KAHUAMA‘A SEABIRD PRESERVE

MANAGEMENT PLAN

PART OF THE KAUA‘I SEABIRD HABITAT CONSERVATION PLAN

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1. SUMMARY MANAGEMENT PLAN

The objective of the Kahuamaʻa Seabird Preserve Management Plan is to create and maintain a terrestrial predator proof sanctuary for ʻaʻo. Birds will be attracted to the site through a Social Attraction component.

Implementation of the plan will, in part, fulfill one of the biological goals of the Kauaʻi Seabird Habitat Conservation Plan (KSHCP): to mitigate authorized take impacts on the Covered Seabirds in the HCP (ʻaʻo or Newell's Shearwater –*Puffinus auricularis newelli*, ʻuaʻu or Hawaiian Petrel - *Pterodroma sandwichensis* and Hawaiʻi distinct population segment (DPS) of the ʻakēʻakē or band-rumped storm-petrel - *Oceanodroma castro*, hereafter ʻakēʻakē) due to light attraction by the participants of the plan, and provide a net benefit to the populations of the Covered Seabirds.

Management of the Kahuamaʻa Seabird Preserve (also referred to as 'the site') will be carried out by a Prime Contractor, on behalf of the participants in the KSHCP. The site is located in Kōkeʻe State Park and Nā Pali Coast State Park.

The creation of the site will commence with the construction of a predator proof fence around 2ha of suitable seabird habitat. Only terrestrial predators can be completely excluded, but barn owls will also be controlled to protect the birds within the site and in neighboring source colonies throughout the Kalalau Valley. Feral cats will also be removed at ingress points to the fenceline area and into neighboring source colonies in the Kalalau Valley.

The project will proceed with the removal of black rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), Polynesian rat (*Rattus exulans*), feral pigs (*Sus scrofa*), black-tailed deer (*Odocoileus hemionus columbianus*), feral goats (*Capra hirca*) and feral cats (*Felis catus*) inside the fence. house mouse (*Mus musculus*) is expected to be eradicated by rat control but is not a target species. Eradication will be complete within the first year. The fence will be monitored constantly to ensure that predators cannot breach it and there will be monitoring within the fenced area in case of reinvasion.

After predator eradication within the fence is complete, the social attraction component of the project will be initiated to bring ʻaʻo to the project site to breed. This will consist of installing artificial burrows and a speaker system to broadcast calls, simulating a large colony.
A variety of monitoring methods will be undertaken to assess the effectiveness of management actions. For seabirds, these will include auditory and visual surveys, camera monitoring, acoustic bird monitoring and bird banding.

Invasive species (seabird habitat modifiers) will be removed from the site to optimize seabird nesting habitat. Monitoring will include a plant survey every five years.

Reporting obligations for the Prime Contractor will include an annual report.

2. INTRODUCTION

Kahuamaʻa Seabird Preserve is a 2 hectare (ha) Social Attraction Site (SAS) for ʻaʻo or Newell's Shearwater (*Puffinus auricularis newelli)* that will be surrounded by a terrestrial predator proof fence. It is located along the Western rim of the Kalalau Valley, part of the Nā Pali coast on the Island of Kauaʻi, Hawai'i at approximately 22°08'57.1"N 159°38'12.2"W.

The site is being developed as mitigation for "unavoidable incidental take impacts"[1] of ʻaʻo, a listed seabird, as part of the Kauaʻi Seabird Habitat Conservation Program (KSHCP). In addition, barn owl (*Tyto alba*) control around the site and the Kalalau Valley will provide mitigation for the take of ʻuaʻu or Hawaiian petrel (*Pterodroma sandwichensis*) and ʻakēʻakē or band-rumped storm-petrel *(Oceanodroma castro*). Collectively, all three species are referred as the "Covered Seabirds".

The KSHCP is an island-wide program to permit and mitigate for impacts to Kauaʻi's endangered seabirds caused by light attraction. The KSHCP aims to offset take and provide conservation benefit to these species by increasing productivity at breeding colonies. The KSHCP has set 'Biological Goals' and 'Biological Objectives'. The purpose of this Kahuamaʻa Seabird Preserve Management Plan is to explain how the objectives toward achieving the goal of "*mitigating authorized take impacts of the Covered Seabirds by enhancing, protecting and managing suitable seabird breeding habitat on Kauaʻi to facilitate successful production of fledglings at a level that over the 30-year term of the Plan offsets or exceeds the impacts of take caused by Covered Activities on the production of fledglings in the wild*" will be delivered and monitored. As such, this Management Plan fulfils certain legal parameters of the KSHCP process as well as describing the management on site. The full suite of KSHCP requirements is described in the KSHCP document to which this Management Plan is an appendix.

'Social Attraction' is a well-established conservation strategy to encourage seabirds to breed in a predator-free location by the simulation of colony activity, principally through the playback of breeding calls, combined with the provision of artificial burrows area (Kildaw 2005, Sawyer and Fogle 2010, Major 2011, Jones and Kress 2012, Raine 2015b). The technique results in high productivity within a small and easily managed.

There are several benefits to establishing a breeding colony within a protected site free of terrestrial predators. The site offers protection from predation which is known to severely impact the breeding of both species on Kauaʻi (Raine et al. 2017f, d, g, e, Raine et al. 2017h). Breeding in a predator-free area can result in a positive growth rate, vitally important for these endangered seabirds (Veitch 2011, Young et al. 2012, Kappes 2014, Buxton 2015). In addition, because of the potential for a high breeding density, a relatively large amount of birds can be

[1] Section 9 of the Endangered Species Act prohibits taking, possession, sale, and transport of listed species. Taking is defined as to "harass, harm, pursue, hunt, shoot, wound, kill, capture, or collect." If an activity is conducted that would "take" a listed species, an 'incidental take permit' is required to avoid being in violation of Section 9 of the Endangered Species Act, a federal offense.

produced in a small area requiring less long term management and funding (Burger 1988, Buxton 2014) – fieldwork for management and monitoring is very labor intensive in this terrain, so having burrows close together for easy monitoring dramatically reduces staff time and thus costs. Finally, creating a "new" colony serves to expand the distribution of the species, recognized as important to the species persistence and survival in the wild (Jones and Kress 2012, Buxton 2015, USFWS 2017b, a). The site also has the potential to provide a sanctuary for other rare and endangered flora and fauna, several species of which are already present at the site. These include candidate or listed forest bird species (nests will be protected from rat predation), ʻōpeʻapeʻa or Hawaiian hoary bat (*Lasiurus cinereus semotus*) and the suite of plant species shown in Table 7.1.

Social Attraction relies on broadcasting breeding calls to attract seabirds to breed; distance to the source population has been identified as one of the most important drivers of seabird recolonization (Buxton et al. 2014). Research by the Kauaʻi Endangered Seabird Recovery Project (KESRP) indicates that Kahuamaʻa is located close to several 'hot spots' (concentrated locations of seabird activity) on the Nā Pali coast, with the nearest "hot spot" polygon just 210m away, two more within 60m, and 26 within 3km. In fact, the majority of known breeding colonies of ʻaʻo and ʻuaʻu on Kauaʻi are located within 25km of the mitigation site. In addition, ʻaʻo and ʻuaʻu calls were recorded at the site in 2016 using an acoustic song meter (Raine et al. 2016). Kahuamaʻa Seabird Preserve has therefore been identified as an excellent location for a SAS, within known seabird flyways along the Nā Pali Coast and nearby existing breeding colonies such as Hono O Nā Pali Natural Area Reserve and in Kalalau State Park.

In addition to the predator proof fenced area, Kahuamaʻa Seabird Preserve will include feral cat removal at ingress points to nearby source colonies in the Kalalau Valley, as well as to the fenceline. The project is expected to benefit this native vegetation as well as other native wildlife such as the ōpeʻapeʻa, pueo or Hawaiian short-eared owl (*Asio flammeus sandwichensis*) and various candidate or listed forest birds.

The site is on land owned and managed by the State of Hawaiʻi - Department of Land and Natural Resources (DLNR) Division of State Parks and straddles two parks: Kōkeʻe State Park and Nā Pali Coast State Park. The area is a designated hunting unit, restricted to archery use only (no firearms). Discussions with State Parks have indicated strong support for the project, which is in line with State Park goals of protecting and restoring native ecosystems.

Under the KSHCP, the Participants will oversee the implementation of the conservation and other plan-related actions and activities with the assistance of the National Fish and Wildlife Foundation and a Prime Contractor. NFWF will hold the funds received from the Participants for the term of the HCP and will make payments to implement the conservation and other plan-related activities. A Prime Contractor selected by the Participants' Committee will implement the conservation and other plan-related activities to meet mitigation obligations under the ITP/ITL. The Prime Contractor may choose to sub-contract specific work to another entity as appropriate. This arrangement is 'Participant-initiated' mitigation and Participants remain

ultimately responsible for implementing mitigation (including actions that may be necessary in response to Adaptive Management provisions as defined in the KSHCP.

3. VISION STATEMENT

The Kahuamaʻa Seabird Preserve will become a terrestrial predator free sanctuary for a thriving colony of breeding ʻaʻo. ʻUaʻu may also be present. The site will continue to attract new birds as well as seeing the return of previous breeders (both chicks and adults). Ongoing management will ensure that the interior of the fenced area remains completely terrestrial predator free and that feral cats are controlled at ingress points to the site and to neighboring source colonies. Mitigation for the take of ʻuaʻu and ʻakēʻakē will be provided through barn owl control. Neighboring colonies will also benefit from this work. The site will provide optimal breeding habitat through artificial burrows and the ongoing removal of invasive species. The site will also serve as a sanctuary for rare and listed plants.

Kahuamaʻa will act as a positive example of a Social Attraction Site benefitting a rapidly declining population of seabird. Key to the vision is that the site will meet its targets for successfully providing mitigation to offset take of a listed species as outlined in the KSHCP document.

4. INFORMATION

4.1. Location and Statutory Information

The Kahuamaʻa Seabird Preserve is located near the terminal end of Highway 550, within Kōkeʻe State Park and Nā Pali Coast State Park, between the Kalalau and Puʻu O Kila visitor lookouts, identified on the map as part of Kahuamaʻa Flat (Figure 4.1)

Figure 4.1: Satellite image of Kahuamaʻa Flats with Kalalau Lookout. Red pin indicates SAS. Google Maps.

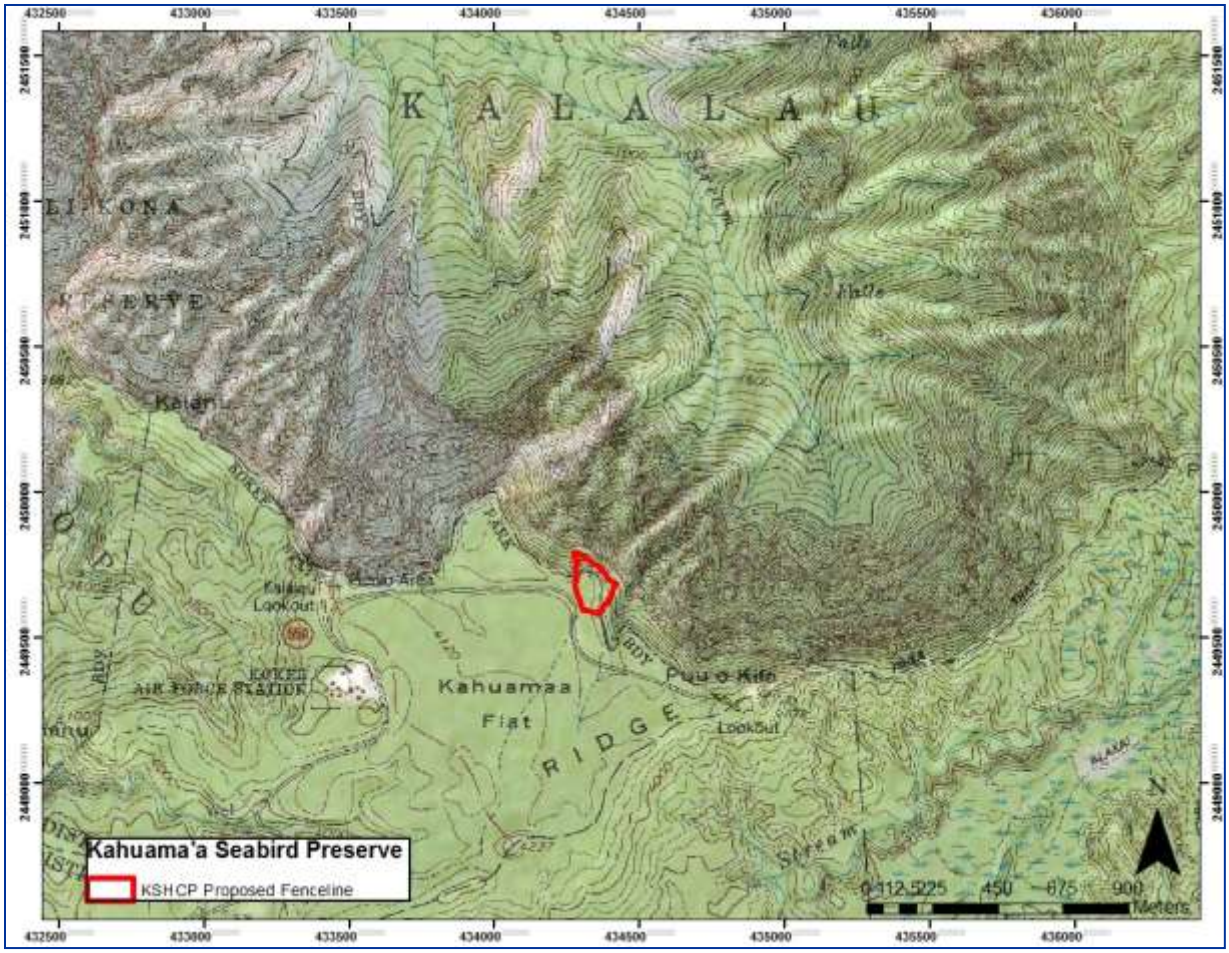


Figure 4.2. Map of SAS location in relation to Kalalau Valley.

Figure 4.3. Photographs of the SAS along the rim of the Kalalau Valley. Y Reiss.

4.2 Legal Status (legislation for site creation, ownership, official managers), MOA

The site is situated on lands managed by DLNR Division of State Parks as Kōkeʻe State Park and Nā Pali Coast State Park. Prior to the commencement of management by the Prime Contractor of the KSHCP, an Agreement between State Parks and the Participants' Committee will be in place as an Appendix to the KSHCP which will include all relevant permits for the activities specified in the Management Plan (for example use of rodenticide, erection of fence etc.). Discussions with State Parks have indicated strong support for this project, which is in line with State Park goals of protecting and restoring native ecosystems.

4.3 Access

The site lies immediately north of and adjacent to Highway 550. A small amount of parking (sufficient for construction and field staff) is available on the west side of the road adjacent to the site. Prior to fence construction, ideally this will be graveled as it is currently muddy (discussions will be held with State Parks or Highways upon commencement of the Management Plan). No public parking or vehicular access is currently planned as the focus of the project is the creation and maintenance of the seabird site for mitigation purposes.

There are no well-defined trails to the site. As management commences at the site, a foot trail to the site will be created to avoid rare plants (see section 17.7.4). Access for fence building and maintenance will use this new foot trail, with heavier equipment and supplies being dropped via helicopter at specified construction staging location immediately adjacent to the site, which will be large enough to provide storage space (see section 10.3). No permanent or vehicular access is planned.

The site is a designated hunting unit, restricted to archery use only. The site comprises only a tiny fraction of the archery hunting zone, therefore the exclusion of hunters from inside this small enclosure is not anticipated to negatively affect overall access to archery hunting.

4.4 Existing Infrastructure

There are currently no utilities or infrastructure at the site as it is a 'wildland portion of Kōkeʻe State Park' (DLNR, 1997) and Nā Pali Coast State Park.

5. ENVIRONMENTAL INFORMATION

5.1 Environmental Setting

Kahuamaʻa Seabird Preserve is located on the northwestern side of Kauaʻi, along the western rim of the Kalalau Valley and is part of the Nā Pali coast, which is characterized by steep cliffs and deeply eroded canyons and valleys. **Figure 5.1**

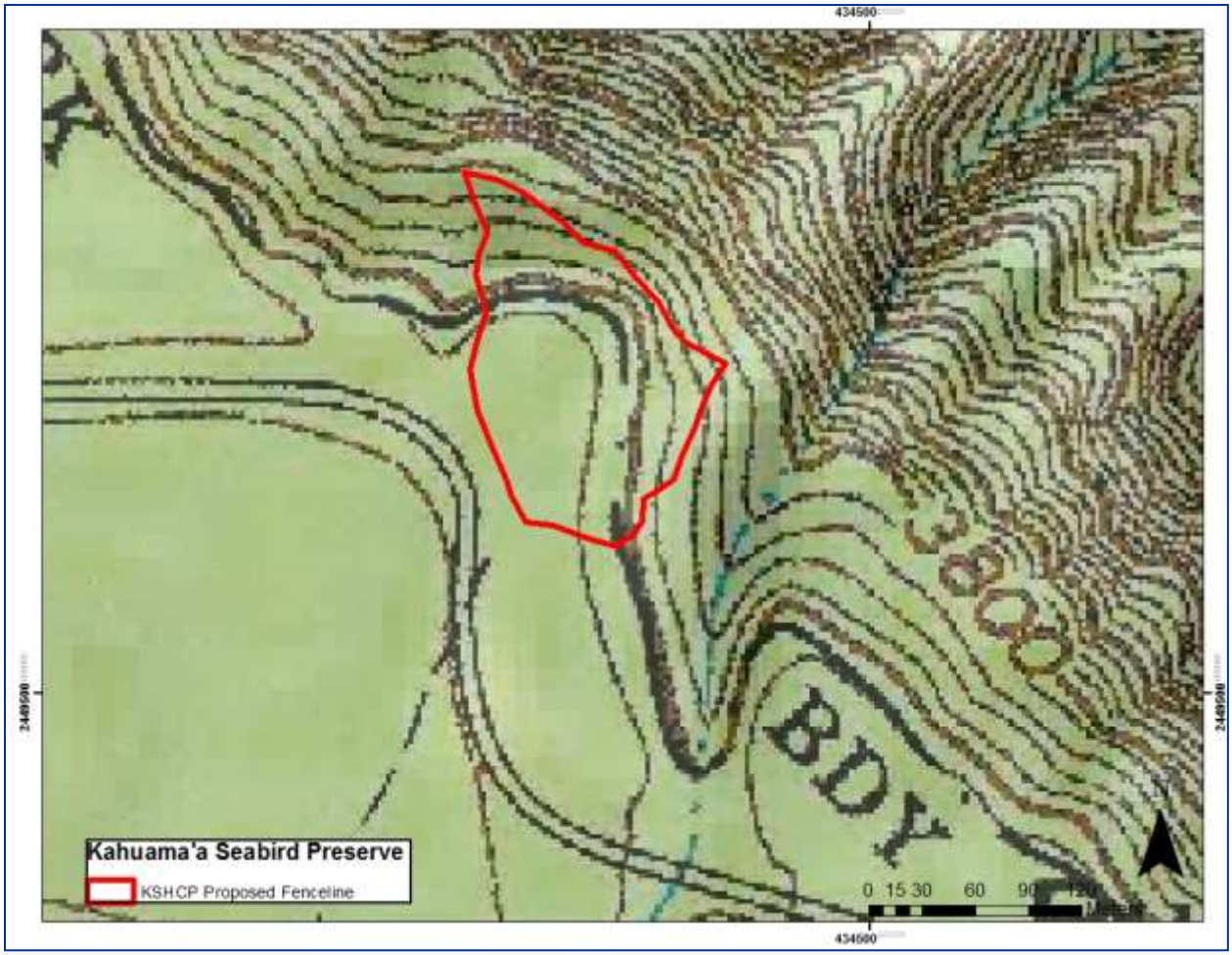


Figure 5.1. Image of site showing topography.

5.2 Climate

The Kahuamaʻa Seabird Preserve is located at an altitude of approx. 1250m. The site receives an estimated annual rainfall of around 150-200cm annually with fog (DLNR 1997). The average air temperature in Kōkeʻe ranges from 10°C in winter to 20°C in summer.

In the past 50 years, strong winds, heavy rains and storm surges caused by periodic hurricanes have resulted in devastating effects. Hurricanes Iwa (1982) and ʻIniki (1992) caused extensive damage to native plant communities.

5.3 Topography/Geology

The site consists of approximate 2ha of mostly sloping ground, interspersed with small hillocks. Carpenter and Yent (1994) describe the soils and topography as; "Kōkeʻe silty clay loam on the upper flat (well-drained soils weathered from igneous rock, probably mixed with volcanic ash). There is rough, mountainous land on the valley wall (very steep land broken by numerous

drainages, very thin soil mantle if any, much of surface is rock, rock outcrop, and eroded spots)".

5.4 Hydrology/Streams, Rivers, Drainages

The site lies within Hanalei aquifer sector / Nāpali System (DLNR 2014) characterized as

- High-level - fresh water not in contact with sea water.
- Unconfined - the water surface is in the upper surface of a saturated aquifer.
- Dike-contained - aquifers are confined in basaltic dike compartments.

There are no streams within the site itself, although in times of heavy rain there is at least one gulch which is likely to channel water.

5.5 Existing Land Use

The primary use of the site and surrounding area is as a State Park which is intended to provide opportunities for outdoor recreation as well as protecting Hawai'i's natural and cultural history and aesthetic values.

The Kahuama'a Seabird Preserve falls within a designated hunting unit, restricted to archery use only. Firearm hunting is prohibited because of safety concerns for other users in the park and its proximity to the public highway and visitor viewpoints.

6. SOCIAL INFORMATION

6.1 Stakeholders

Success of the Kahuama'a Seabird Preserve depends in part upon cooperation amongst the stakeholders in the project. These include the KSHCP Participants, the Prime Contractor, the regulatory agencies, conservation groups and landowners. Table 6.1 outlines these groups in more detail and provides a framework for the Prime Contractor to identify the future point of contact.

Table 6.1. Stakeholders in Kahuamaʻa Seabird Preserve

Stakeholder	Role
KSHCP Participants	
Alexander and Baldwin (A&B)	KSHCP Participant
County of Kauaʻi	KSHCP Participant
Hawaiʻi Department of Transportation (HDOT)	KSHCP Participant
Kauaʻi Coffee	KSHCP Participant
Kauaʻi Marriott Resort, Līhuʻe	KSHCP Participant
Norwegian Cruise Line (Bahamas) Ltd. (NCL)	KSHCP Participant
Princeville Resort Kauaʻi	KSHCP Participant
Kauaʻi Blue, Inc. dba. Sheraton Kauaʻi	KSHCP Participant
Prime Contractor	
Project Manager	Prime Contractor Staff
Staff/Technician	Prime Contractor Staff
Agencies	
USFWS	Regulatory / Advisory
State Parks	Land Owner
DOFAW Plant Extinction Prevention Program (PEPP)	Regulatory / Advisory
DOFAW Admin (Oʻahu)	Regulatory / Advisory
DOFAW Kauaʻi Branch	Advisory
Conservation Groups	
KESRP	Advisory
Kōkeʻe Resource Conservation Program (KRCP)	Advisory
SOS (Kauaʻi Humane Society) or other qualified vet / rehab center shearwaters	Resource
NTBG	Advisory
Land Users	
Hunters (archers only)	Land User
Kōkeʻe Discovery Center	Land User

6.2 Archaeological, Cultural and Historical interest

In 1994, prior to the construction of the Kalalau Rim Endangered Plant Exclosure (which is within 1km of the Kahuamaʻa Seabird Preserve), State Park archaeologists conducted a reconnaissance survey in the area of the Kahuamaʻa Flat. No archaeological sites or features were encountered during this survey (Carpenter and Yent 1994). However, due to dense vegetation and steep slopes, a complete evaluation was not possible. Therefore, while the

archaeologists deemed it unlikely that any important archaeological sites exist in this area (there are few such sites in the uplands of Kōkeʻe and the area is thought to have been a resource-gathering zone rather than a permanent habitation), they made several recommendations to ensure that any possible sites were not adversely affected. These are included in the Best Management Practices - Section 17.1.6 and 17.2.9).

6.3 Visitors

The principal focus of the Kahuamaʻa Seabird Preserve is to provide mitigation for unavoidable incidental take impacts to ʻaʻo. As a result, no funding is currently budgeted for outreach. However, the fence will be visible from the road and is between two popular lookouts, the Kalalau Lookout and the Puʻu O Kila Lookout. Therefore, as part of the Management Plan, the Prime Contractor will investigate ways to work with partner organizations that might allow for the erection of an interpretation panel at each lookout to explain the purpose of the Kahuamaʻa Seabird Preserve as well as providing some information on the special importance of ʻaʻo to Kauaʻi. If further funding can be found, the site has potential for education, awareness raising, demonstration and advocacy.

7. BIOLOGICAL INFORMATION

7.1 Habitats and vegetation communities

The Kahuamaʻa Seabird Preserve is within in a wider area known as the Kalalau rim, an extremely high cliff area which falls over a thousand meters into the Kalalau Valley. Due to the steepness and inaccessibility of the cliff, there are many rare, endemic plants which have survived undisturbed by humans, giving the Kalalau rim unique characteristics. The vegetation at the site is a subtype of ʻŌhiʻa Lowland Mesic Forest, with ʻuluhe fern (*Dicranopteris linearis*) comprising much of the ground cover (Williams, 2016 unpublished report). DLNR (1997) notes that this habitat is significant for endangered, threatened, candidate and other plants of concern; a number of rare and endangered plant species have in fact been recorded within and around the site.

There is degradation from the encroachment of invasive and non-native plants, particularly in the understory. They include Australian tree fern *(Sphaeropteris cooperi*), banana poka *(Passiflora tarminiana*), blackberry *(Rubus argutus*) bush beard grass *(Schizachyrium condensatum, Andropogon spp.*[2]), Karaka nut (*Corynocarpus laevigatus*), parasitic maidenfern (*Cyclosorus parasiticus*), air plant (*Kalanchoe pinnata*), fire tree (*Morella faya*) and daisy fleabane (*Erigeron karvinskianus*). Koster's curse *(Clidemia hirta*), Himalayan (kahili) ginger (*Hedychium gardnerianum*) and strawberry guava (*Psidium cattleianum*) are also present towards the road. Many of these plant species are significant threats for seabirds (particularly

[2] There is some taxonomic confusion about these species in Hawai'i and they are frequently mis-identified and can co-occur. Ecologically they are, however, similar with regard to their invasion biology. (A Williams, 2017, pers.comm.)

