APPENDIX E
BIOLOGICAL SURVEY REPORT

BIOLOGICAL RESOURCES SURVEY

NA PUA MAKANI WIND ENERGY PROJECT

KAHUKU, KOOLAULOA, OAHU, HAWAII

by

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BIOLOGICAL RESOURCES SURVEY
NA PUA MAKANI WIND ENERGY PROJECT
KAHUKU, KOOLAULOA, OAHU

INTRODUCTION

The Na Pua Makani Wind Energy Project lies on 685 acres of land above Kahuku Town, Koolauloa, Oahu TMK's (1) 5-6-08:06 and (1) 5-6-06:16. It is surrounded by agricultural farm lands to the north and east and by undeveloped forested lands to the west and south. This biological study was initiated in fulfillment of environmental requirements of the planning process.

SITE DESCRIPTION

The project consists of steep, dissected ridges surrounding gently sloping valleys. Elevations rise steeply behind Kahuku Town to about 250 ft., while the inland ridges rise to nearly 350 ft. Soils include Kaena Stony Clay, 12-20% slopes (KaeD), Paumalu Badlands Complex (PZ), which is highly dissected and steep, and with coral outcrops (CR) at elevations below 100 ft. (Foote et al. 1972). Rainfall averages 45 in. to 50 in. per year with most falling during a few winter storms (Armstrong, 1983). Vegetation consists mostly of low, windblown shrubs and trees on the ridge tops and larger trees and brush on the slopes and in the gullies.

BIOLOGICAL HISTORY

In pre-contact times the lower, more gently sloping lands would have been extensively farmed by a large Hawaiian population that lived in the lower valleys and along the sea shore. The ridges would have been covered by a dense tangle of native shrubs such as ʻūlei (*Osteomeles anthyllidifolia*), ʻakia (*Wikstroemia oahuensis*), ʻiliahi aloʻe (*Santalum ellipticum*), and ʻuhaloa (*Waltheria indica*).

In the late 1800s much of the area was converted to sugar cane agriculature. The land was cleared, plowed, burned and harvested in continuous cycles for about 100 years. Much of the steeper land was used to pasture plantation horses and mules. This reduced the numbers and diversity of native plants considerably. Sugar was discontinued in the 1980's and the land was put into truck crop agriculture or left idle. Today the area is a largely non-native shrubland and forest consisting of a diverse array of aggressive weedy species and a few tough and persistent native plants that have been able to compete and survive.

SURVEY OBJECTIVES

This report summarizes the findings of a flora and fauna survey of the proposed Na Pua Makani Wind Energy Project which was conducted during June 2013. The objectives of the survey were to:

1. Document what plant, bird and mammal species occur on the property or may likely occur in the existing habitat.

2. Document the status and abundance of each species.

3. Determine the presence or likely occurrence of any native flora and fauna, particularly any that are Federally listed as Threatened or Endangered. If such occur, identify what features of the habitat may be essential for these species.

4. Determine if the project area contains any special habitats, which if lost or altered, might result in a significant negative impact on the flora and fauna in this part of the island.

BOTANICAL SURVEY REPORT

SURVEY METHODS

A walk-through botanical survey method was used following multiple routes to ensure complete coverage of the area. Areas most likely to harbor native plants such as open ridge tops, gullies or rock outcrops were more intensively examined. Notes were made on plant species, distribution and abundance as well as on terrain and substrate.

DESCRIPTION OF THE VEGETATION

The vegetation on this property is a mixture of aggressive weedy species that have taken over since the abandonment of sugar cane agriculture, but there is also a complement of native shrubby species remnant on windy ridge tops. Most abundant throughout the project area is the common ironwood (*Casuarina equisetifolia*). Other common species are koa haole (*Leucaena leucocephala*), octopus tree (*Schefflera actinophylla*), (*Bidens alba*) no common name, Guinea grass (*Megathyrsus maximus*), pitted beardgrass (*Bothriochloa pertusa*), parasol leaf tree (*Macaranga tanarius*), Formosa koa (*Acacia confusa*), kaimi clover (*Desmodium incanum*), ‘uhaloa, Koster’s curse (*Clidemia hirta*), Java plum (*Syzygium cumini*), strawberry guava (*Psidium cattleianum*), huehue haole (*Passiflora suberosa*), ‘ulei, ‘akia and Jamaica vervain (*Stachytarpheta jamaicensis*).

