CH2MHILL
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February 16, 2015

Mr. George Atta, Director
c/o Mr. Raymond Young
Department of Planning and Permitting
650 South King St., 7th Floor
Honolulu, HI 96813

Subject: Kawailoa PV LLC, State Special Use Permit No. 2014/SUP-6(RY), TMK 6-1-005:001 (por.) and 6-1-006:001 (por.)

Dear Mr. Atta:

As the authorized agent for Kawailoa PV, LLC, we are transmitting a letter provided by the Hawaii State Historic Preservation Division (SHPD) documenting their concurrence with the determination of *No Historic Properties Affected* for the proposed Kawailoa Solar Farm Project. In addition, we are also transmitting a copy of the Natural Resource Assessment for the project. We respectfully request that you include this documentation in the project record.

If you have any questions, please contact me at (808) 440-0201.

Sincerely,

CH2M HILL
Paul Luersen, AICP

Enclosure

cc: Wren Wescoatt/ Waiawa PV, LLC

DAVID Y. IGE
GOVERNOR OF HAWAII

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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

February 2, 2014

Robert B. Rechtman, PhD
ASM Affiliates
507A East Lanikaula Street
Hilo, HI 96720

LOG NO: 2014.05215
DOC NO: 1502SL02
Archaeology

Dear Dr. Rechtman:

SUBJECT: **Chapter 6E-42 Historic Preservation Review —**
Archaeological Inventory Survey for First Wind's Kawailoa Solar Power Project
Kawailoa Ahupua`a, Waialua District, Island of Oahu
TMK: (1) 6-1-005:001, 6-1-006:001, and 6-1-007:001

Thank you for the opportunity to review your draft report titled *An Archaeological Inventory Survey of First Wind's Kawailoa Solar Power Project, Portions of TMKs: (1) 6-1-005:001, (1) 6-1-006:001, and (1) 6-1-007: 001 Kawailoa Ahupua 'a, Waialua District, Island of 0`ahu* (Rechtman and Clark, November 2014). We received this submittal on November 19, 2014, and minor revisions on January 14, 2015.

The project area is located within the coastal lowlands of Kawailoa Ahupua`a. It is situated at the shoreward end of a saddle-like plateau along the western edge of the Ko`olau Mountains. ASM Affiliates, Inc. conducted the 360-acre archaeological inventory survey (AIS) of the project area at the request of First Wind Energy, LCC (First Wind). First Wind proposes to develop a solar power generation project. The project will occupy land owned by Kamehameha Schools and leased to First Wind for the specific purpose of the development of alternative energy. First Wind has already developed portions of this land as a wind power energy facility, including baseline infrastructure (i.e., roads, drainage, and power connections). The solar panels will be constructed in four arrays within former plantation fields. The former plantation roads widened and reinforced in support of the wind farm will be used for construction, operation, and maintenance purposes. A new 100-foot corridor for the placement of collection lines will be established, and two solar substations will be constructed within the existing wind power project area; an AIS for one substation (Rechtman et al. 2011) was reviewed and accepted by SHPD on March 14, 2012 (Log No. 2012.0600, Doc. No. 1203RS17/1112NN05).

The AIS field work included a pedestrian survey involving 100% coverage of the project area which is comprised of the following four separate solar array survey areas: Waimea 5 (82 acres), Waimea 6 (113 acres), Waimea 8 (38 acres) and Waimea 26 (130 acres), and the 100-foot wide *makai* Collector Line Corridor. The survey further documented previously-recorded Site 50-80-04-7171 and newly-recorded Site 50-80-04-7716, both of which are within the *makai* Collector Line Corridor. Both sites are portions of plantation ditch systems. Site 7171 (Upper Waimea Ditch Complex) was recorded by Rechtman et al. (2011). It extends beyond the current project area. Portions within the current project area have already been impacted by construction activities associated with development of the proposed Kawailoa Wind Farm (e.g., widening of Ashley Road) and other sections will potentially be impacted by the *makai* collector line, the *makai* solar substation, and the development of the Waimea 5 solar array. Site 7716 (Lower Waimea Ditch Complex) extends the entire width of the current *makai* collector line survey corridor and continues both to the north and south with an overall length of about 1.9 miles. The report indicates that both sites were assessed as significant per Hawaii Administrative Rules (HAR) §13-284-6 under Criterion "d" (have yielded, or is likely to yield, information important for research on prehistory or history). It states that the project effect recommendation is "no historic properties affected," however mitigation in the form of

archaeological monitoring is recommended to address possible inadvertent finds. We concur with the site significance assessments. Our project effect determination is no historic properties affected. We also concur with archaeological monitoring being conducted during project construction to ensure proper documentation and treatment of any inadvertent finds, including possible additional features related to Sites 7171 and 7716.

The report meets the standards set forth in HAR §13-276-5. It is accepted by SHPD. Please send one hardcopy of the document, clearly marked **FINAL,** along with a copy of this review letter and a text-searchable PDF version on CD to the Kapolei SHPD office, attention SHPD Library.

Per HAR §13-284-8(a)(1)C), the agreed-upon mitigation measure for this project is data recovery in the form of archaeological monitoring. Pursuant to HAR §13-284-8(a)(3)(e), we look forward to receiving an archaeological monitoring plan that meets HAR §13-279-4.

Please contact me at (808) 692-8019 or Susan.A.Lebo@hawaii.gov if you have any questions or concerns regarding this letter.

