawaiian Islands, and Micronesia, it is possible that additional predators that affect covered species, particularly ground-nesting seabirds, could become established on Kauaʻi during the permit term. Specific species of concern include mongoose (*Herpestes javanicus*), brown tree snake (*Boiga irregularus*), and yellow crazy ants (*Anopolepis gracilipes*), all of which may be accidentally introduced to Kauaʻi during the 50-year permit term. Each of these species is described in the following subsections and assessed for their potential threats to the covered species. Other unidentified species of rodents, insects, or plants could also be accidentally introduced over the next 50 years.

The threat of new invasive species is heightened by the challenge of maintaining biosecurity on imports into the Hawaiian Islands (State of Hawaiʻi Division of Forestry and Wildlife 2020). In addition to the specific species discussed below, introductions of other invasive insects, fungus, nematodes, mites, and other plant pests that may adversely affect the covered seabirds, waterbirds, and green sea turtles (honu) are possible.

The KIUC HCP conservation strategy does not require habitat management, including invasive species control, as part of the mitigation for the covered waterbirds or green sea turtle (honu). Habitat management is not required to meet the HCP's biological goal for waterbirds (Chapter 4, *Conservation Strategy*, Goal 4) or green sea turtle (honu) (Goal 5). Actions that facilitate the detection of invasive species in habitats utilized by the covered waterbirds are not planned. As such, invasive species control is beyond the scope of this HCP for covered waterbirds and green sea turtle (honu) and is not required to be addressed by KIUC during the 50-year permit term. These covered species are not discussed further in this section.

Mongoose

Mongoose were brought to the Hawaiian Islands in 1883 to control rats and are known to be established on Hawaiʻi, Oʻahu, Maui, and Molokaʻi (Duffy et al. 2015). Mongoose presence has already been documented on Kauaʻi; in 1976 a roadkill lactating female was found (Tomich 1986) and three additional individuals were trapped near Līhuʻe—two in 2012, one in 2016 (Kauaʻi Invasive Species Committee 2021). Despite these rare and intermittent detections of mongoose on Kauaʻi, research and trapping efforts to date have yet to confirm an established population (Duffy et al. 2015; Kauaʻi Invasive Species Committee 2021).

Mongoose are opportunistic feeders with a varied diet that includes birds, small mammals, reptiles, insects, fruits, and plants; on other Hawaiian Islands, they are known to prey on the eggs and hatchlings of native ground-nesting birds. If mongoose become established, they may depredate seabirds, including the eggs and young. Given what has occurred on other Hawaiian Islands, establishment of mongoose may result in population reductions of the covered seabirds potentially affecting the success of conservation actions proposed for this HCP.

Brown Tree Snake

Brown tree snakes were accidentally introduced to Guam around 1952 and rapidly extirpated most of the native forest vertebrate species, including birds and reptiles (Fritts et al. 2005). Brown tree snakes can depredate seabirds. Because Guam is a major transportation hub in the Pacific, numerous opportunities exist for the brown tree snakes on Guam to be introduced accidentally to other Pacific Islands as passive stowaways on ship and air traffic. Although they are not thought to be present on the Hawaiian Islands, a total of eight brown tree snakes were found in Hawaiʻi between 1981 and 1998. All snakes were associated with the movement of civilian and military vehicles or cargo from Guam. Special searches are now conducted on any cargo or crafts leaving Guam and entering Hawaiʻi to minimize the risk of introduction (Hawaiian Invasive Species Council 2021).

Brown tree snakes are primarily arboreal predators that consume many types of small vertebrates (i.e., lizards, birds, and mammals) as well as eggs of an appropriate size, and can eat up to 70 percent of their body weight per day. There are no snakes native to the Hawaiian Islands, so this ecosystem lacks predators that specialize on snakes and the native species have not evolved to defend against snake depredation. Given what has occurred in Guam, the introduction of brown tree snakes to the Hawaiian ecosystem could be potentially devastating in general, but it is unclear to what degree these snakes would affect covered species. Brown tree snakes are primarily arboreal and they target small, tree-nesting forest birds. That said, brown tree snakes have been found on the ground in logs and crevasses, so it is possible that they may encounter and learn to predate the nests and chicks of the covered seabirds and waterbirds in and around forested habitats. If this were to occur, establishment may result in the reductions of covered populations of seabirds, which could affect the success of conservation actions proposed for this HCP.

Yellow Crazy Ant

Yellow crazy ants are originally from Southeast Asia and have been repeatedly transported to various locations throughout the world's tropics by human-assisted dispersal in shipping containers and freight (Queensland Government 2016), including the Hawaiian Islands. They prey on invertebrates and vertebrates, blinding prey by spraying formic acid. In large numbers, they are capable of preying upon relatively large animals (Queensland Government 2016). At Johnston Atoll NWR these ants nearly extirpated the red-tailed tropicbird (*Phaethon rubricauda*) colony in just a few years. Intensive ant eradication measures were implemented there to eradicate the ants from the atoll (Romo 2021). Based on research grade observations submitted to iNaturalist by citizens, yellow crazy ants have been documented on the Big Island, Oʻahu, Maui, and Kauaʻi. With respect to Kauaʻi, there are 13 research-grade observations of this ant, with the first observations reported in 2015, with an average of two additional observations per year since 2015 (iNaturalist 2021; Global Biodiversity Information Facility 2021). These observations are distributed across the Plan Area, with five from the southeast region, five from the eastern region, and three from the northern region. The northern observations were all located in the vicinity of Kalalau Trail, which leads into the Nā Pali Coast State Wilderness Park, where the majority of covered seabirds nest.

Yellow crazy ants prefer moist lowland forests but can inhabit a diversity of habitats. Where they have been introduced, they can form large-scale super-colonies that extend more than 247 acres (100 hectares) and reach densities of more than 2,000 foraging ants per meter squared. Their impacts vary considerably from site to site and can take decades to manifest (as on Christmas Island) but, in places where yellow crazy ants flourish, not much else does; they decimate insect population and can kill various small animals including seabirds, lizards, crabs, and other sympatric species. Given what has occurred on other islands, including the Hawaiian Islands, establishment of yellow crazy ants in the Plan Area may result in population reductions of the covered seabirds, potentially affecting the success of conservation actions proposed for this HCP.

Invasive Plant Species

Highly invasive plant species that currently do not occur or occur in limited distribution on Kauaʻi have the potential to affect the covered seabird burrow habitat or access to their burrows. They can also alter the suitability of covered species habitat by displace native plant species, resulting in habitat loss or degradation from increased erosion and siltation due to shallow root systems, dense vegetation structure limiting burrow density, and loss or alteration of understory vegetation.

Preventive Measures

In the case of introduction of a new mammalian predator (e.g., mongoose), the predator exclusion fencing would prevent access to the social attraction sites for the covered seabirds. In areas where predator exclusion fencing is absent, the high frequency of management and monitoring actions in the seabird conservation sites, including predator control and burrow monitoring (see Chapter 4, Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*, and Chapter 6, Section 6.4.4, *Conservation Site Monitoring and Adaptive Management*) should be sufficient to allow for early detection of any new invasive species affecting the covered seabirds at the conservation sites.

Similarly, KIUC will monitor the threat posed by new invasive plants in the conservation sites incidentally as other management and monitoring actions are implemented during the seabird breeding season. KIUC will act quickly to remove new invasive plant species that pose a high risk to the covered seabirds. KIUC field staff will continue to implement best management practices to minimize transportation of invasive plants or their seeds into conservation sites (Appendix 4D, *Best Management Practices for Invasive Plant Species Control*). KIUC will follow the principles of early detection rapid response to ensure that new invasive plants are controlled before they become a problem. KIUC will implement early detection rapid response actions consistent with the current recommended protocols of the Hawaiian Invasive Species Council Prevention/Early Detection Rapid Response Working Group (https://dlnr.hawaii.gov/hisc/meetings/wg/prevention/).

Changed Circumstance

Because mongoose and yellow crazy ants have both been observed on Kauaʻi numerous times over the previous 30 years, it is foreseeable that these species may become established over the next 50 years of the permit term. While less likely, brown tree snakes may also be accidentally introduced and, if so, the effects could be devastating to the covered bird species. Occurrence of any new invasive plant or animal species affecting the success of the conservation strategy for the covered seabirds will be treated as a changed circumstances for this HCP.

KIUC will notify USFWS and DOFAW within 30 days if a new invasive species changed circumstance has occurred. Following this determination KIUC will evaluate the effects and resulting impacts of the new invasive species on the covered species based on the best available information at that time. Once the impacts have been assessed, KIUC will notify both agencies of its plans to implement remedial measures as described below.

Remedial Measures

For conservation sites without predator exclusion fencing, any newly introduced mammalian species will be detected through trapping and camera monitoring. KIUC will consult with USFWS and DOFAW to ensure that the protocols in place are sufficient to control the new mammalian species and will adjust their control techniques as necessary if they are determined to be insufficient. In some cases, this may require new trapping techniques, new equipment, or increased trapping effort.

In addition, if any other types of invasive species are introduced on Kauaʻi (e.g., insects, amphibians, reptiles, fungus, non-native plants), KIUC will employ the following process to identify remedial measures.

1. Evaluate whether the new invasive species has the potential to affect the success of KIUC's conservation measures for the covered seabirds. This includes review of relevant data collected through the HCP's management and monitoring actions and consultation with USFWS, DOFAW, Hawaiian Invasive Species Council for invasive plants, and species experts. No remedial actions are required if it is determined that the new invasive species is not likely to adversely affect the HCP's conservation measures.
2. If it is determined that the new invasive species is likely to adversely affect the HCP's conservation measures, KIUC will review its existing management and monitoring actions to determine if, as they are currently being implemented, they are sufficient to address the new invasive species. Once KIUC's review is completed they will consult with USFWS and DOFAW to receive concurrence.
3. If the HCP's existing management and monitoring actions are determined not to be sufficient to control the new invasive species, KIUC will evaluate whether the existing actions can be adjusted to address the new invasive species.

4. If none of these options are possible, KIUC will propose a new strategy of control specific to the new invasive species, and obtain concurrence from USFWS, DOFAW, and species experts in partnership with other conservation entities on Kauaʻi prior to implementation.

Unforeseen Circumstance

With respect to the covered seabirds and invasive species, there are no unforeseen circumstances. This means that KIUC will evaluate all newly introduced invasive species in the conservation sites to determine if they have the potential to affect the covered seabirds.

7.3.3.3 Disease Outbreak in the Covered Species

Hawaiian endemic species evolved in the absence of various pathogens that have been transported to the islands over the last century because of globalization. Therefore, the exposure of naïve immune systems to novel diseases may have played an important role in the decline of Hawaiian endemic species (e.g., mosquito-borne malaria and Hawaiian honeycreepers; van Ripper et al. 1986; Freed et al. 2005).

Risk Assessment

Disease has not been cited as having long-term population-level impacts on any covered seabirds (Raine et al. 2017), waterbirds (Reed et al. 2011; Underwood et al. 2013; U.S. Fish and Wildlife Service 2021), or sea turtles (Chaloupka et al. 2008; Seminoff et al. 2014). That said, the covered species are all susceptible to various forms of disease and there is potential for disease outbreaks.

With respect to the covered seabirds, Newell's shearwater (ʻaʻo) (*Puffinus newelli*) fledglings have been found with mild symptoms of mosquito-borne diseases, specifically avian pox (Ainley et al. 2020) and avian malaria (Warner 1968; Raine et al. 2017) but there have been no reports of lethal disease outbreaks in covered seabirds on Kauaʻi. Based on studies to date, otherwise healthy seabirds seem to be more resilient to the impacts of avian pox (Young and VanderWerf 2008) and malaria (Quillfeldt et al. 2011) relative to other types of birds.

Avian botulism, a paralytic disease caused by ingestion of a toxin produced by the bacterium *Clostridium botulinum*, is the most significant disease of migratory birds worldwide, especially waterfowl and shorebirds (Rocke and Bollinger 2007). Avian botulism is a chronic issue at the Hanalei NWR since a November/December 2011 epizootic killed hundreds of endangered waterbirds (U.S. Fish and Wildlife Service 2021). Between 2011 and 2018, there were 1,342 cases of avian botulism recorded on the Hanalei NWR (Reynolds et al. 2019). In 2019, the total number of sick and dead native birds affected by avian botulism was 157, with 90 percent of these birds affected between July and December. In 2020, an additional 165 native birds were affected raising the total to 1,664 suspected botulism cases (U.S. Fish and Wildlife Service 2021). These botulism outbreaks have killed individuals of all the covered waterbird species and have been particularly detrimental to the endangered Hawaiian duck (koloa maoli) (*Anas wyvilliana*), which represents 62 percent of birds affected (Reynolds et al. 2019). On Kauaʻi, these outbreaks can occur year-round due to lack of seasonal variability in temperatures. An avian botulism task force has been formed and monitoring of birds and water quality has been undertaken to better understand the drivers of the outbreaks in the system (U.S. Fish and Wildlife Service 2021).

Covered sea turtles have primarily been afflicted with a tumor-forming disease called fibropapillomatosis (Chaloupka et al. 2008; Jones et al. 2016). Although this disease is of major concern in some green sea turtle (honu) populations, there is photographic evidence that tumors may spontaneously regress, or increase in size and/or number to the point of debilitation (Herbst 1994; Hirama 2001; Hirama and Ehrhart 2007). The primary impact of fibropapillomatosis is the decrease in ability of sea turtles to forage for food, swim, and avoid predation, affecting the overall survival of affected turtles (Work et al. 2004). Although the primary cause of fibropapillomatosis is unknown (see Blackburn et al. 2021), experts suspect that a herpes virus is the causal agent (Lackovich et al. 1999; Jones et al. 2020). This is reminiscent of human cancers with known viral origins, which, together with other environmental and anthropogenic pressures, have contributed to increases in fibropapillomatosis prevalence (reviewed in Jones et al. 2016). There also is currently no cure (see Blackburn et al. 2021). For sea turtles debilitated by fibropapillomatosis, the current standard of care has been and continues to be preoperative screening to confirm that internal tumors are absent, due to their poor prognosis, followed by surgical excision of external tumors. However, postoperative regrowth is seen in 50 percent of treated turtles and the rehabilitation survival rate of fibropapillomatosis-affected turtles is low (25 percent) (Page-Karjian et al. 2020).

Preventive Measures

Actions to proactively avoid or minimize the impacts of disease outbreaks in the covered species are not planned. The primary preventive measure is monitoring disease outbreaks that are occurring or could occur in birds that are brought into the SOS Program. In addition, KIUC's colony monitoring program would document general deteriorations in health, if observed, while monitoring reproductive success.

Changed Circumstance

One or more of the covered species may be affected by a disease outbreak during the 50-year permit term; therefore, this is considered a changed circumstance. Based on the minor impact disease has had on the long-term population trends of the covered seabirds, covered waterbirds, and green sea turtles (honu), it is foreseeable that disease outbreaks over the next 50 years are expected to be relatively rare and/or inconsequential to the long-term population viability of covered species.

Remedial Measures

In the event of a foreseeable disease outbreak among the covered seabirds or waterbirds, KIUC would cooperate with DOFAW and USFWS and commit to finding a solution within the HCP budget described in this chapter. For example, vaccines could be deployed by the SOS Program consistent with the HCP's estimated budget. The SOS Program will be the likely first line of detection and vaccination for the covered seabirds and covered waterbirds.

There are no remedial measures included in this HCP for disease outbreak for green sea turtle (honu), as fibropapillomatosis is not well understood and there is currently no reasonable remedy (National Oceanic and Atmospheric Administration and U.S. Fish and Wildlife Service 1998; National Oceanic and Atmospheric Administration 2021b). If a remedy for fibropapillomatosis becomes available and the disease outbreak among green sea turtles (honu) directly interferes with the success of biological goal and objectives set forth in this HCP for green sea turtle (honu), KIUC would cooperate with DOFAW and USFWS and commit to finding a solution within the HCP budget described in this chapter.