Australian tree fern, Himalayan (kahili) ginger and strawberry guava), as they modify the habitat in which they breed.

In addition, feral pigs, black-tailed deer and feral goats inhabit the area and are having a negative impact upon the vegetation community. Surveys carried out before fence construction (included as part of the Management Plan) will improve understanding of the vegetation communities and their condition.

The fenceline was decided upon based on characteristics suitable for seabirds, including vegetation, slope and aspect. However, PEPP experts and botanists from DOFAW and USFWS also identified the area as providing dual benefit for birds and listed plants, with the protection of rare and PEPP plants being a major consideration.

7.2 Flora

During a preliminary site visit by DOFAW Botanist Adam Williams and PEPP Botanist Steve Perlman, several listed plants were observed within the boundaries of the site. These include two federally Endangered Species, two species that are part of the Plant Extinction Prevention Program (PEPP), which indicates that there are less than 50 individuals left in the wild, and four State Species of Concern. These are highlighted in Table 7.1. This represents a very high concentration of rare and endangered plants. It is anticipated that the fence will be of direct conservation benefit to these plants (Williams 2016, unpublished report).

Surveys carried out before fence construction (included as part of the Management Plan) will detail the exact location and abundance of listed plants, as well as confirming the below species list in

Table .

Table 7.1. Preliminary plant list from KSHCP Social Attraction Site visit on May 12, 2016 with DOFAW and PEP botanists. Highlighted plants are federally or state endangered, threatened or PEPP.

Family	Taxon Name	Common Name	Status	FedStat
Asteliaceae	*Astelia argyrocoma* A.Heller ex Skottsb.	Paʻiniu	Endemic	
Cyperaceae	*Carex wahuensis* sp.	ʻUki	Endemic	
Amaranthaceae	*Charpentiera elliptica* (Hillebr.) A.Heller	Pāpala	Endemic	
Asparagaceae	*Chrysodracon aurea* (H.Mann) P.-L. Lu & Morden	Halapepe	Endemic	
Araliaceae	*Cheirodendron fauriei* Hochr.	ʻŌlapa	Endemic	
Araliaceae	*Cheirodendron trigynum* subsp. *helleri* (Sherff) Lowry	ʻŌlapa	Endemic	
Dicksoniaceae	*Cibotium glaucum* (Sm.) Hook. & Arn.	Hāpuʻu	Endemic	
Dicksoniaceae	*Cibotium nealiae* O.Deg.	Hāpuʻu	Endemic	
Pteridaceae	*Coniogramme pilosa* (Brack.) Hieron.	Loulu	Endemic	
Rubiaceae	*Coprosma kauensis* (A.Gray) A.Heller	Kōī	Endemic	
Rubiaceae	*Coprosma waimeae* Wawra	ʻŌlena	Endemic	
Corynocarpaceae	*Corynocarpus laevigatus* J.R.Forst. & G.Forst.	Karaka nut	Naturalized	
Lauraceae	*Cryptocarya mannii* Hillebr.	Hōlio	Endemic	SOC
Thelypteridaceae	*Cyclosorus parasiticus* (L.) Farw.	Parasitic maidenfern	Naturalized	

Liliaceae	*Dianella sandwicensis* Hook. & Arn.	ʻUkiʻuki	Indigenous	
Gleicheniaceae	*Dicranopteris linearis*	ʻUluhe	Indigenous	
Athyriaceae	*Diplazium sandwichianum* (C.Presl) Diels	Hōʻiʻo	Endemic	
Gleicheniaceae	*Diplopterygium pinnatum* (Kunze) Nakai	ʻUluhe lau nui	Endemic	
Sapindaceae	*Dodonaea viscosa* Jacq.	ʻAʻaliʻi	Indigenous	
Blechnaceae	*Doodia kunthiana* Gaudich.	ʻŌkupukupu, Pāmoho	Endemic	
Asteraceae	*Dubautia kalalauensis*	Naʻenaʻe	Endemic	E, PEP
Dryopteridaceae	*Dryopteris fusco-atra* var. *fusco-atra*	ʻIʻi	Endemic	
Elaeocarpaceae	*Elaeocarpus bifidus* Hook. & Arn.	Kalia	Endemic	
Elaphoglossaceae	*Elaphoglossum paleaceum* (Hook. & Grev.) Sledge	Māku'e	Indigenous	
Asteraceae	*Erigeron karvinskianus* DC.	Daisy Fleabane	Naturalized	
Euphorbiaceae	*Euphorbia remyi* var. *remyi*	ʻAkoko	Endemic	E
Santalaceae	*Exocarpos luteolus* C.N.Forbes	Heau	Endemic	E
Pandanaceae	*Freycinetia arborea* Gaudich.	ʻIeʻie	Indigenous	
Zingiberaceae	*Hedychium gardnerianum* Sheppard ex Ker Gawl.	Himalayan (kahili) ginger	Naturalized	
Aquifoliaceae	*Ilex anomala* Hook. & Arn.	ʻAiea	Indigenous	
Rubiaceae	*Kadua affinis* DC.	Manono	Endemic	
Rubiaceae	*Kadua foggiana* (Fosberg) W.L.Wagner & Lorence	Manono	Endemic	
Crassulaceae	*Kalanchoe pinnata* (Lam.) Pers.	Air plant	Naturalized	
Epacridaceae	*Leptecophylla tameiameiae* (Cham. & Schltdl.) C.M.Weiller	Pūkiawe	Indigenous	
Campanulaceae	*Lobelia yuccoides* Hillebr.	Pānaunau	Endemic	SOC
Primulaceae	*Lysimachia kalalauensis* Skottsb.	No common name	Endemic	
Rutaceae	*Melicope clusiifolia* (A.Gray) T.G.Hartley & B.C.Stone	Kūkaemoa	Endemic	
Rutaceae	*Melicope feddei* (H.Lév.) T.G.Hartley & B.C.Stone	Alani	Endemic	
Myrtaceae	*Metrosideros polymorpha* var. *dieteri* J.W.Dawson & Stemmerm.	ʻŌhiʻa lehua	Endemic	
Myrtaceae	*Metrosideros polymorpha* var. *glaberrima* (H.Lév.) H.St.John	ʻŌhiʻa lehua	Endemic	

Dennstaedtiaceae	*Microlepia strigosa* var. *strigosa*	Palapalai	Indigenous	
Myricaceae	*Morella faya* (Aiton) Wilbur	Fire tree	Naturalized	
Myrsinaceae	*Myrsine alyxifolia* Hosaka	Kōlea	Endemic	
Myrsinaceae	*Myrsine knudsenii* (Rock) Hosaka	Kōlea	Endemic	E, PEP
Lomariopsidaceae	*Nephrolepis exaltata* (L.) Schott	Kupukupu, sword fern	Indigenous	
Oleaceae	*Nestegis sandwicensis* (A.Gray) O.Deg., I.Deg. & L.A.S.Johnson	Olopua	Endemic	
Solanaceae	*Nothocestrum longifolium* A.Gray	ʻAiea	Endemic	
Passifloraceae	*Passiflora tarminiana* Coppens & Barney	Banana poka	Naturalized	
Celastraceae	*Perrottetia sandwicensis* A.Gray	Olomea	Endemic	
Sapotaceae	*Planchonella sandwicensis* (A.Gray) Pierre	ʻĀlaʻa	Endemic	
Araliaceae	*Polyscias flynnii* (Lowry & K.R.Wood) Lowry & G.M.Plunkett	ʻOheʻohe	Endemic	E, PEP
Araliaceae	*Polyscias waialealae* (Rock) Lowry & G.M.Plunkett	ʻOheʻohe	Endemic	
Arecaceae	*Pritchardia minor* Becc.	Loulu	Endemic	SOC
Myrtaceae	*Psidium cattleianum* Sabine	Strawberry guava	Naturalized	
Dennstaedtiaceae	*Pteridium aquilinum* subsp. *decompositum* (Gaudich.) Lamoureux ex J.A.Thomson	Kīlau pueo	Endemic	
Rubiaceae	*Psychotria greenwelliae* Fosberg	Kōpiko	Endemic	
Rubiaceae	*Psychotria hexandra*	Kōpiko	Endemic	
Rosaceae	*Rubus argutus* Link	Sawtooth blackberry	Naturalized	
Blechnaceae	*Sadleria cyatheoides* Kaulf.	ʻAmaʻu	Endemic	
Blechnaceae	*Sadleria souleyetiana* (Gaudich.) T.Moore	ʻAmaʻu	Endemic	
Goodeniaceae	*Scaevola procera* Hillebr.	Naupaka kuahiwi	Endemic	
Poaceae	*Schizachyrium condensatum* , *Andropogon spp.* (Kunth) Nees	Bush beard grass	Naturalized	
Selaginellaceae	*Selaginella arbuscula* (Kaulf.) Spring	Lepelepe a moa	Endemic	

Cyatheaceae	*Sphaeropteris cooperi* (Hook. ex F.Muell.) R.M.Tryon	Australian tree fern	Naturalized	
Gleicheniaceae	*Sticherus owhyhensis* (Hook.) Ching	ʻUluhe	Endemic	
Myrtaceae	*Syzygium sandwicense* (A.Gray) Müll.Berol.	ʻŌhiʻa hā	Endemic	
Ericaceae	*Vaccinium calycinum* Sm.	ʻŌhelo	Endemic	
Ericaceae	*Vaccinium dentatum* Sm.	ʻŌhelo	Endemic	
Flacourtiaceae	*Xylosma Hawaiiense* Seem.	Maua	Endemic	
Rutaceae	*Zanthoxylum dipetalum* var. *dipetalum*	Kāwaʻu	Endemic	SOC

Key: SOC – Species of Concern (Fed); E – Endangered (Fed); PEP – Plant Extinction Prevention Program (State)

7.3 Fauna (mammals, amphibians, reptiles, invertebrates)

There have been no recent surveys of the site for mammals, amphibians, reptiles and invertebrates. However, a DLNR survey (DLNR 1997) carried out prior to construction of the nearby Kalalau Rim Endangered Plant Exclosure, encountered feral pigs, black-tailed deer, feral goats, feral cats, black rat, Norway rat, Polynesian rat and the house mouse.

The surveyors also noted that the ʻōpeʻapeʻa is known to occur 1km to the southwest of the site at the Hawaiʻi Air National Guard Radar Station and likely also resides in the forest surroundings. They further hypothesized at the time that the introduced Metallic skink (*Leiolopisma metallicum*) inhabits the area and the introduced wrinkled frog (*Rana rugose*) may inhabit the small drainages.

7.4 ʻAʻo – Newell's Shearwater

The ʻaʻo, or Newell's Shearwater, is endemic to Hawaiʻi, with Kauaʻi supporting the largest breeding population, estimated at 75 to 90% of the total world population (Ainley et al. 1995, USFWS 2011).
The species is listed as:

- Threatened under Federal and State of Hawaiʻi Endangered Species laws
- Endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (Birdlife International 2010).

Figure 7.1. The ʻaʻo. N Banfield.

Birds are nocturnal and ground nesting, breeding in burrows in steep, high elevation terrain. Their preferred habitat is open native forest dominated by ʻōhiʻa lehua (*Metrosideros polymorpha)* with a dense understory of ʻuluhe fern (*Dicranopteris linearis*).
Breeding begins in early April, when birds return to search for nest sites (Ainley et al. 1997, Zaun 2007, Deringer and Holmes 2009, Raine et al. 2017f, d, g, e). In June, the female lays one egg, which hatches in approximately 60 days. After hatching, both parents take turns to make foraging trips to the ocean to provision chicks. Fledging occurs late September to mid-November, peaking in October (Raine et al. 2017f). Fledglings will remain at sea for the next several years, returning to their natal areas to prospect for nesting sites in years two to five, and breeding by years five or six (Ainley et al. 1997). The ʻaʻo exhibits high site and mate fidelity.

The population of ʻaʻo is estimated to have declined by 94% (at an average rate of ~13% per year) from 1993-2013 (Raine et al. 2017b) and is predicted to continue to decline (Griesemer and Holmes 2011) . The restriction of the species' breeding range on the island is predicted to continue (Day et al. 2003, Holmes et al. 2009, Raine et al. 2017b).

Factors contributing to this decline are principally the effects of collisions with utility structures, fallout from the effect of light attraction and predation at breeding colonies by non-native predators (Raine et al. 2017a, Raine et al. 2017b, Raine et al. 2017f, d, g, e, Raine et al. 2017h). Other threats include climate change which can affect ocean conditions and food availability (Oro 2014).

7.5 Other Avifauna

DLNR surveyors in 1997 noted the koloa or Pacific golden plover (*Pluvialis dominica*), pueo and the nēnē or Hawaiian goose (*Branta sandvicensis*) in the vicinity of the site.

During a site visit and forest bird point counts in 2016 and 2017, KSHCP and KESRP staff observed ʻiʻiwi (*Drepanis coccinea*) (federally listed as threatened under the ESA), ʻapanane (*Himatione sanguinea*), Kauaʻi ʻelepaio (*Chasiempis sandwichensis)*, Kauaʻi amakihi (*Hemignathus Kauaiensis*) and ʻanianiau (*Magumma parva*). ʻAnianiau and Kauaʻi ʻamakihi were observed singing which may be an indication of breeding in the area.

The forest bird breeding season is from Jan – Jun, with most nests being high in the tops of trees. The pueo breeding season and population status is not fully understood but nests have been found throughout the year. Nests consist of simple scrapes in the ground (often under dense vegetative cover) lined with grasses and feather down (DLNR 2015).

Further surveys will be carried out in spring 2018 to complete a baseline of presence and nesting.

7.6 Listed Species

The following listed species are known to be present at the KSHCP mitigation site (. Table 7.2).

Table 7.2. Listed species and Federal Species of Concern known to be present at the site.

Species Common Name	Scientific Name	Confir-med Present	State Status	Federal Status	IUCN Status
Plants					
ʻOheʻohe	*Polyscias flynnii*	√	Endangered, PEP	Endangered	Critically Endangered
Kōlea, (Rock) Hosaka	*Myrsine knudsenii*	√	Endangered, PEP	Endangered	Endangered
Heau	*Exocarpos luteolus*	√	Endangered	Endangered	Critically Endangered
ʻAkoko	*Euphorbia remyi var.*	√	Endangered	Endangered	Critically Endangered
N - CONFIDENTIAL	*D – CONFIDENTIAL*	(outside fence)	Endangered, PEP	Endangered	Critically Endangered
Pānaunau	*Lobelia yuccoides*	√	Species of Concern	Not Listed	Not Assessed
Loulu	*Pritchardia minor*	√	Species of Concern	Not Listed	Endangered
Kāwaʻu	*Zanthoxylum dipetalum var. dipetalum*	√	Species of Concern	Not Listed	Near Threatened

Hōlio	*Cryptocarya mannii Hillebr.*	√	Species of Concern	Not Listed	Near Threatened
Birds					
ʻIʻiwi	*Drepanis coccinea*	√	Threatened	Threatened	Vulnerable
Bats					
Hawaiian hoary bat - ʻōpeʻapeʻat	*Lasiurus cinereus semotus*	possible	Endangered	Endangered	Least Concern

8. SEABIRD STUDIES ON SITE – KAHUAMA‘A SEABIRD PRESERVE

8.1 Kaua‘i and the Kahuama‘a Seabird Preserve – Background to Site Selection and Role in ‘A‘o Conservation

The island of Kaua‘i is critically important for meeting recovery and conservation goals for the ‘a‘o as it supports up to 90% of the world population (Spear et al. 1995, Ainley et al. 1997).

The Kaua‘i Endangered Seabird Recovery Project (KESRP) conducted auditory surveys and identified the ridges and slopes along the northwest coast of Kaua‘i as displaying the highest levels of ‘a‘o and ‘ua‘u breeding activity. These areas are known as ‘polygons’ or ‘calling hotspots’ (Figure 7.2) (Banfield et al. 2013, Raine et al. 2017f, d, g, e). This work helped to focus a search for a suitable SAS on the Kalalau Valley area which has high levels of activity, is relatively easy to access and is on land belonging to the state.

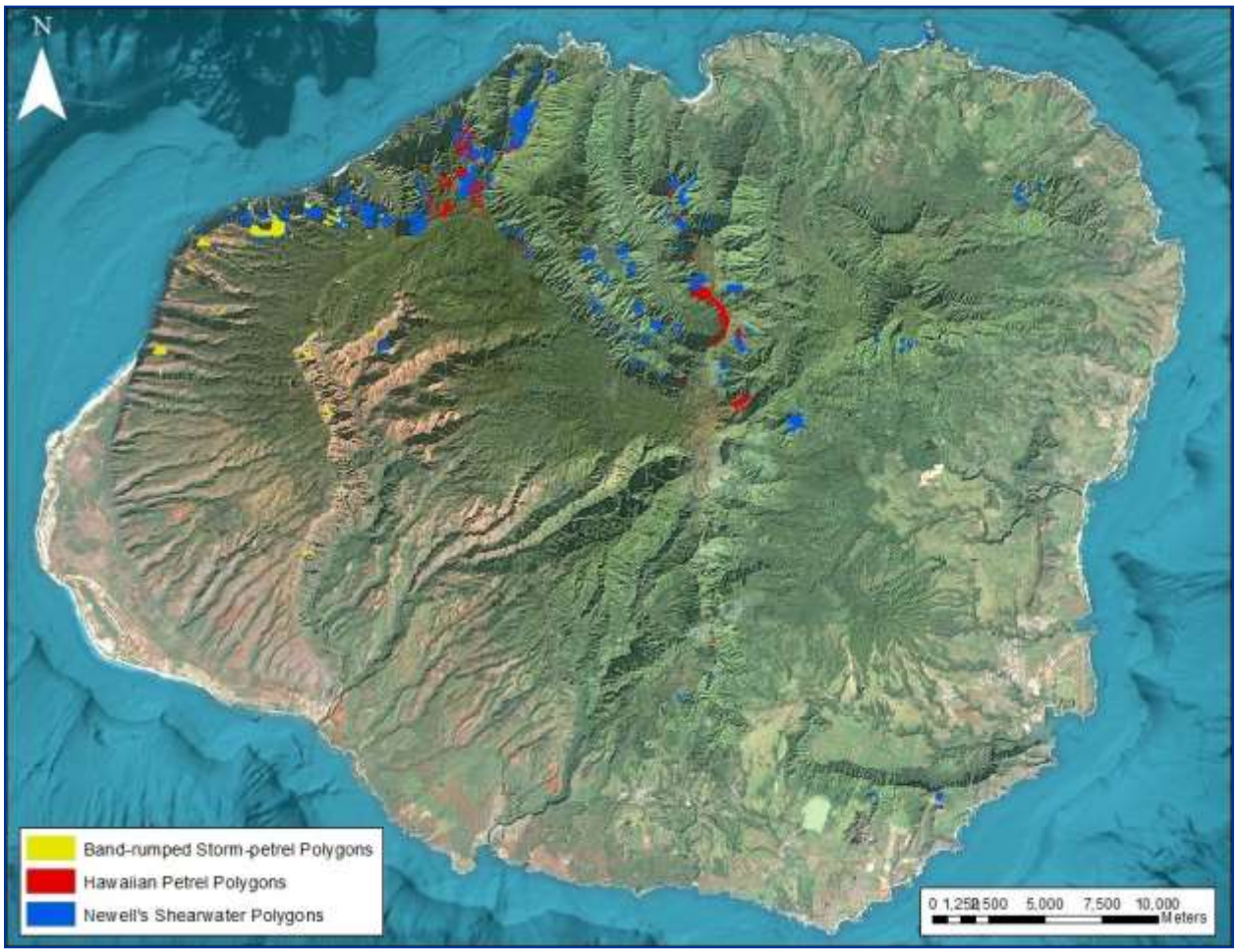


Figure 7.2. Map of ‘Calling Hotspots’ on Kaua‘i (KESRP).

KESRP conducted a series of surveys within and along the rim of the Kalalau Valley from 2006 to 2016 (Raine and Holmes, unpub. data), the results of which contributed heavily to the final selection of the site for the Seabird Preserve. Survey results identified 26 seabird polygons within 3km of the social attraction site, with the nearest polygon only 210 m away (Figure 7.3).

In addition, a song meter recording unit was installed on June 1, 2016 by KESRP staff to record ʻaʻo and ʻuaʻu activity (AUD 1: UTM 0434363 E, 2449690 N). The device was recovered on July 7th, 2016. Data was analyzed by KESRP and Conservation Metrics. ʻAʻo calls were detected almost nightly throughout the survey duration, with a site call rate of 0.3 calls/minute. This call rate is almost an order of magnitude lower than rates detected within a large monitored ʻaʻo colony in Upper Limahuli Preserve but is roughly comparable to lower-activity sites in Pohakea.

Although call rates were low at the survey site, compared to large monitored colonies of this species on Kauaʻi (such as Upper Limahuli Preserve), the fact that they were recorded on almost all nights suggests that potentially, a small number of pairs are breeding within or near to the site itself. The results also indicate that individual birds are flying around the area vocalizing on most nights, which could be drawn in by social attraction. Based on years of surveys by KESRP, it is clear that the wider area (Kalalau Valley and Nā Pali coast) has large breeding populations of both species (as seen in Section 6.2 and 6.3). Thus there are potential source colonies nearby that could be attracted into the site itself through social attraction (Raine et al. 2016).

Only 6 ʻuaʻu calls were recorded by the song meter. No barn owl calls or ʻakēʻakē calls were recorded.

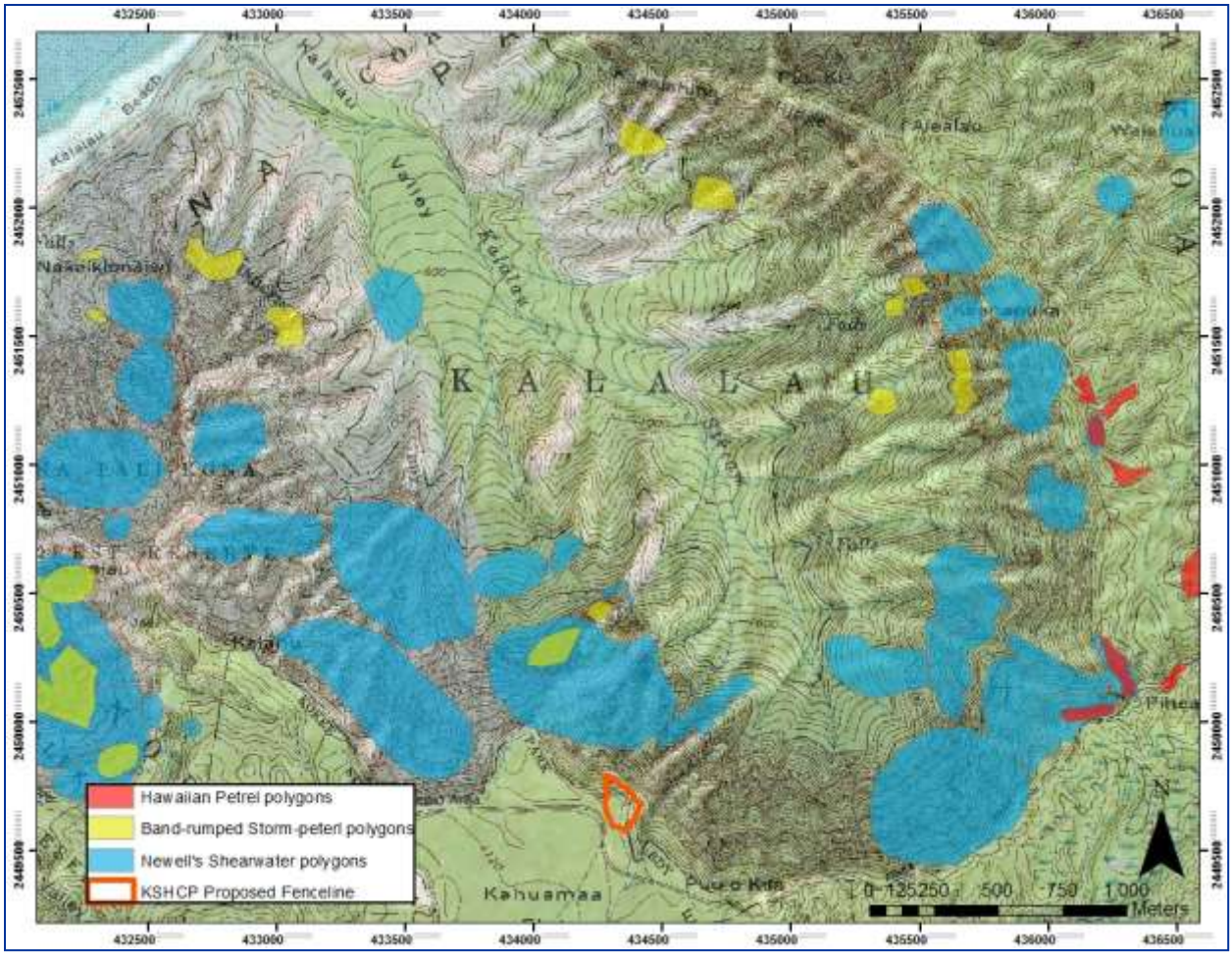


Figure 7.3. Map of location for the Kahuama‘a Seabird Preserve showing ‘hotspot’ polygons for the Covered Seabirds in surrounding area.

As a mitigation project for incidental take of ‘a‘o by KSHCP participants, the Kahuama‘a Seabird Preserve will play an important part in protecting the species over the 30-year lifespan of the project. The habitat in the area is already of high quality for the species and management action at Kahuama‘a will optimize this habitat. The site will become a stronghold for Newell’s by providing a predator proof sanctuary, enhancing reproductive success.
Moreover, the remote northwest region of the island offers an opportunity to conduct conservation away from the threats of light attraction and utility line collisions. Kahuama‘a is known to be relatively free of artificial light both at the site and also on the flyway to and from the ocean.