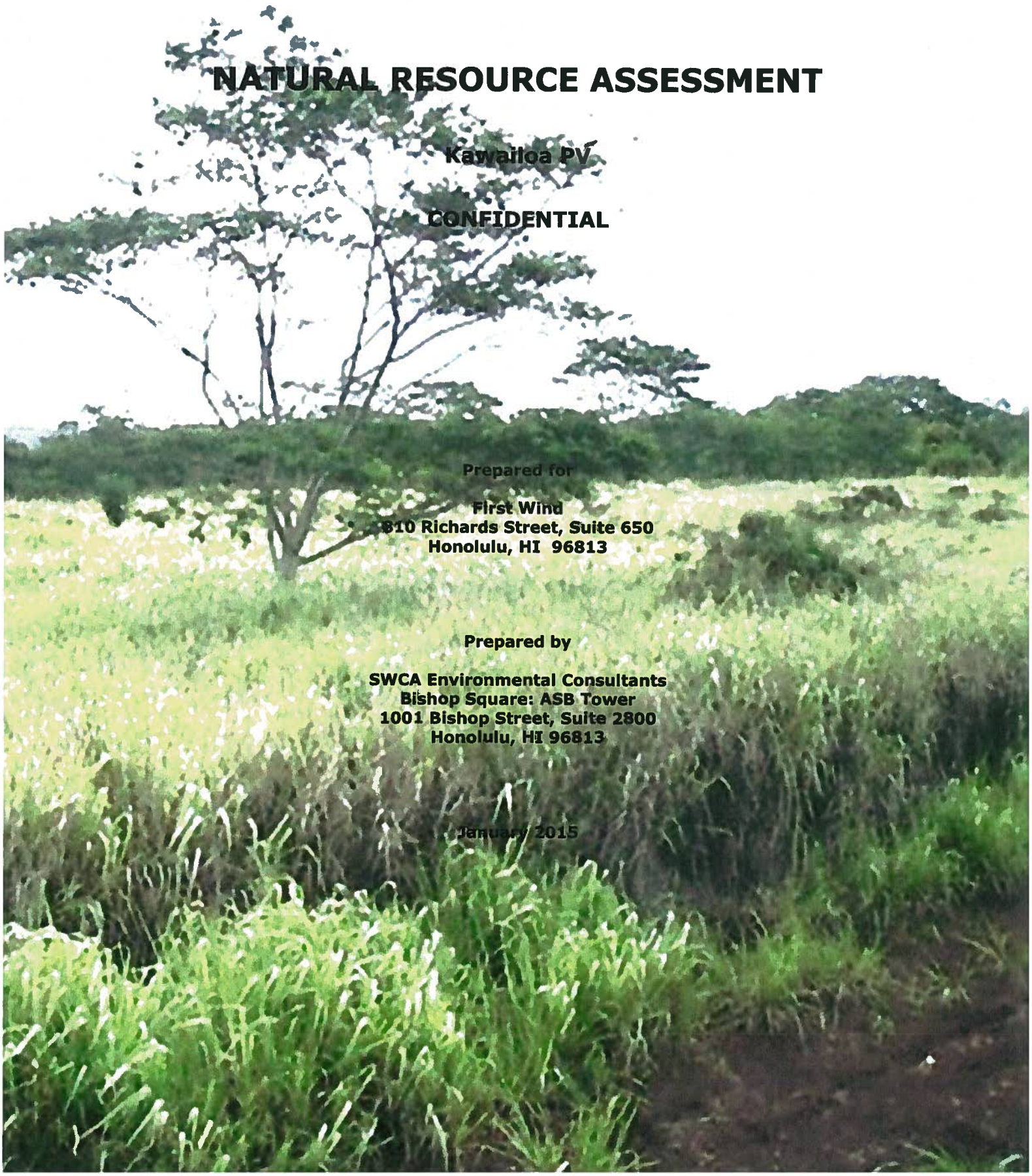
Aloha,

Susan A. Lebo, PhD
Oahu Lead Archaeologist
Acting Archaeology Branch Chief

NATURAL RESOURCE ASSESSMENT

Kawailoa PV

CONFIDENTIAL



Prepared for

First Wind
810 Richards Street, Suite 650
Honolulu, HI 96813

Prepared by

SWCA Environmental Consultants
Bishop Square: ASB Tower
1001 Bishop Street, Suite 2800
Honolulu, HI 96813

January 2015

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TABLE OF CONTENTS

LIST OF FIGURES

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1 INTRODUCTION

SWCA Environmental Consultants (SWCA) was tasked by First Wind to conduct a preliminary assessment of the natural resources at four non-contiguous areas on the north shore of O'ahu (Figure 1), which together total approximately 463.6 acres (ac) (187.6 hectares [ha]) (henceforth referred to as the "study area"). First Wind is assessing the potential of the study area for construction and operation of a photovoltaic (PV) facility. The purpose of this assessment is to identify any natural resource constraints or fatal flaws associated with the study area.

The study area is located within three parcels (Tax Map Key [TMK] 6-1-005:001, 6-1-006:001, 6-1-007:001) owned by Kamehameha Schools. It is situated east of Haleiwa Town and south of Waimea Valley and is primarily accessible via Ashley Road off Kamehameha Highway. This road bisects two of the four portions of the study area. The Kawailoa Wind Power facility surrounds the study area. Other adjacent land uses include agricultural lands, residences (makai of the study area) and military training land (east of the study area). Elevation at the study area ranges approximately from 400 to 720 feet (ft) (122-220 meters [m]) above sea level.

2 METHODS

SWCA conducted a literature review of available scientific and technical literature regarding natural resources within the area and the vicinity. This literature review encompassed a thorough search of refereed scientific journals, technical journals and reports, Habitat Conservation Plans, Environmental Assessments/Environmental Impact Statements, relevant government documents, and unpublished data that provide insight into the natural history and ecology of the area. SWCA also reviewed available geospatial data, aerial photographs, and topographic maps of the area.

A brief field reconnaissance of the study area was conducted by one SWCA biologist on July 9, 2012. The study area was accessed by 4wd, and representative portions of the study area were driven or walked in order to provide brief descriptions of predominant and unique vegetation cover types, wetlands/waterways, typical wildlife, and known or suspected threatened, endangered, or candidate wildlife or plant species on the study area. Areas more likely to support rare native plants (i.e., rocky outcrops, shady areas) were more intensively examined.

3 DESCRIPTION OF THE STUDY AREA

3.1 Climate and geology

Local climatic conditions in the area are characteristic of lowland areas on the windward side of O'ahu, with relatively constant temperatures and persistent northeast trade winds. Average annual rainfall in the study area is less than 59 inches (in) (1,500 millimeters [mm]) (Giambelluca et al. 2011). Daytime temperatures range from 70 °F to 89°F and nighttime temperatures from 60°F to 79°F (WRCC 2010). Prevailing northeasterly trade winds in the area generally blow from 12.3 to 15.7 mph (AWS Truewind 2004).

The study area is located on the Schofield Plateau, an alluvial fan of erosional unconformity that formed when lava flows from the Ko'olau Volcano banked against the eroded slope of the Wai'anae Volcano (Macdonald et al. 1983). The study area is underlain by Ko'olau Basalt lava flows that were active 1.8 to 3 million years ago (Sherrod et al. 2007). No unique or unusual geologic resources or conditions are known from the study area.