7.3.3.4 Vandalism

Vandalism is any action involving deliberate destruction of or damage to public or private property. Vandalism can reasonably be anticipated to affect infrastructure associated with Conservation Measure 4 (see Chapter 4, Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*) and Conservation Measure 5 (see Chapter 4, Section 4.4.5, *Conservation Measure 5. Implement a Green Sea Turtle (honu) Nest Detection and Temporary Shielding Program*). Vandalism, such as purposeful igniting fires (arson) was included as an ignition source in wildfire (Figure 7-4) and arson is included as a potential type of vandalism that would be considered in KIUC's remedial response.

Risk Assessment

Over the course of the 50-year permit term, the predator exclusion fence, predator control equipment, social attraction equipment, and wildlife monitoring equipment may be subject to vandalism. It is also possible that the light-proof shields and associated signage for green sea turtle (honu) may be vandalized.

Based on long-term, ongoing predator control and seabird monitoring efforts at the conservation sites associated with this HCP, vandalism is expected to be minimal and infrequent. Over an 8-year period (2012–2020), only one instance of vandalism was reported. In that one instance in 2012, the total cost of damages was estimated to be $1,000[8] (Raine and McFarland 2013; Zito 2013). Details in Zito (2013) indicate that this vandalism was rapidly detected by field crews, with less than 1 week elapsing between vandalism and detection. Importantly, this vandalism occurred at Pihea, which is the easiest conservation site for tourists and locals to access, as this site is in close proximity to the popular Pihea Overlook along the Pihea Trail at Kōke'e State Park.

Vandalism of the light-proof fences for green sea turtle (honu) may occur regularly because it has historically occurred on both Kaua'i and O'ahu (Jenkins in litt.). Vandalism could occur either through individuals dismantling the fences or vehicles driving on the beach running over the structures and the turtle nesting site.

Preventive Measures

Vandalism at active conservation sites has been very rare and has only been reported once since 2012. Further control of vandalism at the conservation sites is difficult because these sites are generally on state lands and/or are in very remote areas where access by field crews is limited to certain times of year. However, certain actions have been implemented following this vandalism event in 2012 that may have hindered subsequent vandalism events, specifically: (1) following the initial occurrence of vandalism at Pihea, ungulate fencing was installed that clearly indicates the end of Pihea Trail and that public access was prohibited; (2) seabird surveillance equipment and mounting gear were camouflaged to minimize visibility to potential vandals; and (3) as cellphone-enabled video and audio surveillance devices have become more affordable, common, and discreet through time, this may deter vandalism due to the potential of being caught on surveillance. Beyond these actions, the primary measure to control impacts from vandalism is to proactively assess the

[8] The following items were either stolen or damaged beyond repair: one game camera, four cat traps, two water containers, and two tarps.

likelihood of occurrence and the expected impacts over the permit term. That way, remedial measures have already been identified and can be swiftly implemented.

With regard to green sea turtle (honu), there are no actions that can prevent vandalism of the light-proof fences. Monitors will be present at the nest site more frequently closer to the estimated time of nest hatching, which helps to reduce vandalism.

Changed Circumstance

Based on long-term, ongoing predator control and seabird monitoring efforts at conservation sites associated with this HCP, vandalism is expected to be infrequent and minimal. Only one vandalism event was reported between 2012 and 2022, with damages estimated at approximately $1,300 in 2023 dollars. As described earlier, vandalism has been restricted to the most accessible conservation site, Pihea, and occurred before ungulate fencing was installed, which serves to delineate a clear boundary between Kōkeʻe State Park and Hono O Nā Pali Natural Area Reserve. One other conservation site, North Bog, is also in proximity to the popular Alakaʻi Swamp Trail in Kōkeʻe State Park, but is much further inland and less accessible than Pihea. Honopū and Honopū PF are also located adjacent to a public trail and have some risk of vandalism. For these relatively accessible sites, based on historical rates of vandalism, it is foreseeable to anticipate a maximum of one event of vandalism every 10 years costing approximately $1,300 per event. When vandalism does occur, it is expected to be limited and localized in scope because of the sturdiness of fencing and the limited damage possible from hand-carried tools (heavy equipment cannot be brought to any site). As a result, relatively minimal damage to fences is expected, consistent with prior vandalism. Thus, over the HCP permit term, five events of vandalism or any number of events that do not exceed $6,500 in damage is considered foreseeable.

The remainder of conservation sites are in very remote areas of the island that require helicopter access and are not accessible by the general public; acts of vandalism have not been documented here to date and are not expected to occur in the future.

Loss or destruction of entire predator exclusion fences due to more extreme arson-related fire events would be treated as catastrophic events identified in Table 7-2. If more than two entire predator exclusion fences need to be replaced due to catastrophic arson events during the permit term, that would be considered unforeseeable.

However, due to the very accessible and public nature of the location of the green sea turtle (honu) nests and the light-proof fences, it is reasonable to expect that vandalism will regularly occur. Any instance of vandalism of light-proof fences will be considered a changed circumstance and therefore require replacement. It is foreseeable that up to two light-proof fences per year will need to be replaced due to vandalism.

Remedial Measures

In the event of vandalism at conservation sites, KIUC needs the ability to respond quickly and effectively (especially in cases where predator exclusion or ungulate exclusion fencing is damaged). KIUC will assess the situation to determine the appropriate remedial measure and implement then repair as quickly as possible.

Given the low frequency of expected vandalism at the conservation sites (as described under *Risk Assessment* above), it is expected that regular predator fence monitoring already included in the HCP

(Chapter 6, *Monitoring and Adaptive Management Program*) will facilitate timely detection and repair of breaches in the fence lines. Predator control and seabird surveillance equipment would also be checked frequently enough to facilitate timely detection of vandalism. In the case of equipment damage or theft, full replacement will occur.

Similarly, it is expected that daily and sometimes twice daily monitoring of the green sea turtle (honu) nests prior to hatching will help reduce vandalism of the light-proof fences. However, as described above, when monitors are not present, vandalism incidents may occur. KIUC will fund the repair of all instances of vandalism of light-proof fences to stay within requested take limits for this species and fulfill the conservation objective.

In the event of serious or repeated vandalism, law enforcement may need to be engaged to address these events. In the case of the light-proof fences on beaches, if repeated vandalism occurs, KIUC will confer with DOFAW, DAR, and USFWS to design and implement a solution.

7.3.3.5 Population Declines due to Issues at Sea

Risk Assessment

Globally, seabird populations have been in decline due to multiple threats throughout their range including the covered seabird species. Numerous researchers have identified threats originating at sea that include climate change (especially effects on the distribution of prey species and temperature-mediated changes in ocean chemistry that cause the waters to become more acidic), commercial fisheries (through competition for prey), and ocean pollution (oil spills) (see Croxall et al. 2012 and Díaz et al. 2019). Sea surface temperatures and ocean pH, an indicator of acidity, are now beyond levels seen in the instrument record (Keener et al. 2018).

For this HCP, KIUC's seabird conservation measures are focused on improving the extent, breeding suitability, and numbers of terrestrial nesting areas. At every conservation site there will be a substantial reduction in land-based predation hazards that affect all seabird individuals, including those transiting between land-based nesting habitats and at-sea foraging grounds. Given the multitude of potential threats to the covered seabirds at sea, in addition to threats being explicitly addressed on land by KIUC, there is a real risk that the efficacy of the proposed conservation strategy could be undermined by ongoing and emerging circumstances that threaten the wellbeing of covered seabirds while they are at sea.

Preventive Measures

While KIUC is actively implementing actions that address terrestrial threats to covered seabirds (e.g., predation, powerline collisions, light attraction), implementing actions that prevent or minimize effects of climate change, commercial fisheries, or ocean pollution is beyond the control of KIUC or this HCP.

Changed Circumstance

Based on current observations and future predictions about changes to the marine system, as summarized above, it is foreseeable that threats to the covered seabirds at sea over the 50-year permit term will increase in extent and severity. However, there is great uncertainty in the timeframe, magnitude, and extent of how covered seabirds will be affected by potential at-sea threats. Thus, setting exact thresholds to define what is expected over the next 50 years (necessary to distinguish between changes that can be reasonably anticipated from changes that are unforeseeable), is not possible at this time.

Instead, the trigger for this changed circumstance will be based on trends in acoustic call rates across all conservation sites combined dropping below a 1 percent rate of increase per year for either Newell's shearwater (ʻaʻo) or for Hawaiian petrel (ʻuaʻu), which may be due to declines in at-sea conditions.[9] The word "may" is used deliberately because currently available data has large gaps in terms of monitoring the annual at sea distribution of breeding adults that could link factors like foraging dynamics to trends in abundance. If data does become available, it will be used to investigate a specific cause at sea. However, if causes on land for the decline can be eliminated (e.g., predation, disease, or other factors), then undetermined at-sea causes are a likely culprit. KIUC will coordinate with other conservation projects for the same species,10 and with species experts, USFWS, and DOFAW to determine if adverse trends in abundance are likely due to declines in at-sea conditions.

Remedial Measures

While KIUC has no control over events at sea, impacts on seabirds may change the ability of KIUC to offset take, provide a net benefit, and meet HCP biological objectives. KIUC will track the latest research regarding ongoing and new impacts occurring at sea that could potentially cause covered seabird populations to decline. Issues particularly of concern, as summarized above, are population declines resulting from the detrimental effects of marine heat waves and ocean acidification on covered seabirds. However, other issues may arise at sea that could cause declines in covered seabird populations from causes not currently identified.

If the changed circumstance has been determined to occur and more severe at-sea threats are likely to preclude achievement of the biological goals and objectives at the conservation sites for any of the covered seabirds, KIUC will notify USFWS and DOFAW and meet and confer to discuss the addition of one new conservation site that prioritizes the protection of occupied Newell's shearwater (ʻaʻo) burrows, if it is not possible to obtain landowner approval for a location that contains both occupied Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu) burrows. This new conservation site will be managed using predator control but will not include a predator exclusion fence nor a social attraction site. As described in Chapter 4, Conservation Measure 4, intensive predator control without a predator exclusion fence is almost as effective as with a predator exclusion fence and with social attraction. A site without fencing is much faster to establish and implement, is far more likely to receive landowner agreement, and can be accomplished at a far lower capital and operational cost. No other remedial actions will be taken beyond the requirement to add one additional conservation site. KIUC has a list of potential new sites that have already been evaluated using the same criteria as the existing conservation sites. See Appendix 4A, *Conservation Site Selection*, for the site list and further details.

7.3.3.6 Listing of a New Species

If a new species becomes listed during the permit term, KIUC will evaluate whether take of the species may occur from the covered activities, in consultation with USFWS and DOFAW. If take of the

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[9] The rate of increase per year across all conservation sites is selected as the metric for this changed circumstance because while poor at-sea conditions are likely to manifest across multiple life stages, subadult or adult natural mortality rates cannot be measured throughout the year. The HCP will measure reproductive success rates at the conservation sites, so this is a feasible metric.

[10] Any conservation projects on Kauaʻi are likely to be affected by adverse changes in at-sea conditions. Therefore, a coordinated determination and response is likely warranted.

newly listed species may occur, KIUC will immediately implement measures to avoid take. In determining whether or not to seek incidental take coverage of the species, KIUC will consider the feasibility of continuing measures to avoid take and whether the risk of incidental take of the species from the covered activities is reasonably certain to occur. If KIUC, USFWS, or DOFAW determine that incidental take is reasonably certain to occur and in order to remain in compliance with the ESA, KIUC should consider requesting an amendment to the HCP, federal ITP, or state ITL.

Procedures for amendments to the HCP are described in Section 7.6, *Revisions and Amendments*. Any amendment must comply with laws applicable at the time the amendment request is made.

If critical habitat is designated in the Permit Area for the newly listed species, KIUC and USFWS will review the new designation(s) in light of the ongoing HCP authorizations and obligations, and take any measures necessary to ensure compliance with applicable laws.

7.4 Costs of KIUC HCP Implementation

The cost to implement the KIUC HCP is shown in Table 7-4. Estimating the full costs of the KIUC HCP was an essential step to demonstrate adequate funding to meet regulatory standards. To provide enough funding, all costs associated with the HCP had to be identified. Costs for the KIUC HCP are divided into the following cost categories and summarized in this section.

- Plan Administration
- Powerline Collisions Minimization
- Save our Shearwaters Program
- Manage and Enhance Conservation Sites
- Green Sea Turtle (Honu) Nest Detection and Temporary Shielding Program
- Powerline Monitoring Program (formerly called the Underline Monitoring Program)
- Seabird Colony Monitoring
- Adaptive Management
- Changed Circumstances
- Contingency

These costs are identified for planning purposes only to estimate funding levels needed to implement the KIUC HCP. KIUC acknowledges that cost estimates may change over time and will fund the full implementation of the HCP. KIUC is a not-for-profit electric utility governed by a nine-member board and regulated by the Hawai'i Public Utilities Commission (PUC). The KIUC Board will be responsible for reviewing and approving the HCP and the associated funding required to fully implement the HCP each year. Costs associated with the HCP are considered operational costs because they are necessary to KIUC continuing to provide electrical services to Kaua'i. Therefore, the cost of the HCP is considered part of KIUC's overall operating costs paid for by member electric rates. The KIUC Board also reviews and approves Annual Work Plans and associated annual budgets, as part of their annual operational workplan and budget review process. Upon execution and acceptance of the federal ITP and state ITL, KIUC will ensure sufficient funding is available to meet all KIUC HCP, ITP, and ITL obligations.

Table 7-4. Summary of Cost to Implement KIUC HCP (all amounts are in 2024 dollars)

Cost categories	Early HCP implementation cost (2020–2023)	Avg. annual HCP cost (2025–2074)	50-year total HCP cost (2025–2074)	Percentage of 50-year total HCP cost
Plan Administration	N/A	$435,685	$21,784,266	5.1%
Powerline Collisions Minimization	$27,832,555	$2,048,769	$102,438,469	23.8%
Save Our Shearwaters Program	$1,639,598	$300,000	$15,000,000	3.5%
Manage and Enhance Conservation Sites	$6,829,735	$2,442,480	$122,123,979	28.3%
Green Sea Turtle (honu) Nest Detection and Shielding Program	N/A	$166,913	$8,345,650	1.9%
Infrastructure Monitoring and Minimization Program	$4,240,540	$1,169,795	$58,489,770	13.6%
Seabird Colony Monitoring Program	$3,783,729	$1,088,034	$54,401,693	12.6%
State Compliance Monitoring	N/A	$52,708	$2,635,405	0.6%
Changed Circumstances	N/A	$433,510	$21,675,483	5.0%
Adaptive Management		$318,974	$15,948,699	3.7%
Contingency	N/A	$163,795	$8,189,736	1.9%
Total	**$44,326,157**	**$8,620,663**	**$431,033,150**	100.0%

7.4.1 Cost Estimate Methodology

To estimate HCP costs, KIUC developed a cost model to identify specific costs in each major cost category listed above. All potential costs were identified that are expected to be needed to fulfill the requirements of the HCP. The cost model (Appendix 7A, *Cost Model*) was designed to demonstrate that all HCP-related costs are accounted for and reasonably estimated. The goal of the cost model was to conservatively estimate expenses of KIUC over the permit term so that overall costs are accounted for and understood. During plan implementation, KIUC will update the cost model as needed and as cost assumptions are refined based on actual experience to assist with long-term HCP budget planning.

Model assumptions are summarized in the following sections by cost category. It is assumed that all cost components will increase over time due to inflation and other factors (e.g., supply chain issues affecting the cost of fencing materials). To simplify the presentation, all costs are expressed in 2024 dollars, allowing comparisons between costs today and costs later in the permit term. KIUC will pay all costs associated with HCP implementation, including inflation and other cost increases, even if those costs are above the costs estimated in Appendix 7A, *Cost Model*. See Section 7.5.6, *Funding Adequacy*, for a description of built-in financial safeguards and contingencies in the event that HCP costs are greater than expected.