It should be noted that in 2015, a light attraction event resulted in a large number of downed seabirds at the Kōke‘e Airforce base (Raine 2015a, Raine et al. 2015). The Air Force has since signed an agreement with USFWS to minimize lights at this base during the seabird season, and to monitor for any fallout that may occur.

8.2 KSHCP Studies

On the basis of KESRP findings in the broader Kalalau valley area, further work was undertaken at the Kahuamaʻa Seabird Preserve by the KSHCP team. In 2016 and 2017, preliminary auditory surveys were conducted to assess flyover patterns and confirm any seabird activity in and around the site, including any ground calling activity. The objective of auditory surveys is not to obtain an exact estimate of the number of seabirds breeding or present within the survey, but to generate average call rates to allow for a quantitative estimate of the species in comparison with other survey areas.

2016
Fourteen surveys in four locations were carried out for ʻaʻo from May 31 to June 3, 2016 by KSHCP staff. Data recorded included presence of birds calling on the ground with distance to the observer, presence of birds transiting over the site with elevation and distance and number of calls over time. The surveys followed a standardized protocol developed in 2006 by KESRP (see Appendix 1), such that the KSHCP data will serve as a baseline, compatible with KESRP data across years and sites.

For ʻaʻo, the surveys found that no evidence of ground activity at the site itself (birds being present on the ground may be indicative of burrows nearby) but did record ground calling at a distance of approximately 200m. Birds were detected transitting over the site, which indicates a high potential for them to be attracted to playback. No burrows were found in the site but the survey did not include a specific search for burrows. Continuous calling by ʻaʻo was recorded at a distance of >500m within the Kalalau Valley, corroborating some of the KESRP polygons in the area (Figure 7.3), and confirming presence of ʻaʻo in densities that could serve as source colonies for the site. The maximum number of ʻaʻo calls detected in one survey was comparable to KESRP observations at Wainiha which is noted as a 'Medium-activity site' with "ground calling or other signs of potential nesting behavior detected" (Raine and Banfield 2015).

2017
Six surveys in two locations were carried out from August 28-30. Since the proposed fence location has changed since 2016, only one survey site was repeated and the other survey location covered a location within the new fenceline. The majority of the calls recorded came from outside the project site, confirming presence of NESH in densities that could serve as source colonies for the proposed social attraction project. When data for calls within the site itself (0-200m range) was analyzed separately, the 'calls per hour average' was, as expected, low. Nonetheless, almost 200 calls were recorded in one session within this distance bracket, indicating a good number of birds circling or transiting over the site. This is encouraging, suggesting that the site is in an excellent location to attract prospecting birds once social attraction commences. In addition, several calls were heard that might have indicated ground calling, although these calls were not persistent enough to confirm the presence of breeders on site.

The presence of barn owls during three separate sessions indicates that barn owl control is likely to be of great importance at the site once social attraction starts as these introduced birds are known to be aerial predators of Newell's Shearwaters.

The results of the surveys, combined with the KESRP acoustic monitoring survey indicate that the installing a social attraction site at Kahuamaʻa has a high likelihood of success due to the presence of transiting birds, the presence of ground calling birds in the near vicinity and the fact that nearby source colonies have a suitable density of ʻaʻo which will supply new birds to the site.

Note that the social attraction component of the management plan will not be targeting ʻuaʻu directly because the applicants for the light attraction HCP have very low numbers of incidental take for ʻuaʻu which are being mitigated for by barn owl control in the Kalalau Valley. However, if ʻuaʻu choose to breed in the site, it will be an added conservation benefit.

9. OBJECTIVES

The objectives of the Kahuama‘a Seabird Preserve mirror those of the KSHCP in Table 9.1.

Table 9.1: KSHCP Objectives

Goal 2: Mitigate authorized take of the Covered Species and provide a net gain in recovery for each of the Covered Species.	2.A. Construct a predator-proof fence and install social attraction equipment (nest boxes, speakers) within the fenced area at the mitigation site in Year 1 of KSHCP implementation.
	2.B. Remove predators from within the fenced enclosure with monitoring confirmation of their absence, and activation of the social attraction equipment by Year 2; predator eradication within fenced enclosure maintained for the life of the project.
	2.C. Ground activity by Covered Seabirds documented at the mitigation site by Year 4 of KSHCP program implementation.
	2.D. Breeding activity by Covered Seabirds documented at the mitigation site by Years 5-7 of KSHCP program implementation.
	2.E. Cumulative upward trend in Covered Seabird breeding documented at the mitigation site by Years 10-12 of KSHCP program implementation.
	2.F. Continued cumulative upward trend in Covered Seabird breeding documented at the mitigation site by Year 20 of KSHCP program implementation.
	2.G. Maintain high quality seabird habitat at the mitigation site by removal of habitat modifying invasive plants in Year 1 and annually throughout the 30-year duration of the KSHCP.
	2.H Protect nesting birds inside mitigation fence and in nearby source colonies by implementing predator control of 1) barn owls within the area surrounding the fenced enclosure and the Kalalau Valley, and 2) feral cats at ingress points to source colonies in the Kalalau Valley, beginning in year 1 and annually throughout the 30-year duration of the KSHCP.

10. ACTIVITIES

10.1 Activities Overview

Achieving the objectives of the Kahuama‘a Seabird Preserve will require a series of actions over the duration of the project (30 years). For each specific activity within the Management Plan,

the activity and methodology is described in the following sections. The approximate chronology of actions is as follows:

- Obtain permits
- Final confirmation of fence alignment
- Pre-construction surveys
- Fence Construction
- Predator Eradication
- Commence social attraction at site
- Vegetation management (invasive species removal)

Monitoring at the site will be ongoing and is a critical part of project success. All data will be collected digitally in the field to facilitate swift analysis into a database at the office. The Project Manager and Technician will work together to analyze data, produce appropriate monitoring documents and carry out all project management activities.
Section 17 outlines the Best Management Practices (BMPs) that will ensure that listed and / or rare species are not compromised by any of the activities.

10.2 Obtain Permits

Permits from the relevant authorities should be obtained in advance and will be outlined before the project begins. Permits may be required as follows:

Action	Permit / Permission
Fence construction and habitat enhancement	Develop MOA and secure any related approvals from DLNR
Invasive plant removal and pest control	Secure permits as required from DOA, USDA, USFWS and DLNR
Research and monitoring	Secure permits as required from DLNR and USFWS
All	NHPA Section 106 and ESA Section 7 consultation

10.3 Fence Alignment and Pre-Construction Surveys

OBJECTIVE 2A – Construct a predator-proof fence and install social attraction equipment (nest boxes, speakers) within the fenced area at the mitigation site in Year 1 of KSHCP implementation.

10.3.1 Initiate Bids Process. Select and Hire Contractor

The relationship with the fence contractor is extremely important to ensure that Best Management Practices are followed during construction and that the outcome of a terrestrial

predator-free enclosure is successfully achieved. As soon as the Prime Contractor takes over management of the Kahuama'a Seabird Preserve, a fence contractor with a proven track record, capable of working in the terrain, will be engaged through a bids process.

10.3.2 Establish Sling Load Drop Zones, Final Fence Alignment

The chosen contractor will meet on site to establish the final fence alignment and sling load drop zones with Prime Contractor staff, the regulatory agencies and any other stakeholders considered necessary.

Following the onsite meeting, a document will be drawn up with a map showing the exact location of the fence and sling-load drop zones. The contractor will be asked to commit in writing to this document.

10.1.1. Pre-construction Surveys

Prior to work commencing on site, a series of surveys will be carried out and the results used to guide construction work and to ensure that all damage to listed species is completely avoided. These surveys are detailed in the following sections.

- Burrow surveys – Section 12.3.1
- Auditory survey – Section 12.3.4
- Bat survey – Section 17.1.3
- Candidate and listed forest bird & pueo survey – Section 7.5 & 17.1.4
- Archaeological survey – Section 17.1.6
- Plant Survey – Section 12.2

10.4 Fence Construction

OBJECTIVE 2A – Construct a predator-proof fence and install social attraction equipment (nest boxes, speakers) within the fenced area at the mitigation site in Year 1 of KSHCP implementation.

In order to establish a safe breeding sanctuary for the Covered Seabirds, a predator-proof fence will be constructed on site as follows.

10.4.1 Fence Design

Figure 10.1. Technical Drawings of the Fence and Pedestrian Gate (PRC 2017)

The fence (Figure 10.1) will enclose approximately 2ha and will incorporate the following characteristics or similar (Young and VanderWerf 2014):

- Height of 2m
- All fence materials made of the same material (stainless steel)
- The fence base or frame should be constructed using 2.7m long posts spaced at approximately 2m intervals along the fence length. Spacing in areas of high winds along ridge lines should be closer
- Stays (diagonal braces placed behind the posts at a 45° angle) should be used on average every 4 posts and every 2 posts in high wind areas and on steep slopes. Stays must be placed only on the inside (pest-free) side of the fence.
- Stainless steel single strand wires should be tensioned to 150kg horizontally between the posts or poles and be fixed to each pole or post using stainless steel fastenings.
- Fine-aperture mesh will be applied that will exclude any terrestrial animal larger than a 2-day-old mouse. The face of the fence and the horizontal skirt extending out from the base of the fence should be marine grade “316” stainless steel mesh with an aperture no larger than 7mm by 25mm. The mesh should be fixed to the posts and post framework using stainless steel fittings.

- A mesh skirt will be added extending out and down approximately 0.5m to prevent digging, secured to the ground with pins or cement and not loose in any location, with its leading edge covered with topsoil or filled to a depth of approximately 45cm, and not scoured out or eroded under in any way
- Rolled hood will be added to allow animals to escape the enclosure, but not to jump inside. The hood should be of the same material as the rest of the fence and should be braced with brackets at each post and fixed to the fence frame using stainless steel fittings.
- The area immediately outside of the fence (i.e., the pest side) should be completely free of any objects or structures within two meters of the fence at all heights that an animal could use as a base for jumping over the fence
- The main body of the fence should be constructed in such a way that there are no gaps wider than 7 mm to exclude juvenile mice
- No fence corner should turn more sharply than 45 degrees off the line of the previous fence section (Figure 10.2).

Figure 10.2. Fence corner diagram

- Single, half-door design lockable pedestrian access gate will be located along the fence edge nearest to the road, not at ground level, requiring stepping over to reduce the chance of predators entering if the gate is accidentally left open (Figure 10.3). Gate sealed to the main body of the fence in a pest proof manner with no gaps greater than 7mm along more than one dimension, with a mesh skirt or solid concrete footing beneath the gate entrance that extends out from the gate by no less than 350mm
- An extra 5% of materials has been included in the budget to serve as “overage” in case there is variance from the estimated fence length or damage to some materials during transport. The extra materials also can be used for repairs after construction is complete.
- This design minimizes the risk of reinvasion as long as monitoring and maintenance procedures are in place (Day and MacGibbon 2007).

Figure 10.3. Example of pedestrian gate design that does not extend to ground level (Young and VanderWerf 2014)

Figure 10.4. Similar predator-proof fence at Hutton's shearwater colony, Kaikoura, New Zealand. A Raine.

10.4.2 Earthworks (Young and VanderWerf 2014)

- The fence platform should be formed as a gentle mound (when viewed in cross-section) so that drainage water cannot pass through the line of the fence.
- The earthworks and substrate in and around the fence should not have any channels or gaps continuously greater than 7mm across more than one dimension that extends from the ground surface on the outside (pest side) of the fence to the ground surface on the inside of the fence.

- The fence platform and ground conditions in the vicinity of the fence should be such that there is no immediate risk of slumping or erosion that may cause damage to the fence or compromise any of the standards outlined above.

10.4.3 Fence Construction Methods

Fence construction will ensure that the risks of predator incursion are minimal. Constructions will consist of:

- Fencing material will be flown in and landed on the agreed upon sling load drop zones (see section 10.3.2). Fence contractor will agree to a timetable for completion and all BMPs in writing.
- Clearing of fence-line (removing vegetation from a 4m wide swath, with machinery if possible or else by hand with chainsaws / hand tools) following the BMPs outlined in section 17.1 and 17.2
- Removal and maintenance of all woody vegetation from the outside the fence line to a distance of 3.7m to prevent incursion from predators. This may be less where there is an upwards slope away from the fence. Rats have a horizontal jumping capacity of 3.66m and a vertical jumping capacity of 1.8m (L. Young, 2017, pers. comm.). Grass may remain.
- Fence platform formation (earthworks, drainage works and culverts) with use of heavy equipment, such as a bobcat, if possible.
- Base fence erection (installation of posts, anchor poles, braces, 5 base wires);
- Attachment of mesh (including ground pinning/cementing);
- Attachment of cat-proof hood sections;
- Installation of waterway and access components.
- Removal of all waste upon completion.
- Due to the presence of tall canopy forest surrounding the fence, a solar powered tree fall response system (a metal wire that sits above the hood and is triggered if a branch falls on it) will be included in the fence construction process.

10.4.4 Delays in Fence Construction

Fence construction delays could result in additional costs. Some delays are avoidable; for example, in the case of permits, the KSHCP team will work with the agencies in advance, on the basis of the management plan, to ensure that the agencies issue permits before work commences and that any problems are flagged by the agencies early enough to be solved.

Fence construction must start during the period December to April, i.e. outside the breeding season. Fence construction may only commence during this period if it is reasonable to expect that the work that would affect seabirds will be completed on the sloping sections of the fenceline before the seabird breeding season commences, namely vegetation clearance, installation of initial posts and other ground disturbing work.

However, work may continue into the breeding season to complete the fence provided it is either on the flat areas of the site or does not include work noted above that would damage potential burrows or birds in burrows.

Since this means that missing the appropriate window could result in a delay of a year, the fence contractor will be asked to commit to deadlines such as ensuring that materials are in place in advance (see section 10.4). The contract will stipulate per-day monetary penalties beyond the specified deadline for contractor delays, regardless of weather. Intensive efforts will be made by the Prime Contractor to avoid delays.

10.4.5 Confirm Fence Construction Complete

The target for completion of fence construction is end of Year One to fulfil KSHCP requirements. Prime Contractor staff will confirm that this target has been met with a final fence inspection including photographs.

If it becomes clear during the course of construction that this target will be missed, Prime Contractor staff will consult regulatory agencies and initiate adaptive management (outlined in section 16) if required.

10.4.6 Long term Fence Monitoring and Maintenance

Even a well-built predator exclusion fence using proven materials will require a regular monitoring and maintenance program to be effective in the long term. Accidents, vandalism, and acts of nature are likely to damage the fence at some point, potentially resulting in pest reinvasions. A good maintenance and monitoring program will detect the damage quickly, will have people and resources in place to make emergency repairs, and will reduce the likelihood of animals entering when a breach occurs (Young and VanderWerf 2014).

Maintenance will be carried out as follows:

- The contractor will be required to provide a complete parts list, including item description, material, manufacturer and part number in a spreadsheet.
- They should also provide a written maintenance manual, repair kit parts list and one day of on the ground training for managers and staff.
- Based on discussions with other predator fence project managers, annual maintenance cost for materials is estimated to be 1% of the initial cost of the fence, plus labor.
- The fence will be monitored bi-monthly (this can be combined with other monitoring activities, such as predator control) following completion to avoid fresh incursions by predators. Personnel will check for holes, breaches, vandalism, and other damage throughout the life of the project. Ad hoc monitoring will occur after storm events or high winds to ensure no damage was sustained. Gates will be tested for functionality.
- When inspecting, there are four components to look at: hood, posts and stays, skirt and mesh. The hood should be examined for excess lichen growth which can facilitate cats climbing over, corrosion at seams, attachment points, bends and for scratches indicative

of cats attempting to jump over. If scratches are noticed, the area should be examined to determine if there are jump points. Posts and stays should be examined for corrosion and loose attachments. Mesh should be examined for breaks in welds or links, corrosion or abrasion and separation at the seams or attachment points. The skirt should be examined to ensure that there aren't any punctures, it is secured to the ground, not eroded underneath and that the lip is not curling up and allowing pests to dig under.

- Where scratches are seen, feral cat trapping outside the fence will be intensified (see section 11.1.2)
- A risk analysis will be carried out after construction, to identify possible areas of weakness. This analysis should identify possible reinvasion sites, such as at natural barriers like adjacent overhanging trees, steep slopes, areas prone to high winds or rock falls, or areas where public might try to access.
- To assist in having breaches reported in a timely manner, signs could be 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 posts will be tagged with a unique number so that anyone reporting a breach can identify the location easily (e.g. fence panel #180). These can either be engraved into the fence posts, or added as separate metal tags.
- All project staff will carry a small tool box of patch materials and tools at all times during site visits.

10.5 Intruder Detection

Predator intrusions will be identified through the regular deployment of tracking tunnels inside of the fence line. See rodent removal section 11.1.1.

10.6 Predator Defense Zone Around Fenceline

To reduce the likelihood of pests entering through a fence breach, a zone of low, non-woody vegetation will be created and maintained around the perimeter of the fence. Predator eradication will also occur in this zone (and up to 50m beyond) because several species, particularly feral cats, have been noted using a fenceline as a transit trail within their territory (A. Raine, 2017, pers. comm.) and regularly patrol it, increasing their chances of finding a breach before it is repaired. See rodent and feral cat removal section 11.1.1 and 11.1.2.

10.7 Fence Crisis Response to Reduce or Eliminate the Risk of Predator Incursion

A tree fall response system will be installed along the fence which will issue an alert to a mobile phone if the fence is damaged by falling vegetation.

Following such an alert or a storm event and / or hurricane, staff will check the fence as soon as practically possible (ideally within 2 hours, if safe to do so). If a major breach is discovered, e.g. a tree falling on the fence and / or the fence being blown down or partially destroyed by a hurricane, staff will initiate a 'fence crisis procedure' as follows:

- Upon discovery of a major breach or serious damage, Prime Contractor staff will alert the regulatory authorities (DOFAW, DLNR, USFWS) and the KSHCP participants
- Where possible and safe to do so, staff will make an effort to repair the breach themselves for damage limitation
- Where the breach is too large, staff will retain the services of a fence contractor as soon as practically possible to repair the breach.
- If the breach occurred outside the breeding season for covered seabirds, staff will deploy ink card tracking tunnels, visual surveys and cameras to assess the likelihood of predators having entered the Kahuamaʻa Seabird Enclosure. If predators are found to be present, Prime Contractor staff will initiate the predator removal procedures outlined in this management plan in section 11.
- If the breach occurred during the breeding season, Prime Contractor staff will initiate the predator removal procedures immediately to avoid injury or death to the covered seabirds.
- IE staff will also check and repair any damaged artificial burrows following a storm event, as well as the social attraction equipment, cameras, Goodnature (or similar brand) traps and any other hardware relevant to the site.
- The KSHCP includes a contingency fund to pay for incidents of this nature. Prime Contractor staff will draw upon the fund as required to repair the breach.

11. OPERATION OF PROJECT SITE

11.1 Predator Eradication at Project Site

OBJECTIVE 2.B. Remove predators from within the fenced enclosure with monitoring confirmation of their absence, and activation of the social attraction equipment by Year 2; predator eradication within fenced enclosure maintained for the life of the project.

There are many precedents for successful predator removal in fenced seabird enclosures. In Hawaiʻi, these include the Nihoku Ecosystem Restoration Project at Kīlauea Point National Wildlife Refuge in Kauaʻi in 2015, Makamakaʻole Seabird Preserve in Maui in 2013 and Kaʻena Point Natural Area Reserve on Oʻahu in 2011.

Kahuamaʻa Seabird Preserve, predator eradication will target rodents, namely black rat, Norway rat and Polynesian rat. House mouse is likely to be eradicated as part of the process. It will also target feral cats, ungulates, pigs (although these are expected to leave of their own accord due to the levels of disturbance during construction) and barn owls.

11.1.1 Rodent Eradication Methods

Predator removal will be achieved through a grid of mechanical trapping (rodent snap traps, self-resetting rodent Goodnature traps or similar brand) and stationary rodenticide (diphacinone) bait stations. Monitoring will include the counting and collection of carcasses,

monthly deployment of ink card tracking tunnels which show predator footprints, camera monitoring and bait-take monitoring (this is dealt with in section 12.1). Eradication within the fence is expected to take 3 months (Young et al. 2013) but may be longer.

There will also be a secondary line of rodent removal defense just outside the project fence in a 50m predator defense zone consisting of Goodnature (or similar) and snap traps which will remain there permanently. This will help to prevent the ingress of rats and mice into the site by removing them before they reach the fence; research suggests that reinvasion by rodents occurs within 24 hours of a breach (Connolly et al. 2009).

Project staff will be trained by predator eradication experts based on Kaua'i. To remove rodents inside the fence enclosure, trained and certified technicians will set up the following grids using a GPS:

11.1.1.1 Self-resetting rat traps (Goodnature A24 traps or similar)

These traps house a firing system in a narrow opening, positioned vertically to the ground. When rats take the bait, a bolt fires, killing the predator instantly.

- 25 will be spaced every 50m - the average home range size for Black Rats ((Young et al. 2012) - on a grid inside the fence, mounted on trees or roots. If no other support is available, a pole can be used. Traps will be at least 12cm off the ground. They will remain for the duration of the project.
- A further 40 will be mounted every 50m in the 50m predator defense zone outside the fenceline and will remain there for the duration of the project
- Traps will be checked monthly, strike counter noted, CO_2 canister tested and changed if required and trap re-baited if necessary by removing the shroud cap, taking out the longlife lure bottle, tapping out tired lure as a pre-feed to attract pests, wiping and replacing lure. Check frequency may be reduced over time if the automatic lure pump proves effective.
- For further set up and management details see http://www.goodnature.co.nz/support. Similar brands may also be used.

11.1.1.2 Enclosed rat "snap" traps (Victor, DOC 200 or similar)

- Inside the fence, a grid of up to 75 "snap traps" or similar (placed inside a bird-safe housing to prevent non-target capture) will be set up (numbers may vary depending on predator level) with 50 spaced approximately every 25m inside the fence and 40 in the 50m predator defense zone outside the fence.
- These will be used throughout the initial eradication (expected to last three months) and then may be removed except in case of a reinvasion by predators and stored by project. However, if rat presence inside the fence continues to be a problem, the "snap" traps will remain. The snap traps will remain outside the fence for the duration of the project.

- Options include the Victor Rat Traps and the DOC200.
- There are a variety of possible baits. The Makamakaʻole project (S Engler, 2017, pers. comm.) have advised that the most effective bait to date is eggs (with a small hole poked in them) for the DOC200's and a homemade formula of peanut powder, coconut oil, wax and preservatives in a mold for snap traps. This wax bait has proven to last up to 2 weeks in the field without molding (whereas peanut butter alone lasts only 3 days). In Kauaʻi, GoodNature bait has proved effective for snap traps (K Pias, 2017, pers. comm.) but other brands can be used.
- Traps will be placed in a bird excluding box designed to exclude non-target species, guide target species, and maintain the integrity of the trap from weather (Mosher et al. 2010). Plans can be found at (http://www.doc.govt.nz/Documents/conservation/threats-and-impacts/animal-pests/doc250-predator-trap.pdf) (Peters 2017). See Figure 11.1. Alternatively, Tupperware boxes can be used with holes cut in the side of them to exclude birds from the traps, based on a design by Kyle Pias.
- While in use during initial eradication, traps will be checked every two days, carcasses removed and disposed of off-site and bait replaced if required.

Figure 11.1. Bird Excluding Box for DOC 200 Snap Traps from Makamakaʻole Project, Maui

11.1.1.3 Rat bait stations.

Rodent bait stations will be placed inside the fence. Stations are designed to prevent access by birds or non-target species.

Interior rat bait stations

- A grid of approximately 50 tamper-resistant Protecta ® plastic bait stations or similar will be placed every 25m inside the fence.
- Stations will be secured to the ground with metal rebar stakes and plotted by GPS.
- Stations will be baited with 11 1oz Ramik mini-bars ® containing 0.005% diphacinone or similar product approved for conservation of endangered species (Young et al. 2013). Bait will be placed on a rod and box will have lid screws to eliminate risk of removal and caching of bait by rodents. 16 bars are allowed per station according to the label, but 11 is the maximum that will fit in the station on the rod so that bait is not shaken free (Young et al. 2013)

- For the initial bait application, stations will be re-baited twice a week for one month. In month two, stations will be baited once per week; in month three to six, stations will be baited every two weeks; thereafter, stations will be baited once a month until sign disappears (by zero bait take or teethmarks and zero presence on ink cards).
- Bait take 'hot spots' will be mapped, where additional trapping / baiting would be of benefit.
- Once ink card tracking tunnels and bait stations show zero signs of take, predator eradication work and monitoring will continue for a further three months (the average reproductive cycle of a female rat) to ensure that a new litter did not survive. Detailed records of the level of bait take for each station will be kept.
- Any bait blocks that are wet or excessively moldy will be removed and replaced with fresh bait. Spoiled bait blocks will be placed in a plastic bag and disposed of in an off-site location and any bait blocks that have been dragged out of the station will be returned to the station (if in reusable state) or removed if unusable
- Bait stations may be re-utilized at any time during the project based on a suspected breach or rodent evidence found via tracking tunnels, cameras, or other detection methods following the above protocol until rodent signs disappears. They will therefore remain in place. However, their use will be kept to the minimum possible, if used at all.
- KSHCP personnel or contractor will be certified as applicators of restricted-use rodenticide. These certifications will need to be renewed every 4 years, or as dictated by the HDOA.
- Signs indicating diphacinone bait is being used will be placed on the pedestrian entrance to the fenced area.

Even when rodent eradication inside the predator-proof fence is complete, permanent rodent control (snap traps in bird excluding boxes and Goodnature traps or similar) immediately outside the fence will be maintained (traps left out and maintained) to keep animal densities low and prevent immigration into the fenced area.

To facilitate rapid response to a breach, unarmed snap traps and unbaited bait stations will remain in situ inside the fence so that they can be easily redeployed in an emergency.

11.1.2 Feral Cat Eradication, Biosecurity Methods Inside Kahuama'a Seabird Preserve Fence

2.B. Predators removed from within fenced enclosure with monitoring confirmation of their absence, and activation of the social attraction equipment by Year 2; predator eradication within fenced enclosure maintained for the life of the project.

It is anticipated that feral cats (*Felis catus*) will leave the interior area prior to completion of the fence, due to the disturbance caused by construction activities. This will be confirmed by the

deployment of 2 live traps and 10 Reconyx camera traps inside the enclosure for three months or until social attraction commences (these cameras will later be used for burrow monitoring).