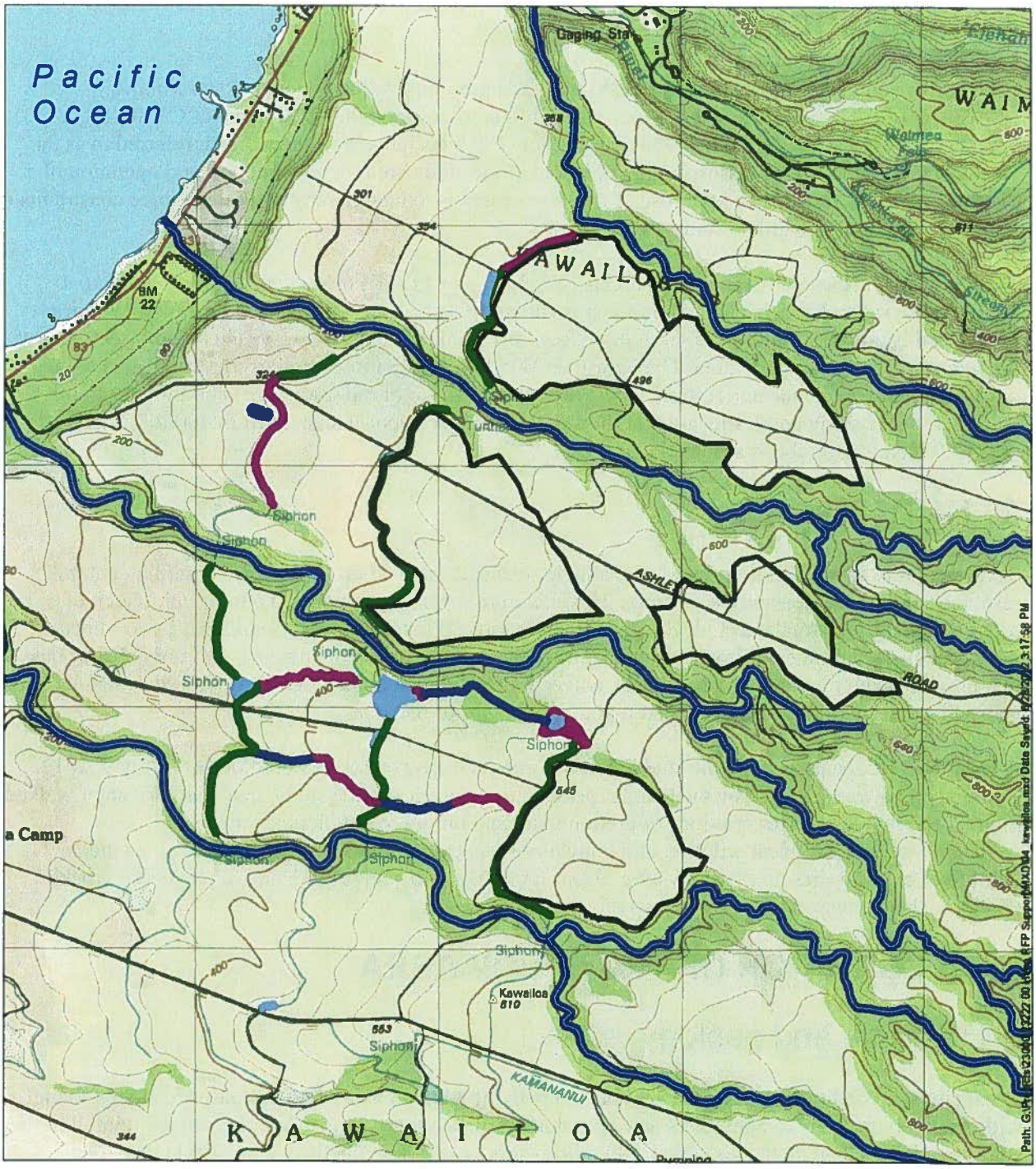

Figure 1: Project area

3.2 Current and historic land use

From the late 1800s-1996, the Kawailoa area was used for extensive sugar cane production by the Waialua Sugar Company. The fields were plowed, burned, harvested, and planted in continuous cycles for about 100 years. Some of the broader gulches within the study area were used to pasture plantation horses and mules (Hobdy 2010a; CH2MHill 2011).

Since the Waialua Sugar Company shut down in 1996, Kamehameha School has leased portions of the parcels for various small agricultural operations (e.g., cultivating papaya, banana, lettuce, seed corn, and tuberose). More recently, areas have been fenced to graze cattle (CH2MHill 2011).

The Kawailoa Wind Power facility encompasses roughly 21.7 ac (8.8 ha) within the vicinity of the study area. This 70- megawatt (MW) facility is composed of 30 wind turbine generators (WTGs), electrical collector lines, one substation, an operations and maintenance (O&M) building, and other facility components (SWCA 2011a).

3.3 Vegetation communities

Botanical surveys of the larger Kawailoa Wind Power project area (which includes the study area) were conducted by Robert Hobdy in 2010 (Appendix 1). During these surveys he recorded 223 plant species, of which thirty are native to the Hawaiian Islands. Thirteen of these species are endemic to Hawai'i, and the remaining 17 are indigenous to Hawai'i (SWCA 2011a). The few native plants observed during his survey persist on steep slopes of the gulches in the upper parts of the Kawailoa Wind Power project area, which is not within the current project area. A second botanical survey was conducted by Jason Cantley on November 7, 2014 of only the study area in order to assess changes in vegetation communities that have occurred over the last four years. The findings were the same as in 2010. However, some native species, such as koa *(Acacia koa)* 'iliahi (*Santalum freycinetianum*) and alahe'e (*Psydrax odorata*), were found to occur in low numbers near the boundary of the study area.

Vegetation within the study area is comprised almost entirely of non-native, weedy plant species that have taken over since sugar cane cultivation was abandoned in the area. The only native species encountered during SWCA's field reconnaissance survey for this report was 'uhaloa (*Waltheria indica*), a common species often found in disturbed areas throughout the Hawaiian Islands. However, it is possible that small number of other native species may be within the study area, primarily as seedlings and young plants. The most abundant species within the study area is Guinea grass (*Urochloa maxima*), which is native to Africa and was introduced widely throughout the Pacific as a forage grass (Wagner et al. 1999). Five dominant vegetation communities occur within the sites proposed for PV development: Guinea Grass Grassland, Albizia Open Forest, and Albizia Closed Forest, Iron Wood Grove and Manicured Wind Turbine Landscape. Brief descriptions of these vegetation communities are provided below.

Guinea Grass Grassland: Much of the area previously used for cultivation of sugar cane is now overgrown by dense, monotypic stands of Guinea grass, reaching heights of 7 feet (2 m) (Figure 2). A number of non-native trees and shrubs are scattered throughout these grasslands, including haole koa (*Leucaena leucocephala*), Christmas berry (*Schinus terebinthifolius*), Chinaberry (*Melia azedarach*), silk oak (*Grevillea robusta*), Formosa koa (*Acacia confusa*) koa haole (*Leucena leucocephala*), and albizia (*Falcataria moluccana*). Guinea Grassland is found in all areas of the study area except for along Ashley Road above the O&M main office building.

Open Albizia Forest: Canopy cover of large-stature albizia trees within this vegetation type is between 30% and 50% (Figure 3). The understory is dominated by contiguous cover of Guinea grass. Albizia is a

particularly prolific and fast-growing species. It can grow roughly 15 feet (4.5 m) per year (Little and Skolmen 1989). Because of its rapid growth capabilities, the wood is relatively brittle, and limbs blown down by strong winds have the potential of causing damage to property, utilities, or people. Other tree and shrub species found interspersed in this vegetation type include Christmas berry, Chinaberry, Formosa koa, and silk oak.

Closed Albizia Forest: Some areas of the study area are comprised on monotypic Albizia stands that maintain canopy cover of 50% or greater. Occasional understory species include koa haole and Guinea grass. Rarely, monotypic ironwood groves are interspersed within this vegetation type in the study area. Closed Albizia Forest occurs in the upper most portions of the study area, primarily along Ashley Road.

Ironwood Grove: Ironwood (*Casuarina equisetifolia*) groves are common in the vicinity, but not found commonly in the study area. In the study area, they are found mostly in upland portions of the study area along Ashley Road intermixed within Closed Albizia Forest. Trees in these groves reach between 50 and 100 ft (15–30 m) in height (Figure 3). These groves are often devoid of understory vegetation and are covered with a layer of needle litter or dominated by Guinea grass.

Manicured Wind Turbine Landscape: Highly maintained landscapes are present near/under wind turbines numbered 27-30 along Ashley Road. This vegetation type is characterized by mowed Bermuda grass (*Cynodon dactylon*). Common ruderal weeds are also present, such as sensitive plant (*Mimosa pudica*), mat chaff flower (*Alternanthera caracasana*) and partridge pea (*Chamaecrista nictians*).

Figure 2. Guinea Grass Grassland, a dominant vegetation community in the study area.