Most of the costs in the cost model were based on actual costs to conduct the same or similar actions, given that KIUC has been implementing or funding all of the programs in Table 7-4 except for the green sea turtle (honu) nest detection and shielding program. In the case of the management and monitoring of covered seabirds, cost estimates were based on actual costs to date and scaled to new conservation sites. Costs for actions that were not implemented by KIUC during the Short-Term HCP or early implementation of the KIUC HCP (e.g., green sea turtle [honu]) were based on estimates from technical experts and costs incurred by other agencies. Costs for plan administration were estimated by KIUC based on the current costs.

Details of each cost category and the key assumptions that were used to develop the HCP cost estimate are described below. See the cost model in Appendix 7A, *Cost Model*, for an accounting of all assumptions.

7.4.2 Plan Administration

Plan administration costs are the costs to support staffing, legal defense, and database administration needed by KIUC to carry out the HCP requirements. Plan administration costs are estimated to be $435,685 annually for years 2 to 50 of the permit term, for a total of $21.8 million over the 50-year permit term (Table 7-5). Costs for plan administration are assumed to be stable throughout the permit term except in the first year. Costs are slightly higher in 2025 ($477,008) due to the need to prepare the first annual report. Once the first annual report is prepared, annual reporting costs are expected to be lower.

Table 7-5. Plan Administration Costs

Program Element	Estimated Annual Costs
Plan management staff	$405,852
Legal support	$26,354
Software license fees	$2,635
Total	**$435,685**
*Annual report template (one-time cost, Year 1)**	*$42,166*

* The cost to establish the annual report template and author the first annual report in Year 1 of HCP implementation is based on the work being contracted to consultants. After the first annual report is completed and the template and content are established, the cost estimate assumes that KIUC will prepare the annual report between Years 2 to 50 of the permit term. As such, costs for preparation of the annual report after Year 1 are subsumed under Plan Management Staff.

Staffing constitutes most of the plan administration cost (Table 7-5). Costs for staffing assumes that the KIUC HCP will be implemented by a team of up to three professionals—Program Manager (responsible for HCP administration and compliance monitoring oversight), Data Analyst/GIS Specialist, and Accountant/Budget Analyst (although one person may do two of these tasks or all three and some of these tasks may be performed by contractors or KIUC staff). It is assumed that the Program Manager will function both as an organizational leader and as a public presence for the implementation effort. For the purposes of the cost estimate, data management and analysis, including GIS work, were based on the work being contracted to consultants.

KIUC may require legal assistance during implementation. For example, legal resources may be needed to draft and review HCP documents or assist with landowner disputes if they occur. Legal costs are based on the billing rate for legal contractors and the estimated time on an annual basis.

7.4.3 Powerline Collisions Minimization

Conservation Measure 1 in Chapter 4, Section 4.4.1, *Conservation Measure 1. Implement Powerline Collision Minimization Projects*, requires KIUC to reduce covered seabird and covered waterbird collisions throughout its powerline system.

In 2020, KIUC began implementing its powerline collision minimization projects. The cost model identifies costs for early implementation of powerline minimization projects to "Plan Year 0" to recognize investments made to reduce take prior to federal ITP and state ITL issuance. Costs of both completed and planned minimization projects are estimated by applying the average costs per span reported by KIUC to the number of spans for which future minimization projects are anticipated. Between 2020 and 2023, the cost to implement KIUC's powerline minimization projects during early implementation of the HCP exceeded $27 million.

Costs that will be incurred during the 50-year permit term related to implementation of Conservation Measure 1 total $102.5 million, and an annual average of $2,048,769 per year. Costs after 2024 are limited to installation of new reflective diverters on new or extended powerlines[11]

[11] Reflective diverters are used more widely across KIUC's powerline system (given that LEDs cannot be placed near roads) and are assumed to be representative of the cost that will be incurred by KIUC throughout the permit term to reduce unminimized strikes resulting from new powerlines, even if a small amount of LED diverters are utilized.

and replacement of LED and reflective diverters on existing and new powerlines.[12] KIUC assumed a constant rate of diverter installation given that the schedule and location for installation of KIUC's new and extended powerlines is currently unknown. Therefore, the cost estimate assumes an average installation rate of diverters of seven spans per year. For replacement, KIUC assumed that reflective diverters would be replaced every 15 years and LED diverters would be replaced every 5 years. A large share of the cost of this measure is the replacement of reflective and LED diverters.

7.4.4 Save our Shearwaters Program

Conservation Measure 3 in Chapter 4, Section 4.4.3, *Conservation Measure 3. Provide Funding for the Save Our Shearwaters Program*, requires KIUC to provide funding to the SOS Program. KIUC has been funding the SOS Program since 2003 and will continue to fund the program with a contribution of $300,000 per year, adjusted annually for inflation, over the 50-year permit term. As shown in Table 7-6, this amount is, on average, approximately $50,000 above KIUC's annual funding contribution over the last 10 years. This amount has proven adequate to operate a functional SOS Program over that time. As such, $300,000 annually is an appropriate level of funding over the 50-year permit term.

KIUC's funding will address the rehabilitation of the covered seabird and waterbird species, as well as ensure the SOS Program remains functional (e.g., enough funding to cover staff time and materials) over the life of the permit term. This funding amount will start at $300,000 the first year of the permit term and increase on an annual basis during the permit term in accordance with the Consumer Price Index for the nearest urban area to ensure a consistent funding stream.

7.4.5 Manage and Enhance Conservation Sites

Conservation Measure 4 in Chapter 4, Section 4.4.4, *Conservation Measure 4. Manage and Enhance Seabird Breeding Habitat and Colonies at Conservation Sites*, requires KIUC to manage and enhance covered seabird breeding habitat in all the conservation sites. The cost estimate includes costs related to the following.

- Contractor staff time and training.
- Helicopter leasing and other transportation cost.
- Fencing installation, maintenance, repair, and replacement.
- Predator eradication equipment, materials, and contractor time.
- Predator control equipment (e.g., traps), installation, maintenance, and repair.
- Invasive plant species control equipment, maintenance, and repair.
- Social attraction equipment purchase, installation, maintenance, and repair.
- Upper Mānoa Valley Conservation Easement costs.

KIUC has been funding habitat management at five of these conservation sites for many years prior to the permit term during implementation of the Short-Term HCP and began managing four

[12] Horizontal configuration is not included in the cost estimate because that minimization technique will be part of the project design for new lines and rolled up as part of the construction cost, which is not a covered activity under this HCP.

additional sites during the HCP's early implementation period (which for the purpose of the cost model is defined as 2020–2023). The cost model recognizes early implementation between 2020 and 2023 of conservation site management in the same way as powerline collision minimization (Section 7.4.3, *Powerline Collisions Minimization*), by identifying investments made prior to permit issuance. The cost for early implementation of Conservation Measure 4 between 2020 and 2023 was approximately $6.8 million.

The actual and projected costs from KIUC's contractors during early implementation were used to estimate the cost to manage the conservation sites during the permit term. The total estimated cost to manage and enhance 12 conservation sites throughout the permit term is approximately $122.1 million, and an average annual cost of approximately $2.4 million per year. This is by far the most expensive cost category in the HCP, accounting for a little under 30 percent of all costs. Costs for management of Upper Mānoa Valley were based on the cost of management at Pōhākea and the relative size of Upper Mānoa Valley, assuming that these past costs are a conservative estimate of costs.

Costs for this conservation measure are greater during the first few years of the HCP implementation at the Upper Limahuli Preserve PF and Upper Mānoa Valley PF conservation sites as predator exclusion fences are built, and predator eradication and social attraction are established. Once these structures and systems are in place, annual costs would be greatly reduced.

Costs for this conservation measure include costs associated with a permanent conservation easement on the Upper Mānoa Valley and Upper Mānoa Valley PF conservation sites. Easement costs include an annual fee to the third-party easement holder to maintain, monitor, and enforce the easement conditions. To ensure that easement maintenance, monitoring, and enforcement continues in perpetuity, KIUC will establish a non-wasting endowment. At the end of the permit term, the endowment will generate sufficient interest to pay the annual maintenance, monitoring, and enforcement fee in perpetuity. See Section 7.5.5, *Endowment*, for funding assumptions.

7.4.6 Green Sea Turtle (Honu) Nest Detection and Temporary Shielding Program

Conservation Measure 5 in Chapter 4, Section 4.4.5, *Conservation Measure 5. Implement a Green Sea Turtle (honu) Nest Detection and Shielding Program*, requires KIUC to monitor and minimize artificial light disorientation from KIUC streetlights on green sea turtle (honu). As such, KIUC will fund monitoring and light minimization for green sea turtle (honu) to reduce hatchling light disorientation on Kauaʻi's beaches that provide suitable habitat for green sea turtle (honu) and that may be affected by KIUC streetlights. The program is estimated to cost $8.3 million throughout the entire 50-year permit term, and has an average annual cost of $166,913. The cost estimate related to minimizing light effects on green sea turtle (honu) includes the following time and materials.

- Project coordinator staff time (12 months per year).
- Data analysis staff time (3 months in Year 1, 2 months in Year 2).
- Additional support staff time (5 months per year).
- Cost to purchase data collection materials (e.g., iPad, software).
- Cost to purchase and maintain fleet vehicle and fuel.

- Cost to purchase light minimization materials (e.g., shade cloth).

The cost to implement the conservation measure is expected to change over time. These costs may increase if green sea turtle (honu) nesting in the Plan Area expands over time or as vegetation or structures are removed, exposing additional beaches to light effects. Conversely, the costs may go down if beach habitat in the Plan Area is lost due to sea level rise, if the green sea turtle (honu) population decreases, or vegetation or structures are installed that screen additional beaches from light effects. Regardless, these changes should not affect the cost estimate in a significant way, given that the monitoring program already assumes that all beaches on Kauaʻi will be monitored for green sea turtle (honu) nesting on an annual basis. Should green sea turtle (honu) nesting increase on new beaches (outside of the beaches identified on Figures 4-12a through 4-12g in Chapter 4, *Conservation Strategy*) where additional minimization and monitoring would be required, KIUC would pay this additional cost using contingency funds (see Section 7.4.11.2, *Contingency*).

There is no cost assumed for permanent streetlight minimization for green sea turtle (honu) described in Chapter 4, Section 4.4.6, *Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle (honu)*. Permanent minimization would replace the temporary shielding. Temporarily shielding costs are assumed to be much higher than the costs to install permanent light shields on streetlights (based on the annual costs for future streetlight shielding), so the temporary shielding costs are assumed to cover the permanent shielding costs in any year in which permanent shielding is implemented.

7.4.7 Infrastructure Monitoring and Minimization Program

The Powerline Monitoring Program[13] estimates mortality of the covered seabirds and waterbirds resulting from powerline collisions. This monitoring program is used to determine the efficacy of the KIUC's powerline minimization projects (Section 7.4.3, *Powerline Collisions Minimization*) and to model take (extrapolating the amount based on monitoring certain spans) that occurs during the permit term. Costs associated with the Powerline Monitoring Program include the following:

- Staff wages and per diem.
- Overhead and Hawaiʻi excise tax.
- Equipment and supplies including song meters, trail cameras, and field gear.
- Song meter data and other data analyses including Bayesian model runs.
- Transportation via helicopter and vehicles.

Powerline Monitoring Program costs also include specific monitoring equipment such as near infrared lights, generators, light shields, weather station, helicopter sling gear, and other miscellaneous supplies.

During the early implementation period for the KIUC HCP (2020–2023), the Powerline Monitoring Program cost $4.2 million dollars over the 4-year period. The total cost of the Powerline Monitoring Program over the 50-year permit term is estimated at approximately $58.5 million, with an average annual cost of $1,169,795. As stated in Chapter 6, Section 6.4.1.2, *Take Monitoring of Powerline Strikes*, the HCP assumes that KIUC will monitor a subset of its high-risk lines, including areas with new or reconfigured lines, during the permit term to inform trends across the island-wide powerline

[13] Formerly known as the Underline Monitoring Program (UMP) under KIUC's Short-Term HCP.

system. This assumption is reflected in the lower annual cost in comparison to the amount that was spent during the early implementation period. This lower cost is also justified because KIUC completed most of its powerline collision minimization projects during the early implementation period.

7.4.8 Seabird Colony Monitoring

Like conservation site management, covered seabird monitoring has been ongoing for many years, both during and following the Short-Term HCP and within many of the conservation sites proposed for this HCP. As such, costs are based on projected monitoring costs for monitoring activities that were conducted in 2023. The cost estimate assumes that contractors will continue to develop and lead the monitoring program throughout the permit term.

The seabird colony monitoring program is estimated to be $54.4 million over the permit term and $1,088,034 annually, on average. Conservation site monitoring will document status and trends of the covered seabird species to allow adjustments to the conservation strategy and to ensure the biological goals and objectives of the HCP are met. Monitoring is described fully in Chapter 6, *Monitoring and Adaptive Management Program*. Costs associated with covered seabird monitoring include similar items as described above for the Powerline Monitoring Program (Section 7.4.7, *Infrastructure Monitoring and Minimization Program*).

7.4.9 Adaptive Management

Adaptive management includes large-scale changes to the conservation measures that go beyond day-to-day minor adjustment that are needed to achieve a biological objective in the event the conservation strategy is not working as intended (Chapter 6, Section 6.2.2, *Adaptative Management*). These changes will be informed by monitoring described in Chapter 6, *Monitoring and Adaptive Management Program*. Adaptive management includes a specific list of actions identified in Chapter 6, Section 6.2.2.2, *Adaptive Management Decisions*.

The adaptive management decision-making process will be a collaborative process between KIUC, USFWS, DOFAW, DAR (when addressing green sea turtle [honu]), and in some cases the ESRC (see Chapter 6, Section 6.2.2.3, *Adaptative Management Decision-Making Process*). Labor costs associated with the adaptive management process are assumed to be part of costs associated with staff time and consultant costs devoted to HCP implementation. It is also assumed that some of KIUC's adaptive management actions will be cost neutral. That is, the cost of the action that is being replaced or altered may be similar to the cost of the new or improved action (e.g., a cost savings realized by a reduction or cessation of ineffective conservation measures). Some adaptive management changes, however, are likely to result in additional costs. Additional costs associated with adaptive management changes (e.g., adding, removing or changing the alignment of predator exclusion fencing) are estimated to cost $15.9 million over the permit term, or an average annual cost of $318,974. This estimate was calculated using an assumed proportional cost of adaptive management by each cost category (Table 7-6).

Table 7-6. Adaptive Management Cost Assumptions and Explanations

Cost Category	Cost Assumption	Est. Average Annual Cost	Estimated 50-year Cost	Explanation
Plan Administration	0.0%	-	-	Not applicable
Minimize Powerline Collisions	2.5%	$51,219	$2,560,962	New technology may be available in future to improve collision avoidance
Save Our Shearwaters Program	5.0%	$15,000	$750,000	New techniques and technology may be available in future to improve rescue rates and rehabilitation
Manage and Enhance Conservation Sites	5.0%	$122,124	$6,106,199	New or different management approaches may improve reproductive success or predator control
Green Sea Turtle (honu) Nest Detection and Shielding Program	10.0%	$16,691	$834,565	As a new program, adaptive management changes are expected throughout
Infrastructure Monitoring and Minimization Project	5.0%	$58,490	$2,924,488	New technology or techniques may improve monitoring effectiveness or efficiency
Seabird Colony Monitoring Program	5.0%	$54,402	$2,720,085	Same as above
State Compliance Monitoring	0.0%	-	-	Not applicable (fixed cost)
Changed Circumstances	0.0%	-	-	See Table 7-7 for separate contingency assumptions
Letter of Credit Fees	0.5%	$1,048	$52,400	Account management, including establishment fee and annual administration fee
Total		**$318,974**	**$15,948,699**	

7.4.10 State Compliance Monitoring

As identified in HRS Section 195D-4(g)(3) "The applicant shall post a bond, provide an irrevocable letter of credit, insurance, or surety bond, or provide other similar financial tools, including depositing a sum of money in the endangered species trust fund created by section 195D-31, or provide other means approved by the board, adequate to ensure monitoring of the species by the State and to ensure that the applicant takes all actions necessary to minimize and mitigate the impacts of the take."