A total of 100 plant species were recorded during the course of the survey. Of this total, 19 were common native species: ni’ani’au (*Nephrolepis exaltata*), kilau (*Pteridium aquilinum* var. *decompositum*), ‘uki’uki (*Dianella sandwicensis*), (*Carex wahuensis*) no common name, ‘akia, pala’a (*Sphenomeris chinensis*), uluhe (*Dicranopteris linearis*), moa (*Psilotum nudum*), pi’ipi’i (*Chrysopogon aciculatus*), pili grass (*Heteropogon contortus*), pukiawe (*Leptecophylla tameiameiae*), kauna’oa pehu (*Cassytha filiformis*), ‘uhaloa, huehue (*Cocculus orbiculatus*), ‘ulei, alahe’e (*Psydrax odorata*), ‘ala’alawainui (*Peperomia latifolia*), naupaka kahakai (*Scaevola taccada*), and ‘iliahi alo’e (*Santalum ellipticum*). None of these are rare species, and all are known from multiple islands. The native species are mixed in with non-native species for the most part with the exception of a few spots on the ridge tops where ‘ulei forms large monotypic patches.

DISCUSSION AND RECOMMENDATIONS

The vegetation on this property is dominated by non-native agricultural weeds and tree species, although a fair number of common native species occupy some of the ridge tops. No officially listed Endangered or Threatened plant species (USFWS, 2013) were found on the property, nor were any found that are proposed for such status. No special habitats were found either.

Due to the lack of unique or sensitive species or habitats there is little of botanical concern with regard to this property, and the proposed project is not expected to have a significant negative impact on the botanical resources in this part of Oahu.

If, however, there is any re-vegetation planned along road cuts or on the margins of tower pads, it is suggested that some of the native species listed above be selected for propagation and outplanting.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within each of three groups: Ferns, Monocots and Dicots. Taxonomy and nomenclature of the flowering plants (Monocots and Dicots) are in accordance with Wagner et al. (1999) and Staples and Herbst, (2005). Ferns follow Palmer, (2003).

For each species, the following information is provided:

1. Scientific name with author citation

2. Common English or Hawaiian name.

3. Bio-geographical status. The following symbols are used:

endemic = plants native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.

indigenous = plants native to the Hawaiian Islands and also to one or more other geographic area(s).

non-native = plants brought to the islands intentionally or accidentally after western contact.

Polynesian = plants brought to Hawaii by the Polynesians during their migrations

4. Abundance of each species within the project area:

abundant = forming a major part of the vegetation within the project area.

common = widely scattered throughout the area or locally abundant within a portion of it.

uncommon = scattered sparsely throughout the area or occurring in a few small patches.