11.1.2.1 Potential Feral Cat Eradication Methods (inside the fence)

- Conibears

Conibears (Body Gripper Traps - Duke #220 or similar) for feral cats will be used following fence completion in case cats have not left the site by their own volition.

Conibears have the potential to kill birds and therefore will only be deployed within bird excluding boxes; these can be homemade out of a Tupperware box (K. Pias, pers. comm.) Two traps will be place in a location to be decided by technicians based on camera data and other evidence of cat presence / knowledge of cat behaviour.

Conibears may also be used in the event of an incursion, as outlined in section 11.1.2.

- Live Traps

If there is any evidence of cats inside the fence after construction (scat, camera, visual sightings etc.), the 8 live traps (tomahawks) from outside the fence will temporarily be deployed inside the fence until all cats are captured.

- Goodnature Traps

The current design of Goodnature cat traps has not proved effective in Kaua‘i, however new models are being considered and might be added to the project in the future.

- Shooting

If the above methods are not successful, feral cats can also be dispatched by shooting. This would be done at night, using visual, scent or aural lures, with a rifle with a night scope, operated by a trained technician.

11.1.2.2 Feral Cat Reinvasion

If cats are detected inside the predator proof enclosure after completion, through any means (for example visually, on a camera or through the appearance of a bird carcass that is likely to have been killed by a feral cat, scat, footprints or other signs), they must be urgently removed, following strict BMPs (see Section 17).

All 8 live feral cat traps will be deployed inside the fence. 2 conibears in bird excluding boxes will be set and baited inside the fenced area at an appropriate location as determined by cameras and other evidence, until the feral cat is eradicated. The feral cat may also be humanely dispatched by shooting as outlined above.

11.1.2.3 Feral Cat Control Methods (outside fence)

Feral cats are observed on the road to Pihea by NARS staff on a near-weekly basis, and NARS camera data reflects significantly higher numbers of cats moving along trails and fence lines than along densely vegetated areas (K Pias, 2017, pers. comm.). It is worth noting that a predated ‘a‘o was documented in 2014 in very close proximity to the Kalalau Lookout (A. Raine, 2016, pers. comm.).

At the Makamaka‘ole Seabird Preserve, cats were noted prowling the exterior of the fenceline, apparently attracted by seabird calls played on the speaker (S. Engler, 2017, pers. comm.). This presents a risk of reinvasion by cats in the event of a breach and also an opportunity to remove cats which might prey on neighbouring source colonies. Therefore, feral cat control along the fenceline will be carried out as follows:

Live feral cat traps

- 8 live feral cat traps (30” and 36” Tomahawks or similar) will be deployed, 2 on each side of the fence. These will be a mixture of baited traps and un-baited trail set traps (double door tomahawks).
- Traps to be run, in the course of technicians’ other duties. When open, they will be checked every 24 hours to adhere to IACUC standards.
- Bait will be a combination of dry cat food and synthetic shellfish oil replaced every 2-3 days or as needed. Baits will be adaptively implemented based on best available information and the findings of related projects.
- Traps will be locked open in place with added bait between trapping efforts to encourage regular visitation by cats. This technique has been observed to greatly increase capture rates (G. Reid, 2016, pers. comm.).
- Feral cat carcasses will be necropsied and stomach contents will be examined for evidence of seabird predation.
- Non-target pest species (e.g. rats) that are caught in the live traps will also be dispatched.

Cameras

- Two cameras will be used outside the fence to monitor for cat presence (see section 11.1.1 for methods)

Trapped Animal Dispatch

- Technicians will receive firearm training. Trapped feral cats will be dispatched humanely.
- The MOA with State Parks will include an agreement regarding use of firearms on designated State Parks land.

11.1.3 Mongoose

The establishment of Indian mongoose (Herpestes javanicus) is uncertain on the island of Kaua‘i (Phillips and Lucey 2016). Two mongoose have been caught on Kaua‘i in recent years and Kaua‘i Invasive Species Committee (KISC) receives multiple “credible” sightings annually. If a mongoose is detected or suspected at the site at any time, the project team will advise the regulatory agencies and seek advice from KISC within 12 hours of the animal being detected and will commence the procedures outlined by Phillips and Lucey (2016). Should this occur, the KSHCP activities will be modified if USFWS and DLNR reasonably determine, in consultation with Participants, that such a response is necessary.

11.1.4 Ungulates and Pigs

Site visits during the project development stage have indicated a high degree of goat disturbance, as well as some pig sign. Black-tailed deer may also be present. However, due to the relatively small size of the enclosure, a need for feral pig, feral goat and deer trapping is not anticipated as large ungulates typically avoid the kind of loud human disturbance that will occur during construction.

Scheduled fence monitoring and maintenance (Section 10.4.6) will ensure any ungulate or pig fence damage is noted and repaired.

Scheduled camera checks for cats and rats (Section 11.1) will ensure that any ungulate or pig presence inside the fence is noted. In the highly unlikely event that an ungulate or pig is found inside the enclosure, a firearm-certified technician will be remove them as soon as practically possible. Snares / legholds may be deployed if necessary.

11.2 Barn Owl Control

Objective 2.H. Protect nesting birds inside mitigation fence and in nearby source colonies by implementing predator control of 1) barn owls within the area surrounding the fenced enclosure and the Kalalau Valley, and 2) feral cats at ingress points to source colonies in the Kalalau Valley, beginning in year 1 and annually throughout the 30-year duration of the KSHCP.

Barn owls are a non-native species and known predators of seabirds (Thomsen and Kroeger 2015, Raine et al. 2017c). They cannot be completely excluded from the reserve as they are aerial predators and their home ranges can vary considerably in size from 1.5km² to 31km² depending on habitat and prey availability (Martin et al. 2014). Therefore, barn owl reduction methods will be deployed in and around the site to ensure that seabirds are not predated at the preserve. This predator control will begin in Year 1 and is expected to continue for the 30-

year duration of the Program. The barn owl control will enhance adult survivorship and the reproductive success of ʻaʻo, ʻuaʻu and 'akē'akē breeding in the affected area (USFWS 2017b).

This is particularly the case for those populations nesting along the Nā Pali Coast such as Honopū Valley (where large numbers of ʻaʻo are known to nest) and along the Pihea side of the Kalalau rim (where large numbers of both ʻaʻo and ʻuaʻu are known to nest (Raine et al. 2016)).

ʻAkēʻakē have also been documented vocalizing from cliff bands within the Kalalau Valley and are present in large numbers in the slot canyons of the Nā Pali coast, including nearby Honopū (KESRP, unpublished data). While they are not expected to breed in the social attraction site, they will benefit from barn owl control as, based on evidence from Lehua Island monitoring by KESRP and the propensity of barn owls to be attracted to ʻakēʻakē calls in Kauaʻi, they are likely to be heavily impacted by this predator. An ʻakēʻakē predated by a barn owl was found in nearby Nuʻalolo ʻĀina in 2014 (A Raine 2017 pers. comm.).

Once an individual or a mating pair of barn owls are removed, new individuals will move into the territory over time. Observers in nearby locations on Kauaʻi have noted a lapse of about 3-12 months between removal of original individuals from a territory and detections of new individuals (G. Reid, 2016, pers. comm.). This underscores the need for ongoing control.

11.2.1 Barn Owl Reduction Methods – Trapping

- 6 Bal-chatri prey traps or Swedish Goshawk-style trap will be employed approximately 4 nights per month or as needed at various points along the Kalalau Rim. These points will be moved as required.
- The owls will be electronically lured into the area using owl or prey calls. Traps will be baited using decoys (a moving toy and playback to mimic the presence of a mouse/rat, or with a live rat/mouse). When the owl pounces on the Bal-chatri trap to get at the decoy, their talons will become entangled in the snares set on top of the trap and the trapped owl dispatched humanely.
- Live bait will consist of captured, humanely-held rats (*Rattus rattus*) or mice (*Mus musculus)*. Food, shelter, water and insulating cover will be provided to bait rodents in the trap.
- Traps will be set at night and closed each morning to ensure humane treatment of both bait and potential target species, and to ensure that non-target species (such as pueo) can be safely released if caught.
- Barn owl traps will be set outside of the enclosure to prevent reintroduction of rodents to the facility.
- Mist netting, pole traps and any other relevant technologies that become available over the timespan of the project will also be employed.
- Trapping will continue for the 30-year duration of the project.

11.2.2 Barn Owl Reduction Methods - Shooting

- Shooting will occur 4 nights per month or as-needed (as determined by auditory surveys and field observations) for the duration of the 30-year Program. Fire-arm technician will choose a location based on auditory data and visual sightings. These points can be altered as more information is gained about individual territories, roosts, etc. to cover the Kalalau Valley.
- Timing will be at and just after sunset, and at or just prior to sunrise. This will be subject to change based upon observed activity patterns of owls, moonlight hours, and weather patterns (barn owls head back to dry roosts during heavy rains). Total hunt times should average 5 hours per night but may vary depending on barn owl activity.
- Barn owls will be lured to the area using playback (such as the noise of a squeaking mouse or an ʻakēʻakē call). Predator control staff will be trained by KESRP staff to distinguish between non-native barn owl and the native pueo. They will also be well-versed in seabird identification. Shooting will only occur when a 100% positive ID has been achieved. If seabirds or pueo are in the immediate environs, no shooting will occur.
- Barn owls will first be spotlit. One person will operate a spotlight, while the other will operate a shotgun with an effective radius of ~37m. Staff will listen and visually scan the area using single-tube night-vision goggles. When spotted, one person will illuminate the individual with a spotlight while the other person confirms the identification and then dispatches the barn owl.
- An attempt will be made to retrieve the remains for autopsy to assess stomach contents but this is frequently not possible (G. Reid, 2016, pers. comm.).
- Traps and shooting locations will be a minimum distance of 50m from all public facilities (parking lots, trails, roadways, and facilities), operating only during dark hours (sunset to sunrise). All shotgun shells will be retrieved after shooting and non-lead ammo will be used. Areas will be checked for human presence prior to shooting. If members of the public are present, shooting operations will be stopped immediately.
- If a barn owl is detected outside of planned trapping periods, a rapid response contingency plan will be in place, and the individual(s) will be hunted on the same night if possible or as soon as practically possible.
-

11.3 Feral Cat Removal at Ingress Points to Source Colonies in the Kalalau Valley

Objective 2.H Protect nesting birds inside mitigation fence and in nearby source colonies by implementing predator control of 1) barn owls within the area surrounding the fenced enclosure and the Kalalau Valley, and 2) feral cats at ingress points to source colonies in the Kalalau Valley, ongoing throughout the 30-year duration of the KSHCP.

Feral cats are using the roads and trails in the vicinity of the Kahuamaʻa Seabird Preserve as ingress points to prey upon nearby established colonies in the Kalalau Valley and Rim, Pihea (part of the Hono O Nā Pali NARS) and Honopū, expected source populations for the Kahuamaʻa Seabird Preserve. Feral cats are having a very serious negative effect on fledging success in these areas - KESRP have recorded numerous incidents of cats eating fledglings and a cat kill of an ʻaʻo was recorded at a parking area near the Honopū colony, which is close to the Kahuamaʻa Seabird Preserve (A. Raine, 2017, pers. comm.). Data from cameras and predation records at various colonies in Kauaʻi show that a cat that is targeting seabirds can predate a series of burrows in a single night, killing multiple adult and juvenile seabirds (A. Raine, 2017, pers. comm.).

The Kahuamaʻa Seabird Preserve Management Plan therefore includes feral cat removal at ingress points to source colonies in the Kalalau Valley. This will include at least 2km of linear trapping lines off roadways between the Kalalau and Puʻu O Kila lookouts, as well as trapping lines along likely cat trails into neighboring colonies and ad hoc trap placement as appropriate based on camera data.

This predator control effort will reduce the impact of feral cat predation on source colonies for the Kahuamaʻa Seabird Preserve by removing individual cats that are migrating towards the colonies, and reducing feline breeding in the area. It will also serve as a line of defense, removing cats which might attempt to enter the Kahuamaʻa Seabird Preserve.

This action will begin in Year 1 and is expected to continue for the 30-year duration of the Program.

11.1.1 Feral Cat Removal Methods

Feral cats will be targeted as follows:

Live feral cat traps

- 30 live feral cat traps (30” and 36” Tomahawks or similar) will be deployed at least 10 nights a month. These will be a mixture of baited traps and un-baited trail set traps (double door tomahawks). 20 will be spaced approximately every 100m along at least 2km of trap lines from Kalalau Lookout to Puʻu O Kila Lookout and along likely cat trails into neighboring colonies. Using camera data as a guide, a further 10 live cat traps will be used in a roving capacity for maximum efficacy.
- Each trap will be placed on level ground, and camouflaged using proximal vegetation. Visual lures and stepping sticks will be installed in all traps to pique feline curiosity and increase trap effectiveness. They will be checked once every 24 hours to meet humane standards and ensure that no seabirds are harmed.

- Traps will be baited using food derived lures such as sardines, cat biscuits and synthetic shellfish oil, replaced every 2-3 days or as needed. Baits will be adaptively implemented based on best available information and the findings of related projects.
- Live traps will be locked open in place with added bait between trapping efforts to encourage regular visitation by cats. This technique has been observed to greatly increase capture rates (Reid 2016 pers. comm.). Traps in public locations will be removed or hidden between trapping efforts to avoid vandalism. However, their locations can still be baited with cat lure between trapping efforts to encourage habitual visitation by cats and increase trapping success when they are reopened.

Conibear feral cats traps:

- 24 conibear traps (with appropriate seabird excluding box) will be deployed, with 14 placed approx. 150m apart along trapping lines, with an additional 10 being used in a roving capacity. Harm to seabirds will be prevented by mounting the traps in boxes and setting them approximately 20-25cm off the ground. Boxes will be cut in half so the bait is visually attractive to predators. This type of trap can be set and left active for longer periods of time, allowing active trapping to take place regardless of staff presence within the preserve. Conibear trap baits will alternate between food-based, glandular, and olfactory lures. Traps will be checked and rebaited twice a month.

Leg Holds:

- 20 Leg holds will be deployed as required. Traps will be “blind” sets, i.e. not baited and set in a manner that requires little behavioral modification on the part of the target animal. Traps will only be set on trails / locations where a feral cat has been observed during the previous week and when technicians consider there is imminent danger to seabirds from a feral cat. They will be deployed well away from any established tourist areas or trails. When set, traps will be checked at least every 24 hours.

Camera Traps

- Camera traps will be used to monitor trails for predator activity. Camera monitoring provides managers with data on the number and distribution of cats present, allowing them to make informed management decisions on the placement and types of traps to use at particular times. 20 cameras will be set at various locations on the 2km of feral cat removal trails, as well as other ingress points to provide observations on feral cats, including the exact time an animal is seen and the direction it is headed. The data from each trail camera will be collected and photos will be checked approximately every two weeks. All data will be reviewed in the field, and notable photos stored.
- DOFAW and NARS are working on a system which will equip traps with cameras and radio transmitters, advising technicians by text when the traps are triggered and showing the predator caught. The KSHCP may be able to deploy this technology once it becomes available, saving a great deal of staff time and reducing human presence and scent along trails. If this occurs, the budget for monitoring cameras for feral cats will be partially transferred to this technology.

Additional Protocols

- Other traps may be used as appropriate, particularly if new technology becomes available.
- In public use areas, care will be taken to place all traps out of the way, hidden within vegetation.
- Feral cat carcasses will be necropsied and stomach contents will be examined for evidence of seabird predation.
- If a feral cat is detected outside of planned trapping periods, the next trapping period will be brought forward to start as soon as practically possible.
- Non-target pest species (e.g. rats) that are caught in the live traps will also be dispatched.
- Technicians will receive firearm training to dispatch trapped animals humanely.
- All predator control activities performed by Prime Contractor staff will include the necessary training and permitting.

11.3 Creation of Social Attraction Site

2.A. Permanent, predator-proof fence constructed and social attraction equipment (nest boxes, speakers) installed at the mitigation site in Year 1 of KSHCP program implementation.
2.B. Predators removed from within fenced enclosure with monitoring confirmation of their absence, and activation of the social attraction equipment by Year 2; predator eradication within fenced enclosure maintained for the life of the project.
2.C. Ground activity by Covered Seabirds documented at the mitigation site by Year 4 of KSHCP program implementation.
2.D. Breeding activity by Covered Seabirds documented at the mitigation site by Years 5-7 of KSHCP program implementation.

Establishing a seabird breeding colony in a terrestrial predator free fence enclosure through the broadcasting of breeding calls is an effective and proven conservation tool (Gummer 2003, Sawyer and Fogle 2010, McIver et al. 2016). Seabirds, especially prospectors, transiting to and from their natal colonies, are drawn to the apparent activity at the site and, when they choose to breed there, are protected by the predator proof fence, increasing their breeding and fledging success considerably (Young et al. 2012).

An integral part of best management in a social attraction site is the provision of artificial burrows to optimize seabird habitat (Bourgeois et al. 2015) and expedite the process of establishing breeding at a new site - burrow excavation by a newly established breeding pair can take a year or more (Bancroft et al. 2004). Artificial burrows are used in almost all the successful social attraction sites documented in the literature. Not only does this increase the likelihood of earlier success at the social attraction site and increase the density of nesting pairs in an area (Podolsky and Kress 1992), it also makes the monitoring of nests much easier and less likely to cause disturbance to burrows and birds. Since monitoring of nests and nesting

success is an important part of mitigation for the KSHCP, artificial burrows are key in this project. Since the vegetation understory at the site is already damaged and disturbed in the areas where burrows will be installed, the installation of artificial burrows will not affect a pristine habitat, based on observations by botanists at the site, who noted high levels of invasive species in the understory and little ground cover. It should be noted that other areas at the site provide excellent habitat for natural burrows). Artificial burrows will be located in two main areas (Figure 11.2).

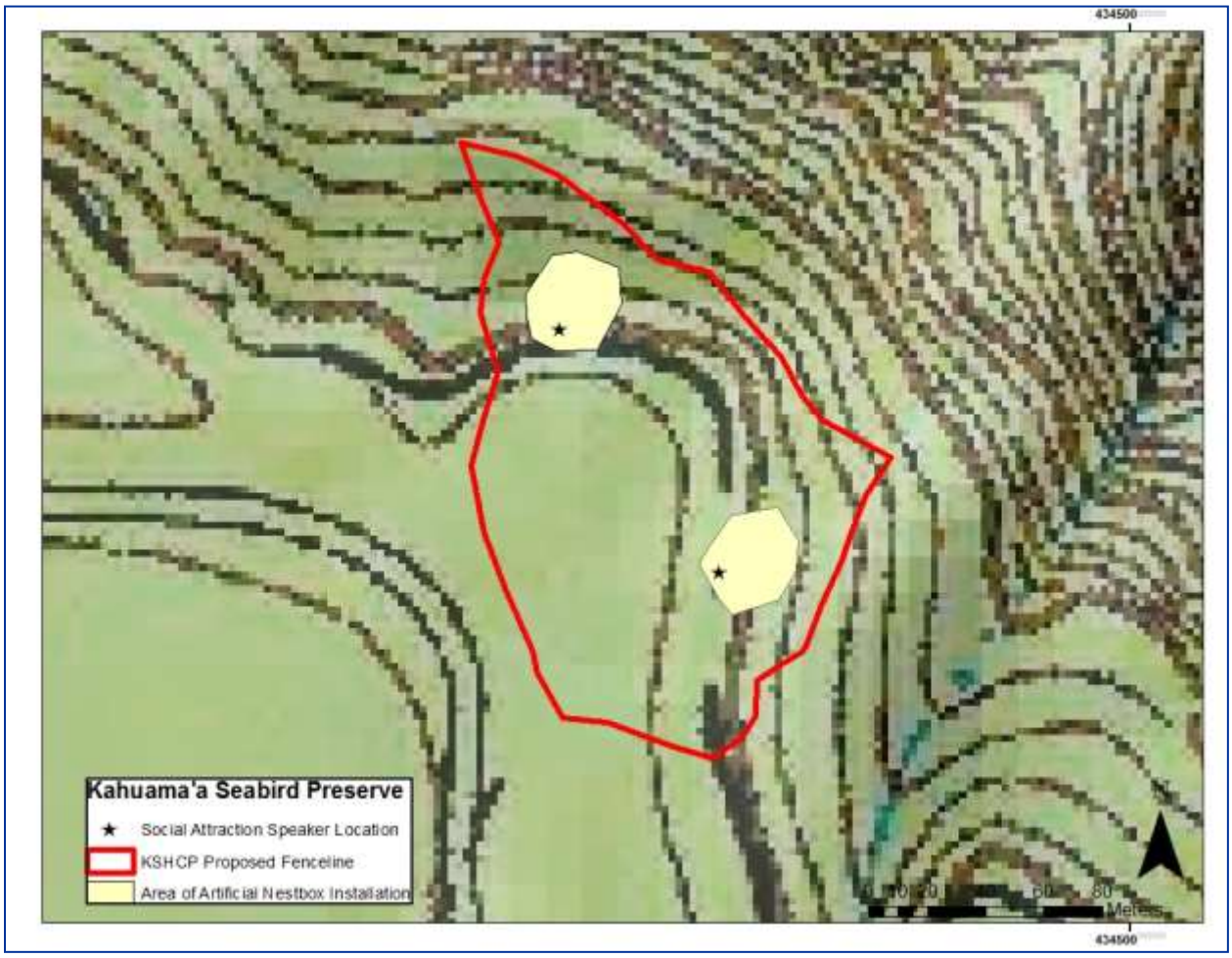


Figure 11.2. Map of Speaker System and Artificial Burrow Locations

11.3.1 Social Attraction – Call Broadcast Methods

The social attraction element of the Kahuama‘a Seabird Preserve will be implemented as follows:

- Two speaker systems will be installed and maintained (the location is shown in Figure 11.2), consisting of 2 or 4 (as required) weatherproof, omni-directional outdoor

speakers, mounted on the fence and / or poles inside the fence line and powered by 12v sealed solar powered batteries (see an example from New Zealand, Figure 11.3).

- Digital recordings will be obtained of ‘a‘o colonies taken within 2km of the site. Recordings will be of multiple birds (simulating a large colony) and using a complete set of typical colony sounds to attract the most birds (Podolsky et al. 1998).
- The speakers will turn on at sunset and continue to play species-specific calls until sunrise, drawing prospecting birds to the site to establish nesting within the predator-free area. Broadcasting will be timed to begin with the first arrival and courtship dates (01 Apr) until the 15th Sep (by which time the majority of non-breeders have left the colonies (A. Raine, 2017, pers. comm.).
- Because the Covered Seabirds are nocturnal, decoys are not anticipated to be needed (Jones and Kress 2012); However, if additional conservation actions are needed to enhance productivity at the site (e.g. if there is no ground activity by year 3), custom fabricated decoys will be placed on the ground as was done at the Makamaka‘ole Seabird Preserve social attraction site on West Maui (Wind 2014, USFWS 2016).

Figure 11.3. Social attraction speaker system and nest boxes at Hutton’s shearwater colony, Kaikoura, New Zealand. A. Raine

11.3.2 Social Attraction – Artificial Burrow Installation Methods

- The area for artificial burrows inside the Kahuama‘a Seabird Preserve will be thoroughly searched for natural burrows (active or inactive) to prevent damage or destruction during artificial burrow installation (no surveys for burrows have been carried out to date).
- IE staff will be trained on burrow installation and operation.
- 100 artificial nest boxes will be purchased and installed. A proposed design is shown in Figure 11.4 but other alternatives will also be reviewed before purchase. Artificial burrows will likely consist of a box with a locking lid for convenient inspection and segments of drain pipe as the entry point.
- Two optimal locations (Figure 11.2) have been selected within the site based:
    - Slope - Shearwaters use wind and updrafts in addition to vigorous flapping to provide lift during takeoff (Elkins 1983, Yoda et al. 2017). A moderate to steeply

sloped site greater than or equal to 29° facing into the prevailing winds (A. Raine, 2016, pers. comm.) is preferred to facilitate flight and landing. A sloping site far enough away from the lower fenceline (>50m) also helps prevent the risk of collisions with the fence during landing and take-off.
    - Low vegetation, such as grasses, which will facilitate installation of next boxes.
- Invasive vegetation will be removed (see Section 11.3 Vegetation Restoration and Monitoring).
- Each artificially installed burrow will be assigned a nest ID, be clearly marked, labeled and mapped using GPS.
- Wherever possible, artificial burrows should be shaded by vegetation (Carlile et al. 2012).

Figure 11.4. Possible design (by David Wingate) of artificial seabird burrow to be used

Figure 11.5. Vegetation and slope in the "bowl" section of the site, where part of the artificial burrows will be installed.

11.3.3 Social Attraction Site – Confirm Installation Complete

The target for the installation of social attraction equipment (playback speakers and nest boxes) is end of Year One to fulfil KSHCP requirements. Prime Contractor staff will confirm that this target has been met with a final inspection and a report including photographs (presented in the annual report).
If it becomes clear during the course of construction that this target will be missed, Prime Contractor staff will consult regulatory agencies and initiate adaptive management outlined in the KSHCP if required.

11.3.4 Social Attraction Site – Maintenance

Before the beginning of each breeding season, the social attraction site will be maintained as follows:

- Visually inspection of each burrow in Jan or Feb. Repair damaged burrows (old nesting material should be left in situ as a scent marker), ensure access.
- Test loudspeakers. After Year 4, test song meter / loud speaker alternation system.

11.4 Vegetation Management

OBJECTIVE 2G: Maintain high quality seabird habitat at the mitigation site by removal of habitat modifying invasive plants in Year 1 and annually throughout the 30-year duration of the KSHCP.

11.4.1 Background

The Kahuamaʻa Seabird Preserve predator proof fence is expected to benefit native vegetation and rare plants as they are currently being adversely affected by rats, pigs, goats and deer. The habitat at the site is dominated by native vegetation, but certain invasive plants are proliferating, especially within the understory. There is very little forest regeneration due to ungulate trampling and grazing, which is also encouraging swathes of thick, non-native invasive plants and grasses. Rat damage, consisting of chewing of stems, leaves, and fruit/seed predation has been observed at the site. Exclusion of these feral animals will have an immediate beneficial effect, especially when combined with the removal non-native invasive plants, some of which out-compete native plants in the understory and modify microhabitat suitable for seabirds.