KIUC will set aside $50,000 annually to fund state monitoring to comply with this requirement. This amount is assumed to be sufficient for state compliance monitoring of KIUC's implementation of the HCP considering that accessibility to most of KIUC's electrical infrastructure is along roadways or at facilities. Because the conservation sites are typically very difficult to access, state monitoring will not likely occur on an annual basis. This funding will also cover coordination meetings by state staff and review of relevant documents by state staff.

7.4.11 Other Costs

7.4.11.1 Changed Circumstances

Remedial measure costs are estimated to address responses to the changed circumstances described above in Section 7.3.3, *Changed Circumstances Addressed by this HCP*. The cost estimate for remedial measures is approximately 6 percent of the total 50-year cost to implement this HCP. This amounts to a total of approximately $21.7 million, with an annual amount of $433,510. The cost estimate for changed circumstances uses assumptions, including but not limited to the following.

- Due to damage from severe weather (e.g., hurricane, landslide, wildfire), KIUC may need to do the following.
  - Fully replace each predator exclusion fence up to two times during the permit term. This obligation does not include KIUC's obligation to repair or replace any fence segment or entire fence due to regular wear and tear and aging at any of the conservation sites, as needed to ensure the fences are fully functional and remain in good repair throughout the permit term.
  - Replace reflective and LED diverters (assuming that over the course of the permit term all diverters will need to be replaced once due to severe weather in different parts of the Plan Area).
  - Address issues with conservation sites such as temporary access limitation, destruction of a portion of a conservation site, or increase in access to conservation site by predators (e.g., due to vegetation damage).
  - Replace green sea turtle (honu) permanent light shields or temporary light fencing and/or increased monitoring to determine nest outcomes and document habitat loss and alteration.
- Due to new invasive species, KIUC may need to purchase additional predator control equipment to increase trapping efforts. Changed circumstances costs also include additional labor costs that may be needed to address new invasive species efforts.
- Due to vandalism, KIUC may need to repair small sections of predator fencing or replace damaged predator control cameras.
- Due to vandalism, KIUC may need to replace or repair up to two green sea turtle (honu) temporary light-proof shields per year.

7.4.11.2 Contingency

To account for uncertainties in costs, the cost model includes a contingency cost category that amounts to $8.2 million dollars over the 50-year permit term. The contingency is calculated as a percent of the total HCP costs for each cost category (Table 7-7).

Contingency costs are expected to be low enough that they can be funded through KIUC's annual operational budget approval process. The contingency costs will be applied to any program costs that are higher than predicted by this HCP in other categories. Contingency funds may be needed, for example, for the following.

- Buy new or repair existing equipment before replacement or repair costs have been budgeted.
- Acquire materials not forecast in the budgets.
- Add temporary staff to address new issues.
- Implement additional or more expensive minimization projects.
- Apply more expensive management techniques.
- Conduct additional monitoring.
- Address unforeseen administrative costs.

Table 7-7. Contingency Cost Assumptions and Explanations

Cost Category	Contingency Assumption	Est. Average Annual Cost	Estimated 50-year Cost	Explanation
Plan Administration	0.0%	-	-	Staffing costs are highly predictable
Minimize Powerline Collisions[a]	1.0%	$20,488	$1,024,385	Powerline minimization costs are very predictable
Save Our Shearwaters Program[a]	1.0%	$3,000	$150,000	There is a long track record of consistent costs at SOS
Manage and Enhance Conservation Sites[a]	4.0%	$97,699	$4,884,959	Accounts for potential cost increases for materials or fuel (e.g., vehicles, helicopters)
Green Sea Turtle Nest Detection and Temporary Shielding Program	12.0%	$20,030	$1,001,478	New program with uncertain costs
Powerline Monitoring Program[a]	1.0%	$11,698	$584,898	10-year record of actual monitoring costs
Seabird Colony Monitoring Program[a]	1.0%	$10,880	$544,017	Multi-year record of actual monitoring costs
State Compliance Monitoring	0.0%	-	-	Fixed cost
Changed Circumstances	0.0%	-	-	Contingency built into remedial action costs
Total		**$163,795**	**$8,189,736**	

[a] There is a high degree of confidence in these costs due to the years of ongoing implementation of HCP minimization and mitigation measures (see Chapter 4, *Conservation Strategy*, for details).

7.5 Funding Assurances

KIUC has the financial capacity and commits to fully fund all costs of the KIUC HCP described above. As shown in Table 7-4 and Table 7-8, KIUC has spent an average of $10.2 million per year over the last 4 years (2020–2023) on early implementation projects and ongoing tasks. This amount exceeds the average estimated total cost of HCP implementation of $8.6 million annually throughout the permit term (Table 7-4). As stated in Section 7.4, *Costs of KIUC HCP Implementation*, the KIUC Board reviews and approves HCP funding on an annual basis that is required to implement the HCP in that year, regardless of whether it exceeds the estimated annual average for the permit term.

A summary of all estimated HCP costs by cost category and their funding source is shown in Table 7-8. Each of these funding sources is summarized below and described in more detail in Appendix 7B, *Funding Assurances: Supporting Information*.

Table 7-8. KIUC HCP Costs and Funding Sources

Cost category	Average Annual HCP Cost (2025–2074)[1]	Type of Cost (Operating or Capital)	KIUC Funding Sources
Plan Administration	$435,685	Operating	Annual operating budget (recovered through proposed 2022 rate increase)
Powerline Collisions Minimization	$2,048,769	Capital	Capital funding through debt financing or lines of credit with banks (see Table 7B-1)
Save Our Shearwaters Program	$300,000	Operating	Annual operating budget (recovered through proposed 2022 rate increase)
Manage and Enhance Conservation Sites	$2,442,480	Operating (68%) and Capital (32%)[2]	Annual operating budget (recovered through proposed 2022 rate increase); capital funding through debt financing or lines of credit with banks (see Table 7B-1)
Green Sea Turtle Nest Detection and Temporary Shielding Program	$166,913	Operating	Annual operating budget (recovered through proposed 2022 rate increase)
Powerline Monitoring Program	$1,169,795	Operating	Annual operating budget (recovered through proposed 2022 rate increase)
Seabird Colony Monitoring Program	$1,088,034	Operating	Annual operating budget (recovered through proposed 2022 rate increase)
State Compliance Monitoring	$52,708	Operating	Annual operating budget (recovered through proposed 2022 rate increase)
Changed Circumstances	$433,510	Operating (50%) and Capital (50%)	Annual operating budget for smaller costs and disaster recovery line of credit for larger costs. Guaranteed by an irrevocable line of credit for remedial actions.

Cost category	Average Annual HCP Cost (2025–2074)[1]	Type of Cost (Operating or Capital)	KIUC Funding Sources
Adaptive Management	$318,974	Operating (80%) and Capital (20%)	Annual operating budget (recovered through proposed 2022 rate increase) for smaller costs. Guaranteed by an irrevocable line of credit for remedial actions.
Contingency	$163,795	Operating	Annual operating budget (for smaller costs) or line of credit through banks (see Table 7B-1) for larger unexpected costs
Total	**$8,620,663**		

[1] Sources: Table 7-4 and Table 7B-2 in Appendix 7B, *Funding Assurances: Supporting Information*.

[2] Approximately 32% of costs in this category are for predator-proof fence construction, maintenance, and repair, which are considered capital costs. All other costs in this category are considered operational costs.

7.5.1 HCP Operational Funding

As shown in Table 7-8, the majority of HCP costs are operational costs. The KIUC Board will need to approve the HCP, which would represent KIUC's commitment to the program for the full HCP term. In addition to this overall program approval, all HCP annual operating costs would be reviewed and approved by the KIUC Board as part of their annual budgeting process each fall for the coming calendar year. KIUC would pay these operational costs through revenue received from ratepayers. All HCP costs (operational and capital) would be eligible for cost recovery through rate cases to the Hawaiʻi PUC, as described in Section 7.5.3, *Cost Recovery through Rate Cases*.

Once an additional HCP expense was identified beyond the approved annual budget, KIUC staff would submit the expense to the KIUC Board for approval of a budget variance for that calendar year. Because the HCP itself would be an approved program by the KIUC Board, the Board would be making the approval as a budget variance (i.e., budget increase) rather than a new budget item. The KIUC Board meets monthly, so a budget variance can be approved relatively quickly to ensure no interruption in HCP implementation. If necessary, a special Board meeting can be called if a budget variance approval is urgently needed to ensure that HCP implementation continues uninterrupted.

7.5.2 HCP Capital Funding

HCP capital costs include implementing powerline minimization projects and installing bird flight diverters (reflective and LED) and installing or replacing fencing at the conservation sites (Table 7-8). Additional capital costs are expected in the event of some changed circumstances, such as landslides or hurricanes at the conservation sites that could destroy fencing. In addition, some capital costs are expected in response to adaptive management changes (Table 7-8).

Small capital costs would be included in the HCP operating budget along with routine operational costs. Larger capital costs would be eligible to use KIUC's several lines of credit available from two financial institutions. KIUC maintains two lines of credit with the National Rural Utilities Cooperative Finance Corporation, a non-profit specialized financial institution lending solely to electric cooperative members and borrowers. KIUC maintains a $25 million line of credit with this bank and a $60 million line of credit specifically for disaster recovery. KIUC also maintains a $15 million line of credit with CoBank, ASB. For details on these lines of credit, see Appendix 7B, *Funding Assurances: Supporting Information*.

All capital costs would be reviewed and approved by the KIUC Board as part of their annual budgeting process each fall for the coming calendar year. These costs would be eligible for cost recovery through rate cases to the Hawai'i PUC, as described in Section 7.5.3, *Cost Recovery through Rate Cases*.

7.5.3 Cost Recovery through Rate Cases

KIUC is a regulated public utility under Chapter 269 of the HRS, in the same way that investor-owned utilities are regulated. Jurisdiction over rates and financing matters of regulated public utilities are vested with the Hawai'i PUC. Under Chapter 269, KIUC is allowed to recover all prudently incurred costs and expenses in its cost of service for ratemaking purposes. All HCP costs are considered prudently incurred costs and expenses because they are directly related to KIUC's day-to-day operations. In other words, compliance with the HCP is critical to KIUC's mission and to its day-to-day operations.

Costs for implementation of the KIUC HCP are part of KIUC's operational and capital costs, which are largely passed on to ratepayers. KIUC's costs for implementation of the KIUC HCP are anticipated to be fully covered by its revenues received, electricity rates charged, and debt financing. Collection of these funds is anticipated to be authorized by the Hawai'i PUC for costs associated with the ongoing operation, maintenance, and construction of utility facilities. HCP-related costs for capital projects would be recovered through debt service and depreciation expenses. All non-capital, operating expenses related to the HCP would be recovered dollar-for-dollar in cost of service.

On October 17, 2022, KIUC filed Docket No. 2022-0208[14] with the Hawai'i PUC to increase rates due to inflationary pressures, increased expenses for the HCP, and the need to recover costs related to the COVID-19 pandemic. The HCP expenditures for which KIUC is requesting rate recovery include:

- Costs to prepare the KIUC HCP and EIS
- Ongoing costs of powerline collision monitoring (see Section 7.4.7, *Infrastructure Monitoring and Minimization Program*)
- Ongoing costs to support the SOS bird recovery and rehabilitation program (see Section 7.4.4, *Save Our Shearwaters Program*)
- Early implementation of conservation sites for the covered seabirds, including predator fence construction, predator control, and site monitoring (see Section 7.4.5, *Manage and Enhance Conservation Sites*).

In Hawai'i, rate cases are requested for a forward looking "test year." KIUC's 2022 rate increase request was for the 2023 test year. For the HCP, this means costs KIUC expected to incur for the HCP in 2023. The rate case sought complete recovery for $4.91 million in test-year operating costs related to HCP activities and depreciation and related debt service on $14.15 million in HCP-related capital projects completed to date.

[14] See https://www.kiuc.coop/ratecase for documents related to this filing. Or see https://puc.hawaii.gov and search for Docket No. 2022-0208.

In November 2023, the Hawaiʻi PUC issued an interim decision[15] that granted KIUC the ability to raise rates by 7.95 percent. The rate increase provides for complete recovery of $4.91 million in test-year operating costs related to HCP activities and depreciation and related debt service on $14.15 million in HCP-related capital projects completed to date. The interim rate increase remains in effect until the Hawaiʻi PUC makes a final decision. Upon final approval by Hawaiʻi PUC, the rate increase becomes permanent and applies to all future years until KIUC requests another rate change.

KIUC does not anticipate that the Hawaiʻi PUC will deny any future request for a rate increase associated with the HCP because the HCP and its permits will continue to be an obligatory operational cost necessary for KIUC to provide reliable service to its customers. KIUC has received approval for recovery of HCP costs in both rate filings made since becoming a cooperative.[16] Should future costs exceed current spending capacity or deteriorate KIUC's margins to an unacceptably low level, KIUC would apply to the Hawaiʻi PUC to request a future utility rate increase.

Once any operational expenditures and capital project costs related to the HCP have been approved by the Hawaiʻi PUC, KIUC shall not, under any circumstance, re-allocate any of the budgeted funds from the HCP to any other budget items or expenses.

Finally, KIUC acknowledges that it must fund all HCP, federal ITP, and state ITL-related compliance costs from available funding sources which may include, without limitation, KIUC operating funds, reserve funds, bonds, and loan guarantees. The Hawaiʻi PUC's decline to approve of any KIUC-requested rate increases to pay for HCP, federal ITP, and state ITL compliance would not relieve KIUC of its responsibility to fully and timely fund its HCP, federal ITP, and state ITL compliance obligations.

7.5.4 Funding Remedial Actions and Adaptive Management

Remedial actions in response to a changed circumstance and adaptive management actions are both a special case for funding because the actual costs and their timing are unpredictable. Remedial action costs would be incurred soon after a changed circumstance is identified and remedial actions are planned in coordination with USFWS and DOFAW (see Section 7.3, *Regulatory Assurances*, for details). Similarly, adaptive management costs would be needed whenever an adaptive management action is identified and the costs to implement that action may exceed routine HCP costs (see Section 7.4.9, *Adaptive Management*). Costs for remedial actions and new costs for adaptive management actions are expected to be funded through one or more of these funding mechanisms:

- Annual HCP operational budget
- Budget variance approved by the KIUC Board (at a time other than the annual budget approval process)
- Debt financing through KIUC's lines of credit, in the case of a new capital cost
- Cost recovery through a rate case request, in the case of a substantial recurring new cost

[15] Interim Decision and Order No. 40404, November 27, 2023 (for Docket No. 2022-0208).

[16] KIUC first applied to the Hawaiʻi PUC for a rate increase in 2009. The 2009 rate case was approved and allowed KIUC to adjust their utility rates to cover the costs of the Short-Term HCP.

To ensure funding, KIUC has provided a special funding guarantee for remedial actions and adaptive management actions, as described below.

7.5.4.1 Funding Guarantee for Remedial Actions and Adaptive Management

Most remedial actions in response to a changed circumstance, as well as adaptive management actions, are expected to be funded through a variety of routine funding sources available to the HCP.

However, because of the importance of these actions and the unpredictability of when they might occur, USFWS and DOFAW have requested an additional financial guarantee that will ensure funding in an amount sufficient to fund a reasonable proportion of expected adaptive management or remedial actions in any one year. This financial guarantee will ensure that, in the event that KIUC does not fund a necessary remedial action in response to a changed circumstance (see Section 7.3.3, *Changed Circumstances Addressed by this HCP*) or KIUC does not fund an adaptive management action agreed to according to the adaptive management decision-making process (see Chapter 6, Section 6.2.2.3, *Adaptive Management Decision-Making Process*), guaranteed funds would be available to implement the required actions.