Figure 3. Ashley Road within the study area showing Open Albizia Forest on the left side and Ironwood Grove on the right side.

3.4 Wildlife

Wildlife surveys were conducted within the larger Kawailoa wind power facility project area through a combination of pedestrian surveys (Hobdy 2010a, 2010b), visual bird surveys (SWCA 2010a), nocturnal radar surveys (Cooper et al. 2011; Cooper and Sanzenbacher 2011), and the use of bat detection devices (SWCA 2010a). An additional bird survey by Ling Ong was conducted on November 7, 2014 of only the study area in order to assess changes in wildlife communities that may have occurred over the last four years.

A total of 26 bird species have been detected in the study area and the immediate vicinity (Table 1). Of these, only four are native or winter migrants to the Hawaiian Islands and include: Black-crowned night heron (*Nycticorax Nycticorax*), Pacific golden-plover (*Pluvialis fulva*), Hawaiian duck-mallard hybrid (*Anas* sp.), and the endangered Newell's shearwater (*Puffinus auricularis newelli*). The Black-crowned night heron and the Pacific golden-plover are common in disturbed and urban lowland areas across the Hawaiian Islands (SWCA 2011b). The other two birds are discussed in Section 3.5.2. No additional bird species were documented during the November 2014 survey.

No mollusk survey was conducted within the study area because native snails are not expected in low elevation sites dominated by non-native vegetation.

Feral pigs (*Sus scrofa*) domestic dogs (*Canis familiaris*), rats (*Rattus* spp.), small Indian mongoose (*Herpestes auropunctatus*), and feral cats (*Felis catus*) have all been reported in the study area or the immediate vicinity. Although not seen, it is likely that mice (*Mus domesticus*) also occur in study area (Hobdy 2010a, 2010b; SWCA 2011b).

3.5 Listed species (including known and suspected critical habitat)

3.5.1 Plants

No state or federally listed threatened, endangered, or candidate endangered plant species, have been observed within the study area during the various surveys. Additionally, no plant Species of Concern (i.e., considered rare or in marked decline on the island) were observed during the surveys. The study area does not contain proposed or designated critical habitat for threatened or endangered plants (USFWS 2012).

3.5.2 Seabirds

Nocturnal surveys or radar surveys to detect the endangered Hawaiian petrel (*Pterodroma sandwichensis*) and the threatened Newell's shearwater (*Puffinus newelli*) were not conducted within the study area during the reconnaissance. However, based on previous radar surveys within the Kawailoa Wind Power project area, it is presumed that a small number of Newell's shearwaters may transit the study area during the seabird breeding season (April- December). Although unlikely, it is also possible that Hawaiian petrels could transit the area. One dead bird resembling a Hawaiian petrel was found within the Kawailoa Wind Power project area in September 2012; however, identification of the bird has not been confirmed.

Nesting habitat for these listed species (i.e., steep slopes vegetated by uluhe fern [*Dicranopteris linearis*] undergrowth and scattered 'ōhi'a [*Metrosideros polymorpha*] does not exist in the study area. No critical habitat has been designated or proposed by the U.S. Fish and Wildlife Service (USFWS) for these species on any of the Hawaiian Islands.

3.5.3 Waterbirds

No permanent open water features or mudflats are present in the study area; therefore, permanent suitable waterbird habitat does not occur in the study area. However, several listed waterbirds have been observed at nearby waterbodies and/or flying over the Kawailoa area. Given these factors, it is possible that listed waterbirds could transit the study area while moving between wetlands, ephemeral ponds, and islands. Critical habitat has not been designated or proposed for these species. Brief summaries of the potential occurrence of these four endangered waterbirds are provided below.

No Hawaiian stilts (*Himantopus mexicanus knudseni*) have been observed within the study area or at nearby waterbodies by SWCA or Hobdy. Irrigation ponds in the vicinity of the study area may potentially be attractive to Hawaiian stilt. Because of the known dispersal capabilities of these birds (Reed et al. 1998), it is expected that individual stilts can fly over the Kawailoa area on a very irregular basis (SWCA 2011b).

Ducks resembling Hawaiian ducks (*Anas wyvilliana*) (but likely to be hybrids) have been seen flying over the Kawailoa area and the vicinity. Because of the hybridization of Hawaiian ducks with feral mallards, it is questionable whether any pure Hawaiian ducks are resident on the Island of O'ahu (Browne et al. 1993; USFWS 2005; Uyehara et al. 2007). Given the dispersal capabilities of the species, it is possible for pure Hawaiian ducks to occasionally fly over from Kaua'i. Genetic research in 2007 showed presence of several Hawaiian ducks at James Campbell National Wildlife Refuge, and a bird struck by a plane at Honolulu International Airport in 2005 was found to be Hawaiian duck (Wright 2008). Thus, Hawaiian ducks could potentially transit the study area.

Table 1. Bird species observed within the study area and the vicinity.
E= endemic; I = indigenous, V = visitor, NN = non-native permanent resident; *E* = Endangered, *T* = threatened

Common Name	Scientific Name	Status	MBTA[1]
Newell's shearwater[2]	*Puffinus auricularis newelli*	E, *T*	X
Cattle egret	*Bubulcus ibis*	NN	X
Black-crowned night heron	*Nycticorax nycticorax*	I	X
Hawaiian duck-mallard hybrids[3]	*Anas* sp.	E	X
Gray francolin	*Francolinus pondicerianus*	NN	
Black francolin	*Francolinus francolinus*	NN	
Domestic chicken	*Gallus gallus*	NN	
Common peafowl	*Pavo cristatus*	NN	
Pacific golden- plover	*Pluvialis fulva*	V	X
Spotted dove	*Streptopelia chinensis*	NN	
Zebra dove	*Geopelia striata*	NN	
Barn owl	*Tyto alba*	NN	X
Red-vented bulbul	*Pycnonotus cafer*	NN	
Red-whiskered bulbul	*Pycnonotus jocosus*	NN	
Japanese bush-warbler	*Cettia diphone*	NN	
White-rumped shama	*Copsychus malabaricus*	NN	
Red billed leothrix	*Leiothrix lutea*	NN	
Japanese white-eye	*Zosterops japonicus*	NN	
Common myna	*Acridotheres tristis*	NN	
Red-crested cardinal	*Paroaria coronata*	NN	
Northern cardinal	*Cardinalis cardinalis*	NN	X
House finch	*Heamorhous mexicanus*	NN	X
Common waxbill	*Estrilda astrild*	NN	
Red avadavat	*Amandava amandava*	NN	
Nutmeg mannikin	*Lonchura punctulata*	NN	
Chestnut munia	*Lonchura malacca*	NN	

[1] Migratory Bird Treaty Act.
[2] Based on radar data, not confirmed by visual assessment.
[3] Presumed hybrids, see section 3.5.2.

One observation of the Hawaiian coot (*Fulica alai*) was made at an adjacent waterbody south of Kawailoa Road; thus, there is potential for coots to occasionally fly over the lower elevations of Kawailoa Wind Power project area if moving between foraging sites or islands.

No Hawaiian gallinules (*Gallinula chloropus sandvicensis*) have been detected in the study area. Hawaiian moorhen have been seen at nearby 'Uko'a Pond and in the lotus ponds in Waimea Valley (northwest of the study area). It is very unlikely that Hawaiian gallinules regularly fly over the study area; however, given their ability to fly and their occurrence at nearby waterbodies, it is possible that individual Hawaiian gallinules could very occasionally fly over the project area (SWCA 2011b).