Seabird habitat suitability mapping exercises consistently identify native vegetation as a critical component for successful nesting (Troy et al. 2014). Conversely, habitat modification by invasive plant species has been correlated with a reduction in seabird breeding. When compared to active breeding colonies, inactive breeding colonies were found to contain a higher proportion of non-native, invasive vegetation cover (Holmes and Troy 2008, Holmes et al. 2009). A suite of invasive plant species that have been identified as significant seabird habitat modifiers (Table11.1) are present at the Kahuamaʻa Seabird Preserve.

Table 11.1. Seabird Habitat Modifiers

Common Name	Scientific Name	Priority
Strawberry guava	*Psidium cattleianum*	*1*
Himalayan (kahili) ginger	*Hedychium gardnerianum*	*1*
Australian tree fern	*Sphaeropteris cooperi*	*1*
Blackberry	*Rubus argutus*	*2*
Banana poka	*Passiflora tarminiana*	*2*
Bush beard grass	*Schizachyrium condensatum, Andropogon spp.*	*2*
Koster's curse	*Clidemia hirta*	*2*
Daisy fleabane	*Erigeron karvinskianus*	*3*
Air plant	*Kalanchoe pinnata*	*3*

This list will be expanded during the project if new and important invasive seabird habitat modifiers are discovered in the area.

Vegetation work on site will focus on three key areas:

- Eradication or effective suppression of seabird habitat modifiers, focusing particularly on priority 1 & 2 species.
- Vegetation management during construction and operation of the fence (along fenceline and around artificial burrows and speaker system)
- Monitoring of vegetation to ensure that habitat quality targets are being met across the site.

It is important to note that the primary purpose of the Kahuama'a Seabird Preserve is to fulfil the obligations of the KSHCP by providing mitigation for take of the Covered Seabirds. The key requirement towards this process is the removal of seabird habitat modifiers and monitoring to ensure that the habitat remains suitable for seabird breeding.

To ensure that listed plants are not harmed during management on site, detailed BMPs have been prepared (see section 17).

Outplanting of rare species within the preserve is not in the remit of this management plan. Nonetheless, the Preserve presents an opportunity for other entities to outplant rare species on the flatter areas that will be protected within the predator proof fence and the regulatory authorities (USFWS and DLNR) have expressed strong support for this. In addition, this will be the first predator proof fence constructed on Kaua'i in an area that is primarily native habitat. This provides an opportunity to study forest and ecosystem response to removal of rats and ungulates, and to the influx of seabird derived marine nutrients. The Prime Contractor will seek partnerships with universities and other interested research organizations who may desire to capitalize such opportunities.

11.4.2 Eradication / suppression of seabird habitat modifiers

Vegetation work at the Kahuama'a Seabird Preserve will focus primarily on removing invasive plants that negatively affect the ability of seabirds to nest (see Table 11.1 - Seabird Habitat Modifiers). Non-native vegetation can impede breeding activities such as take-off and landing, prospecting, courtship and burrow excavation. For example, fast growing strawberry guava (*Psidium cattleianum*) thickets reduce the burrowing habitat available (Penniman 2010, VanZandt et al. 2014) and their fruit have a synergistic interaction with non-native mammals (Nogueira-Filho et al. 2009). Plants such as Himalayan (kahili) ginger (*Hedychium gardnerianum)* and blackberry (*Rubus argutus*) can also form a dense thicket of roots and stands that prevents burrow excavation; Australian tree fern (*Sphaeropteris cooperi*) outcompetes native plants that shade burrows and provide shelter from predators, and can rapidly take over entire hillsides; and banana poka (*Passiflora tarminiana*), bush beard grass (*Schizachyrium condensatum, Andropogon spp.*[3]), Koster's curse (*Clidemia hirta*), daisy fleabane (*Erigeron karvinskianus*) and air plant (*Kalanchoe pinnata*) form mats that might impede take-off and landing or have spikes which deter birds from the area.

Conversely, native vegetation is likely to offer suitable appropriate vegetative structure to facilitate breeding (Asner G.P et al. 2008, Duffy 2010), while the structural root components of native trees provide burrow stability (Gilham 1961, Ainley et al. 1997, Underwood and Bunce 2004). Native trees also provide a launch pad for take-off (Ainley et al. 1997, Sullivan and Wilson 2001).

For the 30-year duration of the Program, Prime Contractor staff will remove habitat modifying plants (Table 11.1) from within the fence enclosure, with the goal of removal of habitat modifying invasive plants in Year 1 and annually throughout the 30-year duration of the KSHCP (ingress of these species will be ongoing due to the seedbank / seeds blowing in from outside the fence).

11.4.2.1 Methods

- The presence, location and abundance of the above seabird habitat modifiers will be mapped prior to removal using GPS and GIS. The priority one species (strawberry guava, Himalayan (kahili) ginger and Australian tree fern) are the most important to remove as they are likely to be the most damaging for seabirds.
- An initial removal effort will occur in a one-time targeted event during fence construction, carried out by a suitably qualified contractor. All three priority species will be targeted in this first pass, but subsequent maintenance will focus on priority 1 & 2 species first.

[3] There is some taxonomic confusion about these species in Hawai'i; they are frequently misidentified and can co-occur. Ecologically they are, however, similar with regard to their invasion biology. (A Williams, 2017, pers. comm.)

- For all plants, both for removal method as well as maintenance (except for blackberry), hand pulling for small/young individuals will often be the first method, with chemical used on larger plants that can't be hand pulled. As the project goes on, the use of chemicals will decline, with hand pulling increasing, as long as regular maintenance is occurring and new weeds are being found when still in seedling stage. Table 11.2 gives more detail on different methods for each modifier.
- During the initial removal of seabird habitat modifiers, groundcovers and low grasses will be left to reduce erosion.
- If appropriate, biodegradable erosion control cloths and / or weed control cloths will be laid down during the phase where large areas of non-natives are removed. The Kōke'e Resource Conservation Program has found this to be more cost effective than weeding afterwards (K. Cassel, 2017, pers. comm.)
- The entire site will be monitored annually for seabird habitat modifiers in Table 11.1. See Section 11.3.
- Additional removal and ongoing control of seabird habitat modifiers will then occur annually, outside the breeding season according to Table 11.2, with additional spot treatments carried out based on ad hoc sightings of concern. Technicians will also look for new species of concern. If found, a suitable eradication plan will be drawn up and carried out.

Table 11.2. Seabird Habitat Modifiers, Removal Methods, Maintenance and Harm Avoidance

Seabird habitat modifier	Scientific Name	Removal Method	Maintenance	Harm Minimization
Strawberry Guava	*Psidium cattleianum*	Trees "frilled" (notched girdling technique). Fill cuts with Garlon application using lab squirt applicator bottle / brush or use tool to pry strawberry guava < 2.5cm in diameter out of ground.	Drizzle spray Garlon on reemerging plants (TNC, 2015) (Trees currently not in large groves)	1) Careful application with squirt bottle or brush in dry weather only 2) no herbicide use with 10m of rare / listed plants or burrows 3) To be carried out by trained staff not volunteers 4) staff to be aware that *Myrsine knudsenii* might be mistaken for Strawberry Guava 5) No trees above 4.6m will be cut during bat pupping season June 1 – Sept 15.
Himalayan (Kahili) Ginger	*Hedychium gardnerianum*	Manually cut and spot-treat with Escort using a cut stump technique with a lab squirt applicator bottle	Pull out small shoots. Cut larger shoots and treat with Escort using lab squirt bottle (ginger mainly at edges of site and not currently in large clumps)	1) Careful application with squirt bottle or brush in dry weather only 2) no herbicide use with 10m of rare / listed plants or burrows 4) 4) to be carried out by trained staff not volunteers
Australian Tree Fern	*Sphaeropteris cooperi*	Manually remove by chopping with a machete and crushing the apical meristem	Should not resprout but follow up removal will be required due to presence of spores and new individuals	
Banana Poka	*Passiflora tarminiana*	Manually remove by pulling up with roots	Entire vine will die from uprooting but seeds are long-lived so ongoing uprooting required.	

Blackberry	*Rubus argutus*	Manually cut and treated with Garlon cut stump treatment. Foliar applications Garlon or Imazpyr	Follow up will be required as blackberry will come back if not maintained. Manually cut and treat with cut stump treatment. Foliar applications Garlon or Imazpyr	1) Careful application with squirt bottle or brush in dry weather only 2) no herbicide use with 10m of rare / listed plants or burrows 4) when plant is killed, dead stalks will be left in situ to inhibit growth of other invasive species and reduce removal effort 5) erosion / weed control cloths may be required. 4) to be carried out by trained staff not volunteers
Bush Beard Grass	*Schizachyrium condensatum*, Andropogon spp.	Spray application of Roundup Pro	Spray application of Roundup Pro	1) Careful application in dry weather only 2) large areas could be removed a little at a time and / or erosion / weed control cloths may be required 4) no herbicide use with 10m of rare / listed plants or burrows 5) to be carried out by trained staff and not volunteers
Koster's Curse	*Clidemia hirta*	Manually cut and treat with Garlon cut stump treatment. Attempt not to spread seeds during cutting	Manually cut and treated with Garlon cut stump treatment. 100% of seedling need to be killed to eradicate population so maintenance will be indefinite (DeWalt 2006)	1) Careful application with squirt bottle or brush in dry weather only 2) every effort to control spread of seeds such as seed collection during cutting, black bagging immediately rather than carrying in open off site 3) erosion / weed control cloths may be required 4) no herbicide use with 10m of rare / listed plants or burrows. 5) to be carried out by trained staff and not volunteers
Daisy Fleabane	*Erigeron karvinskianus*	Manual Removal. Foliar applications Garlon	Manual Removal. Foliar applications Garlon	1) Careful application with squirt bottle or brush in dry weather only 2) every effort to control spread of seeds such as seed collection during cutting, black bagging immediately rather than carrying in open off site 3) erosion / weed control cloths may be required 4) no herbicide use with 10m of rare / listed plants or burrows. 5) to be carried out by trained staff and not volunteers
Air Plant	*Kalanchoe Pinnata*	Foliar application of Roundup. Manual removal and bagging	Foliar application of Roundup. Manual removal and bagging	1) every effort to control spread of seeds such as seed collection during cutting, black bagging immediately rather than carrying in open off site Leaves will need to be bagged too, each leaf can produce several individuals 2) erosion / weed control cloths may be required

11.4.3 Vegetation Management during Construction and Operation of the Fence

There are three main actions in this project that will require the removal and / or ongoing control of vegetation:

- Fence construction
- Maintenance of a 4m zone outside the fence that is free of woody vegetation (this is within, but not the same as, the predator defense zone).
- Installation of artificial burrows and speaker system

11.4.3.1 Methods

- Following fence construction, restoration within the fence terrestrial predator defense zone will be carried out by means of replanting appropriate native grass and / or Aalii (*Dodonea viscoa*) to prevent the regrowth of seabird habitat modifiers. Alternatively, DOFAW has been looking into a 'low growing and low maintenance slurry' (W. Kishida, 2017, pers. comm.) made up of native ferns and grasses for use along road ways where a high incidence of nēnē 'take' happens. The slurry is still in development, but might be an option along the fence by construction. All planting will be vulnerable to grazing and trampling by pigs, goats or deer (A Williams, 2017, pers. comm.) but these options offer the best possibility of establishing some cover.
- No woody vegetation higher than 0.5m will be allowed to grow within the 4m zone along the fence line, to prevent reinvasion by predators. The height of vegetation will be kept low by means of trimming, scything, mowing or any other appropriate methods. Loose logs and vegetation will be moved off the mesh skirt area to prevent rodents using logs etc. as a solid edge to dig against (Day and MacGibbon 2007).
- Control of seabird habitat modifiers will be important in the cleared area outside the fence to ensure that this area does not become an ingress point for invasive plants. This will be carried out using the methods outlined in Table 11.2. Staff will conduct a monthly walk through of the zone (in conjunction with efforts to keep vegetation below 0.5m above) and conduct simplified veg plots (5 plots of 3x3m where the % of seabird habitat modifiers only is assessed) to confirm that the percentage of modifiers is not increasing.
- In the case of the artificial burrows, after installation it is expected that native vegetation will regenerate naturally. If this does not occur, or if seabird habitat modifiers invade the area, weeding (see Table 11.2) and / or outplanting will be considered. Vegetation will be managed to shade burrows to prevent heat stress to the seabirds. This may include some planting.

11.4.4 Targets for Removal of Habitat Modifiers

Objective 2G (Maintain high quality seabird habitat at the mitigation site by removal of habitat modifying invasive plants in Year 1 and annually throughout the 30-year duration of the KSHCP.) requires targets in order to measure success. These are shown in Tables 11.3 and 11.4.

Table 11.3: Targets for Removal of Seabird Habitat Modifiers

Action	Target Year 1	Target Year 5	Target Year 10	Target Year 15	Target Year 20	Target Year 30
% of Tier 1 & 2 seabird habitat modifiers removed across site (vs baseline)	≤50% cover	≤20% removed	≤5% cover of these species	≤5% cover of these species	≤5% cover of these species	≤5% cover of these species
% of Tier 1 & 2 invasive plants per veg plot	Target to be set once baseline established	Target to be set once baseline established	Target to be set once baseline established	Target to be set once baseline established	Target to be set once baseline established	Target to be set once baseline established

Note – Tier 3 Habitat Modifiers will be removed time permitting or if they are found to be affecting the burrowing ability of seabirds.

11.3.1 Consideration of PEPP and Endangered Plants

There are several PEPP and Endangered Plants at the site as shown in Table 7.1. However, extensive discussion and site visits with USFWS and DOFAW botanists has confirmed that the only plant that might be considered at risk from construction and operation is *E. remyi* var. *remyi*. Section 17, Best Management Practices, describes how damage will be completely avoided for this plant in particular as well as other PEPP and Endangered Plant species.

12. MONITOR EFFECTIVENESS OF KAHUAMA‘A SEABIRD PRESERVE & FERAL CAT / BARN OWL CONTROL AS MITIGATION FOR TAKE OF ‘A‘O

Effectiveness monitoring at the Kahuama‘a Seabird Preserve will be carried out by the Prime contractor. Monitoring is intended to ensure that the objectives of the Kahuama‘a Seabird Preserve and thus the KSHCP are met. Effectiveness monitoring will cover three main areas:

- Monitoring that predators have been removed and do not reinvade the site
- Monitoring barn owl Control
- Monitoring that Seabird Habitat Modifiers have been removed / suppressed
- Monitoring the Response of Covered Seabirds to management actions (Predator Removal, Vegetation Management and Social Attraction Components).

Monitoring to ensure that objectives 2, C, D, E and F have been met are further defined in Table 12.1.

Table 12.1: Definitions of KSHCP Objectives.

	Objective	Definition
2C	2.C. Ground activity by Covered Seabirds documented at the mitigation site by Year 4 of KSHCP program implementation.	Ground activity is defined as presence of one or more ‘a‘o individuals on the ground within the project enclosure as documented by an observer or a Reconyx camera trap. “Presence” includes guano, feathers, ground calling bird heard by observer / captured on camera and confirmed as being within the fence, as well as physical sightings.
2D	2.D. Breeding activity by Covered Seabirds documented at the mitigation site by Years 5-7 of KSHCP program implementation.	• Egg, chick, or incubating adult noted within the site • Breeding attempts in natural or artificial burrows are observed (such as copulation, digging a burrow, entering the burrow with nesting material, sitting in the burrow). • Signs of digging/trampling, feathers, guano, or an egg shell • Evidence of predation or nest failure
2E	2.E. Cumulative upward trend in Covered Seabird breeding documented at the mitigation site by Year 10-12 of KSHCP program implementation.	Increased number of active burrows (artificial or natural) compared to years 5-7
2F	2.F. Continued cumulative upward trend in Covered Seabird breeding documented at the mitigation site by Year 20 of KSHCP program implementation.	Increased number of active burrows (artificial or natural) compared to years 10-12

12.1 Monitoring of Predator Removal

12.1.1 Monitoring of Rodent Removal

Rodent removal will be monitored as follows:

- **Camera Traps**: predators will be monitored using 10 remote camera traps (Reconyx or similar) placed strategically at known ingress routes, along trails, along interior fencelines and at other appropriate locations. Camera will be checked monthly during initial eradication (more frequent checks make camera failure more likely). After rat eradication is completed in year one, cameras will be moved to focus on seabird ground and burrow activity, but will still be able to pick up any predator activity. They will be checked monthly at this point.

- **Ink-card tracking tunnels:** 25 tracking tunnels will be set out on a 50m transect (Gillies 2013). They will be placed on flat ground with the ends unobstructed, baited with a peanut butter lure (see snap traps) and monitored for three nights. This will be repeated bi-monthly until technicians feel confident that rodent eradication has been achieved (no rodent sign for one month). Thereafter, they will be deployed once a month for one night during breeding season (Apr to Dec). If reinvasion is suspected, the tunnels can be redeployed at any time.
- If, after the initial rodent eradication, **rat signs are noted again** on the ink card tracking tunnels, snap traps and stationary bait boxes (if necessary) will re-deployed, until all signs of rodents inside the fence cease. If rodenticide is considered necessary, it will be used for the minimum time possible.
- **Formal routine fence checks** will be carried out to discover potential biosecurity breaches monthly but technicians will also check fence while rebaiting traps outside the fence and in the course of other duties. In the case of a reinvasion, a more thorough fence check will be carried out to determine the ingress point of the predators and necessary maintenance action taken to prevent further breaches. Detailed records will be kept of breaches and reinvasion records. Technicians will also look for collision events (feathers, carcass).
- Goodnature traps have a counter (purchased as an add-on) which indicates the number of 'firings'. They will be checked weekly during initial eradication to ensure they are working and monthly thereafter with results noted on iPad. However, it should be noted that traps can fire on their own (e.g. through tree fall, wind etc.) so do not necessarily indicate the presence of predators. Where firings are noted, additional ink card tracking tunnels will be deployed and rat eradication action taken inside the fence. Similar brands can be used.
- Snap traps in a bird excluding housing will be checked daily during initial eradication to ensure they are working and remove any carcasses with results noted on iPad. They will remain in situ even when zero signs of rodents has been recorded for four weeks in case of reinvasion.
- Technicians will record and remove any carcasses from Goodnature (or similar) and snap traps daily during the initial eradication and weekly thereafter with results noted on iPad.
- Technicians will record number and species of predators present, location of predators and possible ingress pathways utilized, number of predators killed and caught by a monitored trap, fence integrity. Results noted on iPad.
- Monitoring frequency is summarized in Table 12.2.

Table 12.2: Summary of Predator Monitoring Frequency

Biological Objectives	Monitoring Frequency During Normal Operation
2.B. Remove predators from within the fenced enclosure with monitoring confirmation of their absence, and activation of the social attraction equipment by Year 2; predator eradication within fenced enclosure maintained for the life of the project.	- Camera traps checked monthly. - Monthly Goodnature check - Monthly ink-card tracking - Twice weekly snap trap checks 50m predator defense zone

12.1.2 Cat Removal Monitoring at Fenceline

Camera Traps

- Monitoring of cats will be ongoing using 4 camera traps along the fenceline, located on the outside of the fenceline, (in addition to the 20 burrow monitoring cameras around the project site. They can be moved as appropriate depending on trapping results, visual sightings and predation events. They will be checked monthly.

12.1.3 Barn Owl Control Monitoring

The objective of barn owl Control is to protect birds nesting inside the fence as well as in nearby source colonies. Complete eradication is not possible due to the propensity of new owls to fill an empty territory, however suppression of the population will have a beneficial effect. This objective will be monitored as follows:

- The technician will provide an annual report detailing how many barn owls were seen versus how many were shot during barn owl control operations (detailed in section 11.2). In addition, the technician will keep note of all ad hoc sightings of barn owls and barn owl calls during the course of other duties.
- Predation events (presence of carcasses, camera sightings or visual sightings) by barn owls inside or adjacent to the fence will be documented (barn owls may carry carcasses outside the fence). If a predation occurs, additional barn owl control will be undertaken (more shooting and trapping nights) and new techniques will be investigated

12.1.3 Feral Cat Control Monitoring

The objective of feral cat control is to protect birds nesting at nearby source colonies in the Kalalau Valley and to present the risk of reinvasion of cats into the predator proof fence. Complete eradication is not possible due to the propensity of new cats to enter the territory,

however suppression of the population will have a beneficial effect. This objective will be monitored as follows:

- The technician will provide an annual report detailing how many feral cats were removed during control operations and where this occurred. In addition, the technician will keep note of all ad hoc sightings of cats (visually or on camera) during the course of other duties and will use both sets of information future feral cat removal work.
- Predation events by feral cats in the vicinity of the fence will be documented by project staff. In addition, managers of source colonies of the Kalalau Valley / Pihea / Honopū / Hono O Nā Pali) will be asked to supply data on predations in their area. If a predation occurs, additional feral cat control will be undertaken (more shooting and trapping nights) and new techniques will be investigated.
- Technicians will keep up to date on latest feral cat removal technology and employ new techniques as appropriate to increase efficiency.

12.1.4 Seabird Carcass Discovery

- Once seabird breeding is established, any bird carcasses found will be assessed for cause of death. Depending on the predator, the following action will be taken:
    - All: Camera traps will be checked to look for predators
    - Rodent: interior snap traps redeployed. Interior bait stations will be rebaited with diphacinone until all signs of predators (further deaths, ink-card tracking tunnels, camera sightings) end.
    - Feral cat: 8 live feral cat traps will be opened inside the fence. Firearm-certified technician will attempt to humanely remove feral cat with firearm. Fence will be checked for breaches.
    - Barn owl: additional shooting nights will be arranged as soon as practically possible after the discovery. New techniques will be investigated for barn owl removal.
    - Pig: firearm-certified technician will remove the pig

12.2 Monitoring of Vegetation Management

To ensure that the quality of native habitat remains optimal for seabirds (i.e. that basic structure of native vegetation is stable or improving and that the ingress of seabird habitat modifiers is not occurring), a vegetation monitoring project will be initiated.

12.2.1 Methods

- Prime Contractor staff will be trained in plant identification.
- A baseline plant inventory will be carried out by a suitably qualified consultant (with the assistance of Prime Contractor staff for training purposes) within the fence line and 50m zone outside the fence to determine a plant inventory as a baseline (including status and abundance of each species) and species composition. The survey will also map the

location of listed or rare plants to ensure their protection. This will take place before construction commences and will also cover the fenceline itself.

- Federally listed, endangered and threatened plants will be noted, flagged and mapped. This will be carried out by an appropriate consultant.
- To monitor vegetation composition and change over time, a plant survey will be conducted every five years to document improvements in desired habitat conditions to maximize seabird production. This will be achieved by "broad brush" monitoring of five randomly selected vegetation plots (50m x 50m) inside the fenced enclosure (if a plot is selected in an area with a PEP or listed plant, or an area which is unsuitable for surveying due to steepness or safety concerns, another plot will be generated). Compass bearings will be used to ensure that the lines are straight.
- The following data will be collected: Coordinates, dominant aspect, estimated slope, habitat classification (VI: Highest Quality Native Ecosystems; V2: Predominantly Native; V3: Considerably Disturbed; V4: Badly Degraded), Average Canopy Height Class. For the canopy and Understory, % Cover, % Native Species Cover, Max Height of Cover will be recorded. Bare ground will be recorded by %.
- Within each 50m plot, two smaller random 2m² plots will be used to measure other vegetation (using a square of PVC pipes to form the size of the plot) in which the following will be monitored:
  - native woody vegetation cover, tree density, and species richness
  - seedling number, %, age class, stem diameter and cover
  - presence, %, cover and composition of seabird habitat modifiers
  - presence, % cover and composition of any other non-native species
- DOFAW and PEPP already monitor listed and rare species on the site. This will remain in their remit. (It should be noted that some of the rare and listed plants on site are already in decline due to factors outside the control of the project such as insects, wood boring beetles, etc.)
- Targets in Table 12.3 will be set at the beginning of the project, once a baseline has been established.

Table 12.3: Targets for Vegetation Monitoring

Action	Target Year 1	Target Year 5	Target Year 10	Target Year 15	Target Year 20	Target Year 30
% and composition of native plants per veg plot	Target to be set once baseline established	Target to be set once baseline established	Target to be set once baseline established	Target to be set once baseline established	Target to be set once baseline established	Target to be set once baseline established
% and composition of seabird habitat modifiers per veg plot	Target to be set once baseline established	Target to be set once baseline established	Target to be set once baseline established	Target to be set once baseline established	Target to be set once baseline established	Target to be set once baseline established
Listed plants - damage from project	0	0	0	0	0	0

12.3 Monitoring of Seabird Response to Management

Monitoring seabird response is a critical part of the social attraction site, not only to ensure that biological goals are met in terms of attracting the Covered Seabirds to breed and providing the right conditions to ensure breeding success, but also to fulfill the requirements of the KSHCP to provide mitigation for the take of these seabirds by KSHCP participants who are financing the project.

Effectiveness Monitoring will be carried out through the following means (listed in order of importance):

- Burrow Monitoring
- Camera monitoring
- Chick banding
- Auditory surveys with night vision
- Acoustic bird call monitoring (song meters)

The KSHCP supports the use of the best available, most cost-effective scientific tools and techniques for monitoring. Methods used may change based on new technological developments, site conditions and effectiveness in the field. For example, automated bird detection and monitoring technologies may be used to increase monitoring efficiency and accuracy. Any proposed changes will be discussed with the regulatory agencies in advance and with the KSHCP participants (and other stakeholders, if appropriate).

12.3.1 Burrow searching and monitoring

Burrow searching and monitoring of natural and artificial burrows is a critical part of seabird response monitoring. Technicians will search for burrows using established techniques outlined below. Once burrows are found, burrow checks will be undertaken to assess the status of any breeding attempts (e.g. is there an egg, chick or adult present). This data will be compared to data from the cameras to collect information which can be used to extrapolate results to unmonitored burrows on site.

Burrow monitoring fulfills, in part, Objective 2D – Breeding activity by Covered Seabirds documented at the mitigation site by Years 5-7 of KSHCP program implementation and Objective 2E &F – Cumulative upward trend in Covered Seabird breeding documented at the mitigation site by year 10-12 and 20.