To provide this financial guarantee, KIUC will secure an irrevocable letter of credit (ILOC). An ILOC is an irrevocable contract that a financial institution issues on behalf of an Obligor (in this case, KIUC) to guarantee payment up to a specified amount to an Obligee (in this case, DOFAW and the National Fish and Wildlife Foundation [NFWF] or another nonprofit organization with financial expertise and natural resource stewardship [collectively the "nonprofit Obligee"] mutually agreed to by DOFAW and USFWS) during a specified period of time. If the Obligor's duties to the Obligee are not fulfilled according to the term of the ILOC, the Obligee can require payment of the funds held by the financial institution. If funds are paid pursuant to the ILOC, the Obligor would owe that amount paid by the financial institution in accordance with the terms of a loan agreement established to secure the ILOC.

The ILOC will have a term of one year that renews automatically until the end of the permit term or until the ILOC is fully utilized, whichever comes first. KIUC's ILOC cannot be terminated during the permit term without the written approval of USFWS and DOFAW. If KIUC wishes to replace the ILOC, KIUC will provide a draft replacement ILOC for review and written approval by USFWS and DOFAW at a minimum of 3 months prior to the expiration of the previous ILOC. If USFWS and DOFAW do not approve the replacement ILOC, the existing ILOC will remain in place and automatically renew.

The ILOC will be issued on terms agreed upon by KIUC, USFWS, DOFAW, and the nonprofit Obligee, which terms may be amended by mutual written agreement. The ILOC will fund annually and continually over the term of the HCP $301,720 for adaptive management plus $487,103 for remedial measures for changed circumstances should they occur (Table 7-3), for a total secured funding level of $788,823. The ILOC amount will increase annually according to inflation. This amount is expected to be sufficient to pay for any necessary adaptive management action or remedial action in any one year. If the ILOC credit is used, KIUC will fully replenish the ILOC funding in the following calendar year.

KIUC's Annual Work Plan and annual budget process described in Section 7.2.1, *Responsibilities of Kauaʻi Island Utility Cooperative*, will include the ILOC to account for these costs. KIUC may request from USFWS and DOFAW an adjustment in the value of the ILOC at future renewal periods of the HCP; however, any changes in funding amounts must be approved by USFWS and DOFAW.

The terms of the ILOC will allow the nonprofit Obligee to request a draw upon the ILOC. Funds may be drawn from the ILOC only if a letter from USFWS or DOFAW is submitted by the nonprofit Obligee to the bank holding the ILOC stating that KIUC has failed to comply with the HCP. If the funds are needed for action on State-owned land, the nonprofit Obligee will pay the receipts directly to DOFAW. If the funds are needed for actions on land other than State land, NFWF will contract necessary personnel to carry out the required corrective action. KIUC shall be responsible for all costs associated with NFWF's services.

If the nonprofit Obligee cannot fulfill the role contemplated for it in this paragraph for any reason, KIUC will recommend, and USFWS and DOFAW shall review and approve, an alternate nonprofit entity to assume the role. If an alternate nonprofit Obligee is not secured, KIUC, USFWS, and DOFAW will mutually agree on an alternative financial assurance mechanism(s) such as a surety bond. KIUC will use its best efforts to ensure that there is never a gap in financial assurance coverage for remedial actions or adaptive management actions.

Any unused funds in the ILOC for adaptive management and change circumstances remedial actions which are held by the nonprofit Obligee will be returned to KIUC by the nonprofit Obligee after the permit term is complete and all of KIUC's obligations and responsibilities incurred during the permit term are complete and paid.

7.5.5 Endowment

As described in Section 7.4.5, *Manage and Enhance Conservation Sites*, KIUC will be establishing a permanent conservation easement on the Upper Mānoa Valley and Upper Mānoa Valley PF conservation sites. The easement will be held by a third party approved by USFWS and DOFAW to monitor and ensure compliance with the conservation easement. Easement monitoring is estimated to cost $15,000 annually. During the permit term, KIUC will pay these easement monitoring costs annually. As a condition of the easement, KIUC will also establish in the first year of the permits a non-wasting endowment. KIUC will fund the endowment with an annual contribution of $3,500. Assuming a net annual interest (minus inflation and fees) of 3.5 percent, the endowment is expected to grow to approximately $475,000 by the end of the permit term. Beyond the permit term, the non-wasting endowment will generate annual interest estimated at $16,500, which is sufficient to pay for the easement monitoring cost plus a 10 percent fee on each annual withdrawal.

7.5.6 Funding Adequacy

KIUC has been in existence as a successful electric cooperative since November 2002. In 2022, KIUC received $174.8 million in revenue with expenses that totaled $165.2 million, generating a net margin before interest of $9.6 million (Kauaʻi Island Utility Cooperative 2023). These expenses included early HCP implementation costs shown in Table 7-4 and as described below.

KIUC is solvent and able to meet its current financial obligations, including the conditions and obligations of the KIUC HCP. KIUC will provide adequate resources to fulfill commitments as described in the KIUC HCP. KIUC will forecast anticipated program needs, ensuring that KIUC is able to pay for all conservation measures, monitoring and adaptive management, and HCP administration.

As a non-profit cooperative owned by its member customers, KIUC has access to low-interest loans or loan guarantees provided by the federal government for capital investments through programs such as the U.S. Department of Agriculture Rural Utilities Service. These figures and KIUC's status as a utility cooperative demonstrate that KIUC has the financial ability to pay the HCP implementation costs described in this chapter.

KIUC has demonstrated its ability to fund HCP implementation since 2011. Table 7-9 documents what KIUC has spent to date on HCP implementation. From 2011 to 2016 KIUC successfully implemented and completed the Short-Term HCP. Since 2016, KIUC has continued to implement many of the same conservation measures in the Short-Term HCP that are now part of this HCP. In addition, KIUC has implemented a significant number of powerline minimization projects after the Short-Term HCP (i.e., between 2017 and 2023) as early implementation actions for this HCP. The average annual cost of HCP implementation is approximately $8.2 million (Table 7-4). KIUC has exceeded that level of annual spending on early HCP implementation actions in three of the last 4 years (2020–2022) (Table 7-9).

Table 7-9. KIUC Spending on Implementation of Measures Similar to those in this HCP (adjusted for inflation through 2023)

Year	Powerline Minimization	Streetlight Retrofit	Conservation Site Management and Monitoring	Powerline Collision Monitoring	SOS Program[a]	Total
2011	$5,989,222	$0.00	$1,153,911	$287,655	$344,614	$7,775,402
2012	$306,105	$0.00	$643,678	$303,228	$338,294	$1,591,304
2013	$1,207,926	$0.00	$422,942	$125,274	$335,253	$2,091,395
2014	$2,104,591	$0.00	$772,040	$292,163	$320,963	$3,489,756
2015	$1,363,652	$0.00	$898,766	$286,406	$363,236	$2,912,060
2016	$275,460	$0.00	$2,201,183	$1,484,817	$305,589	$4,267,050
2017	$258,619	$0.00	$1,738,590	$720,703	$316,721	$3,034,632
2018	$494,888	$0.00	$1,929,260	$775,023	$320,190	$3,519,361
2019	$82,169	$0.00	$1,403,329	$732,574	$278,620	$2,496,692
2020	$7,117,986	$0.00	$1,284,883	$671,534	$343,877	$8,741,488
2021	$6,863,172	$0.00	$1,533,188	$1,144,341	$480,208	$10,649,834
2022	$7,551,330	$0.00	$1,715,986	$1,098,595	$408,550	$10,981,575
2023	$3,703,817	$0.00	$3,339,233	$1,108,195	$322,721	$8,473,966
Total	$37,318,937	$0.00	$19,036,989	$9,030,508	$4,478,836	$70,024,515

Sources: Short-Term Habitat Conservation Plan Kaua'i Island Utility Cooperative Annual Reports, 2015 to 2023
[a] KIUC funding of the SOS Program dates to 2003. Only funding since 2011 is shown.

The cost estimate for HCP implementation is designed to be conservative; that is, it likely somewhat overestimates future costs. Reasons for this conservative estimate include the following.

- When cost ranges were available, the higher unit cost was chosen as the assumption for the cost model.

- New technologies may be developed during the 50-year permit term that may allow KIUC to achieve the biological goals and objectives of the Plan, or implement the monitoring program, with greater efficiency and lower cost.
- Cost estimates for management of the conservation sites (the largest share of all costs) are based on actual KIUC contractor costs that were scaled up to the 12 conservation sites that will be operational under this HCP. With a larger conservation program, future unit costs may be lower as KIUC seeks more competitive bids for HCP services, realizing more economies of scale.

However, despite the conservative nature of the cost estimate, costs may still exceed predictions. This section describes the safeguards in place if funding needs are greater than those described in this chapter.

- **Cost savings.** Some cost savings are expected due to the economies of scale realized by scaling up KIUC’s existing conservation program. In addition, advances in technology are expected to reduce some costs. These cost savings may partially or fully offset any unexpected HCP costs.
- **Contingency fund.** In the event that cost increases cannot be offset by cost savings elsewhere in the HCP program, the contingency fund is designed to pay for unexpected costs. Contingency amounts vary by cost category to account for different levels of uncertainty in the cost of HCP actions. See Section 7.4.11.2, *Contingency*, and Appendix 7A, *Cost Model*, for details.
- **KIUC Board approval.** The KIUC Board has the ability at any time to approve budget variances in the event that additional HCP funding is needed that exceeds annual budgets. Budget variances can be approved at a monthly Board meeting or a special Board meeting to ensure no interruption in HCP funding.
- **Lines of credit for unexpected capital costs.** As described above in Section 7.5.2, *HCP Capital Funding*, KIUC has access to $40 million in lines of credit in the event that unexpected capital costs are incurred to implement the HCP. If capital costs are associated with a natural disaster, KIUC can access up to $60 million more in lines of credit to rebuild following that natural disaster.
- **Cost recovery through rate cases.** As described above in Section 7.5.3, *Cost Recovery through Rate Cases*, KIUC has the ability to recover HCP implementation costs that may exceed projections. Once approved by the Hawai‘i PUC, the cost recovery becomes permanent until the next rate case adjustment is requested.
- **Irrevocable line of credit for remedial actions or adaptive management.** KIUC will secure an irrevocable letter of credit to guarantee that costs for necessary remedial actions should changed circumstances occur, or costs for necessary adaptive management actions, will be paid for. DOFAW or the nonprofit Obligee can draw upon this line or credit in the event that KIUC fails to meet its obligations for these specific responses. See Section 7.5.4.1, *Funding Guarantee for Remedial Actions and Adaptive Management*, for details.
- **Amend the HCP.** Finally, in the event that HCP implementation costs far exceed projections, KIUC always has the ability to apply to amend the HCP, federal ITP, and state ITL in accordance with federal and state regulations. One purpose of a plan amendment may be to adjust the conservation strategy and monitoring program to reduce costs while still meeting all regulatory requirements of the Hawai‘i and federal ESAs. Any plan amendment is subject to the approval of USFWS and DOFAW, as described in Section 7.6.2, *Major Amendments*.

7.6 Revisions and Amendments

There are two types of changes that may be made to the HCP: minor modifications or major amendments, each of which is described in the following subsections. All revisions and amendments will be processed in accordance with all applicable legal requirements.

7.6.1 Minor Modifications

Minor modifications are changes to the HCP provided for under the operating conservation program, including adaptive management changes and responses to changed circumstances (Section 7.3.1, *Changed Circumstances*). They also include revisions that do not increase the levels of authorized incidental take and do not materially modify the scope or nature of activities or actions covered by the ITP and state ITL to the extent that they potentially increase adverse effects on the covered species or diminish beneficial effects of the conservation strategy on the covered species. Minor modifications may include, but are not limited to, the following.

- Correction of any maps or exhibits to correct errors in mapping or to reflect previously approved changes in the HCP.
- Correction of the HCP or its appendices to for any spelling errors or omissions.
- Modifying existing or establishing new conservation measures to further minimize or avoid take of the covered species.
- Modifying reporting protocols for the annual report.
- Minor changes to monitoring or reporting protocols.
- Revising conservation site enhancement and management techniques.

USFWS and DOFAW will confirm receipt of any modification request and will notify KIUC acknowledging the minor modification or determining if such modification request would require a major amendment as described below. KIUC will not implement a proposed minor modification until it receives written confirmation from both USFWS and DOFAW that a major amendment is not required.

7.6.2 Major Amendments

Major amendments are changes in the HCP that may affect the impact analysis or conservation strategy. Amendments to the HCP and either the federal ITP or state ITL follow the same formal review process as the original HCP and permits, including NEPA/Hawai'i Environmental Protection Act[17] review, *Federal Register* notices, an internal Section 7 consultation with USFWS, and approval by the ESRC and BLNR. A major amendment includes but is not limited to the following.

- Adding a new covered species to the HCP and the incidental take authorizations.
- Changes to the covered activities (either deletion or addition) not addressed in the HCP as originally adopted, and which otherwise do not meet the criteria for a minor modification as discussed in Section 7.6.1, *Minor Modifications*.

[17] HRS Chapter 343.

- Increasing take authorization for any of the covered species.
- Proposal for new or modified powerlines or streetlights as defined in Appendix 4E, *Review of New Powerlines and Streetlights in Northwestern Kauaʻi*, in the Area of Additional Conservation Commitments where the agencies determine the activity requires an amendment to the HCP consistent with the evaluation described in Appendix 4E.
- Substantial changes to the conservation strategy beyond what is contemplated in the adaptive management process in Chapter 6, *Monitoring and Adaptive Management Program*.
- Extending the terms of the federal ITP or state ITL other than through a permit or license renewal process described below.

A major amendment requires submittal to USFWS and DOFAW of a written application and implementation of all permit processing procedures applicable to an original ITP and state ITL. The specific documentation required to comply with the federal ESA, HRS Chapter 195D, NEPA, and Hawaiʻi Environmental Protection Act will vary based on the nature of the amendment.

7.6.3 Permit Suspension or Revocation

USFWS or DOFAW may suspend or revoke their federal ITP or state ITL if KIUC fails to implement the HCP in accordance with the terms and conditions of the ITP or state ITL or as otherwise provided by law. Suspension or revocation of the federal ITP or state ITL shall be done in accordance with applicable federal or state law.

7.6.4 Permit Renewal

7.6.4.1 Renewal of Federal Incidental Take Permit

The federal ITP associated with this HCP may be eligible for renewal before the 50-year permit term expires in accordance with applicable law at the time the renewal request is made.

7.6.4.2 Renewal of State Incidental Take License

Upon expiration, and to the extent permitted by law, the state ITL may be renewed without the issuance of a new license, provided that the license is renewable, and that biological circumstances and other pertinent factors affecting the covered species are not significantly different than those described in the original HCP. To renew the license, KIUC must submit to DOFAW, in writing, the following.

- A request to renew the state ITL.
- Reference to the original license number.
- Certification that all statements and information provided in the original HCP and license application, together with any approved HCP amendments, are still true and correct, or inclusion of a list of changes.
- A description of what take has occurred under the existing license.
- A description of what activities under the original license the renewal is intended to cover.

If DOFAW concurs with the information provided in the request, they will renew the take authorizations consistent with their respective renewal procedures. If KIUC files a renewal request and the request is on file with DOFAW at least 30 days prior to the expiration of the state ITL, the authorizations will remain valid while the renewal is being processed, provided the existing authorization is renewable. If KIUC fails to file a renewal request at least 30 days prior to license expiration, the license will become invalid upon expiration. KIUC must have complied with all annual reporting requirements to qualify for a license renewal.