3.5.4 Hawaiian short-eared owl

The Hawaiian short-eared owl or pueo (*Asio flammeus sandwichensis*) is listed as endangered by the state on the Island of O'ahu. The pueo has not been detected within the larger Kawailoa Wind Power project area or at nearby water bodies during previous surveys, but the species has been reported from the Kawailoa Wind Power construction site. Regurgitated owl pellets have been observed in the vicinity of meteorological towers in the Kawailoa Wind Power facility area, but it is probable that these belong to the non-native barn owl (*Tyto alba*). As suitable grassland habitat does occur at the study area, the Hawaiian short-eared owl may occasionally be present in or transit the study area (SWCA 2011b).

3.5.5 Mammals

The Hawaiian hoary bat (*Lasiurus cinereus semotus*) is the only native mammal species which is still extant within the Hawaiian Islands (USFWS 1998). The Hawaiian hoary bat has been recorded on O'ahu as well as on Molokai, Maui, Kaua'i, and Hawai'i, but no historical or current population estimates or information exist for this endemic subspecies. Population estimates for all islands in the state in the recent past have ranged from hundreds to a few thousand bats (Menard 2001). The Hawaiian hoary bat is believed to occur primarily below an elevation of 4,000 feet (1,220 m).

The endangered Hawaiian hoary bat has been documented flying in the Kawailoa area through the use of bat detection devices (SWCA 2011b). Data suggests that bat activity in the Kawailoa area is higher between March and November and lower to absent during the winter. Bat activity has been detected in essentially all habitats in the Kawailoa area, including clearings, along roads, along the edges of tree lines, in gulches and at irrigation ponds. Monitoring to date indicates that bats use all of these features for travelling and foraging (SWCA 2011b).

3.6 Wetlands, streams and waterways

In the late 1970s, USFWS Division of Ecological Services biologists used U.S. Geological Survey (USGS) 7.5-minute quadrangle maps and georectified orthophotos to spot check and map wetlands in Hawai'i as a part of the National Wetlands Inventory (NWI) Program (Cowardin et al. 1979). Review of NWI data is a first step in assessing potential restrictions of land use related to wetlands. According to the NWI program, there are no features within the study area. Several features occur immediately adjacent to the study area including: Riverine (R4SBCx), Freshwater Forested/Shrub Wetland (PFO3C), Freshwater Pond (PUBHx), and Freshwater Emergent Wetland (PEM1Cx).

However, when SWCA conducted a preliminary jurisdictional determination in July and September 2010, all NWI features were visited and no wetlands meeting the three established criteria of hydrophytic vegetation, hydric soils, and water regime were found (SWCA 2010b). A network of agricultural ditches and ponds exist which convey irrigation water throughout the Kawailoa property. These were all

constructed in upland areas and do not directly connect to (or impound) natural water features. Thus, these features would likely not be considered jurisdictional by the U.S. Army Corps of Engineers (USACE).

Low-lying areas that can temporarily hold water after heavy rainfall may occur within the study area; however, none of these are considered permanent waterbodies.

Several intermittent waterways occur adjacent to the study area - Laniākea, Kawailoa, Ka'alaea, and the unnamed tributary to Waimea River. Laniākea and the Waimea River tributary flow to the north and south of the study area, respectively. Kawailoa and Ka'alaea flow between the four sites. These waterways typically do not have continuous or seasonal flow, but would likely be subject to USACE jurisdiction because of their "significant nexus" with 'Uko'a Pond and the Pacific Ocean. Placement of fill materials into jurisdictional waters is regulated under Sections 404 and 401 of the Clean Water Act (CWA). Placement of fill from land-based renewable energy generation facilities and associated features such as roads are covered under CWA Nationwide Permit 51 if impacts are less than 0.5 acre (0.2 ha), or less than 300 linear feet (92 m) of streambed.

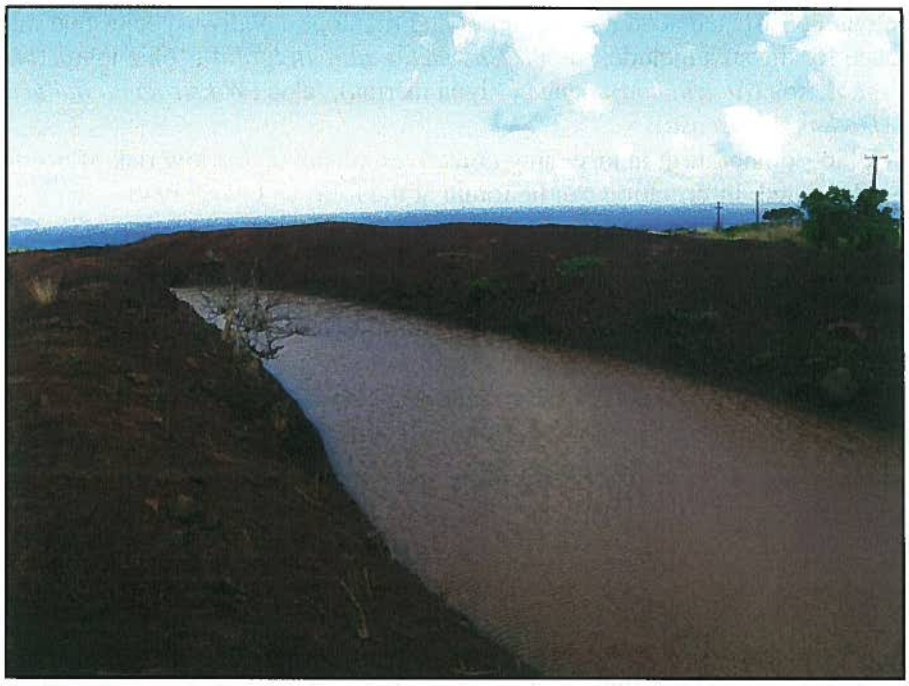

Figure 4. Example of irrigation ditch that occurs adjacent to the study area.

4 CONCLUSION AND RECOMMENDATIONS

4.1 Vegetation

No state or federally listed threatened, endangered, or candidate plant species have been recorded within the study area. The study area does not contain critical habitat as proposed or designated by USFWS. The vegetation in the study area is dominated by non-native grasses and trees that are common throughout O'ahu and the main Hawaiian Islands. Due to the general condition of the area and the specific lack of any rare or sensitive native plant species within the study area, construction and operation of the facility is not expected to result in any significant adverse impact on botanical resources in this part of O'ahu.

SWCA recommends the following measures to reduce impacts to vegetation as a result of the proposed project:

- Following construction, disturbed areas should be revegetated with a suitable ground cover for soil stabilization, and minimization of erosion.
- Where practical, native Hawaiian plants should be employed for landscaping or to stabilize bank slopes along constructed access roads or cut and fill slopes. Native species that may be appropriate for the area include: 'ūlei (*Osteomeles anthyllidifolia*), 'ōhia lehua (*Metrosideros polymorpha*), koa (*Acacia koa*), nanea (Vigna marina), 'akia (*Wikstroemia oahuensis*), and 'a'ali'i (*Dodonaea viscosa*).
- If native plants do not meet landscaping objectives, plants with a low risk of becoming invasive may be substituted. Information can be found at the following websites:
    - http://www.plantpono.org/
    - http://www.botany.hawaii.edu/faculty/daehler/wra/default2.htm
    - http://www.hear.org/alternativestoinvasives/
- To minimize the potential spread or introduction of invasive species at the study area, all equipment and contractor vehicles brought from off-site should perform a complete wash-down prior to entering and departing the site to remove excessive debris or plant materials.
- Site grading and construction should be designed to prevent or correct excessive runoff and to alleviate any ongoing and/or long-term erosion problems.