rare = only a few isolated individuals within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
FERNS			
BLECHNACEAE (Chain Fern Family)			
Blechnum appendiculatum Willd.	----------	non-native	uncommon
DENNSTAEDTIACEAE (Bracken Fern Family)			
Pteridium aquilinum (L.) Kuhn *var. decompositum* (Gaud.) R.M. Tyron	*kilau*, bracken fern	endemic	rare
GLEICHENIACEAE (False Staghorn Fern Family)			
Dicranopteris linearis (Burm.f.) Underw.	*uluhe*	indigenous	rare
LINDSAEACEAE (Lindsaea Fern Family)			
Lindsaea ensifolia Sw.	----------	non-native	rare
Sphenomeris chinensis (L.) Maxon	*pala'a*	indigenous	rare
NEPHROLEPIDACEAE (Sword Fern Family)			
Nephrolepis brownii (Desv.) Hovencamp & Miyam.	Asian sword fern	non-native	rare
Nephrolepis exaltata (L.) Schott	*ni'ani'au*	indigenous	uncommon
POLYPODIACEAE (Polypody Fern Family)			
Phlebodium aureum (L.) J. Sm.	rabbit's foot fern	non-native	rare
Phymatosorus grossus (Langsdon&Fisch.) Brownlie	*laua'e*	non-native	uncommon
PSILOTACEAE (Whisk Fern Family)			
Psilotum nudum (L.) P. Beauv.	*moa*	indigenous	rare
PTERIDACEAE (Brake Fern Family)			
Cheilanthes viridis (Forssk.) Sw.	green cliff brake	non-native	uncommon
Pityrogramma austroamericana Domin	gold fern	non-native	rare
Pityrogramma x *mckenneyi* W.H. Wagner	hybrid gold fern	non-native	rare
THELYPTERIDACEAE (Marsh Fern Family)			
Christella parasitica (L.) H. Lev.	----------	non-native	rare
MONOCOTS			
ARECACEAE (Palm Family)			
Cocos nucifera L.	*niu*, coconut	Polynesian	rare
Phoenix x *dactylifera*	hybrid date palm	non-native	rare
ASPARAGACEAE (Asparagus Family)	----------	non-native	rare
Agave sisalana Perrine	sisal	non-native	rare
COMMELINACEAE (Spiderwort Family)			
Commelina diffusa N.L. Burm.	honohono	non-native	rare
CYPERACEAE (Sedge Family)			
Carex wahuensis C.A. Meyen	----------	endemic	rare
Cyperus rotundus L.	nut sedge	non-native	uncommon
HEMEROCALLIDACEAE (Hemerocallis Family)			
Dianella sandwicensis Hooker & Arnott	'uki'uki	indigenous	uncommon
ORCHIDACEAE (Orchid Family)			
Arundina graminifolia (D.Don) Hochr.	bamboo orchid	non-native	rare
POACEAE (Grass Family)			
Andropogon virginicus L.	broomsedge	non-native	uncommon
Axonopus fissifolius (Raddi) Kuhlm.	narrow-leaved carpetgrass	non-native	uncommon

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Bothriochloa pertusa (L.) A. Camus	pitted beardgrass	non-native	common
Chloris barbata (L.) Sw.	swollen fingergrass	non-native	uncommon
Chloris radiata (L.) Sw.	plushgrass	non-native	rare
Chrysopogon aciculatus (Retz) Trin.	*pi'ipi'i*	indigenous	uncommon
Cynodon dactylon (L.) Pers.	Bermuda grass	non-native	rare
Digitaria ciliaris (Roetz.) Koeler	Henry's crabgrass	non-native	rare
Digitaria insularis (L.) Mez ex Ekman	sourgrass	non-native	rare
Eleusine indica (L.) Gaertner	wiregrass	non-native	uncommon
Heteropogon contortus (L.) Beauv.	*pili* grass	indigenous	rare
Hyparrhenia rufa (Nees) Stapf	thatching grass	non-native	rare
Melinis minutiflora P. Beauv.	molasses grass	non-native	rare
Melinis repens (Willd.) Zizka	Natal redtop	non-native	rare
Oplismenus hirtellus (L.) P.Beauv.	basketgrass	non-native	uncommon
Panicum maximum Jacq.	Guinea grass	non-native	common
Paspalum conjugatum Bergius	*Hilo* grass	non-native	uncommon
Paspalum dilatatum Poir.	Dallis grass	non-native	uncommon
Paspalum fimbriatum Kunth	Panama grass	non-native	rare
Paspalum scrobiculatum L.	ricegrass	non-native	rare
Pennisetum polystachion (L.) Schult.	feathery pennisetum	non-native	uncommon
Pennisetum purpureum Schumach.	Napier grass	non-native	rare
Saccharum officinarum L.	sugar cane	non-native	rare
Setaria parviflora (Poir.) Kerguelen	yellow foxtail	non-native	rare
Sorghum halapense (L.) Pers.	Johnson grass	non-native	uncommon
Sporobolus africanus (Poir.) Robyns & Tournay	African dropseed	non-native	uncommon
Urochloa mutica (Forrsk.) T.Q.Nguyen	California grass	non-native	rare
ACANTHACEAE (Acanthus Family)			
Asystasia gangetica (L.) T.Anderson	Chinese violet	non-native	common
AMARANTHACEAE (Amaranth Family)			
Alternanthera pungens Kunth	khaki weed	non-native	rare
Amaranthus spinosus L.	spiny amaranth	non-native	uncommon
ANACARDIACEAE (Mango Family)			
Schinus terebinthifolius Raddi	Christmas berry	non-native	uncommon
ARALIACEAE (Ginseng Family)			
Polyscias guilfoylei (W.Bull) L.H.Bailey	panax	non-native	rare
Schefflera actinophylla (Endl.) Harms	octopus tree	non-native	common
ASTERACEAE (Sunflower Family)			
Bidens alba (L.) DC	----------	non-native	common
Calyptocarpus vialis Less.	straggler daisy	non-native	rare
Conyza bonariensis (L.) Cronq.	hairy horseweed	non-native	uncommon
Crassocephalum crepidioides (Benth.)S.Moore	redflower ragleaf	non-native	rare
Cyanthillium cinereum (L.) H. Rob.	little ironweed	non-native	uncommon
Emilia fosbergii Nicolson	red pualele	non-native	uncommon