12.3.1.1 Methods for locating and monitoring natural burrows

- Auditory surveys with night vision will occur twice a night for 4 nights per month (Jun – Aug) split over two observers (i.e. 2 nights a month each) to help guide burrow searching by indicating ground-calling hotspots.
- This will be supplemented with diurnal "cold searching" where staff actively search vegetation for burrow cavities with signs of seabirds (e.g., scent, feathers, guano, etc.). Burrow searching will happen a minimum of once a month for one day from Jun-Sep. (before incubation, burrow searching is too difficult due to a lack of clear signs of use, and requires unnecessary disturbance to vegetation). More searching could result in damage to vegetation.
- Active breeding can be distinguished from ground activity (Objective 2.C) if breeding attempts in natural or artificial burrows are observed (such as copulation, digging a burrow, entering the burrow with nesting material, sitting in the burrow), or an egg is laid.
- Natural burrows will have "stick fences" placed at their entrances after each inspection (these are toothpicks or short sticks placed in a 'fence' configuration i.e. in a row). Any activity by birds will knock down the sticks, alerting technicians to the possibility that the burrow is in use and triggering further monitoring through Reconyx camera traps and / or inserting push button cameras (such as Olympus Stylus Tough TG4) into burrow to capture image of end of burrow and / or use of endoscope.
- During burrow searching, any predator presence will also be assessed (such as scat, owl pellets or carcasses).
- Any burrows found will be marked with an identification tag and burrow locations will be recorded with a handheld global position system (GPS).
- Once burrow sites are located, they will be monitored, along with artificial burrows, once a month to determine occupancy, status changes over the course of the breeding season (abandonment, death of chick etc..), signs of predation and timing of breeding attempt.

12.3.1.2 Methods for monitoring artificial burrows.

- Each artificial burrow will be checked to make sure it is in working order and repaired if necessary before the breeding season commences and the entrance and tunnel will be cleared of obstructing vegetation.
- Each artificial burrow will be checked a minimum of once a month during the breeding season between April and October to monitor for signs of seabird activity around the entrance and inside the burrow chamber. Temperature and humidity will be monitored.
- Variables measured include number of active burrows, species present, signs of predator presence, evidence of predation, and nest success.
- A subset of 20 artificial burrows will be equipped with Reconyx camera traps to document visits by prospectors and / or breeders.
- Burrows occupied by breeding pairs will be monitored by Reconyx camera traps and checked monthly by Prime Contractor staff through the breeding season to estimate breeding success (egg laying, chick rearing and fledging) and any predator incursions.

12.3.1.3 Methods applicable to both artificial and natural burrows

- Document internal burrow contents with visual observations or a handheld digital camera,
- Burrows will be identified to species (if possible) and classified as follows:
    - Inactive
    - Prospecting birds (birds observed to be visiting a nest with no further evidence of breeding. Examples include fresh excavations in a previously inactive burrow, a single visit to a previously inactive burrow, bird(s) found in a burrow where both adults were confirmed killed in the previous year, or a seabird present at a preliminary burrow excavation
- Burrows are assessed for breeding activity by monitoring for signs of activity in and around the burrow, including:
    - Presence of an egg, chick, or adult in or near the burrow
    - Signs of digging/trampling, feathers, guano, or an egg shell
    - Evidence of predation or nest failure
    - Scent
    - Ability to see back of burrow
- Nesting outcomes for active nests are recorded as “success”, “failure”, or “outcome unknown” as follows:

    - Success is indicated by a successfully fledged chick. In the absence of a Reconyx burrow-monitoring camera, this is determined by a chick confirmed in the burrow until the typical fledging time (late September to early December, peaking in October), down outside the burrow entrance

indicating that the chick was exercising, and no signs of predation or predator presence.
- An active nest is recorded as a failure if it did not fledge a chick. Evidence of failure is recorded when observed.
- "Outcome unknown" is assigned to an active nest where breeding was confirmed but no follow-up visits were made, final visit was too early in the season, or signs were inconclusive. Very few, if any, burrows should fall into this category.

- All data collected in the field is digitized at the end of each trip with individual burrow locations, evidence of predation, and/or predator presence mapped using a GIS.

(Methods developed by KESRP)

12.3.2 Camera Monitoring

A camera trap is a remotely activated camera that is equipped with an infrared sensor. Camera trapping allows researchers to photograph birds or predators at a burrow and has been used in ecological research for decades.

At the site, camera traps will allow for ground activity to be observed on a continuous basis. Cameras will be initially placed near the speaker system where birds are most likely to land when responding to social attraction playback. They will also be used on burrows to record ingress of prospectors, breeding attempts and success of the egg, chick and fledging stage and predator interactions.

The cameras will provide data pertinent to Objective 2C – Ground activity by Covered Seabirds documented at the mitigation site by Year 4 of KSHCP implementation and Objective 2D – Breeding activity by Covered Seabirds documented at the mitigation site by Years 5-7 of KSHCP implementation, and will be ongoing throughout the lifetime of the project as the data will also be used to measure Objective 2E & F – Cumulative Upward Trend in Covered Seabird breeding documented at the mitigation site by Year 10 & 20.

The proposed models are a Reconyx Hyperfire PC900 camera trap (Figure 12.1) and a Reconyx Ultrafire XR6 (capable of also taking high definition video but using more memory and therefore requiring more frequent checks). However, if improved technology or another brand is found to be more effective or cost efficient, they will be selected instead.

Figure 12.1. Reconyx Camera Trap

12.3.2.1 Methods for Camera Monitoring

- IE staff will monitor artificial and / or natural burrows of ‘a‘o (and ‘ua‘u if they also arrive at the site) at mitigation sites using Reconyx Hyperfire PC900 or similar cameras.
- After the first year (cameras will initially be used to monitor predators only), 20 of the 100 artificial burrows will be monitored by cameras. Burrows closer to the speaker system are likely to be occupied first and so cameras will be placed there initially; they will also be able to pick up ground activity in that area.
- Artificial burrows or natural burrows (these will be mapped as they are found, either through burrow searching or auditory surveys) will be surveyed monthly during the breeding season and toothpicks placed in the entrance. Any that show signs of use (toothpicks falling, scent, guano etc.) will have a camera placed on them (moved from an inactive site).
- Cameras may be strategically placed in other areas within the fence enclosure to document ground activity not associated with specific burrows.
- Camera Monitoring will occur throughout the pre-breeding season, starting when the sub-adult prospectors and adults arrive (01 Apr). (Note that while most birds return in early Apr, cameras should be operational from mid-Mar to ensure that early birds are not missed)
- Variables measured include number of visitations (ground activity), number of burrows with breeding activity, number of active burrows with a chick that fledges, predator visitation rates and predation events.
- Cameras will be mounted on stakes 1-3m from the burrow entrance to record species, seabird activity and nesting outcome. Cameras will be triggered by movement and are set on a rapid-fire setting.
- All secure digital (SD) memory cards will be changed monthly, batteries changed as needed and all camera locations will be recorded using a handheld GPS unit. SD cards are to be viewed in the field to briefly assess activity levels and presence/absence of seabird predators at burrows. They will be reviewed fully in the office.

- Cameras will be checked monthly.
- All data collected in the field (i.e. on the number of images on the camera, date of SD card and battery switch out etc.) is digitized at the time on the iPad. Data will be downloaded to the server in the office. Camera viewing will take place in the office at the end of each trip and will be digitized.

12.3.3 Bird Banding

Banding is an important part of the SAS project and an established best practice monitoring technique for seabird colonies, providing data on sub-adult and adult survival rates, nest site fidelity, age at first breeding, ratio of birds recruited via social attraction versus natal philopatry and breeding probability. Morphometric measurements allow for inter-annual comparisons and could be used to indicate the general health of seabirds breeding at the mitigation site from one year to the next. This data will also contribute to the body of knowledge on ʻaʻo (and ʻuaʻu if found at the site) throughout the Island and the State.

This social attraction site was chosen because of the lack of artificial light in vicinity. It is thought that birds from this colony will not be subject to light attraction when fledging due to the orientation of the site, the dark conditions on the obvious flyway out to the ocean and a lack of visible artificial lights from the site. However, banding birds on site means that any birds that are downed by artificial lights can be identified back to the project site and mitigation measures taken to reduce any light attraction.

12.3.3.1 Methods for Banding Chicks and Adults

- Biologists conducting banding of seabirds will be required to be covered under Bird Banding Lab banding permits and be authorized by the DLNR to band or otherwise handle seabirds on Kauaʻi.
- Chicks will not receive bands until approximately 4 to 2 weeks from fledging, which occurs late September to early December, peaking in October.
- Banding will take place during burrow checks and opportunistically, if birds are found on site.
- IE staff will carry banding kits at all times during colony site visits in the breeding season and will ensure all caught birds are banded (both adults and chicks).
- A list of bird banding equipment needed to safely band and measure ʻaʻo and ʻuaʻu includes:
    - Appropriate shearwater-sized banding pliers;
    - Spreader pliers;
    - Pesola 1000 g scale;
    - 15 clean bird weighing bags;
    - Wing chord ruler;
    - Banding leg gauge;

- USGS issued bird bands size #4 (50) for ʻaʻo and 3A (50) for ʻuaʻu;
- 15 clean bird handling towels;
- Pens and pencils
- Banding logbook or notebook and iPad with custom built banding app (KESRP).
- Umbrella or tarpaulin in case of rain during banding
- Antibacterial handwash

Variables measured include individual identification number (USGS band number), species, weight, tarsus length, culmen length, wing length.

12.3.4 Auditory and Visual Surveys

Auditory surveys are an important part of the strategy for biological monitoring. ʻAʻo are nocturnal and tend to vocalize within their colonies (and occasionally in transit); therefore, activity and location of these species may be effectively monitored at a distance of up to 1km using an auditory point count survey technique to establish and document ground activity and / or flyovers at the site. ʻAkēʻakē and ʻuaʻu are also nocturnal - they may be breeding or transiting within the 1km radius and therefore will be included in the monitoring although they are not expected to breed at the site.

These surveys will measure criteria for Objective 2C. Ground activity by Covered Seabirds documented at the mitigation site by Year 4 of KSHCP program implementation, Objective 2D – Breeding activity by Covered Seabirds documented at the mitigation site by Years 5-7 of KSHCP program implementation. After Year 7, however, Acoustic Song Meters will be a more efficient and accurate way to measure Objective 2 E & F – Cumulative upward trend in Covered Seabird breeding documented at the mitigation site by Year 10 & 20 of KSHCP implementation, so Auditory Surveys will be reviewed at year 7 and phased out if the success of the project merits it.

12.3.4.1 Methods for Auditory & Visual Surveys

- Auditory surveys will be carried out by trained observers using night vision goggles. The observer auditory range is an estimated radius of 1 km. There will be 4 permanent survey locations.
- A standardized survey protocol and data sheet or iPad page (Appendix 1) will be used to allow for inter-site and inter-annual comparison and to make data compatible with KESRP surveys.
- Auditory surveys will take place twice a night (PM and AM) for 4 nights a month (1 night at each location). 2 surveyors will cover 2 locations a night for 2 nights.
- Ideally, there will be two observers for the surveys so surveys will take place AM and PM for location 1 and 2 for two nights and then likewise for 3+4 for two nights.

- Surveys will take place during the peak of the breeding season (Jun- Aug; vocalizations dramatically reduce after mid Sep).
- Surveys during full moon (and one week before and after) will be avoided as birds vocalize less during full moon periods.
- Observers will survey during the peak evening and pre-dawn activity period to account for the key calling periods of the Covered Seabirds. Although ʻaʻo are the primary focus, ʻuaʻu and ʻakēʻakē will also be recorded.) ʻAʻo are more vocal in the morning; ʻuaʻu and ʻakēʻakē are mainly vocal in the evening, while.
    - Evening surveys start at sunset and last for 2 hours: 4 x 30 min sessions, with 25 minutes to record seabird calls, and any visual seabird observations (using either naked-eye, binocular or night vision goggles) and 5 minutes allotted for weather data collection
    - Morning surveys start 2 hours prior to sunrise and last 1.5 hours: 3 x 30 min sessions, otherwise methodologically the same.
- Variables measured include number of calls and sightings for each species, breeding activity seen (flight paths, circling, ground calling etc.) distance and direction of each observation from the survey point, weather conditions during survey and habitat characteristics of the survey site. Particular attention will be paid to ground activity, with individual ground calling locations noted on a map.
- Auditory surveys will be used in tandem with static song meters (after year 4) as a method of ground- truthing the song meter data with the intent of locating and mapping calling hotspots, ground activity, and flight corridors for ʻaʻo (and ʻuaʻu and ʻakēʻakē if heard) unless song meters are found to be incompatible with the social attraction element.
- Survey locations are recorded in UTMs.
- At the end of the season the data from the field maps is entered into GIS digitized mapping to create individual breeding activity polygons for ʻaʻo and ʻuaʻu.

A standardized field datasheet can be found in Appendix 1 – a digital version will incorporate the same information.

12.3.5 Acoustic Bird Call Monitoring (Song Meters)

An acoustic recording device is a sound recording unit that is weather-proof, self-contained and can be used to remotely collect data in the field (Figure 12.2). The proposed models are SM4 Song Meters, made by Wildlife Acoustics.

Acoustic bird call monitoring uses song meters to create a database of calls over time, without observer bias, that can be useful in developing breeding density estimates. This technique is a powerful monitoring tool and is widely used by managers at monitored seabird colonies on Kauaʻi. It will be used to provide a baseline of activity at the colony which can be accurately measured to show population changes over the thirty years of the project (Oppel 2014).

Calls/hr are relatable to the number of burrows in an area, so if call rates increase over time, one can confidently assume that seabird activity at the site is increasing.

Figure 12.2: SM4 Song Meter

Auditory and visual surveys by human observers as well as onsite burrow searching and monitoring will remain important complementary parts of the monitoring strategy to confirm birds on the ground and indications of breeding until year 7. However, not all burrows will be found by observers – song meter data gives a monitoring output for the site as a whole to offset this problem.

The song meters can record seabird vocalizations at a distance of well over 250m. Outputs from the analysis will include call rate per minute, total number of calls and activity by time.

Song meters will provide data pertinent to Objective 2C - Ground activity by Covered Seabirds documented at the mitigation site by Year 4 of KSHCP implementation and Objective 2D – Breeding activity by Covered Seabirds documented at the mitigation site by Years 5-7 of KSHCP program implementation. They will be critical in terms of measuring Objective 2E & F – Cumulative Upward Trend in Covered Seabird breeding documented at the mitigation site by Year 10 & 20.

Song Meter use will only commence in year 4 as they are incompatible with full time social attraction playback, which is most critical in the first few years of the SAS.

In 2016, as part of an assessment of a potential social attraction site on the edge of the Kalalau Valley, KESRP deployed a song meter at a central location within the site to assess whether there was any seabird activity within the site. Both ‘a‘o and ‘ua‘u were recorded at the Social Attraction Site (Raine et al 2016). ‘A‘o were recorded almost nightly (suggesting regular activity of this species in the area), while ‘ua‘u were recorded on 6 occasions. The results will be used as a baseline at the site.

For the ‘a‘o, call rates were low at the survey site compared to large monitored colonies of this species on Kaua‘i (such as Upper Limahuli Preserve). However, the fact that they were recorded almost nightly during the survey suggests the possibility that a very small number of pairs may be breeding within or near the site itself. Further surveys will be carried out in 2017 and 2018 to look for burrows. Furthermore, individual birds are flying around the area vocalizing on most nights, and could therefore be drawn in by social attraction. Based on years of surveys by KESRP,

the wider area (Kalalau Valley and Nā Pali coast) has large breeding populations of both species which will act as source colonies (Raine et al. 2016).

The results of this survey will represent a useful baseline for the site. The same surveys will be repeated annually until the Seabird Preserve is constructed.

12.3.5.1 Methods for Song Meter Deployment

- A Song Meter IV sensor (http://www.wildlifeacoustics.com) or similar model will be deployed within the social attraction site in the same location used by KESRP in preceding years.
- Deployment will commence in Year 4.
- The song meter will be powered by 4 D-cell alkaline batteries and store recordings on a 32GB SD memory card. Sensors will record on two channels at a sampling rate of 22 kHz. The sensor will be mounted 0.3m off the ground on a length of PVC pipe with the omni-directional microphones oriented horizontally. The location will be selected such that the sensor microphones are sheltered from prevailing winds, well away from moving branches and leaves. Microphones will be weather-proofed with scotch guard and sheltered from above with a length of PVC pipe cut in half. Other compatible technology may be used to compare previously gathered data as appropriate
- 2016 & subsequent years prior to the fence construction will provide a baseline of seabird acoustic activity at or around the site and will be supported by observer data from the auditory and visual surveys to pinpoint the location of the calls.
- To allow for comparison with KESRP data, sensors will be programmed to record 1 minute every 5 minutes for 3 hours after sunset, and 1 minute every 10 minutes for three hours before sunrise. Programming will be undertaken using the SMCONFIG software package.
- Year 1-3: Song meter recording requires social attraction vocalization speakers to be turned off. Therefore, no song meter data will be collected in Years 1-3 of the Program, because the key objective during those years is to attract seabirds through social attraction to fulfil objective 2C in response to mitigation requirements for the KSHCP.
- Year 4 onwards: Song meter will be deployed annually for 2 months (June-July) to monitor long term changes of the seabird populations within or around the site.
- To record calling activity in the absence of social attraction playback, during the above recording schedule, loudspeakers will be temporarily disabled every third night to allow for song meter recording. Electronic timers will be used to achieve this and two nights of testing will be carried out to ensure this works, along with periodic checks by project staff.
- All song meter audio data will be sent off to an appropriate organization for automated analysis (currently Conservation Metrics Inc., Santa Cruz, California).
- Song meter will be checked (cards and battery changed) once a month.
- Seabird response monitoring frequency is shown in Table 12.5.

12.3.6 Summary of Seabird Response Monitoring

Table 12.5 outlines the monitoring frequency required to establish seabird response to management.

Table 12.5: Seabird Response – Monitoring Frequency

Biological Objectives	Monitoring Frequency
2.C. Ground activity by Covered Seabirds documented at the mitigation site by Year 4 of KSHCP program implementation. 2.D. Breeding activity by Covered Seabirds documented at the mitigation site by Years 5-7 of KSHCP program implementation. 2.E&F. Cumulative upward trend in Covered Seabird breeding documented at the mitigation site by Year 10 and 20 of KSHCP program implementation.	- Cameras installed by end Mar and checked monthly 01 Apr to 15 Dec - Auditory surveys with night vision: 2 surveys 4 nights monthly (Jun to Aug) (to year 7) - Burrow monitoring monthly 15 Apr -15 Dec - Chicks banded 2-4 weeks before fledging; adults banded whenever encountered. - Song meters from year 4 (May to Jul / Aug)

12.4 Annual Reports

An annual report will be delivered to the agencies by 15th April. It will include a detailed section on the project monitoring and results. This will enable USFWS and DLNR to evaluate:

1) compliance with terms and conditions of ITP/ITLs issued under the Program;
2) effectiveness of KSHCP conservation measures;
3) that continuing to authorize the permitted Covered Activities will not appreciably reduce the likelihood of survival or recovery of the Covered Species in the wild;
4) that the implementation of the Program results in a net benefit to the Covered Species as required under State of Hawai‘i law.

Reports will specifically outline project progress and / or achievement of the Biological Objectives 2A-H.

13. TIMELINES FOR ALL ACTIONS AT KAHUAMA‘A SEABIRD PRESERVE

Table 13.1 below provides an outline of the pre-construction, construction and initial set up maintenance actions required in the management plan for year one of conservation work at the Kahuama‘a Seabird Preserve. The estimated time noted in the table is based on extensive

discussions with local experts about their fieldwork. For example, in the case of setting Goodnature traps (or similar), the time taken per trap is multiplied by the total number of traps plus some time allotted for walking between traps. (This table does not include standard fieldwork operations, which are shown in Table 13.2).

Table 13.1: Fieldwork Actions and Estimated Staff Resources Pre & During Construction

Obj	Actions (Pre & During Construction) (additional actions to standard fieldwork during operation)	Frequency in 3 month construction period
	Pre-Construction	
All	Staff training	1
2A	12 return trips to the site (overnight stays at DOFAW cabin or camping	12
2A	Site meeting contractor	4+
2A	Search entire fenceline & surroundings for seabird burrows	2
2A	Forest bird & pueo survey - baseline & pre-construction & office write up	2
2A	Assist with pre-construction baseline veg monitoring	1
2G	Flag rare plants	1
2A	Assist contractor in removing vegetation along fenceline. Botanist and archaeologist present	1
2A	1 staff present during equipment fly in and entire fence construction to oversee all BMPs	1
2A	Training from contractor on fence maintenance	1
2A	Risk analysis for fence post construction	1
2A	Order and put up public signage on what to do if public sees a breach	1
2A	Report to confirm fence complete / report to confirm SAS work complete	1
2A, C,D	Install speaker system, test	1
2C-F	Install artificial burrows	1
All	Project management - 17 hours per week	12
	Rodent Trapping Post Construction Actions	
2B	Rodent trapping - Set up **snap trap grid**; 50 inside fence and 40 in 50m zone outside fence.	1
2B	Rodent trapping - Check snap traps (75) removal of carcass, bait and reset - inside & outside fence. Every 2 days for 3 months	45
2B	Rodent trapping - Set up **bait stations grid** (50) - inside fence	1

2B	Rodent trapping - Check and rebait bait stations: 50 inside fence twice a week for one month. Frequency can reduce to weekly after one month if appropriate, then twice a month for three months, then once a month thereafter if stations are still required	12
2B	Rodent trapping - Set up **Goodnature grid** (25) - inside fence, and 20 outside the fence in 50m predator defense zone.	1
2B	Rodent trapping - Check **Goodnature grid** (25) - inside fence, and 16 outside the fence in 50m predator defense zone. Check and zero counter, check CO_2, rebait monthly	3
2B	Rodent trapping - Set up **camera traps** (20) inside fence and outside fenceline (4)	1
2B	Rodent trapping - Check **camera traps** (24) check - 2 x month	6
2B	Set up live **feral cat traps** (8 outside fence - only outside ones will remain after initial eradication). 2 conibears will also be placed inside the enclosure for the initial eradication.	1
2B	Set up and monitor **ink card tracking tunnel** (25) 2 x a month	6
2C-F	Move 20 camera traps from rodent detection to burrow detection	1
All	Project management - 20 hours per week	weekly

Table 13.2: Ongoing conservation actions during operation and effectiveness monitoring.

Bio Obj	Action	No. per month	Season
	Fieldwork		
2A	Fence checks (additional checks will happen as part of rodent control outside fence)	1	all
2A	Fence maintenance, crisis response	1	all
All	Return drive to site	4	all
2B	Rodent trapping - Goodnature Check: 25 inside fence, 16 outside fence in 50m zone, rebaiting, counter check, CO_2 check	1	all
2B	Ink card tracking tunnel (25)	1	all
2B	Rodent trapping - Snap trap check (25) removal of carcass, bait and reset - 50m zone outside fence	2	all
2H	Feral cat trapping – fenceline (8) - opening & closing traps	2	all
2H	Feral cat trapping – fenceline (8) - checking & rebaiting	8	all
2H	Feral cat trapping – fenceline - camera trap (4) check (change cards and batteries) - occur at same time as cat trap checks	1	all

2H	Barn owl reduction - trapping (6)	4	all
2H	Barn owl reduction - shooting	4	all
2H	Feral cat control Kalalau valley - opening & closing traps, 30 live feral traps, 24 conibears, 20 legholds	2	all
2H	Feral cat control Kalalau valley 30 live feral traps, 24 conibears, 20 legholds - checking once open & rebaiting	8	all
2H	Feral cat control Kalalau valley - camera trap (20) check (change cards and batteries)	1	all
2G	Vegetation monitoring (veg plots), seabird habitat modifier removal, outplanting of native species if required	1/year	outside seabird season
2G, 2B	Maintain low vegetation in predator defense zone	2	
2C-F	Seabird monitoring - auditory surveys with night vision 2 x a night (am and pm), 4 locations, 4 nights	4/month x twice a day	inside breeding season only, Jun-Aug
2C-F	Seabird monitoring - camera traps (20) cards and battery changed	1	inside breeding season only, 15 Mar – 15 Dec
2C-F	Seabird monitoring - song meter (1) cards and battery changed.	1	Jun 01 –Nov 30 only
2C-F	Seabird monitoring - burrow searching (incubation to fledging)	1	Jun - Nov
2C-F	Seabird monitoring - burrow monitoring (100 artificial, tba natural), annual cleaning	1	Mar - Dec
2C-F	Seabird monitoring - chick banding (during burrow monitoring, 2-4 weeks before fledging only; also adhoc banding of any adults encountered.)	1	Oct - Dec
2A,C, D	Check speaker system & song meter alternation system	1	Mar - Dec
	Office		
2B	Rodent trapping - Log results from Goodnature (transf. from iPad) / analysis	1	all
2B-F	Camera traps - watch cameras (20) and log data (30 mins per camera) / analysis	1	all
2B	Ink card tracking tunnel (25)	1	all
2H	Feral cat trapping - log results (tranf. from iPad) / analysis	1	all

2H	Feral cat trapping – Reconyx camera trap - watch cameras and log data (20 mins per camera) / analysis (included with rodent work)	2	all
2H	Barn owl reduction - trapping (6) - log results (transf. from iPad) / analysis	1	all
2H	Barn owl reduction - shooting - log results (transf. from iPad) / analysis	1	all
2G	Invasive plant monitoring and removal - log results / analysis	1	outside breeding season
2G	Vegetation monitoring - veg plots and transect - log results (transf. from iPad) and analysis	1	outside breeding season
2C-F	Seabird monitoring - auditory surveys. Log data (transf. from iPad) and analysis	1	during breeding season only
2C-F	Seabird monitoring - song meter (1) cards to CM, review results	1	Jun 01 –Nov 30 only
2C-F	Seabird Monitoring - burrow searching. Log results (tranf. from iPad) and analysis	1	Jun-Nov
2C-F	Seabird monitoring - burrow monitoring (100 artificial, tba natural). Log results (tranf. from iPad) and analysis	1	Mar - Dec
2C-F	Seabird monitoring - chick banding (during burrow monitoring, 2-4 weeks before fledging). Log results (tranf. From iPad) and analysis	1	Oct - Dec
	Project management, including annual reports, progress reports, stakeholder management, staff management, budgeting	4	
	Permit & certification renewals (e.g. pesticide, rodenticide, firearms)	1	
	RCUH training / first aid etc.	1	
	ESCR presentations – one per year		
	Other admin	1	

14. MAXIMIZE PROJECT EFFICIENCY

In order to ensure that the deliverables are met to provide mitigation for incidental take as outlined in the KSHCP, it is important that the Kahuamaʻa Seabird Preserve is run efficiently. Staffing is a key part of that. Final decisions on the staffing or contractual consultant required to complete all Management Plan tasks will be decided by the Prime Contractor, but a possible outline is provided below.