4.2 Birds

One of the main impacts on flora and fauna of solar power plants is due to the large footprint needed for commercial-scale energy production. However, there are limited data on birds strikes associated with solar panels. Academic publications contain only hypothetical analyses of potential impacts, and are often very brief (Turney and Fthenakis 2011). The only quantitative analysis of impacts to wildlife from solar power is that of McCrary et al. (1986). Over a period of 40 weeks, researchers at Solar One, located in the Mojave Desert, California, documented 70 bird fatalities, involving 26 species. Solar one consists of 6.9 x 6.9 m heliostats (mirrors), which concentrate sunlight on a centrally located, tower mounted boiler. Collisions with structures accounted for 81% of the avian mortalities, almost all from collisions with the mirrored heliostats. The remainder of the avian mortalities, as well as mortality of insects, is a result of burning from concentrated sunlight. The overall impact on the local bird population was considered low (0.6-0.7% per week) (McCrary et al. 1986).

Solar One is located within close proximity of open water, and 19 of the 57 collision fatalities were waterbird species, including 2 American coots (*Fulica americana*) and 2 black-necked stilts (*Himantopus mexicanus*), close relatives of the endangered Hawaiian coot and Hawaiian stilt (McCrary et al. 1986). Although heliostats are structurally similar to photo voltaic panels, and birds can strike any fixed object,

photovoltaic panels are black rather than reflective, and there is no scientific evidence of fatality risks to birds associated with photovoltaic arrays. Reflective surfaces are considered especially prone to collisions (McCrary et al. 1986).

Low-lying areas within the study area may have the potential to temporarily hold ponded water after periods of extended heavy rainfall. SWCA recommends that these low-lying areas be graded to improve drainage. This would prevent these ponds from forming and attracting Hawaiian stilts during construction or operation.

4.3 Bats

SWCA recommends several measures in order to minimize impacts to the Hawaiian hoary bat during construction and operation activities. The following two measures are recommended as minimization measures by the USFWS and DOFAW for all project areas throughout the State of Hawai'i known to be used by Hawaii hoary bats:

- Refrain from clearing trees above 15 feet (4.5 m) in height between June 1 and September 15, which is the period when non-volant Hawaiian hoary bat juveniles may occur in the project area.
- Ensure that any fences built in the area have a barbless top-strand of wire to prevent entanglements of the Hawaiian hoary bat on barbed wire. Existing fences within the project area should have the top strand of barbed wire removed or replaced with barbless wire.

4.4 Wetlands, streams and waterways

The study area does not encompass or intersect with any wetlands and waters of the United States. Thus, it is not anticipated that construction or operation of a PV facility within the study area would require a permit from USACE as long as the project does not involve placing dredged or fill material into adjacent wetlands or waters of the U.S.

The following Best Management Practices (BMPs) should also be incorporated during the construction phase to reduce potential impacts to adjacent water features:

- Clearing and grubbing should be held to the minimum necessary for grading, access and equipment operation.
- Erosion and sediment control measures should be in place prior to initiating earth moving activities. Functionality should be maintained throughout the construction period.
- Construction should be sequenced to minimize the exposure time of the cleared surface area.
- Areas that are disturbed during the course of construction should be protected and stabilized according to BMPs approved by the State Department of Health.
- Control measures (i.e., silt fences, sand bag barriers, sediment traps, geotextile mats, and other measures intended for soil/sediment trapping) should be inspected once a week during dry periods and repaired as necessary.
- Control measures (i.e., silt fences, sand bag barriers, sediment traps, geotextile mats, and other measures intended for soil/sediment trapping) should be inspected and repaired as needed within 24 hours after a rainfall event of 0.5 inch (13 mm) or greater over a 24-hour period. During periods of prolonged rainfall, daily inspection would occur, unless extended heavy rainfall makes access impossible or hazardous.
- Records for all inspections and repairs should be maintained on site.
- Permanent soil stabilization (i.e., graveling or re-planting of vegetation) should be applied as soon as practical after final grading.

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APPENDIX 1: HOBDY FLORA AND FAUNA SURVE

BIOLOGICAL RESOURCES SURVEY

for the

KAWAILOA WIND FARM

KAWAILOA, OAHU HAWAII

by

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February 2010

Prepared for: CH2M HILL

TABLE OF CONTENTS

BIOLOGICAL RESOURCES SURVEY
KAWAILOA WINDFARM

INTRODUCTION

The proposed Kawailoa Wind Farm Project site lies on approximately 4,200 acres of land east of Haleiwa Town, Kawailoa, Waialua District, O'ahu (TMKs 6-1-05:1,6-1-06:1. 6-1-07:1,6-2-09:1, 6-2-11:1). It is adjacent to Waimea Valley on the north and Kawailoa Valley on the south. Below it are agricultural fields and above it are mountainous lands in the Kawailoa Forest Reserve. This document summarizes the results of a biological study that was initiated in fulfillment of environmental requirements of the planning process for this wind farm project.

SITE DESCRIPTION

The project area is a triangular shaped piece of land formerly used for cane production that is now fallow and overgrown with grass and trees. It consists of gently sloping ridges that are dissected by several small gulches. Elevations range from 400 feet at the bottom up to 1,600 feet at the top of the triangle. Soils consist of silty clays of the Wahiawa, Helemano and Leilehua Series on the ridge tops. The soils in the gulches are of the Rough Mountainous Lands and Rock Lands Series (Foote et al, 1972). Rainfall ranges from 40 inches per year at the lower elevations to 75 inches per year at the top (Armstrong, 1983).

BIOLOGICAL HISTORY

In pre-contact times these slopes would have been forested with native 'öhi'a (*Metrosideros polymorpha*) and koa (*Acacia koa*) trees with a dense understory of smaller native trees, shrubs, ferns and vines in great diversity and profusion. Gulches would have had an even denser growth of delicate shade-loving species.

In the late 1800s the area was cleared and converted to sugar cane agriculture. The fields were plowed, burned, harvested and planted in continuous cycles for about 100 years. Some of the broader gulches were used to pasture plantation horses and mules. These uses greatly reduced the numbers and overall diversity of native plants, and these were gradually replaced by increasing numbers of non-native agricultural and pasture plants. A number of tree species were planted along the edges of fields to serve as windbreaks. Other species deemed to be useful or ornamental were also planted in gulches and along ditches. Many of these have proliferated and some have become invasive. Feral pigs have spread throughout the area and have had a negative impact on native vegetation. They also are an important vector for the spread of weed species throughout the forests.

Today, little remains of native plant diversity in the project area. A few native species persist on steep gulch slopes in the upper parts of the property, but most of the area is covered with a few invasive non-native species.