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Emilia sonchifolia (L.) DC.	violet pualele	non-native	rare
Pluchea carolinensis (Jacq.) G.Don	sourbush	non-native	rare
Pluchea indica (L.) Less.	Indian fleabane	non-native	rare
Sonchus oleraceus L.	*pualele*	non-native	uncommon
BIGNONIACEAE (Bignonia Family)			
Spathodea campanulata P.Beauv.	African tulip tree	non-native	rare
CASUARINACEAE (She-oak Family)			
Casuarina cunninghamiana Miquel	river she-oak	non-native	rare
Casuarina equisetifolia Stickm.	common ironwood	non-native	abundant
CONVOLVULACEAE (Morning Glory Family)			
Ipomoea obscura (L.) Ker-Gawler	----------	non-native	uncommon
Ipomoea triloba L.	little bell	non-native	rare
Merremia tubersoa (L.) Rendle	wood rose	non-native	rare
CUCURBITACEAE (Melon Family)			
Coccinea grandis (L.) Voigt	ivy gourd	non-native	uncommon
Momordica charantia L.	balsam pear	non-native	rare
ERICACEAE (Heath Family)			
Leptecophylla tameiameiae (Cham.&Schlect.) C.M. Weiller	*pukiawe*	indigenous	rare
EUPHORBIACEAE (Spurge Family)			
Aleurites moluccana (L.) Willd.	*kukui*	Polynesian	rare
Euphorbia hirta L.	hairy spurge	non-native	rare
Euphorbia hypericifolia L.	graceful spurge	non-native	rare
Euphorbia prostrata L.	prostrate spurge	non-native	rare
Macaranga tanarius (L.) Mull. Arg.	parasol leaf tree	non-native	common
Phyllanthus debilis Klein ex Willd.	niruri	non-native	common
Ricinus communis L.	Castor bean	non-native	rare
FABACEAE (Pea Family)			
Acacia confusa Merr.	Formosa koa	non-native	common
Alysicarpus vaginalis (L.) DC.	alyce clover	non-native	rare
Canavalia cathartica Thouars	*maunaloa*	non-native	rare
Chamaecrista nictitans (L.) Moench	partridge pea	non-native	uncommon
Crotalaria pallida Aiton	smooth rattlepod	non-native	rare
Desmanthus pernambucanus (L.) Thellung	slender mimosa	non-native	rare
Desmodium incanum DC.	*ka'im*i clover	non-native	common
Desmodium triflorum (L.) DC.	three-flowered beggarweed	non-native	uncommon
Falcataria moluccana (Miq.) Barneby & Grimes	albizia	non-native	rare
Indigofera hendecaphylla Jacq.	creeping indigo	non-native	rare
Leucaena leucocephala (Lam.) de Wit	*koa haole*	non-native	uncommon
Mimosa pudica L.	sensitive plant	non-native	rare
Neonotonia wightii (Wight & Arnott) Lackey	glycine	non-native	rare
Senna occidentalis (L.) Link	coffee senna	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
GOODENIACEAE (Goodenia Family)			
Scaevola taccada (Gaertner) Roxburgh	*naupaka kahakai*	indigenous	rare
LAMIACEAE (Mint Family)			
Hyptis pectinata (L.) Poit.	comb hyptis	non-native	rare
Leonotis nepetifolia (L.) R. Brown	lion's ear	non-native	uncommon
LAURACEAE (Laurel Family)			
Cassytha filiformis L.	*kauna'oa pehu*	indigenous	rare
Cinnamomum burmanni (Nees) Blume	Padang cassia	non-native	rare
MALVACEAE (Mallow Family)			
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	non-native	rare
Malvastrum coromandelianum (L.) Garcke	false mallow	non-native	rare
Sida rhombifolia L.	Cuban jute	non-native	rare
Sida spinosa L.	prickly sida	non-native	rare
Waltheria indica L.	*'uhaloa*	indigenous	common
MELASTOMATACEAE (Melastoma Family)			
Clidemia hirta (L.) D.Don	Koster's curse	non-native	common
MENISPERMACEAE (Moonseed Family)			
Cocculus orbiculatus (L.) DC.	*huehue*	indigenous	uncommon
MORACEAE (Mulberry Family)			
Ficus microcarpa L.	Chinese banyan	non-native	uncommon
MYRSINACEAE (Myrsine Family)			
Ardisia elliptica Thunb.	shoebutton ardisia	non-native	rare
MYRTACEAE (Myrtle Family)			
Pimenta dioica (L.) Merr.	allspice	non-native	uncommon
Psidium cattleianum Sabine	strawberry guava	non-native	common
Psidium guajava L.	common guava	non-native	uncommon
Syzygium cumini (L.) Skeels	Java plum	non-native	common
NYCTAGINACEAE (Four-o'clock Family)			
Bougainvillea spectabilis Willd.	bougainvillea	non-native	rare
PASSIFLORACEAE (Passion Flower Family)			
Passiflora edulis Sims	passion fruit	non-native	rare
Passiflora foetida L.	love-in-a-mist	non-native	rare
Passiflora suberosa L.	*huehue haole*	non-native	common
PHYTOLACCACEAE (Pokeberry Family)			
Rivinia humilis L.	Coral berry	non-native	rare
PIPERACEAE (Pepper Family)			
Peperomia latifolia Miquel	*'ala'alawainui*	endemic	rare
PLANTAGINACEAE (Plantain Family)			
Plantago lanceolata L.	narrow-leaved plantain	non-native	uncommon
POLYGALACEAE (Milkwort Family)			
Polygala paniculata L.	----------	non-native	rare
ROSACEAE (Rose Family)			
Osteomeles anthyllidifolia (Sm.) Lindl.	*'ulei*	indigneous	common