7.6.5 Change in Ownership

In the event of sale or transfer of ownership of facilities covered under this HCP during the permit term, the permit/license may be transferred to the new owner. KIUC must notify USFWS and DOFAW in advance of the sale or transfer of ownership for information on the requirements for state ITL and federal ITP in effect at that time.

7.7 Reporting

7.7.1 Annual Reporting

KIUC will prepare an annual report for each year of the 50-year permit term of the KIUC HCP. The annual reports will summarize implementation activities in the previous calendar year (January 1 to December 31) as well as cumulatively over the permit term. KIUC will submit each annual report following the reporting year in order to comply with the reporting deadline established by the Hawaiʻi ESA.[18]

Immediately following each calendar year, KIUC's contractors will submit to KIUC technical reports that summarize their activities in the previous calendar year. Once all of the technical reports are available (usually in the spring of each year), KIUC will prepare an annual report and submit it to USFWS and DOFAW by a target date of July 1 of each year, but no later than September 28 as required by the Hawaiʻi ESA.

KIUC's annual reports will include the following information.

- A description of all covered activities implemented during the reporting period categorized by major activity type (per Chapter 2, *Covered Activities*).
- A list of new powerlines or streetlights installed within the reporting period.
- A list of any proposed new powerlines or streetlights planned for installation in the *Area of Additional Conservation Commitments* (Figure 4E-1 in Appendix 4E, *Review of New Powerlines and Streetlights in Northwestern Kauaʻi*) discussed with USFWS and DOFAW in the previous year, or newly proposed in the future.
- A summary of searches for covered seabirds at covered facilities, including a list of dates and times of searches and the results.

[18] HRS Section 195D-21(f) requires HCP permittees to submit an annual report within 90 days of each fiscal year ending June 30.

- An annual and cumulative summary (i.e., from the start of the permit term) of the amount of take of each covered species (see *Take Monitoring* sections in Chapter 6, *Monitoring and Adaptive Management Program*, for the methods for each covered species).
- An accounting of all minimization actions applied to the covered activities during the reporting period.
- A summary of all conservation actions implemented during the reporting period.
- An annual and cumulative summary of the rescues and releases from the SOS Program (or similar rehabilitation program) of each of the covered seabirds and covered waterbirds.
- A description of the monitoring undertaken for covered seabirds and covered waterbirds during the reporting period and a summary of monitoring results.
- A description of the monitoring undertaken for the green sea turtle (honu) during the reporting period and a summary of the monitoring results, including all the reporting requirements described under Chapter 4, Section 4.4.5.5, *Annual Training and Reporting*.
- A summary of coordination with Kaua‘i DAR, NOAA, and USFWS and the avoidance measures utilized at these locations, if applicable, when a Hawaiian monk seal (‘ilio holo i ka uaua) (*Neomonachus schauinslandi*) occurs at a beach where the green sea turtle (honu) nest detection and shielding program is implemented and a green sea turtle (honu) nest is within 50 ft of a monk seal adult or within 150 ft of a monk seal mother and pup.
- An assessment of the HCP's achievement to date of each of the biological objectives, including an analysis of the problems and issues encountered in meeting or failing to meet the HCP biological objectives.[19]
- A description of the adaptive management process utilized during the reporting period, including any changes implemented because of that process.
- A summary of any changes to the monitoring program techniques or protocols including monitoring locations, variables measured, sampling frequency, timing, and duration, and analysis methods, and an explanation for those changes.
- An assessment of the efficacy of the minimization, conservation, and monitoring actions and recommended changes based on interpretation of monitoring results and research findings.
- A description of any remedial actions taken or planned for changed circumstances, and an assessment of the results of remedial actions taken.
- A summary of planned actions and management objectives for the next fiscal year, including any proposed modifications to conservation measures (as required by HRS Section 195D-21(f)).
- The status of HCP funding (as required by HRS Section 195D-21(f)).
- A summary of any administrative changes, minor modifications, or major amendments proposed or approved during the reporting year, as defined in Section 7.6, *Revisions and Amendments*.
- A schedule showing when HCP components will be implemented and when each component is completed.

[19] As required by HRS Section 195D-21(f).

- A summary description of any model updates.
- An assessment of new and emerging technology that may be useful to meet HCP objectives.

7.7.2 Other Reporting and Coordination

This section addresses reporting situations or coordination that could arise during HCP implementation in which reporting to or coordination with USFWS and DOFAW would need to occur sooner than the annual reporting cycle.

- KIUC will schedule regular coordination meetings with USFWS and DOFAW to facilitate communication and provide updates as identified in Chapter 6, Section 6.2.2.3, *Adaptive Management Decision-Making Process*.
- A description of any delays in scheduled KIUC HCP implementation, reasons for delays, and planned responses.
- Notify USFWS and DOFAW of any changes regarding the ILOC.
- When locating any dead, injured, or sick individuals at the two covered KIUC facilities (Port Allen Generating Station and Kapaia Generating Station), initial notification to USFWS and DOFAW must be made within 24 hours by phone or email. A written report will be provided to USFWS and DOFAW within one week of detecting the dead, injured, or sick individual.
- When locating any injured or sick individuals at conservation sites that are removed to the SOS Program, initial notification to USFWS and DOFAW must be made within 24 hours by phone or email. A written report will be provided to USFWS and DOFAW within one week of detecting the injured or sick individual.
- For active green sea turtle (honu) nests that require shielding, monitors will estimate the age of the nest. KIUC will submit this information to USFWS, DOFAW, and DAR within 30 days of nest discovery for their review (Chapter 4, Section 4.4.5.1, *Nest Detection*).
- Evidence of emergence and take (if any occurs) of green sea turtle (honu) will be reported to USFWS, DOFAW, and DAR within 24 hours (Chapter 4, Section 4.4.5.3, *Monitoring Schedule*).
- If any active green sea turtle (honu) nests are overlooked by the monitoring program and if any resulting take occurs that can be attributed to KIUC streetlights, KIUC will also report these incidents as soon as possible to USFWS, DOFAW, DAR, and in the annual report (Chapter 4, Section 4.4.5.5, *Annual Training and Reporting*).

Chapter 8
Alternatives to Take

Chapter 8 Highlights

Chapter Purpose: This chapter identifies alternative actions considered by KIUC that could avoid or reduce take of the covered species. These alternatives were determined by KIUC to be infeasible, impractical, or unaffordable and therefore were not selected for this HCP. The chapter describes the reasons each alternative considered was rejected.

Context: The federal Endangered Species Act, Section 10(a)(2)(A), requires applicants to consider alternative actions to the take of covered species and to explain the reasons why those alternatives were not selected.

Major Conclusions: KIUC considered and rejected four alternatives to the proposed HCP.	**See the following for more information:**
• **No Take Alternative.** This alternative would require KIUC to either remove or place underground all overhead wires and remove or turn off all streetlights and covered facility lights. This is not feasible because KIUC is mandated by state regulations to provide reliable electricity to its customers at affordable rates. Similarly, streetlight operations are required by State and County regulations and facility light operations are necessary for employee safety.	Section 8.1
• **Underground High-Risk Transmission Lines.** This alternative would incur prohibitively high costs to rate payers. The cost to underground 65 miles (104.6 kilometers) of powerlines was estimated at $340 million to $690 million, two to four times KIUC's total operating income. In addition, trenching and continuous vegetation management along the easements would have substantial and likely unacceptable effects on cultural and historic resources, and on native and protected plant communities.	Section 8.2
• **Reconfigure High-Risk Transmission Lines**. KIUC considered reconfiguring a larger number of high-risk powerline segments than what was implemented. Reconfiguring more high-risk transmission lines take much longer to result in benefits and are less cost-efficient in reducing powerline collisions than employing other minimization methods such as removal of static wire and installation of bird flight diverters.	Section 8.2
• **Extensive Tree Planting**. Shielding powerlines by planting trees to reduce the risk and incidence of covered bird species strikes was determined to be infeasible for many reasons. For example, fire risk, extensive private land ownership and lack of KIUC control over land uses, unacceptable visual impacts, and incompatible land uses adjacent to powerline corridors. Most importantly, increased tree cover near powerlines would greatly increase the risk of trees or tree limbs falling and damaging powerlines, which causes power outages and increased fire risk and costs of repairs.	Section 8.3
• **Data Sources:** A report prepared by an engineering company was used as the basis for cost estimates of placing overhead powerlines underground. The effectiveness of minimization methods has been estimated by KIUC using powerline collision monitoring data collected by KIUC annually since 2013 across its powerline system.	

Section 10(a)(2)(A) of the federal Endangered Species Act (ESA) requires applicants to consider alternative actions to the take of covered species and to explain the reasons why those alternatives were not selected. The Endangered Species Habitat Conservation Planning (HCP) Handbook (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016) identifies several types of alternatives commonly used in HCPs: (1) an alternative that would reduce take below levels anticipated for the proposed project, (2) an alternative that would avoid take and hence not require a permit from the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, and (3) an alternative where the proposed project would not occur.

This chapter identifies four alternative actions considered by KIUC that would avoid or minimize the potential for take of each covered species in the KIUC HCP: A "no take" alternative, undergrounding high-risk transmission lines, reconfiguring high-risk transmission lines, and extensive tree planting. These alternatives were not selected by KIUC because they were not feasible nor practical, as explained in this chapter.

8.1 No Take Alternative

The no take alternative would require KIUC to modify all of its existing and future infrastructure (Chapter 2, *Covered Activities*) to prevent any take of the covered species. As discussed in Chapter 4, *Conservation Strategy*, and Chapter 5, *Effects,* certain existing and future KIUC powerlines, streetlights, and facility lights result or are likely to result in take of the covered species. Even with substantial avoidance and minimization measures applied, take would continue to result from collisions with powerlines and attraction and disorientation due to KIUC-owned and -operated streetlights and facility lights.

8.1.1 No Take of Covered Seabirds and Waterbirds

The only approaches that KIUC could use to completely eliminate the possibility of take of the covered seabirds and covered waterbirds from its infrastructure are to: (1) remove all powerlines on the Island of Kauaʻi that result in take; or (2) underground all powerlines not completely shielded by topography, vegetation, or other structures. In addition, KIUC would have to remove or turn off all streetlights and facility lights that result in take during the seabird fledging season (September 15 to December 15).

These no take alternative approaches are neither feasible nor practicable. KIUC cannot remove all of its powerlines that have a reasonable likelihood of take of covered species because it is mandated by state regulations to provide reliable electricity to its customers. Similarly, it is not feasible to eliminate nighttime lighting along state and county roadways during the three months of the seabird fledging season. Streetlight operation is governed by State and County regulations and operated for public safety. HCP covered generation and distribution facilities that KIUC operates 24 hours per day, 7 days per week, must be lit at night for reasons of public and worker health and safety.

Undergrounding all KIUC powerlines to eliminate take of covered seabirds and waterbirds is not feasible because (1) it is cost prohibitive, (2) it would involve significant impacts on cultural and historic resources, (3) it would affect native and protected plant communities to varying degrees depending on specific locations both during construction and during repairs, and (4) it would substantially increase the time and cost necessary to conduct line repairs. Each of these factors is described further below.

Cost. The existing KIUC transmission, distribution, and communication system includes roughly 1,500 miles (mi) (2,414 kilometers [km]) of overhead electrical cables. KIUC commissioned a study in 2015 to estimate the cost of undergrounding 4.0 mi (6.4 km) of transmission lines in three high-risk collision areas (see Section 8.2, *Underground or Reconfigure High-Risk Transmission Lines*, for details). In this study, the cost to underground KIUC transmission lines in high-risk collision areas was estimated to be (inflated to 2023 dollars) roughly $10 million per mile of existing overhead line (per mile costs ranged between $7.5 million and $14.3 million depending on the spans).[1] Applying this cost factor to KIUC's entire system returns a rough cost of $10.3 billion. This is likely an underestimate of cost because:

- The total length of undergrounded lines would have to be considerably more than the total length of existing overhead lines due to constraints of land ownership, access, topography, surface infrastructure, and cultural sites (i.e., underground lines could not always follow the same path as overhead lines).
- Uncertain indirect costs are excluded such as the environmental review process, legal costs associated with the Hawai'i Public Utilities Commission process, landowner negotiations, or citizen lawsuits.
- Cost estimates only include initial capital costs, not long-term operational costs. The cost to repair underground lines is typically much greater than the cost to repair overhead lines due to the increased complexity of the infrastructure and greater repair constraints when underground.
- Based on outage data from other mainland utilities, the frequency of repair of underground lines would likely be reduced by approximately half (e.g., repairs would be nearly eliminated from downed trees, vehicular collisions with power poles, or storms) (e.g., Johnson 2004). However, this may not offset the substantial increase in cost per repair event. Furthermore, the typical lifespan of underground wires is about half that of overhead wires (40–50 years vs. 80–100 years [Xcel Energy 2014][2]), meaning that underground wires would have to be replaced twice as often as overhead wires. Thus, operational costs of underground lines are considerably higher than the operational costs of overhead lines.
- These costs are only to replace existing powerlines. They do not include the additional construction costs of building new powerlines underground and the additional operational costs for new underground lines. KIUC's system is expected to grow by up to approximately 23 percent (360 mi [579 km] of new powerlines in a system of 1,531 circuit-mi [2,464 km] of powerlines; see Chapter 2, *Covered Activities*). Applying this to the rough cost above means that undergrounding additional powerlines would cost at least another $2.4 billion in current dollars.

KIUC already has some of the highest electricity rates in the country (U.S. Bureau of Labor Statistics 2023) and a very small base of ratepayers that would carry these additional costs. In addition, KIUC's federal and private sector lenders and the Hawai'i Public Utilities Commission impose financial responsibility on KIUC that limit its ability to substantially raise rates. For these reasons,

[1] In 2021, Pacific Gas & Electric Company (PG&E) proposed to underground 10,000 miles of their powerline system to reduce wildfire risk at a cost of approximately $20 billion. This equates to an average per mile cost of $2 million. Actual costs in 2022 by PG&E ranged from $2.5 million per mile to $3.75 million per mile. The higher cost of KIUC's estimate is likely due to the higher cost of materials and labor in Hawaii, the lower economies of scale as compared to the PG&E program, and the greater complexity in Hawaii of topography and land use constraints as compared to PG&E's vast service area in northern California (Institute for Energy Research 2021; De Lombaerde 2022).

[2] Other sources cite a lifespan of underground powerlines as 30 to 35 years as compared to overhead powerlines having a lifespan of 70 to 80 years (Institute for Energy Research 2021).

undergrounding all of its powerlines that have a risk of causing take of the covered species is not financially feasible. See Section 8.2, *Underground or Reconfigure High-Risk Transmission Lines*, for additional information on the prohibitive cost of moving some transmission lines underground.

Impacts on cultural and historic resources. Undergrounding powerlines throughout the island would require trenching of 1,500 mi (2,414 km) to 2,000 mi (3,219 km) or more, depending on new alignments. Trench width would vary by line types and terrain but would be expected to be at least 4 feet (1.2 meters) wide and 6 feet (1.8 meters) deep. To ensure a stable trench and equipment access, the disturbance footprint would have to be much wider. Trenching at this scale across Kaua'i would have substantial adverse effects on sensitive cultural and historic resources. Rerouting underground powerlines to avoid such resources would increase the time and cost to complete them. In some cases, it may not be possible to avoid these impacts by altering the alignment. This scale of trenching would also carry a high risk of disturbing unmarked and unidentified burials.

Impacts on native and protected plant communities. Undergrounding powerlines throughout the island would result in many alignments traversing through native and protected plant communities. Once lines were underground, the easement would require long-term maintenance to prevent the growth of vegetation other than grasses along the buried alignment, which would prevent native and protected plant communities from re-establishing. Examples include the distribution line that runs through Waimea Canyon State Park and crosses extensive stands of native and protected 'ōhi'a forests. Undergrounding these powerline spans would result in extensive disturbance and loss to these native and protected plant communities.