SURVEY OBJECTIVES

This report summarizes the findings of a flora and fauna survey of the proposed Kawailoa Wind Farm Project which was conducted during February, 2010. 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.

5. Note which aspects of the proposed development pose significant concerns for plants or for wildlife and recommend measures that would mitigate or avoid these problems.

BOTANICAL SURVEY REPORT

SURVEY METHODS

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

DESCRIPTION OF THE VEGETATION

The vegetation on the project site is a mixture of aggressive weedy species that have taken over since the abandonment of sugar cane agriculture, but there are significant remnants of native vegetation on steep slopes of the gulches near the top of the site. One non-native species that is truly abundant across the property, Guinea grass (*Panicum maximum*), which forms a sea of deep growth on all the ridge tops and in many of the gulches. Also common and non-native are common ironwood (*Casuarina equisetifolia*), albizia (*Falcataria moluccana*), Formosa koa (*Acacia confusa*), koa haole (*Leucaena leucocephala*), padang cassia (*Cinnamomum burmanni*), Java plum (*Syzygium cumini*), strawberry guava (*Psidium cattleianum*), cork bark passion flower (*Passiflora suberosa*) and swamp mahogany (*Eucalyptus robusta*). All of these species have spread dramatically since the abandonment of sugar cane agriculture.

A total of 183 plant species were recorded during the course of the survey. Of this total, 27 were common native species: kilau (*Pteridium aquilinum* var. *decompositum*), hapu'u (*Cibotium chamissoi*), uluhe (*Dicranopteris linearis*), pala'ā (*Sphenomeris chinensis*), ni'ani'au (*Nephrolepis exaltata*), pakahakaha (*Lepisorus thunbergianus*), moa (*Psilotum nudum*) halapepe (*Pleomele halapepe*), (*Carex meyenii*) no common name, (*Carex wahuensis*) no common name, (*Cyperus polystachyos*) no common name, 'ie'ie (*Freycinetia arborea*), lama (*Diospyros sandwicensis*), pukiawe (*Leptecophylla tameiameiae*), koa (*Acacia koa*), nanea (*Vigna marina*), naupaka kuahiwi (*Scaevola gaudichaudiana*), kauna'oa pehu (*Cassytha filiformis*), 'uhaloa (*Waltheria indica*), huehue (*Cocculus orbiculatus*), 'öhi'a (*Metrosideros polymorpha* var. *polymorpha*), olopua (*Nestegis sandwicensis*), kopiko (*Psychotria mariniana*), alahe'e (*Psydrax odorata*), 'iliahi (*Santalum freycinetianum* var. *freycinetianum*), 'a'ali'i (*Dodonaea viscosa*), 'akia (*Wikstroemia oahuensis)*. None of these are rare species and all but one are known from multiple islands. This one species of halapepe is known only from Oahu but is not uncommon here. Seven species were of Polynesian origin: niu (*Cocos nucifera*), kö (*Saccharum officinarum*), ki (*Cordyline fruticosa*), pa'ihi (*Rorippa sarmentosa*), kukui (*Aleurites moluccana*), 'ihi (*Oxalis corniculata*) and noni (*Morinda citrifolia*). The remaining 149 species were non-native plants that were agricultural weeds, windbreak tree species, forestry plantings or ornamentals.

DISCUSSION AND RECOMMENDATIONS

The vegetation on this large site is dominated by invasive non-native species. Guinea grass, albizia and koa haole occupy the ridge tops. Common ironwood, Formosa koa, Java plum, cork-bark passion flower and swamp mahogany dominate the lower gulches along with many other weeds. Padang cassia and strawberry guava form extremely dense stands in the upper, wetter gulches to the near exclusion of anything else. A fair number of common native trees, shrubs, vines and ferns still occupy the steep slopes of the upper gulches in a few spots.

No federally-listed Endangered or Threatened plant species (USFWS, 2009) were found on the property, nor were any found that are proposed for such status. No special plant habitats or communities were identified.

Due to the lack of any protected species or habitats, there is little of botanical concern with regard to this property and the proposed project which is likely to affect only small areas on ridge tops is not expected to have a measurable negative impact on the botanical resources in this part of O'ahu.

If, however, there is any revegetation planned along road cuts or on the margins of tower pads, it is recommended that some of the native species listed above be selected for propagation and out planting.

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 four groups: Conifers, Ferns, Monocots and Dicots. Taxonomy and nomenclature of the conifers and 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 = native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.
   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   non-native = all those plants brought to the islands intentionally or accidentally after western contact.

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.	palm fern	non-native	rare
DENNSTAEDTIACEAE (Bracken Fern Family)			
Pteridium aquilinum (L.) Kuhn *var. decompositum* (Gaud.) R.M.Tryon	kilau, bracken fern	endemic	rare
DICKSONIACEAE (Dicksonia Family)			
Cibotium chamissoi Kaulf.	hapu'u	endemic	rare
GLEICHENIACEAE (False Staghorn Fern Family)			
Dicranopteris linearis (Burm.f.) Underw.	uluhe	indigenous	uncommon
LINDSAEACEAE (Lindsaea Fern Family)			
Sphenomeris chinensis (L.) Maxon	pala'a	indigenous	rare
NEPHROLEPIDACEAE (Sword Fern Family)			
Nephrolepis brownii (Desv.) Hovencamp & Miyam.	Asian sword fern	non-native	uncommon
Nephrolepis exaltata (L.) Schott	ni'ani'au	indigenous	rare
POLYPODIACEAE (Polypody Fern Family)			
Lepisorus thunbergianus (Kaulf.) Ching	pākahakaha	indigenous	rare
Phlebodium aureum (L.) J. Sm.	rabbit's foot fern	non-native	rare
Phymatosorus grossus (Langsdon&Fisch.) Brownlie	laua'e	non-native	rare
PSILOTACEAE (Whisk Fern Family)			
Psilotum nudum (L.) P. Beauv.	moa	indigenous	rare
PTERIDACEAE (Brake Fern Family)			
Pityrogramma calomelanos (L.) Link	silver fern	non-native	rare
THELYPTERIDACEAE (Marsh Fern Family)			
Christella dentata (Forssk.) Brownsey & Jermy	----------	non-native	rare
Christella parasitica (L.) H. Lev.	----------	non-native	uncommon
CONIFERS			
ARAUCARIACEAE (Araucaria Family)			

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Agathis robusta (F.Mueller) F.M. Bailey	Queensland kauri	non-native	rare
Araucaria columnaris (G. Forster) J.D. Hooker	Cook pine	non-native	rare
MONOCOTS			
AMARYLLIDACEAE (Amaryllis Family)			
Hippeastrum striatum (Lam.) H.E. Moore	amaryllis	non-native	rare
ARECACEAE (Palm Family)			
Cocos nucifera L.	niu	Polynesian	rare
Phoenix x dactylifera	phoenix hybrid	non-native	rare
ASPARAGACEAE (Asparagus Family)			
Cordyline fruticosa (L.) A. Chev.	kī, ti leaf	Polynesian	uncommon
Pleomele halapepe St. John	halapepe	endemic	rare
Sanseviera trifasciata Prain	sanseviera	non-native	rare
COMMELINACEAE (Spiderwort Family)			
Commelina diffusa N.L. Burm.	honohono	non-native	rare
CYPERACEAE (Sedge Family)			
Carex meyenii Nees	----------	indigenous	rare
Carex wahuensis C.A. Meyen	----------	endemic	rare
Cyperus difformis L.	----------	non-native	rare
Cyperus polystachyos Rottb.	----------	indigenous	rare
Cyperus rotundus L.	nut sedge	non-native	rare
Kyllingia brevifolia Rottb.	kili'o'opu	non-native	rare
ORCHIDACEAE (Orchid Family)			
Phaius tankarvilleae (Banks ex L'Her) Blume	nun's orchid	non-native	rare
Spathoglottis plicata Blume	Phillipine ground orchid	non-native	rare
PANDANACEAE (Screwpine Family)			
Freycinetia arborea Gaud.	'ie'ie	indigenous	rare
POACEAE (Grass Family)			