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
RUBIACEAE (Coffee Family)			
Morinda citrifolia L.	*noni*	Polynesian	rare
Psydrax odorata (G.Forst.) A.C. Smith & S.P. Darwin	*alahe'e*	indigenous	rare
Spermacoce assurgens Ruiz & Pav.	buttonweed	non-native	rare
SANTALACEAE (Sandalwood Family)			
Santalum album L.	white sandalwood	non-native	rare
Santalum ellipticum Gaud.	*'iliahi alo'e*	endemic	uncommon
SAPOTACEAE (Sapodilla Family)			
Chrysophyllum mexicanum T. Brandegee	satin leaf	non-native	rare
SOLANACEAE (Nighshade Family)			
Solanum torvum Sw.	pea aubergine	non-native	rare
THYMELAEACEAE ('Akia Family)			
Wikstroemia oahuensis (A. Gray) Rock	*'akia*	endemic	common
VERBENACEAE (Verbena Family)			
Lantana camara L.	lantana	non-native	uncommon
Stachytarpheta australis Moldenke	*owi*	non-native	rare
Stachytarpheta cayennensis (Rich.) Vahl	nettle-leaved vervain	non-native	uncommon
Stachytarpheta jamaicensis (Jacq.) Vahl	Jamaican vervain	non-native	common