Staff will be recruited in the first quarter of the first year and will be appropriately trained and equipped. Both staff members will be trained as a conservation firearm specialist (training provided).

14.1 Staffing - Program Manager

The Program Manager is the lead staff member implementing the KSHCP on behalf of the Participants. This is likely to be a part-time position. The responsibilities for this position include implementing the Management Plan for the Kahuamaʻa Seabird Preserve but also encompass other KSHCP duties. The incumbent will have expertise in conservation biology as well as proven project management experience. Position will be both field and office based.

Duties will include overall project management, budget management, hiring Prime Contractor staff members, personnel supervision compiling data and writing annual reports on project progress, ensuring that mitigation goals are achieved, implementing adaptive management if required, coordinating with SOS (or other qualified veterinarian) as needed, presenting at ESRC and other professional conferences, serving as a liaison between the mitigation project, regulatory agencies and participants. Field duties include working with fence contractor, supervising technicians and overseeing / carrying out monitoring fieldwork and predator removal efforts.

14.2 Staffing - Technician

The Technician is a field position posted primarily at the Kahuamaʻa Seabird Preserve. The Technician will have experience in conservation, field work, monitoring and reporting. Primary duties will also include effectiveness monitoring for mitigation work, monitoring breeding of covered species on site, long term biosecurity at the mitigation site, feral cat and barn owl predator control and non-native plant removal.

14.3 Staff Training

Staff will receive training as follows:

- Wilderness First Aid
- Firearms
- Vegetation monitoring
- Seabird monitoring, management and predator control

14.4 Equipment and Office

IE will purchase and maintain appropriate equipment. For a full list of equipment, see budget Appendix H in the KSHCP.

IE will source appropriate office space. Options include moving into an agency office.

14.5 Stakeholder and Partner Management

IE will ensure cooperation amongst stakeholders by:

- Maintaining a website
- Setting up a Facebook page for the project which will be updated quarterly, and encouraging stakeholders to follow it.
- Answering stakeholder queries as they arise.

IE will manage any conflict between stakeholders, project and other users of the area and employ stakeholder conflict resolution techniques if required.

14.6 Fulfill Reporting Obligations

IE will initiate regular reporting schedule to participants and regulatory agencies, including financial reporting.

14.7 Fulfil Accounting Obligations

IE will keep a full accounting record of the project.

14.8 Review and Revise Management Plan Every 5 Years

IE will review and revise (as needed) the management plan every 5 years, in conjunction with the agencies.

15. BUDGET SUMMARY

The budget is a key section of the Management Plan, outlining project expenditure and income for every category and action. However, the budget for the Kahuamaʻa Seabird Preserve is also important for the KSHCP as income is dependent upon Applicant take. For that reason, the full budget has been included as an appendix to the KSHCP (Appendix G). An introduction and explanation of Management Plan costed items can be found there.

16. ADAPTIVE MANAGEMENT SOLUTIONS

The adaptive management process for the KSHCP is outlined in Section 6.9 of that document. The biological objectives of the KSHCP set triggers for initiating adaptive management by specifying actions that must be accomplished by target years. If these targets are not met, the actions described this Management Plan may be altered to better achieve program outcomes.

While it is not possible to consider every alternative, Table 16.1 lists potential adaptive management solutions, though other solutions may be more appropriate at the time of implementing adaptive management. Across all actions, if alternate technology becomes available that is within stated budget and will achieve objectives more efficiently or cost effectively, this may be employed. Costs associated with potential solutions below are presented in Appendix H of the KSHCP.

Table 16.1. Adaptive Management Scenarios

KSHCP Objectives	Scenario requiring adaptive management	Potential Solutions
2.A. Construct a predator-proof fence and install social attraction equipment (nest boxes, speakers) within the fenced area at the mitigation site in Year 1 of KSHCP implementation.	Fence construction. delayed by unforeseen event	Additional funds to contractor - 15% more labor @ low cost
	Fence design not adequate to exclude predators & repairs needed	Additional materials & labor needed to rebuild fence
	Additional rare plants found, work delayed	Additional funds to contractor - 15% more labor
	Archaeological remains found, work delayed	Additional funds to contractor - 15% more labor
	No suitably qualified fence contractor available in US to build fence in year one	Fly team from NZ or elsewhere
2.B. Remove predators from within the fenced enclosure with monitoring confirmation of their absence, and activation of the social attraction equipment by Year 2; predator eradication within fenced enclosure maintained for the life of the project	Predator removal unsuccessful at 1st attempt	Double trapping efforts inside fence - equipment

		Fly in and/ or consult with predator control expert
	Fence breach from tree fall, predators enter	Repair fence
		Repeat trapping effort inside fence
2.C. Ground activity by Covered Seabirds documented at the mitigation site by Year 4 of KSHCP implementation.	Monitoring insufficient	Increase camera trap effort by 20%
	Birds not attracted to site	Double speaker system & change soundtrack
	Birds not attracted to site	Fly in and/ or consult with expert from NZ
	Birds not attracted to site	Install decoys
2.D. Breeding activity by Covered Seabirds documented at the mitigation site by Years 5-7 of KSHCP implementation.	Monitoring insufficient	Increase camera trap effort by 20%
	Birds not breeding at site	Add new artificial burrows within fence
	Birds not breeding at site	Fly in and/ or consult with expert from NZ
	Birds not breeding at site	Survey for additional invasive plants that may be modifying habitat to make it unsuitable
	Birds not breeding at site	Replace all artificial burrows
2.F. Continued cumulative upward trend in Covered Seabird breeding documented at the mitigation site by Year 20 of KSHCP program implementation.	see 2D	
2.G. Maintain high quality seabird habitat at the mitigation site by removal of habitat modifying invasive plants in Year 1 and annually throughout the 30-year duration of the KSHCP.	Initial pass at habitat modifier removal fails	Repeat
	Additional invasive plant found	Removal effort

	Habitat modifiers persist despite technician maintenance work	Repeat removal pass
	Removal work is more expensive than predicted due to e.g. presence of additional rare plants	Additional funds
2.H Protect nesting birds inside mitigation fence and in nearby source colonies by implementing predator control of 1) barn owls within the area surrounding the fenced enclosure and the Kalalau Valley, and 2) feral cats at ingress points to source colonies in the Kalalau Valley, beginning in year 1 and annually throughout the 30-year duration of the KSHCP.	No barn owls removed	Additional shooting nights
		Alternative trapping/luring techniques
	Barn owls kills still occurring in preserve	Additional shooting nights / new techniques

17. BEST MANAGEMENT PRACTICES

To avoid any adverse effects to species and habitats of conservation concern, Best Management Practices will be employed at all times at the project site for the following species and specific concerns:

- **Covered Species** – ʻAʻo, ʻuaʻu and ʻakēʻakē. The benefits to these species of the Kahuamaʻa Seabird Preserve have been outlined above. See individual BMPs on each activity for further details on how harm will be completely avoided.
- **Ōpeʻapeʻa**: This is a listed species (Federal and State). It could be present at the Kahuamaʻa Seabird Preserve. Overall, the creation of the Preserve will provide a potential benefit to the ʻōpeʻapeʻa through conservation of the native habitat and control of non-native predators. The amount of disturbance that will occur while conducting conservation measures is minimal, temporary, and of limited duration. See individual BMPs on each activity for further details on how harm will be completely avoided.
- **Forest Birds:** Several candidate and listed native forest birds and pueo may use the Preserve as territories and / during the breeding season Jan to Jun (see section 3.1.4). Overall, the creation of the Preserve will provide a potential benefit to forest birds and

pueo through removal of non-native habitat and control of non-native predators - both are identified as primary threats to native forest bird species in Hawai‘i (VanderWerf 2012). The amount of disturbance that will occur while conducting conservation measures is minimal, temporary, and of limited duration. See individual BMPs on each activity for further details on how harm will be completely avoided. It should be noted that KESRP located a pueo nest that had been predated by cats in Pihea in 2015, indicating that cat control will be beneficial to this species.

- **Listed or Rare Plants and native plant habitat:** Several listed or rare species of plant have been observed in the project area. Overall, conservation activities in the Kahuama‘a Seabird Preserve are anticipated to result in dramatically improved habitat and reduced habitat modification that could otherwise occur from the negative effects of non-native animals and plants (see Section 12 - Vegetation Restoration - for a fuller explanation). The preserve’s proximity to the road, and proximity to lookouts frequented by high numbers of tourists, presence of feral animals such as pigs and rats and current habitat degradation means that the area is already exposed to the risk of invasive species. Specifically, botanists have reported that the fence will be of direct conservation benefit to one individual of *Myrsine knudsenii* (E, PEP), four individuals of *Exocarpos luteolus* (E), one *Lobelia yuccoides* (SOC), one *Polyscias flynnii* (E, PEP), and a large occurrence (unknown number of individuals) of *Euphorbia remyi* var. *remyi* (E) (A. Williams, Pers. Comm.) Plant monitoring will not be limited to endangered species; changes to more common plant species that form the bulk of the native habitat will also be monitored. See individual BMPs on each activity for further details on how harm will be completely avoided.
- **Soil Erosion:** In the longer term, with re-vegetation and removal of ungulates, soil stability is expected to improve. Improved soil stability is expected to reduce erosion in the mitigation area which will reduce surface water runoff and water turbidity. In the short term, however, erosion might compromise the exclusion of predators from the fence as well as affecting Listed and Rare Plant species. See individual BMPs on each activity for further details on how harm will be completely avoided.
- **Rapid ‘Ōhi‘a Death (ROD),** a fungal disease, is currently attacking and killing ‘ōhi‘a (*Metrosideros polymorpha*), the most abundant native tree in the state of Hawai‘i. The fungus *Ceratocystis* was first detected in 2014 on the island of Hawai‘i killing hundreds of thousands of ‘ōhi‘a across thousands of acres on the island. It has more recently been found on the islands of Kaua‘i, Maui, and O‘ahu and has the potential to devastate the native forest. *Ceratocystis lukuohia* (destroyer of ‘ōhi‘a) and *Ceratocystis huliohia* (disruptor of ‘ōhi‘a), the two fungal pathogens causing ROD have been confirmed on both Hawai‘i Island and Kaua‘i. Both species of *Ceratocystis* will kill ‘ōhi‘a, however the more aggressive form has not been found on Maui or O‘ahu, and is extremely limited on Kaua‘i. In July 2019, a single tree was detected on Maui and another tree on the island of O‘ahu. Both were infected by *C. huliohia*. Sanitation protocols will occur to prevent the introduction and spread of ROD. See individual BMPs on each activity for further details on how harm will be completely avoided.
- **Cultural Resources**: There is currently no evidence of archaeological remains at the Kahuama‘a Seabird Preserve as noted in section 7.2. In 1997, prior to the construction of

the nearby Kalalau Rim Endangered Plant Exclosure, State Park archaeologists conducted a reconnaissance survey in the area of the Kahuamaʻa Flat and did not encounter archaeological sites or features. Nonetheless, archaeologist guidelines will be followed as specified in the BMPs for individual actions. See individual BMPs on each activity for further details on how harm will be completely avoided.

KSHCP conservation program activities in the Management Plan for the Kahuamaʻa Seabird Preserve will not result in take under section 10(a)(1)(B). The Prime Contractor will have conservation biology and project management experience and will hold recovery permits necessary to conduct its work under Section 10(a)(1)(A) of the Endangered Species Act and Sections 13-124-4 and 13-124-6 of the Hawaiʻi Administrative Rules.

To ensure that BMPS are followed during construction, a suitably fence qualified contractor will be engaged through a bids process. As part of the contract, contractor will agree orally and in writing to all BMPs. The Prime Contractor will be made aware that failure to follow BMPs may result in legal and financial penalties. The Prime Contractor and staff will receive training on BMPs. A concrete timeline for the delivery of the fence will be established in the contract. A construction deadline will be established during contract negotiations with monetary penalties.

The following sections outline in detail how BMPs will be used to avoid causing harm to listed species and to habitats. All staff, including biologists and technicians, entering the enclosure will be trained and follow the BMPs or will not be permitted to enter the enclosure. Any visitation to the mitigation area will be limited to what is absolutely necessary to accomplish objectives of the management plan and for compliance monitoring.

17.1 SEABIRDS

17.1.1. BMPs – Seabird Protection During Pre-construction & Construction

Pre-construction monitoring is critical to ensure that no seabird burrows are damaged during fence construction and sling-load drops. No burrows were found in 2016 or 2017 during auditory surveys, but no active burrow searching was carried out on site. Further surveys will be carried out in 2018.

If burrows were to be present, risks to covered seabirds through clearing of vegetation, increased risk of soil erosion, increased human presence, low altitude helicopter traffic and equipment drops could be:

- Damage to or destruction of burrows
- Disturbance to breeding seabirds (potentially leading to abandonment of nesting sites)

Impacts will be completely avoided using BMPs as follows:

- Work most likely to damage seabird burrows will occur during the period December to April (e.g. outside the breeding season, namely vegetation clearance, pole installation

and other ground disturbing work). Fence construction may only commence during this period if it is reasonable to expect that work that could affect seabirds will be completed on the sloping sections of the fenceline (i.e. those most favorable to seabird colonization) before the seabird breeding season commences. If the project is delayed for any reason, the second phase of construction will only go ahead if it does not affect the covered species.

- However, work may continue into the breeding season to complete the fence provided it is either on the flat areas of the site or does not include ground disturbing work noted above that would damage potential burrows or birds in burrows. If construction occurs during the breeding season, 8 auditory surveys will be carried out in advance (see section 12.3.4) within 10m of the fenceline to ensure that there is no ground activity in the immediate area of the fenceline.
- The proposed fence lines and sling load drop zones will be thoroughly searched for seabird burrows by trained personnel before or during the onsite meeting. Training will be provided by KESRP or other qualified trainers. Staff will check all tree roots within 10m of the fence line. Any suitable holes within 10m of the fence line will be checked for guano, scent, feathers, eggshell, digging.
- Any burrows located will be marked on a GPS, cattle tagged and obviously flagged.
- If burrows likely to have been recently active (within last breeding season) are found along the proposed fence alignment route, the fence will re-routed if practically possible or the fence installation will work around burrows so that they are not destroyed.
- Buffer zone between the burrow and the fence will depend on the angle of the burrow and the slope that the burrow is situated upon, but is expected to be no less than 5m and up to 20m if near a possible take-off zone. If a burrow is present in a proposed sling-load drop zone, the zone will be relocated.
- A seabird biologist will be present during all vegetation clearing by the contractor.
- After vegetation has been removed along the fence line, a further burrow search will be carried out. Vegetation removal should not be necessary on sling load drop zones.
- A pre-construction monitoring report will be completed outlining how the above conditions have been satisfied.
- As the fence is being installed, a Prime Contractor staff member will be on site at all times to monitor the immediate environs to ensure that no seabird burrows are present. They will look for suitable holes and will also note the presence of seabird signs such as guano, footprints, scent, presence of feathers, down or eggshell and nesting material that might have appeared since the pre-construction surveys. They will also check all tree roots as these are often the site of burrows.
    - It is highly unlikely, given the provisions in the pre-construction section, that burrows will be located along the fence line by the Prime Contractor monitor once construction commences. If this occurs, however, Prime Contractor staff will consult with the regulatory agencies and the fence contractor so that impacts to the burrows are avoided.
- Sling load drop zones will most likely not be used post construction, but if required, they will be re-assessed for burrows before each post-construction use.

- All personnel (including the fence contractor) working in the mitigation sites will be trained to follow the seabird protection BMPs and given oral and written instructions. Training will be provided by the KESRP or other qualified trainers. Both project staff and fence contractors will be required to carry paper and / or GPS maps showing the locations of any known burrows and will know how to recognize burrow tagging.

17.1.2. BMPs - Seabird Protection during Rodent Eradication (inside fence)

The eradication of predators is likely to have a highly positive effect on breeding success once the Kahuamaʻa Seabird Colony is colonized. However, risks to covered seabirds could be:

- Damage to or destruction of burrows during monitoring of traps
- Disturbance to breeding birds (potentially leading to abandonment of nesting sites)
- A bird being killed or injured by a trap

Impacts will be completely avoided using BMPs as follows:

- Goodnature traps were designed to be used in seabird colonies. They are difficult for birds to trigger when placed 12cm off the ground and in addition, are not attractive to birds (Goodnature 2017). It is exceptionally unlikely that a seabird would be killed by a Goodnature and in 5 years of using this method in Kauaʻi by KESRP and other projects, no seabird deaths have been recorded (A Raine, 2017, pers. comm.) Other brands can be used provided they will not affected listed species.
- Snap traps have the potential to cause harm or death to Covered or Listed Species. This will be prevented by enclosing the trap in a boxed housing that cannot be accessed by the seabirds. Boxed housings will be inspected and repaired immediately prior to a planned trapping effort.
- Stationary bait boxes are designed in such a way that they cannot be accessed by seabirds. Poison bait may be removed by rats and left outside the box, however the bait is not appealing to seabirds and therefore the risk of ingestion is considered to be zero.
- All field workers and technicians will receive training to recognize potential seabird breeding burrows, (both active and inactive) and recognize burrow markers and program them into a GPS. They will be required to have a map of burrows and / or GPS points on them at all times at project site. Any burrows will be reported to KESRP.
- Workers will route trails around burrows and place traps and bait stations at least 10m away from known breeding burrows to avoid inadvertent trampling (and predator attraction from the scent of the bait) during the course of setting and checking traps and bait stations.
- Training will emphasize the use of due caution when walking off trail to avoid the trampling of burrows, particularly in areas which look suitable for seabird breeding activity.

17.1.3. BMPs - Seabird Protection – Collision Avoidance

The curved hood of the predator-proof fence is prominent and likely improves visibility. Similar projects for petrels and shearwaters in New Zealand have not encountered any problems related to seabirds colliding with the fence (SWCA 2011). Nonetheless, risks to covered seabirds could be:

- Injury or death due to collision with conservation fencing during the hours of darkness
- Downing of adult birds resulting in an ability to take off; this could lead to starvation of parent and chick
- Impeding take-off ability of chicks, leading to starvation

Impacts will be completely avoided using BMPs during construction work as follows:

- The fence will not be erected within 20m of a known seabird burrow
- Fencing will be installed without barbed wires, or similar sharp pieces, which could snag the birds (Hodges and Nagata 2001).
- A stripe of white reflective paint will be applied to increase the visibility of the fence to incoming and outgoing seabirds (Swift 2004). Commercial bird reflectors will be hung every 20m if appropriate.

17.1.4. BMPs – Seabird Protection during Cat Control

Cats will be removed from inside the fence before social attraction commences and the trapping of cats outside the fence (in the predator defense zone) will reduce the risk of reinvasion. However, as live feral cat traps sit on the ground, the risk to covered seabirds could be:

- A bird being caught, injured or killed by a trap

Impacts will be completely avoided using BMPs as follows:

- Live trap placement will be ≥25m away from known seabird burrows
- Conibears will be placed in bird excluding boxes
- All field workers and technicians will receive training to recognize potential seabird breeding burrows, (both active and inactive) and recognize field markers. They will be required to have a map of burrows and / or GPS points on them at all times at the site. Any burrows will be reported to KESRP.
- Live Traps will be checked every 24 hours.
- In the rare and unlikely event that a seabird does become caught, the live traps are well concealed and spacious enough that a seabird will not become harmed from exposure or damage from the trap itself. If a bird is found in the trap during daylight hours, then it will be released into the nearest potential seabird burrow where it has sufficient space to hide for the rest of the day (i.e., workers will not release birds into vegetation or attempt to get a bird to fly away).

17.1.5. BMPs - Seabird Protection during Barn Owl Trapping and Shooting

The trapping / reduction of barn owls is expected to have a positive effect on breeding success in the preserve and the source colonies for the Kahuama‘a Seabird Colony as this species is a known seabird predator on Kaua‘i. However, the risk to Covered Species could be:

- Damage to or destruction of burrows during monitoring of traps
- Disturbance to breeding birds (potentially leading to abandonment of nesting sites)
- A seabird being caught, injured or killed by a trap
- A seabird being mistaken for a barn owl and shot

Impacts will be completely avoided using BMPs as follows:

- Existing paths will be utilized as much as possible to minimize local impact and barn owl trapping will be combined with other predator control activities to reduce trips.
- Barn owl control will maintain a greater than 25m distance from known nesting seabirds to avoid impacts to the birds. Prime Contractor staff will be required to carry a map and or GPS points with known burrow locations.
- There is potential that Covered Seabirds could be mistaken for barn owls and shot. This risk will be completely avoided by 1) providing appropriate training to technicians 2) using a spotlight at all times 3) requiring positive identification before shooting.

17.1.6. BMPs - Seabird Protection during Monitoring Work

Risks to listed seabird species could be:

- Injury during banding
- Trampling of natural burrows during burrow searching
- Trampling of natural burrows or crushing of birds during auditory and visual surveys

Impacts to Covered Species will be completely avoided by following BMPs as follows:

Banding

- Biologists conducting banding of seabirds will be required to be covered under Bird Banding Lab banding permits and be authorized by the DLNR to band or otherwise handle seabirds on Kaua‘i.
- Chicks will not receive bands until approximately 4 to 2 weeks from fledging.
- Only individuals trained in seabird handling and banding will be allowed to touch birds, unless an emergency occurs in which a bird requires rescuing.
- The amount of time a bird is handled during banding will be kept to a minimum, typically less than 2 minutes.
- If harm to an individual seabird does occur, due to an unexpected event or an accident while conducting the conservation measures, the regulatory agencies will be notified

within 24 hours or as soon as practically possible, and a report filed within 3 days. Technicians and field workers will deliver injured birds to the Save Our Shearwaters (SOS) project or other qualified veterinarian or rehab center immediately for rehabilitation and potential release.

Burrow searching

- If burrows are located along the fenceline post construction, locations will be clearly marked with flagging and an individually numbered cattle tag, and the fence-monitoring trail will be re-routed to avoid unnecessary disturbance to burrows during regular fence maintenance activities.
- Staff will be trained to look for and recognize burrows (active and inactive) as they are searching the site to ensure that they do not inadvertently trample a burrow. If this occurs, staff will excavate the burrow and ensure that any bird inside was not injured (if injury occurs, see point above). Staff will attempt to repair the burrow using any means possible to ensure that it is still usable, whether or not a bird is inside. Burrow locations will be programed into a GPS and shared with all other project staff. Staff will be required to have a map of burrows and / or GPS points on them at all times at the site. Any burrows will be marked with a cattle tag and reported to KESRP.

Auditory and Visual Surveys

- To avoid damage to seabirds at night by trampling during auditory and visual surveys, staff will stay in one place as much as possible and when moving, will take care to avoid stepping on birds. Training will be supplied by KESRP or other qualified body.

17.1.7. BMPs – Seabird Protection during Restoration and Monitoring

Risks to listed seabird species could be:

- Trampling of or damage to natural burrows during invasive species removal and nature vegetation restoration
- Presence of herbicide residue near burrows

Impacts will be completely avoided through BMPs as follows:

- Vegetation removal and restoration activities will not occur during seabird breeding season (01 Apr to 15 Dec)
- Herbicides will not be used within 3m of a known burrow.
- Where shrubs and / or trees need to be removed within 10m of a known burrow, the burrow will be inspected first to see if removal might compromise the structural integrity of the burrow. If the burrow is known to have been used, it may be appropriate to simply trim the invasive plant species rather than risk damaging the burrow through removal. Where the burrow has shown no signs of recent use (guano, feathers,

excavations, eggshell, scent) every care will be taken to prevent burrow damage and the shrub/tree removal will go ahead.
- Existing paths will be utilized as much as possible to minimize local impact
- All personnel working on invasive species removal and vegetation restoration must be trained to follow the seabird protection BMPs and given oral and written instructions. Training will be provided by KESRP or other qualified trainers.
- All staff will be required to carry a map and / or GPS showing the seabird burrows located in the Kahuama‘a Preserve and to take particular care not to crush them. Known burrows will also be clearly marked with a cattle tag and reported to KESRP.

17.2. BATS

17.2.1. BMPs – Bats – Pre-Construction, Construction & Operation

Risks to ‘ōpe‘ape‘a from activities such as tree trimming, removal of woody plants greater than 4.6m, fence construction and invasive species removal could be:

- Inadvertently harming or by disturbing roosting sites during the roosting and pup-rearing season (June 1 through September 15).

Impacts will be completely avoided using BMPs during pre-construction work as follows:

- The proposed fence lines will be thoroughly searched for trees which would be suitable for bat roosts (4.6m or above).
- Where trees over 4.6m need to be removed for construction, a Fluke Ti400 thermal imager (or similar) will be used to scan the tree or a contractor will be hired, in conjunction with an acoustic survey using bat detectors and a visual survey to ensure that no bats with pups are present.
- If there are trees 4.6m or above in the proposed sling load drop zones they will be scanned for bats as above and only removed outside the pupping season.
- Tree trimming and invasive species removal / vegetation restoration will take place outside the roosting and pup-rearing season (June 1 through September 15). If this is not possible, a Fluke Ti400 thermal imager (or similar) will be used to scan the tree, in conjunction with an acoustic survey using bat detectors and a visual survey to ensure that no bats with pups are present. If bats or pups are found, work will stop and the regulatory agencies will be consulted.
- All personnel (including the fence contractors) in the mitigation sites must be trained to follow the bat protection BMPs and given oral and written instructions.