More time to conduct line repairs and restore power. Damage to overhead powerlines is relatively easy to locate and typically takes hours or days to repair. Damage to underground powerlines is more difficult to pinpoint and often takes days, weeks or months to repair. This considerably longer time for repairs of underground lines would severely affect KIUC's system reliability goals. Such delays may also be unacceptable to KIUC customers who are accustomed to repair times with overhead powerlines.

For all of the reasons described above, it is infeasible for KIUC to bury underground all or most of its powerlines in order to eliminate take of covered seabirds and covered waterbirds.

8.1.2 No Take of Green Sea Turtle

For green sea turtle (honu) (*Chelonia mydas*), the no take alternative may or may not be feasible depending on the outcomes of discussions between KIUC, Kaua'i County, and the State as discussed in Chapter 4, Section 4.4.6, *Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle (honu)*. The no take alternative for this species would involve KIUC, in coordination with the County and the State, implementing measures that ensure streetlights near sandy beaches are not visible from green sea turtle (honu) nesting habitat.

KIUC will continue to consult with the County and State to determine if there are practicable ways to avoid take of green sea turtle (honu) hatchlings due to light disorientation resulting from KIUC streetlights. As stated in Section 4.4.6, these techniques may include shielding, change in wattage, or height reduction (streetlights cannot be moved, turned off, or dimmed). Changes in local regulations are needed to allow these measures to be consistent with public health and safety requirements. Therefore, KIUC can only implement these measures with agreement from the County and State. The conservation strategy for green sea turtle (honu) relies solely on a monitoring and nest shielding program (see Section 4.4.5, *Conservation Measure 5. Implement a Green Sea Turtle (honu) Nest*

Detection and Shielding Program) to minimize take, until such time as an agreement between KIUC, the County, and the State can be reached to modify streetlights in ways that avoid take of green sea turtle (honu).

As stated in Section 4.4.6, *Conservation Measure 6. Identify and Implement Practicable Streetlight Minimization Techniques for Green Sea Turtle (honu)*, streetlight modifications must be (1) practicable from an engineering standpoint (e.g., compatible with current streetlight equipment), (2) legal (i.e., what is allowed by County and State regulations and safety risk management), (3) financially practicable (i.e., not cost prohibitive) and (4) will benefit green sea turtle (honu). If any of these requirements cannot be met, then the no take alternative for green sea turtle (honu) is not feasible.

8.2 Underground or Reconfigure High-Risk Transmission Lines

Under this alternative, KIUC evaluated undergrounding or reconfiguring transmission lines that constituted a significant number of bird strikes based on Kauaʻi Endangered Seabird Recovery Project monitoring (Kauaʻi Endangered Seabird Recovery Project 2020). This alternative would target KIUC's cross-island line, which runs from Port Allen across the interior of the island to Wainiha, and the major electrical feeds that connect to it.

To evaluate the cost of undergrounding, KIUC contracted with Electric Power Engineers, Inc. (EPE) for a detailed assessment of the technical and economic feasibility of undergrounding three spans of the cross-island line. The study did not consider environmental or permitting feasibility.

- 2.5-mi-long (4-km) span across the Powerline Trail
- 1.0-mi-long (1.6-km) span across the ʻEleʻele Coffee Fields
- 0.5-mi-long (0.8-km) span across Lāwaʻi Valley

In its June 11, 2015, report titled Assessment of Opportunities for Minimizing Adverse Effects to Seabirds: Wainiha – Port Allen 69 kV Double Circuit Transmission Line, EPE concluded that while undergrounding the cross-island line spans would completely eliminate the potential for covered seabird collisions in those areas, it would be very difficult and prohibitively expensive to construct and maintain. In addition, when line failures did occur, they would be very difficult to locate and repair, and this would result in extended circuit outages that increases the risk of a system failure with wide-ranging adverse consequences.

EPE calculated the following costs for the three line spans, expressed in 2023 dollars.

- The cost to underground the Powerline Trail span would be approximately $30.9 million. The underground route is approximately double the length of the overhead route due to land ownership, topography, access, and other engineering constraints. The cost amounts to approximately $12.5 million per existing overhead alignment mile and $8.2 million per new underground alignment mile.
- The cost to underground the ʻEleʻele Coffee Fields span would be approximately $7.5 million per mile.
- The cost to underground the Lāwaʻi Valley span would be approximately $7.2 million (or approximately $14.3 million per mile).

Using the per-mile costs noted above, KIUC extrapolated the costs to underground all 47 miles (75.6 km) of cross-island line and associated connector lines from the Port Allen Generating Station to Wainiha, including the Powerline Trail. KIUC estimated that undergrounding the cross-island line would cost a minimum of $215 million, and that the cost could easily be more than twice that amount (over $430 million). If the major electrical feeds extending from this line (e.g., the 69-kilovolt lines from the Kilohana Tap to Līhu‘e [5 mi {8 km}], from Hanahanapuni to Kapa‘a [7 mi {11.3 km}], and from the Kōloa Substation to the cross-island line [6 mi {9.7 km}]), were also undergrounded, the cost would increase by another 60 percent—$340 to $690 million.

The potential costs are prohibitively high. KIUC's utility operating income in 2022 was approximately $174.8 million, so the additional costs represent two to four times KIUC’s total operating income (Kaua‘i Island Utility Cooperative 2023). In addition, this approach would leave most of the existing overhead electrical powerlines in place, presenting continued risk of powerline collisions to the covered seabirds. The costs to underground powerlines can be highly variable, depending on terrain, access, geological conditions, and physical obstacles such as roads and bodies of water. Typically, the cost to underground 69-kilovolt lines along roadways are three to five times as much as costs undergrounding the same line away from a roadway. The underground differential costs are even greater where the route is unable to follow the more direct route of overhead lines, or if significant directional boring is required (e.g., to cross a river, a perpendicular pipeline, or other buried infrastructure).

KIUC has implemented powerline collision minimization projects throughout its powerline system, including high-risk lines, utilizing techniques that in many cases are nearly as effective as burying powerlines, but are substantially more cost effective and can be implemented much sooner (i.e., years earlier), providing benefits to the covered seabirds much earlier than burying lines. For example, KIUC installed light-emitting diode (LED) diverters along Powerline Trail in 2021 to avoid and minimize powerline collisions. LED diverters are estimated to reduce powerline collisions of the covered seabirds by 90 percent (Table 4-2b, Figure 4-5b). In combination with static wire removal LED diverters can reduce powerline collisions of covered seabirds upwards of 95 percent or more (Travers and Raine 2020). Similarly, reflective diverters in combination with static wire removal have been estimated to reduce powerline collisions of the covered seabirds by up to 80 percent.

KIUC has also implemented powerline reconfiguration projects along three of its high-risk transmission lines (see Table 4-3 and Figure 4-4). All these minimization techniques in combination and across all of KIUC’s system are expected to reduce covered species collisions substantially at a cost of less than 14 percent ($18 million) of the cost to underground a small portion of KIUC’s transmission line system. It is therefore infeasible for KIUC to implement the alternative to underground high-risk powerlines because a much more cost-effective technique is available (bird flight diverters in combination with static wire removal) that is nearly as effective.

KIUC also considered reconfiguring a larger number of high-risk powerline spans than what has been completed. For example, KIUC considered powerline reconfiguration projects on Powerline Trail and Kīlauea, both of which are high-risk line spans for collisions of covered seabirds. After careful study and analysis of monitoring data, KIUC determined that a combination of removing static wires and installation of reflective diverters (on Kīlauea) or LED diverters (on Powerline Trail) was as effective or more effective in reducing seabird collisions than what a powerline reconfiguration could accomplish, were much quicker to implement, and at considerably less cost.

8.3 Extensive Tree Planting

This alternative would involve extensive tree planting in areas with exposed powerlines, especially in any high-strike locations along perimeter lines. The trees, once tall enough, would shield the powerlines and reduce the risk and incidence of covered bird species strikes.

KIUC considered this alternative but determined that extensive tree planting is not a viable alternative. This alternative was not selected because:

- Trees planted adjacent to powerlines would take many years to reach a height and canopy coverage to provide the shielding necessary to substantially reduce or eliminate collision risk. Fast-growing trees such as Albizia (*Falcataria moluccana*), which can grow up to 15 feet (4.6 meters) per year, are nonnative, invasive, and at great risk of damage from storms. Native trees or trees better able to withstand storms tend to be slower growing.
- Many interior powerlines are elevated above the existing tree line, even using alternative tree species. Therefore, in some areas trees would not grow tall enough to reduce collision risk.
- Vegetation and powerlines are incompatible, in terms of the risk associated with trees falling on the lines, especially during storms. KIUC has a legal responsibility to provide reliable power to its members. It does this by reducing the risk of outages to the greatest extent possible. Falling trees and tree limbs are the number one cause of power outages on the island. Therefore, it is KIUC's responsibility to limit or remove vegetation around powerlines to improve and maintain system reliability.
- Land on either side of the powerlines where trees would need to be planted and maintained is mostly privately owned. It would be infeasible to negotiate with thousands of individual landowners to plant and maintain additional trees on their property.
- KIUC does not own or control the land where they install lines. In addition, KIUC does not utilize eminent domain. Line access is acquired through easements with willing landowners.
- In some areas, land uses adjacent to the powerline corridor are incompatible with planting more tall trees. For example, some KIUC transmission lines run through extensive coffee farms on southern Kauaʻi. Planting large, tall trees would require displacing coffee plants and would likely shade additional acreage that would disrupt production.
- Planting tall trees in many areas can have unacceptable visual impacts. Many KIUC powerlines along the coast occur in areas with little or no vegetation. Tall trees would block desirable views of the mountains or ocean from homeowners or recreationalists.

KIUC attempted to promote the ideas to private landowners, including programs to supply plant materials appropriate for the purpose, but was largely rebuffed by the landowners (Planning Solutions, Inc. 2013). Landowners and their neighbors were opposed to this proposal primarily because of concerns about the loss of views of the ocean from their property.

Chapter 9
References

9.1 Executive Summary

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9.10 Chapter 10, *Glossary*

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Chapter 10
Glossary of Terms

This glossary lists the terms found in the HCP that require definitions. Terms defined here are for the purposes of this HCP. Where terms are also found in federal or state regulations, the terms are defined for this HCP for clarity and to be consistent with these federal or state regulations but are not verbatim quotes. Regulatory citations are provided to indicate this consistency in meaning or definition. When definitions for this HCP are verbatim from federal or state regulations, the definition is provided in quotation marks.

Term	Definition
active breeding burrow	determined when an adult bird is either observed in or at the burrow or when signs of bird presence in or around the burrow are documented during the breeding season (e.g., feathers, guano, digging).
adaptive management	a method for examining alternative strategies for meeting measurable biological goals and objectives, and then if necessary, adjusting future conservation management actions according to what is learned (65 *Federal Register* 106 35242–35257, June 1, 2000). Not a strategy to address changed circumstances, but a strategy to address uncertainty associated with an HCP's conservation program, particularly where there is uncertainty posing a significant risk to covered species.
adult	life stage in which a species has reached sexual maturity.
avoidance measures	actions that aim to avoid all potential take of a covered species or impacts on a covered species.
baseline conditions	conditions surrounding the presence and/or status of a species or its habitat that exists within the Plan Area prior to implementation of an HCP.
biological goals	an overarching component of an HCP conservation strategy meant to define what the HCP intends to accomplish for wildlife conservation. Biological goals are descriptive, open-ended, and often broad statements of desired future conditions that convey a purpose, but do not define measurable units. Biological goals lay the foundation from which all conservation activities arise.
biological objectives	the steps that outline how an applicant will achieve biological goals. Biological objectives are specific, measurable, achievable, result-oriented, and time fixed. They identify elements to be monitored to assess whether the biological objectives will be met.
changed circumstances	changes in circumstances affecting a species or geographic area covered by the KIUC HCP that can reasonably be anticipated during the permit term and that can reasonably be planned for (e.g., the listing of new species, effects of climate change, or other natural catastrophic event in areas prone to those events). By identifying a specific response to each changed circumstance, the costs of implementing the response, and the funding assurances for those responses in the HCP, it is possible to facilitate adjustments to the HCP's conservation program without having to amend the HCP. Changed circumstances are part of the HCP's operating conservation program.
circuit	completed path for electric current from source to point of use and back.
climate	the average weather over many years.

Term	Definition
climate change	a statistically significant change in the state of the climate or its variability that persists for an extended period, typically for decades or longer.
colony	area where birds nest and breed in proximity as a group, often sharing communal behaviors for the benefit of the entire group. The size of the colony can vary from just a few breeding pairs to hundreds or thousands of birds depending on the species and availability of resources, including suitable nest sites and takeoff/landing zones.
communication wire	a wire that delivers information by currents of various frequencies. Telephone conversations, photographs, sound and television broadcasts, and statistical data for computer centers are transmitted through communication wire.
compliance monitoring	process used to verify that KIUC is conforming to permit terms and conditions, including correct implementation of the HCP. Also known as implementation monitoring.
conservation measures	describe the specific actions to benefit or promote recovery of listed species that are an integral part of the proposed actions that serve to minimize or compensate for KIUC effects on the covered species
conservation sites	specific parcels on Kauaʻi with occupied or suitable breeding habitat for the covered seabird species where some of the HCP's conservation measures will be undertaken.
conservation strategy	the HCP's overall and unified approach for achieving the biological goals and objectives.
construction	making or forming a structure by combining or arranging various parts or elements to serve a particular purpose.
covered activities	the projects or ongoing activities that have the potential to take the covered species for which KIUC is requesting incidental take authorization.
covered seabird	the species are Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), and the Hawaiian distinct population segment of band-rumped storm-petrel (ʻakēʻakē).
covered species	the species that are included in this HCP and for which take is authorized through an incidental take permit or incidental take license. The covered species in this HCP are Newell's shearwater (ʻaʻo), Hawaiian petrel (ʻuaʻu), the Hawaiian distinct population segment of band-rumped storm-petrel (ʻakēʻakē), Hawaiian stilt (aeʻo), Hawaiian duck (koloa maoli), Hawaiian coot (ʻalae keʻokeʻo), Hawaiian common gallinule (ʻalae ʻula), Hawaiian goose (nēnē), and the Central North Pacific distinct population segment of green sea turtle (honu).
covered waterbird	the species are Hawaiian stilt (aeʻo), Hawaiian duck (koloa maoli), Hawaiian coot (ʻalae keʻokeʻo), Hawaiian common gallinule (ʻalae ʻula), and Hawaiian goose (nēnē).
crippling bias	for the purposes of this HCP, crippling bias is defined as the proportion of birds colliding with powerlines that manage to fly or glide beyond the search corridor before dying. This term is relevant for powerline monitoring (acoustic and observer) and associated data sets in which the number of injuries or mortalities are estimated through underline searches for dead and injured birds.
crippling rate	the proportion of birds colliding with powerlines that subsequently die due to their injuries. Referred to in Chapter 5, *Effects*, as "mortality rate" for powerline strikes.