FAUNA SURVEY REPORT

SURVEY METHODS

A walk-through survey method was conducted in conjunction with the botanical survey. All parts of the project area were covered. Field observations were made with the aid of binoculars and by listening to vocalizations. Notes were made on species, abundance, activities and location as well as observations of trails, tracks, scat and signs of feeding. In addition, an evening visit was made to the area to record crepuscular activities and vocalizations and to see if there was any evidence of occurrence of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) in the area.

RESULTS

MAMMALS

Four species of mammals were observed within the project area during six site visits. Taxonomy and nomenclature follow Tomich (1986). Two species were of uncommon occurrence, the small Indian mongoose (*Herpestes auropunctatus*) and the domestic cat (*Felis catus*). Two others, the domestic dog (*Canis familiaris*) and the endemic and Endangered *'ōpe'ape'a* or Hawaiian hoary bat (*Lasiurus cinereus semotus*) were rare.

The bat survey was conducted at three separate locations within the project area during the evening of June 24, 2013. A bat detecting device (Batbox IIID) was employed, set to the frequency of 27,000 Hertz that these bats are known to use to echolocate for flying insects. A single bat was detected in the northwestern portion of the area along the road to a meteorological tower site. Echolocation calls were produced in two second bursts of modulated sound, and were repeated every few seconds as the bat located and homed in on flying insects. These calls were followed for several minutes.

Dense vegetation prevented good visibility of other ground-dwelling mammals, but a significant population of rats (*Rattus* spp.) and mice (*Mus domesticus*) would be expected, as they are known to frequent this type of habitat.

BIRDS

There was moderate birdlife diversity observed within this project area during six site visits. A total of fourteen species of non-native birds were observed. Taxonomy and nomenclature follow American Ornithologists' Union (2011). One species was abundant throughout the project area, the red-vented bulbul (*Pycnonotus cafer*). Also common were the zebra dove (*Geopelia striatus*) and the common myna (*Acridotheres tristis*). The remaining species were uncommon or rare.

This study area is situtated about ¾ mile above the substantial wetlands of the James Campbell National Wildlife Refuge that provides habitat for three Endangered waterbirds, the *'alae 'ula* or common moorhen (*Gallinula chloropus sandvicensis*), the *'alae ke'oke'o* or Hawaiian coot (*Fulica alai*), and the *ae'o* or Black-necked stilt (*Himantopus mexicanus knudseni*) as well as other commoner waterbirds and shorebirds. These birds fly substantial distances and could overfly the project area enroute to other wetland habitats. This area, however, has no wetland habitat to attract such waterbirds and none were seen.

INSECTS

Diverse insect life was observed across this large property during six site visits. Taxonomy and nomenclature follow Nishida et al. (1992). Eighteen insect species were observed in seven Orders. Three non-native species were common throughout the area, the cabbage butterfly (*Pieris rapae*), the honey bee (*Apis mellifera*) and the Southern house mosquito (*Culex quinquefasciatus*). The remaining species were uncommon or rare. One native dragonfly, the globe skimmer (*Pantala flavescens*) was seen. This indigenous dragonfly is widespread and common throughout the tropics worldwide.