17.2.2. BMPs - Bat Protection during Barn Owl Control

Barn owls are known to prey on bats in other locations (Speakman 1991) so it is possible that they may be a predator of the ‘ōpe‘ape‘a. Therefore, their trapping or suppression is likely to be

beneficial or neutral to bats. Since bats fly at night however, the risk to them could be:

- Accidental shooting

This risk will be completely avoided using BMPs as follows:

- providing appropriate training to technicians
- using a spotlight at all times
- requiring positive identification before shooting
- no shooting when bats are seen flying in the immediate environs (i.e. within 500m)

The activities carried out in the rodent eradication, cat trapping, and monitoring work are expected to have no potential to negatively affect the ʻōpeʻapeʻa.

17.3. FOREST BIRDS AND PUEO

17.3.1. BMPs – Forest Birds and Pueo – Pre-Construction and Construction

Forest birds are known to be in the area, including ʻiʻiwi (*Drepanis coccinea*) (federally listed as threatened under the ESA), ʻapanane (*Himatione sanguinea*), Kauaʻi ʻelepaio (*Chasiempis sandwichensis)*, Kauaʻi amakihi (*Hemignathus Kauaiensis*) and ʻanianiau (*Magumma parva*). ʻAnianiau and Kauaʻi ʻamakihi were observed singing which may be an indication of breeding in the area. The pueo, a native Hawaiian owl, has also been sighted several times in the area. Pueo have relatively wide home ranges and as such, it is possible that the Kahuamaʻa Seabird Reserve is part of the range several pueo.

Risks to listed forest birds and pueo through tree trimming and fence construction, could be:

- Disturbance of breeding birds and nests
- Removal of nesting habitat and feeding habitat in the form of large trees, especially ʻōhiʻa.

Impacts will be completely avoided using BMPs during pre-construction work as follows:

- Consultation with KFBRP will occur before the start of construction to exchange the most current information on the distribution and status of candidate and listed forest birds at the site.
- All personnel (including the fence contractors) working in the mitigation sites must be trained to follow BMPs and given oral and written instructions.
- A baseline survey will be completed to establish use of the area by forest birds during the breeding season January through June and to locate any nests. Pueo nest throughout the year, so a search for their nests would be necessary all year round.
- Pre-construction, surveys will be conducted at areas proposed for conducting conservation activities including installing fences, creating helicopter landing zones, installing social attraction equipment, trapping and baiting, and monitoring.

- Any candidate or listed forest bird species (trees) or pueo (ground nesters) nests found nesting in the vicinity of these areas must be marked via GPS and identified on maps and the information transmitted to managers, other staff and the regulatory agencies.
- Pueo nests will be given a buffer of 20m that will be marked with flags. No disturbance of these nests should occur in that buffer area and if not already occurring, predator control should be initiated. Trees with forest bird nests will be flagged. (Project staff will be required to know these locations and to recognize nest markers in the field.
- Fencing & helicopter sling-load drop zone: For listed forest birds or pueo found nesting along the proposed fence line, the trees supporting nests will be marked and/or fenced off (forest birds) and the ground area of the nest marked and / or fenced off (pueo) and the fence re-routed to avoid impacts to the forest bird species and pueo. Drop zones will be relocated if candidate or listed forest bird nests or pueo are found to be within 50m.
- Workers are required to know the location of marked and identified nests and maintain a 5-meter buffer around the nesting area for candidate or listed forest birds. Clearing and trimming activities are not to occur within this area. For pueo, a 100m buffer would be required. If that is not possible, incubation and nesting is complete within 35-55 days in total and it may be necessary to delay work that would cause disturbance until the birds have fledged.
- Every effort will be made to avoid removing large trees, especially ʻōhiʻa. However, it is recognized that the benefits of the predator proof fence will outweigh any potential habitat loss for forest birds, since this would be of negligible size.
- It is unlikely, given the provisions of the pre-construction monitoring, that nests will be discovered in the vicinity of the fence line. As a precaution, when the fence is being installed, a Prime Contractor staff member will be onsite at all time to monitor the immediate environs for candidate or listed forest bird or pueo nests, or breeding pairs in a territory. If nests are found, the tree will be flagged and no activity likely to disturb the nest will take place within a 100m buffer zone or until after fledging. This includes vegetation / tree removal. However, in the case that a nest is empty and birds are not actively breeding (based on expert advice, which will be sought) trees can be removed.
- Little is known about the breeding biology of pueo, but their nests, which are on the ground, have been found throughout the year (DLNR 2005). If nests are found, the nest will be flagged and no activity will take place within a 20m buffer zone. This includes vegetation and tree removal. A mini fence will be erected to ensure that someone does not accidentally step on the nest.
- All personnel (including the fence contractors) working in the mitigation sites must be trained to follow the forest bird and pueo protection BMPs and given oral and written instructions.

17.3.2. BMPs - Forest Bird Protection during Predator Control and Invasive Species Removal

The eradication of predators and vegetation restoration work is likely to have a positive effect on any forest birds that make a breeding attempt inside the Kahuama‘a Seabird Colony. However, the risks from project work could be:

- Disturbance of nests.

Impacts will be completely avoided using BMPs as follows:

- KRBRP or other qualified person will provide training to project staff annually or as required on identification of forest birds by call and sight as well as nest finding.
- Any nests will be marked and the Prime Contractor staff will be required to carry a paper map and or GPS with nests marked.
- Ongoing monitoring of trapping and baiting will occur year-round, encompassing the forest bird breeding season. Areas for trapping and baiting will be surveyed monthly during the breeding season to confirm the presence or absence of forest bird nests. Any nests will be clearly marked and trails used to access traps and bait stations will be re-routed if necessary to avoid disturbance to any nesting candidate or listed forest bird species. Survey results will be reported to KFBRP.
- When placing, setting, and checking traps and bait stations workers are required to know the location of any nesting candidate or listed forest birds and pueo and to maintain a 5m buffer around the nests, each of which will be marked (e.g., with flags and with GPS coordinates).
- When placing, setting, and checking traps and bait stations workers are required to know the location of any nesting candidate or listed forest birds and pueo and to maintain a 10m buffer around the nests for forest birds and 20m for pueo, each of which will be marked (e.g. with flags and GPS coordinates).
- Areas for seabird monitoring will be surveyed monthly during the breeding season to confirm the presence or absence of candidate or listed forest bird and pueo nests. Any nests will be clearly marked (buffer area will be marked in the case of the pueo) and trails used to access traps and bait stations will be re-routed if necessary to avoid disturbance to any nesting forest bird species. Survey results will be reported to KFBRP.
- If burrows need to be checked in the vicinity of a nest, extra care will be taken not to disturb the candidate or listed forest bird or pueo nest, such as keeping noise to a minimum and having only one person check the burrow quickly.
- Cameras will not be placed on burrows within 10m of forest bird nests and 100m within pueo nests as this requires extra disturbance.
- Invasive plant removal and habitat restoration will not take place within 25m of the nest.

17.3.3. BMPs - Pueo Protection during Eradication (inside fence)

Diphacinone is noted to have a 'moderate' risk of secondary poisoning to birds by the National Pesticide Information Centre although large amounts of the poison would need to be ingested. The risk from the predator control work to pueo could be:

- Secondary poisoning from pueo consuming rodents which have ingested poison.

The following protocol will be followed to ensure that impacts are completely avoided:

- Project staff will collect any dead rodents and dispose of them off site. Whenever stationary rodent bait traps are in use, staff will monitor the project site weekly to increase the likelihood of finding carcasses.
- Stationary bait stations will only be used inside the fence and for the minimum time possible to achieve zero rat sign on ink-card tracking tunnels and signs of bait take for three months (slightly longer than the average reproductive cycle for rats).
- Secondary poisoning to animals other than rodents as well as any occurrences of damaged or vandalized bait boxes will be reported to the U.S. Fish and Wildlife Service, DLNR and Pesticides Branch of the Hawai'i Department of Agriculture within 24 hours of being discovered.

17.3.4. BMPs – Pueo Protection during Barn Owl Trapping and Shooting

Since pueo are similar in flight to barn owls, there risk to this species could be:

- Accidental shooting

Impacts will be completely avoided using BMPs as follows:

- Providing appropriate training to technicians
- Using a spotlight at all times
- Requiring positive identification before shooting
- No shooting when pueo are seen flying in the immediate environs

17.4. PLANTS

17.4.1. BMPs - Plant Protection – Pre-construction and construction

Removal and disruption to some native plant species will be unavoidable during construction but will be kept to a minimum. It is important to note that the site was specifically selected to minimize damage to listed and rare plants.

Risks to listed or rare plant species during fence construction could be:

- Uprooting, trampling, soil erosion, crushing
- Damage to *E. remyi* var*. remyi (E)*, (a vining, weakly branched plant whose stems are growing on top of and through the mats of uluhe fern).

- Damage to other PEP plants within the fenceline
- Alteration to native habitat

The only Endangered species that occurs close to the proposed fenceline that might be affected is to *E. remyi* var*. remyi* and appropriate precautions will be taken (as listed below) to ensure that damage does not occur.

Impacts will be completely avoided using BMPs during pre-construction & construction work as follows:

- Prior to fence alignment and sling load drop zone creation, staff (including the fence contractors) will receive training from a botanist (either from the regulatory agencies or a consultant) on identification of rare plants in the area and be given oral and written instructions.
- Pre-construction baseline monitoring will be carried out to identify and / or confirm all listed and rare plants and their locations (see Section 12 – Vegetation Restoration - for full details.)
- A botanist or member of the Prime Contractor staff trained in plant identification for the localized area will be present at all times during alignment and sling load drop zone discussions on site as well as during construction.
- Within the enclosure, unknown number of individuals of *E. remyi* var*. remyi* are growing. This is a vining, weakly branched plant whose stems are growing on top of and through the great mats of ‘uluhe fern that dominate the area and as such, is at risk of being cut or trampled during fence construction. During pre-construction surveys, the plants will be indicated by flagging and staff will be provided with a map showing the location, as well as GPS points (these flags will not be left permanently as botanists are concerned that this will incite vandalism or theft, so after construction, nearby plants will be flagged instead to indicate to staff their location).
- If necessary, outplanting of propagules from the same population inside the fenced enclosure will occur. This is likely to be out-sourced to a consultant such as NTBG.
- An example of *Dubautia kalalauensis*, a PEPP plant, occurs well away from the entire project. No fence or project activities will occur in this area.
- A specimen of *Polyscias flynnii* (E, PEP) is safely within the fenceline and will not be damaged during construction. The plant or an adjacent plant will be marked with tape during pre-construction surveys. Prime Contractor staff and fence contractors will be required to carry, at all times, a map showing the location and or GPS points. No trimming of the tree will be allowed. A 10m buffer zone around the tree will be observed, with no construction activities allowed in that area.
- A culvert will be inserted into the fence if required in areas that might act as a watercourse during heavy rain, to avoid flooding which might wash out plants.
- BMPs to protect against the ingress of invasive species are outlined in section 17.4.3.
- Proper footwear (spiked/corked boots or tabis) will be worn by personnel (applies to all BMPs)
- There will be strategic placement of wood or plastic boards, webbing, or other simple trail infrastructure in areas where mud pits or slides may form (applies to all BMPs)

17.4.2. BMPs - Plant Protection– Rapid ʻŌhiʻa Death (ROD)

The spread of Rapid ʻōhiʻa Death (ROD) to local ʻōhiʻa trees could lead to a major ecological disaster through Kauaʻi. Local trees could potentially contract ROD due to staff or contractors bringing the disease to Kauaʻi through tools or clothes. Impacts will be completely avoided using BMPs during construction work outlined by the College of Tropical Agriculture and Human Resources, UH at Manoa:

- Staff and contractors will not move ʻōhiʻa wood or ʻōhiʻa parts inter-island. If ʻōhiʻa trees need to be removed as part of fence construction, they will be taken to the nearest location suitable for incineration immediately.
- Tools used for cutting ʻōhiʻa will be cleaned with 70% rubbing alcohol, a proven cleaning measure. This is particularly important if the tools may have come into contact with infected trees, but should happen regardless. A freshly prepared 10% solution of chlorine bleach and water can be used as long as tools are oiled afterwards, as chlorine bleach will corrode metal tools. Chainsaw blades will be brushed clean, sprayed with cleaning solution, and run briefly to lubricate the chain.
- Gear (including shoes, packs and clothes) will be cleaned before and after entering forests in a non-forest environment with running water. All soil will be brushed off shoes then sprayed with 70% rubbing alcohol. Clothes will be washed with hot water and soap. This will also help to reduce the spread of invasive species. A buddy system will be initiated where partners check each other's gear.
- Vehicles will be washed with soap after off-roading or after picking up mud from driving. A pressure washer with soap will be used to clean all soil off the tires and vehicle undercarriage.
- If staff have visited infected islands, they will take additional precautions of washing all field clothing, boots and tools in Sterigene before returning to the site. Staff will be asked to sign an agreement to this effect, since the severity of the consequences if ROD reaches Kauaʻi.

17.4.3. BMPs - Plant Protection– Invasive Species

Risks to native plant ecosystems could occur should non-native invasive plants be accidentally introduced/reintroduced by staff or contractors. This could lead to the spread of invasive species to surrounding forested areas.

Impacts will be completely avoided using BMPs during construction work as follows:

- Cleaning boots, clothes, packs and gear between site visits to ensure that seeds are not carried from or to other areas and using a buddy system to ensure that this occurs.
- Keeping soil and vegetation disturbance to a minimum
- Where disturbance is unavoidable, staff will monitor bare ground and ensure invasive species are removed.

- Invasive species monitoring and removal within the fence will happen on a quarterly basis with waste hauled off site and destroyed
- Staff will be trained to recognize invasive species and to report them to project manager so that an action plan can be drawn up if new invasive species are encountered, if necessary.
- Vehicles will be washed with soap after off-roading or after picking up mud from driving. A pressure washer with soap will be used to clean all soil off the tires and vehicle undercarriage.
- Tools used in other areas will be cleaned thoroughly before use in or around the site.

17.4.4. BMPs - Plant Protection during Predator Control

As noted above, the overall effect on plants of the Kahuama‘a Seabird Preserve is likely to be positive. However, the risk to rare and listed plants from the need to enter the preserve to monitor rodent eradication equipment, especially during the initial phase of eradication, could be:

- Trampling, erosion, disturbance
- Alteration to native habitat
- Frequently traveled transects will experience increased disturbance and erosion risk
- Listed or rare plants risk being trampled or disturbed

Impacts will be completely avoided using BMPs as follows:

- Listed or rare plants will be identified and flagged. Prime Contractor staff will be required to have a map and or GPS point of listed or rare plants with them at all time while in the field.
- Personnel will be encouraged to tread lightly and to remain on trails rather than cutting through vegetation.
- If listed or rare plants are thought to be at particular risk of trampling because of their location near a trap or bait box, the trap or bait box will be moved. If this is not possible, the plant will be protected by a small fence.
- No live feral cat trapping or barn owl control will occur within 10m of known listed plant species to avoid harm to those species.

17.4.5. BMPs - Plant Protection during Monitoring Work

Risks to listed or rare plants could be:

- Listed or rare plants risk being trampled or disturbed during burrow monitoring, camera installation and auditory / visual surveys.

Impacts will be completely avoided using BMPs as follows:

- Prior to the commencement of the work, pre-construction surveys will have identified the presence of any rare or listed plants. These will be marked and mapped and staff will be required to carry a map and / or GPS will the location of the plants. If necessary, protective mini-fences will be placed around specimens to ensure that they are not accidentally trampled.
- Cameras will not be placed on natural burrows within 10m of listed plant species to reduce traffic and disturbance.

17.4.6. BMPs - Plant Protection during Habitat Restoration

Risks to listed and rare plant species during invasive species removal and vegetation restoration could be:

- Disturbance and uprooting.
- Loss of sediment
- Soil instability
- Erosion
- Risk being trampled or disturbed during invasive plant species removal
- Accidental introduction of additional invasive species
- Bare ground following invasive removal being recolonized by invasive species
- Herbicide affecting native plants
- *Myrsine knudsenii* being mistaken for strawberry guava

Impacts will be completely avoided through the following BMPs for erosion control.

- In steep grade areas (>25%), clearance will be conducted by hand rather than with machinery.
- Vegetation clearance will be timed for periods of good weather as far as practically possible.
- To minimize risk of increased erosion in freshly disturbed areas during rainfall events, re-vegetation will occur as soon as possible after clearing and within 3 months, using with suitable native grass outside the fence.
- Clearing will not be conducted during heavy rain.
- If damage to vegetation and substrate is likely to occur during monitoring activities in certain areas, boardwalk sections will be placed over the area.
- Control of key seabird habitat modifiers especially in the maintenance phase will be accomplished by mechanical means (i.e. physically removing) with hand tools over the use of herbicides where possible. Large patches of seabird habitat modifiers will not be removed all at once to avoid leaving large areas of bare soil. Where this is not possible, erosion and weed control cloths will be put down if appropriate.

- Where required, herbicides will be applied following instructions at minimum volumes, rather than broadcast, and during prolonged spells of dry weather where possible and never during periods of heavy rainfall. Whenever possible (expected to be most cases), small volume bottle applicators, which delivers herbicide in very small quantities, will be used
- These identified herbicides are classified as 'general use' and not 'restricted use' but will need to be applied under a herbicide application permit. Personnel conducting these activities will adhere to all label restrictions and guidelines. Non-native vegetation removal BMPs may be improved or adapted as new technologies become available.
- All plant waste will be black bagged at the point of removal (rather than carrying off site and dropping seeds) then removed and destroyed off site in a lowland facility. Dead blackberry stalks will be left in situ to deter in ingress of other non-natives.
- Specific plant locations (e.g., UTM coordinates) will not be revealed in the public review.
- Where invasive species are within 10m of listed plant species, herbicides will not be used.
- Currently, trails at the site are based on botany surveys and lead to rare plants. Prime Contractor staff will discontinue the use of these trails to avoid rare plants and establish a new route to and around the site.
- DOFAW/PEPP staff will continue to monitor individual plants long term.
- Project staff will be trained on plant identification by State or Federal botanists.
- Care will be taken not to introduce new non-native plants through construction and or monitoring activities by cleaning boots, clothes, packs and gear between site visits to ensure that seeds are not carried from other areas
- Vehicles will be washed with soap after off-roading or after picking up mud from driving. A pressure washer with soap will be used to clean all soil off the tires and vehicle undercarriage.
- Tools used in other areas will be cleaned thoroughly before use in and around the site..
- Every effort will be made to ensure that the area remains visually and structurally intact. Soil and vegetation disturbance will be kept to a minimum. Where damage to the ground cover is unavoidable from invasive species removal, replanting with native plants will be carried out.
- Staff will receive training so that they can tell the difference between native / listed plants and invasive plants. Staff will carry an identification guide while undertaking plant work.

17.5. WATER COURSE, DRAINAGE & EROSION

17.5.1. BMPs – Watercourse, Drainage, Erosion Protection

During fence construction, BMPs will be employed to minimize erosion, sedimentation and contamination of aquatic environments (e.g. streams) in the project area.

Contaminations
The proposed bait for the rat stations is diphacinone. The project site is more than 200m from any known water source and diphacinone in this bait form is almost insoluble in water.

Erosion and Sedimentation
Figure 17.1 shows the topography at the site which contributes to the risk of erosion.

Figure 17.1. 3D Map showing topography at the site.

Risks to listed and rare plant species, listed seabirds and natural habitat could be:

- Disturbance and uprooting.
- Erosion might compromise the exclusion of predators from the fence
- Erosion of soil particles into watercourse could damage fish and other freshwater habitat species
- Bait dragged out of the boxes by rodents could fall into water courses and drainage areas.

Impacts will be completely avoided as follows:

Erosion

- In steep grade areas (>25%), fence clearing will be conducted by hand rather than with machinery.
- To minimize risk of increased erosion in freshly disturbed areas during rainfall events, clearing will not occur more than 1 week prior to construction.
- Clearing will not be conducted during heavy rain.

- Prior to disturbance, erosion control devices including (but not limited to) sand bag barriers, trenches, geotextile, filter fabric, vegetation matting, and rubber water guides will be put in place if required. Small trenches (≤ 2 m in length) will be dug from the fenceline during the fence installation process to divert water away from the fence if required.
- Sandbags, trenches, and water guides will be inspected daily during construction activities and monthly for the 30-year duration of the Program.
- Cleared areas will be outplanted within 3 months after construction with native grass.
- BMPs to protect against the ingress of invasive species are outlined in section 17.4.3.

Contamination

- The minimum amount of bait will be used to achieve additional rat eradication.
- Project staff will remove all bait found outside of the bait stations and either dispose of it or replace it in a bait box
- Bait stations will only be used inside the fence
- Bait will be placed on metal sticks inside the bait boxes
- Fueling of project related equipment (chainsaws) will take place away from the aquatic environment. Absorbent pads should be stored on-site to facilitate clean-up of accidental petroleum spill should a release occur.

17.6. CULTURAL /ARCHAEOLOGICAL

17.6.1. BMPs – Cultural / Archeological – all aspects of project

Risks to any possible sites could be:

- Damage or destruction to archaeological remains and features

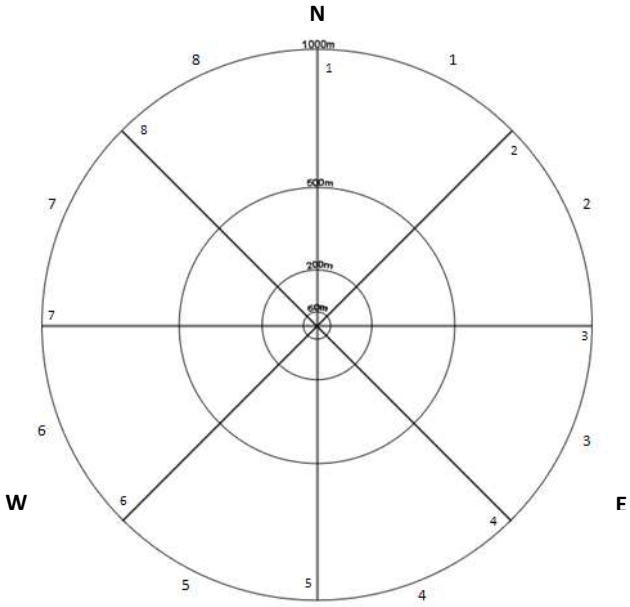
Impacts will be completely avoided using BMPs during pre-construction work as follows:

- All ground disturbing clearing efforts will be monitored by an archaeologist so that any potential surface archaeological sites are not disturbed, especially in the event that heavy equipment is used. Alternately, all clearing activities that do not disturb the ground surface will be inspected by an archaeologist immediately following the clearing to determine the presence or absence of sites;
- The installation of fences will be monitored by an archaeologist to assure that potential surface features as well as potential subsurface cultural deposits are not disturbed by these activities;
- If at any time during development of the mitigation site archaeological features are encountered, State Parks archaeologists will be notified. If activities could impact any archaeological feature, these activities will cease until such time as the feature is evaluated by a qualified archaeologist; and

- If activities extend into the steep cliff portion of the project area, the potential for encountering rock shelters or caves (features known to be used by Hawaiians for interment of the dead) does exist. In the event that human remains are inadvertently discovered, those remains shall not be disturbed and the State Historic Preservation Division (SHPD) immediately notified in accordance with HRS Chapter 6E.
- All staff (including the fence contractors) will be given oral and written instructions pertaining to archaeological and cultural sites.

18. APPENDICES

Appendix 1: KESRP Data Sheet



Time start and survey duration: Dusk surveys start at sunset, and survey duration is 2 hours. Dawn surveys start 2 hours before sunrise and duration is 90 min. Surveys are split into 30 minute sessions, with 5 minutes allotted for weather data, 25 for auditory, and 5-10 for concurrent night vision if available.

Location: Use a GPS and record ~ error in m. Create a waypoint for your location with year (2 digits), Julian date (3 digits), initials (2 letters), and time (AM/PM), e.g. **09125JHPM**

Weather: Use code descriptions. Use geographic reference points (how high are adjacent cliffs compared to clouds?) and make comments about cloud activity at height.

The target circle: Take 5 min to draw in major features and bearings. Confirm major directions to geographic features.

What is a call? A call is a single **unbroken** note or series of notes. Where there is a pause any subsequent call is treated as a new and separate call (regardless of if you perceive it to be the same bird). ≥2 birds calling at the same time are treated as separate calls. If a site is so active that it is impossible to accurately count calls/minute, 25 is recorded in the multiplier column and "uncountable" is recorded in the comments.

Data to be collected:

1. **Time:** 2400 clock, min scale. Tally calls with same distance and direction in that minute.
2. **Quadrat:** One of 8 regions you heard the call based on direction.
3. **Distance:** The approximate distance from the listener to the caller. Distance is broken into 5 basic categories – 0-50m (1), 51-200m (2), 201 – 500m (3), 501-1000m (4). Distance can also be recorded in 100m (e.g. 1=100). NOTE: *also include 50m as* (0.5). Data will be treated in 4 basic categories. ***If you find that this scale (i.e. calls up to 1000m) is inappropriate (e.g. birds calling on ground close by) include additional distance estimate in comments.***
4. **Behavior:** The direction the bird is flying TOWARDS if it is possible to determine. This can become somewhat subjective to determine if the call is > 500m, or if only partial notes are heard. 1=North, 2=NE, 3=East, etc.. 9=circling, 10=stationary/ground, 11=transit. ***If you hear ground calling, record a bearing!***
5. **Elevation:** Either below (1), same / approx. equal height to observer (2) or above (3). Leave blank if unknown or indeterminate.
6. **Species:** Leave blank if NESH. If any other species record as 4-letter codes based on first and second names.
7. **Comments:** Based on footnote system – use numbers in cell and record comments in space below**.**

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20. PERSONAL COMMUNICATIONS

Katie Cassel, 2017, Founder and Manager, Kōke'e Resource Conservation Program.
Spencer Engler, 2017, Habitat Conservation Plan Compliance Technician for First Wind, Makamaka'ole Seabird Preserve.
Wendy Kishida, 2017, Kaua'i PEPP Coordinator, Kaua'i Plant Extinction Prevention Program.
Dr. Andre Raine, 2017, Manager, Kaua'i Endangered Seabird Recovery Project.
Galen Reid, 2016, Predator Control Specialist, DOFAW.
Kyle Pias, 2017, Co-ordinator, Hono O Nā Pali Seabird Mitigation Project.
Adam Williams, 2017, DOFAW.
Dr. Lindsay Young, 2017, Vice President and Executive Director, Pacific Rim Conservation.