Term	Definition
distribution wire	the electrical wire that delivers power to neighborhoods, businesses, and other facilities in towns and cities from transmission wire. The voltage of distribution wire is typically 13,000 volts or 13 kilovolts.
effectiveness monitoring	used to determine if KIUC is achieving the stated biological goals and objectives of the HCP. It provides the evaluation of whether the effect of the HCP's conservation program is consistent with the assumptions and predictions made when the HCP was developed and approved.
endangered species	under the federal Endangered Species Act (ESA): a native species, subspecies, variety of organism, or distinct population segment which is in danger of extinction throughout all or a significant portion of its range (16 United States Code [U.S.C.] 1532[6]). Under Hawai'i Revised Statutes 195D-2: any species whose continued existence as a viable component of Hawai'i's indigenous fauna or flora is determined to be in jeopardy and has been so designated pursuant to [Hawai'i Revised Statutes] 195D-4. Hawai'i Revised Statutes 195D-4 (a) also states: "[a]ny species of aquatic life, wildlife, or land plant that has been determined to be an endangered species pursuant to the Endangered Species Act shall be deemed to be an endangered species under this chapter."
enhance	the manipulation of the physical, chemical, or biological characteristics of a land cover type to heighten, intensify, or improve one or more specific existing ecological function(s). Enhancement results in the gain of selected existing ecological function(s), but may also lead to a decline in other ecological function(s).
facility	structure built, installed, or established to serve a particular purpose.
fallout	a phenomenon primarily affecting young seabirds (petrels and shearwaters) that leave their nest for the first time but can also affect adults (e.g., presence of unshielded lights, particularly near breeding colonies). These seabirds use natural lighting such as moonlight to navigate out to sea where they spend their time feeding. They can become disoriented by artificial lighting (e.g., streetlights, building lights) and circle lights repeatedly, become exhausted, and often grounded as a result or collide with structures in the process. Grounded seabirds can suffer injury, starvation, predation, or collision (e.g., with vehicles). Seabirds that collide in flight with structures are commonly injured or killed.
fallout season	September 15 to December 15, when the majority of Newell's shearwater ('a'o), Hawaiian petrel ('ua'u) are fledging from their burrows.
fledging	the act of leaving the nest/burrow for the first time and migrating to the ocean to begin foraging. After fledging, seabirds will not return to their natal burrow until they are 2–5 years old. See also **sub-adults.**
fledgling	a young bird, typically with fully developed wing muscles and feathers, that leaves the nest for good and can survive away from the nest.
full-cutoff shielded fixture	light fixtures that have no direct uplight (i.e., no light emitted above horizontal). These fixtures prevent light from shining upwards by enclosing the bulb and directing it downward. A full-cutoff shield also requires luminaries to comply with the glare requirement limiting intensity of light from the luminaire in the region between 80 and 90 degrees.
fully offset	completely mitigating any impacts of the taking expected to remain after avoidance and minimization measures are implemented. The biological value that would be lost from covered activities will be replaced through covered activities with equivalent or greater biological value.

Term	Definition
grounded	a bird on the ground in locations where they normally would not be found, usually because of attraction and disorientation by artificial lights or structure collisions. These birds are unable to get off the ground again naturally. This a term typically used for the covered seabirds.
habitat conservation plan (HCP)	details, without limitation, all applicant proposed enforceable commitments including take avoidance, minimization, and mitigation actions, and monitoring and ensured funding commitments. An HCP is required by Section 10(a)(2)(B) of the ESA and HRS Section 195D-21, that an applicant must submit when applying for a federal incidental take permit and state incidental take license.
harass	is a component of the definition of *take* under the federal ESA (16 U.S.C. 1532). Pursuant to U.S. Fish and Wildlife Service (USFWS) ESA implementing regulations, *harass* is defined as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 Code of Federal Regulations [CFR] 17.3). Under the Hawai'i Revised Statutes, *harass* is included in the definition of *take,* but the term *harass* is not separately defined.
harm	under the federal ESA, *harm* means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering (50 CFR 17.3). Under the Hawai'i Revised Statutes, *harm* is included in the definition of *take,* but the term *harm* is not separately defined.
hatchling	a young animal that has recently come out of its egg. All the covered species emerge from eggs and may be referred to as a *hatchling*, but in the KIUC HCP this term is used with reference to green sea turtle (honu).
hurricane	an intense tropical weather system with well-defined circulation and maximum sustained winds of 74 miles per hour (119 kilometers per hour) or higher.
immediate grounding rate	the proportion of birds colliding with powerlines that are grounded within the search corridor (inverse of crippling rate) or assumed to have lost flight and hit the ground in unsearchable areas.
impact	the effects that covered activities have on the covered species. Synonymous with effects and used interchangeably.
impact of the taking	the impacts that result from the taking of the covered species, and described in terms of context, intensity, and duration of the impact. Context is the setting in which the impact of the take analysis occurs and includes consideration of other threats to covered species. Duration of the impact encompasses both current and probable future conditions and trends spanning the entire duration of the requested take. The impact of the taking should be described relative to a species reproduction, numbers, and distribution. The impact of the taking must not appreciably reduce the likelihood of survival and recovery of the species.
inactive burrow	no sign (e.g., bird presence, feathers, guano, digging) that the burrow has been visited during a breeding season.

Term	Definition
incidental take	any take otherwise prohibited if such take is incidental to and not the purpose of the carrying out of an otherwise lawful activity (16 U.S.C. 1539(a)(1)(B); 50 CFR 17.3).
incidental take license (ITL)	a temporary license issued by the Board of Land and Natural Resources as part of an HCP to allow take of endangered or threatened species otherwise prohibited if the take is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity, under specific circumstances outlined in HRS Section 195D-4. All qualifying private, non-federal entities can request a state ITL.
incidental take permit (ITP)	pursuant to Section 10(a)(1)(B) of the federal ESA, a permit can be issued by USFWS to non-federal entities, allowing incidental take of an endangered or threatened species when the take is incidental to, and is not the purpose of, carrying out an otherwise lawful activity. This permitting document must be accompanied with an approved HCP.
invasive species	a species that is nonnative to the ecosystem and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112).
Kona storm	the term was originally applied to the slow-moving subtropical cyclones that occasionally enter the Hawaiian area. Increasingly, this term is now applied by the local public to any widespread rainstorm accompanied by winds from a direction other than that of the trade winds. Kona storms are cool winter storms associated with a southward shift in the mid-latitude jet stream. They are most common during the late fall, winter, and spring and are associated with cold air over the central Pacific Ocean. They bring cloudy wet conditions to the western and southwestern sides of the island.
Kona weather	usually the warmest days in the Hawaiian Islands, when the trade winds, which come from cooler latitudes, fail and air stagnates over the heated islands.
light attraction	disorientation in nocturnal seabirds or green sea turtle (honu) hatchlings caused by attraction toward artificial lighting.
light disorientation	altered behavior in hatchling green sea turtles (honu) that are disoriented by an artificial light source and do not migrate directly to the ocean after emerging from their nest.
land cover type	the dominant feature of the land surface discernible from aerial photographs and defined by vegetation, water, or human uses.
major amendments	changes in the HCP that may affect the impact analysis or conservation strategy. Major amendments require submittal to USFWS and State of Hawaiʻi Division of Forestry and Wildlife of a written application and implementation of all permit processing procedures applicable to an original federal ITP and state ITL.
massif	a block of the earth's crust bounded by faults and shifted to form peaks of a mountain range.
maximum extent practicable	pursuant to section 10 of the federal ESA, USFWS must determine that the combination of minimization and mitigation in the HCP leaves no remaining impacts of the taking on the species that could be further mitigated or minimized. Therefore, all impacts of the taking must be either fully offset, or if an applicant cannot fully offset the impacts of the taking, they must demonstrate to the USFWS' satisfaction that it is not practicable to carry out any additional minimization or mitigation.

Term	Definition
metapopulation	a group of partially isolated populations belonging to the same species that are connected by pathways of immigration and emigration. Exchange of individuals occurs between such populations, enabling recolonization of sites from which the species has recently become extirpated.
minimization measures	within the context of the HCP, minimization is related to the impacts of the proposed covered activities on the species to be covered. In other words, minimization measures comprise actions that will reduce the impacts of the taking that have been identified during development of the HCP.
minimization efficacy	the desired or intended results from minimization projects on KIUC infrastructure.
minor modifications	changes to the HCP that do not increase the levels of authorized incidental take and do materially modify the scope or nature of activities or actions covered by the federal ITP and state ITL in terms of their effect on the covered species.
monitoring	the systematic surveillance or sampling of air, water, soil, and biota to observe and study the environment, and to derive knowledge from this process. The processes and activities that need to take place to characterize and monitor the quality of the environment or effectiveness of a project.
net benefit	abbreviated reference to "net conservation benefit", a requirement under Hawaiʻi State law for HCPs to mitigate commensurate for the requested take plus additional mitigation to ensure the likelihood of the survival and recovery of the species in the wild.
nonnative species	species that is not native to the ecosystems in Kauaʻi.
"no surprises assurances"	assurances to permit holders that if unforeseen circumstances arise, USFWS will not require the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources beyond the level stated in the HCP without the consent of KIUC (16 CFR 17.22((b)(5); 17.32(b)(5)). This assurance applies as long as KIUC is implementing the terms and conditions of the HCP properly and applies only with respect to species adequately covered by the conservation plan. See also **unforeseen circumstances**. For purposes of this definition, the term "adequately covered" means that a proposed conservation plan has satisfied the permit issuance criteria under Section 10(a)(2)(B) of the federal ESA for the species covered by the HCP and listed on the ITP, if issued. See 50 CFR 17.3.
open water	aquatic habitats such as lakes, reservoirs, water-treatment ponds, sloughs, and ponds (including percolation and stock ponds) that do not support emergent vegetation.
operation	the fact or condition of a structure being linked to the take of covered species. For powerlines, the wires are operational once they are in place, but those wire do not need to be energized or functional. Streetlights are only operational when the lights are on.
permit area	the geographic area where the ITP applies. For the purposes of this HCP, it includes the areas under the control of the KIUC where covered activities will occur. The permit area must be delineated in the permit and license and be included within the plan area of the HCP. See also **plan area**.
permit term	the period over which KIUC is authorized to incidentally take the covered species in conjunction with implementing the HCP for both the federal ITP and state ITL. The permit term for this HCP is 50 years.

Term	Definition
plan area	the geographic area where covered activities and conservation measures described in the KIUC HCP will occur. The KIUC HCP plan area covers the full geographic extent of Kauaʻi.
predator control	the act of controlling animals defined as predators via a variety of techniques.
predator eradication	complete removal of predators from within a predator exclusion fence.
predator exclusion fence	a fence specially designed to exclude all mammalian predators on Kauaʻi from entry, including but not limited to rats, feral cats, and ungulates. See **ungulate fence**.
population	a group of individuals of the same species inhabiting a given geographic area, among which mature individuals reproduce or are likely to reproduce. Ecological interactions and genetic exchange are more likely among individuals within a population than among individuals of separate populations of the same species.
powerline	Overhead (i.e., aerial) electrical wires strung between supporting structure, including poles, towers, lattice structures, and H-frames. The KIUC HCP covers transmission wires, distribution wires, and communication wires, and associate supporting structures.
range	the geographic area a species currently or historically occupied.
recovery	the process by which the decline of an endangered or threatened species is arrested or reversed or threats to its survival neutralized so that its long-term survival in nature can be ensured. Recovery entails actions to achieve the conservation and survival of a species (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2016), including actions to prevent any further erosion of a population's viability and genetic integrity, as well as actions to restore or establish environmental conditions that enable a species to persist (i.e., the long-term occurrence of a species through the full range of environmental variation). Implementation of an HCP may not impede the ability of a covered species to recover.
reproductive success rate	number of covered seabird burrows that fledged a chick divided by the number of burrows that were confirmed breeding and where an outcome could be determined.
Save Our Shearwaters (SOS) Program	the SOS Program operates year-round on Kauaʻi rescuing and rehabilitating native Hawaiian birds and the Hawaiian hoary bat (ʻōpeʻapeʻa). SOS focuses on the rescue and rehabilitation of Newell's shearwater (ʻaʻo) and Hawaiian petrel (ʻuaʻu).
seabird	a bird that frequents coastal waters and the open ocean.
social attraction	a colony creation technique whereby seabirds are attracted to an area to initiate breeding by playing recordings of other seabirds of the same species and installing artificial burrows. This is an effective technique due to the colonial nature of seabirds.
strike reduction	the amount of decrease in avian powerline collisions between the unminimized state and the post-minimization state (e.g., after bird flight diverters are installed).
sub-adult	birds 2–5 years old who have not reached sexual maturity.

Term	Definition
subpopulation	represents a subset of the modeled metapopulation on Kaua'i. Each subpopulation is associated with a geographic portion of the island which has similar conservation threats and management efforts for the species, as well as similar available data sources for estimating the abundance and trend of breeding pairs that nest there. The modeling framework allows each subpopulation to have its own set of vital rate values (e.g., mortality, carrying capacity) and, therefore, potentially different trends in abundance through time. This reflects the fact that pressures such as powerline collisions and predation vary depending on region and topography. Likewise, because predation mortality rates inside the predator exclusion fences (PF) will be less than those outside the fences, each of the PF areas is tracked as a separate subpopulation for the purposes of the model. This definition of subpopulation is purely for the purpose of the model, making no assumptions about demographic independence, genetic structuring, or lack thereof between modeled subpopulations. However, natal fidelity is assumed, such that subpopulation recruitment is internally driven. In other words, individuals that fledge in one subpopulation are assumed to return to breed in the same subpopulation unless they relocate due to social attraction measures.
suitable habitat	habitat that exhibits the characteristics necessary to support a given species. This habitat may be currently occupied or unoccupied but historically harbored the given species. Suitable habitat is used as a criterion for conservation site selection.
take authorizations	the permits that authorize take of species, in this case the federal ITP issued by USFWS, and the state ITL issued by the State of Hawai'i, Board of Land and Natural Resources. For the state, it is specifically the number of take anticipated in an ITL.
take	under the federal ESA, the term *take* means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect listed species or to attempt to engage in any such conduct (16 U.S.C. 1532 (18); *See also,* the definition of "harm" found in 50 CFR 17.3). Under the Hawai'i Revised Statutes, *take* is defined similarly to the federal ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect endangered or threatened species of aquatic life or wildlife, or to cut, collect, uproot, destroy, injure, or possess endangered or threatened species of aquatic life or land plants, or to attempt to engage in any such conduct.
threatened species	any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. 16 U.S.C. 1532(20).
transmission wire	the electrical wire that delivers power from substations to distribution wire. The voltage of transmission wire is typically 100,000 volts or 100 kilovolts.
triggers	qualitative or quantitative thresholds, which can include established schedule milestones, that if not met will initiate adaptive management.
tropical storm	an organized system of strong thunderstorms with a defined circulation (i.e. tropical cyclone) and maximum sustained winds of 39 to 73 miles per hour (62.8 to 117.5 kilometers per hour).
under-build	distribution wires built on the same pole as transmission wires are always mounted underneath the transmission wires.

Term	Definition
ungulate fence	a fence designed to keep out hoofed mammals. On Kaua'i, existing ungulates that may trample burrows and seabird habitat, or predate on nesting seabirds include feral pigs, goats and deer.
unoccupied habitat	habitat that exhibits all the constituent elements necessary for a species, but which surveys have determined is not currently occupied by that species. The lack of individuals or populations in the habitat is assumed to be the result of reduced numbers or distribution of the species such that some habitat areas are unused. It is possible that these areas would be used if species numbers, or distribution, were greater. See also **suitable habitat**.
unforeseen circumstances	changes in circumstances affecting a covered species or geographic area covered by the KIUC HCP that could not reasonably have been anticipated by the plan developers and USFWS at the time of the HCP's development, and that result in a substantial and adverse change in the status of a covered species. Under the state permit, this refers to changes affecting one or more species, habitat, or the geographic area covered by a conservation plan that could not reasonably have been anticipated at the time of plan development, and that result in a substantial adverse change in the status of one or more covered species.
viable metapopulation	an estimated number of individuals within a metapopulation to persist with high probability in the long term measured by its distribution, population size, age structure, growth rate, and additional demographic variables (e.g., age/cohort survivorship, reproductive success). For the purposes of this HCP, 2,500 breeding pairs and 10,000 individuals is considered a viable metapopulation for Newell's shearwater and Hawaiian petrel. For the other covered species, there are no estimates for what would be considered a viable metapopulation.
waterbird	a bird that is found in a variety of wetland habitats including freshwater marshes and ponds, coastal estuaries and ponds, artificial reservoirs, kalo or taro lo'i or patches, irrigation ditches, sewage treatment ponds, and, in some cases, montane streams and marshlands.

Chapter 11
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