MOLLUSKS

Two non-native snails, the giant East African snail (*Achatina fulica*) and the roseate cannibal snail (*Euglandina rosea*), were seen at scattered locations across the property.

DISCUSSION AND RECOMMENDATIONS

Most of the wildlife observed on the property is non-native and generally unremarkable from an environmental protection standpoint. One native species, however, the Hawaiian hoary bat which was detected near the lower margins of the project is a federally Endangered species with all of the protections that are associated with this status.

The Hawaiian hoary bat is currently known from the six largest islands, but is considered rare on the island of Oahu where a few recent confirmed sightings have been made on the rural northern end of the island.

The Hawaiian hoary bat is a highly mobile creature that is known to move about in response to temperature changes and insect population spikes. They are solitary (rather than colonial) bats whose roosting sites appear to be opportunistic and ever-changing. They have been recorded from almost every conceivable habitat including high and low elevations, forests, pastures, lava flows, bogs and even rural communities. They can occupy an area when flying insects are abundant and be absent when feeding opportunities have moved elsewhere. Thus, no critical habitats have been established for them. The more we focus on these cryptic, nocturnal bats, the more of them we find and the more widespread we find them to be.

None-the-less, the presence of these Endangered flying mammals in the vicinity of proposed wind turbines is of concern and merits consideration as to how to minimize threats to their well-being.

In the same vein, there is also a small possibility that Endangered water birds from the not too distant James Campbell National Wildlife Refuge might overfly the project area and place themselves in harms way. The situations with both the water birds and the bats may need to be addressed in consultation with the U.S. Fish and Wildlife Service.

No other concerns regarding the wildlife in this project area are anticipated.

ANIMAL SPECIES LIST

Following is a checklist of the animal species inventoried during the field work. Animal species are arranged in descending abundance within four groups: mammals, birds, insects and mollusks. For each species the following information is provided:

1. Common name

2. Scientific name

3. Bio-geographical status. The following symbols are used:

   endemic = animals native only to Hawaii; not naturally occurring anywhere else in the world.

   indigenous = animals native to the Hawaiian Islands and also to one or more other geographic area(s).

   non-native = animals brought to Hawaii intentionally or accidentally after western contact.

   migratory = spending a portion of the year in Hawaii and a portion elsewhere. In Hawaii the migratory birds are usually in the overwintering/non-breeding phase of their life cycle.

4. Abundance of each species within the project area:

   abundant = many flocks or individuals seen throughout the area at all times of day.

   common = a few flocks or well scattered individuals throughout the area.

   uncommon = only one flock or several individuals seen within the project area.

   rare = only one or two seen within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
MAMMALS			
Herpestes auropunctatus Hodgson	small Indian mongoose	non-native	uncommon
Felis catus L.	domestic cat	non-native	uncommon
Canis familiaris L.	domestic dog	non-native	rare
Lasiurus cinereus semotus Allen	*'ōpe'ape'a,* Hawaii hoary bat	endemic	rare
BIRDS			
Pycnonotus cafer L.	red-vented bulbul	non-native	abundant
Geopelia striata L.	zebra dove	non-native	common
Acridotheres tristis L.	common myna	non-native	common
Zosterops japonicus Temminck & Schlegel	Japanese white-eye	non-native	uncommon
Estrilda astrild L.	common waxbill	non-native	uncommon
*Lonchura punctulat*a L.	nutmeg mannikin	non-native	uncommon
Copsychus malabaricus Scopoli	white-rumped shama	non-native	uncommon
Carpodacus mexicanus Muller	house finch	non-native	uncommon
Streptopelia chinensis Scopoli	spotted dove	non-native	uncommon
Pycnonotus jocosus L.	red-whiskered bulbul	non-native	rare
Bubulcus ibis L.	cattle egret	non-native	rare
Cettia diphone Kittlitz	Japanese bush-warbler	non-native	rare
Cardinalis cardinalis L.	northern cardinal	non-native	rare
Gallus gallus L.	chicken	non-native	rare
INSECTS			
Order ARANEAE - true spiders			
ARANEIDAE (Orb Weaver Family)			
Araneus diadematus Clerck	European garden spider	non-native	rare
Order DIPTERA - flies			
CULICIDAE (Mosquito Family)			
Culex albopictus Skuse	tiger mosquito	non-native	uncommon
Culex quinqefasciatus	southern house mosquito	non-native	common
DROSOPHILIDAE (Fruit Fly Family)			
Drosophila melanogaster Meigen	common fruit fly	non-native	uncommon
SYRPHIDAE (Hoverfly Family)			
Eristalinus aeneus Scopoli	drone fly	non-native	rare
Order HYMENOPTERA - bees, wasps & ants			
APIDAE (Honey Bee Family)			
Apis mellifera L.	honey bee	non-native	common
Xylocopa sonorina Smith	Sonoran carpenter bee	non-native	uncommon
FORMICIDAE (Ant Family)			
*Anopolepis longipe*s Jerdon	long-legged ant	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Pheidole megacephala Fabricius	big-headed ant	non-native	rare
Order LEPIDOPTERA - butterflies & moths			
CRAMBIDAE (Grass Moth Family)			
Spoladea recurvalis Fabricus	beet webworm moth	non-native	rare
LYCAENIDAE (Gossamer-winged Butterfly Family)			
Lampides boeticus L.	long tail blue butterfly	non-native	uncommon
NOCTUIDAE (Owlet Moth Family)			
Ascalapha oderata L.	black witch moth	non-native	rare
NYMPHALIDAE (Brush-footed Butterfly Family)			
Agraulis vanillae L.	passion flower butterfly	non-native	uncommon
PIERIDAE (White and Sulphur Butterfly Family)			
Phoebis agarithe Boisduval	large orange sulfur butterfly	non-native	rare
Pieris rapae L.	cabbage butterfly	non-native	common
Order ODONATA - dragonflies & damselflies			
LIBELLULIDAE (Skimmer Dragonfly Family)			
Pantala flavescens Fabricius	globe skimmer	indigenous	uncommon
Order ORTHOPTERA - grasshoppers & crickets			
ACRIDIDAE (Grasshopper Family)			
Oxya japonica Thunberg	small rice grasshopper	non-native	uncommon
Order SPIROBOLIDA - round-backed millipedes			
TRIGONIULIDAE (Rusty Millipede Family)			
Trigoniulus corallinus Gervais	rusty millipede	non-native	rare
MOLLUSKS			
Achatina fulica Ferussac	giant East African snail	non-native	rare
Euglandina rosea Ferussac	roseate cannibal snail	non-native	rare

Produced by the United States Geological Survey
SCALE 1:24 000
KAWAILOA TRAINING AREA
(MILITARY RESERVATION)
WAIMEA
KAUNALA
KAHUKU
(MILITARY RESERVATION)
TRAINING AREA
MALAEKAHANA
KEANA
KAWELA
HANAKAOE
OLO
ULUPEHUPEHU
PUNALAU
PAHIPAHIALUA
OPANA
WAILEE
Kaunala
Kahuku
Kahuku Point
Makahoa Point
Kaiwi Point
Kawela Bay
Kawela Beach Park
Kuilima Beach Park
Kuilima Point
Kuilima Cove
Turtle Bay
Kaiwi Point
Kahuku Beach Park
Kahuku Golf Course
Kahuku Sugar Mill
Kahuku Hospital
Kahuku Post Office
Kahuku Elementary School
Kahuku High and Intermediate School
Kahuku Sugar Mill
Kahuku Golf Course
Kahuku Beach Park
Kahuku Point
Kaiwi Point
Kawela Bay
Kawela Beach Park
Kuilima Beach Park
Kuilima Point
Kuilima Cove
Turtle Bay
Kaiwi Point
Makahoa

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