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Andropogon virginicus L.	broomsedge	non-native	uncommon
Axonopus compressus (S.W.) P. Beauv.	broad-leaved carpetgrass	non-native	rare
Axonopus fissifolius (Raddi) Kuhlm.	narrow-leaved carpetgrass	non-native	rare
Chloris barbata (L.) Sw.	swollen fingergrass	non-native	rare
Chloris radiata (L.) Sw.	plush grass	non-native	rare
Cynodon dactylon (L.) Pers.	Bermuda grass	non-native	rare
Eleusine indica (L.) Gaertn.	wiregrass	non-native	rare
Hyparrhenia rufa (Nees) Stapf	thatching grass	non-native	uncommon
Melinis minutiflora P. Beauv.	molasses grass	non-native	uncommon
Oplismenus hirtellus (L.) P.Beauv.	basketgrass	non-native	rare
Panicum maximum Jacq.	Guinea grass	non-native	abundant
Panicum sp.	----------	non-native	rare
Paspalum conjugatum Bergius	Hilo grass	non-native	uncommon
Paspalum dilatatum Poir.	Dallis grass	non-native	rare
Paspalum fimbriatum Kunth	Panama grass	non-native	rare
Paspalum scrobiculatum L.	ricegrass	non-native	rare
Paspalum urvillei Steud.	Vasey grass	non-native	rare
Pennisetum polystachion (L.) Schult.	feathery pennisetum	non-native	rare
Pennisetum purpureum Schumach.	Napier grass	non-native	uncommon
Saccharum officinarum L.	sugar cane	Polynesian	rare
Sacciolepis indica (L.) chase	Glenwood grass	non-native	rare
Setaria palmifolia (J. Konig) Stapf	palmgrass	non-native	rare
Setaria parviflora (Poir.) Kerguelen	yellow foxtail	non-native	rare
Sporobolus africanus (Poir.) Robyns & Tournay	smutgrass	non-native	uncommon
Urochloa mutica (Forssk.) T.Q. Nguyen	California grass	non-native	uncommon
ZINGIBERACEAE (Ginger Family)			
Alpinia zerumbet (Pers.) B.L. Burtt & R.M. Smith	shell ginger	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
DICOTS			
ACANTHACEAE (Acanthus Family)			
Asystasia gangetica (L.) T.Anderson	Chinese violet	non-native	rare
Justicia betonica L.	white shrimp plant	non-native	rare
AMARANTHACEAE (Amaranth Family)			
Amaranthus viridis L.	slender amaranth	non-native	rare
ANACARDIACEAE (Mango Family)			
Mangifera indica L.	mango	non-native	rare
Schinus terebinthifolius Raddi	Christmas berry	non-native	uncommon
APIACEAE (Parsley Family)			
Centella asiatica (L.) Urb.	Asiatic pennywort	non-native	rare
Ciclospermum leptophyllum (Pers.) Sprague	fir-leaved celery	non-native	rare
ARALIACEAE (Ginseng Family)			
Shefflera actinophylla (Endl.) Harms	octopus tree	non-native	rare
ASTERACEAE (Sunflower Family)			
Acanthospermum australe (Loefl.) Kuntze	spiny bur	non-native	rare
Ageratum conyzoides L.	maile hohono	non-native	uncommon
Bidens alba (L.) DC	Spanish needle	non-native	uncommon
Conyza bonariensis (L.) Cronq.	hairy horseweed	non-native	uncommon
Crassocephalum crepidioides (Benth.)S.Moore	redflower ragleaf	non-native	rare
Eclipta prostrata (L.) L.	false daisy	non-native	rare
Emilia fosbergii Nicolson	red pualele	non-native	rare
Emilia sonchifolia (L.) DC.	violet pualele	non-native	uncommon
Gamochaeta purpurea (L.) Cabrera	purple cudweed	non-native	rare
Pluchea carolinensis (Jacq.) G.Don	sourbush	non-native	uncommon
Sonchus oleraceus L.	pualele	non-native	rare
BIGNONIACEAE (Bignonia Family)			
Spathodea campanulata P.Beauv.	African tulip tree	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
BRASSICACEAE (Mustard Family)			
Rorippa sarmentosa (J. Forst. ex DC.) J.F. Macbr	pa'ihi	Polynesian	rare
CARICACEAE (Papaya Family)			
Carica papaya L.	papaya	non-native	rare
CASUARINACEAE (She-oak Family)			
Casuarina equisetifolia L.	common ironwood	non-native	common
CLUSICACEAE (Mangosteen Family)			
Clusia rosea Jacq.	autograph tree	non-native	rare
CONVOLVULACEAE (Morning Glory Family)			
Ipomoea obscura (L.) Ker-Gawl.	----------	non-native	rare
Ipomoea triloba L.	little bell	non-native	rare
Merremia tuberosa (L.) Rendle	wood rose	non-native	rare
CUCURBITACEAE (Gourd Family)			
Coccinia grandis (L.) Voigt	ivy gourd	non-native	rare
Lagenaria siceraria (Molina) Standley	long squash	non-native	rare
Momordica charantia L.	balsam pear	non-native	rare
EBENACEAE (Ebony Family)			
Diospyros sandwicensis (A.DC.) Fosb.	lama	endemic	rare
ERICACEAE (Heath Family)			
Leptecophylla tameiameiae (Cham.&Schlect.) C.M. Weiller	pukiawe	indigenous	rare
EUPHORBIACEAE (Spurge Family)			
Aleurites moluccana (L.) Willd.	kukui	Polynesian	uncommon
Chamaesyce hirta (L.) Millsp.	hairy spurge	non-native	rare
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	non-native	rare
Codiaeum variegatum (L.) Blume	croton	non-native	rare
Phyllanthus debilis Klein ex Willd.	niruri	non-native	rare
FABACEAE (Pea Family)			

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Acacia confusa Merr.	Formosa koa	non-native	common
Acacia koa A. Gray	koa	endemic	uncommon
Arachis glabrata Bentham	rhizoma peanut	non-native	rare
Bauhinia variegata L.	orchid tree	non-native	rare
Calliandra surinamensis Benthan	powderpuff	non-native	rare
Canavalia cathartica Thouars	maunaloa	non-native	rare
Chamaecrista nictitans (L.) Moench	partridge pea	non-native	uncommon
Crotalaria incana L.	fuzzy rattlepod	non-native	rare
Crotalaria pallida Aiton	smooth rattlepod	non-native	rare
Desmanthus pernambucanus (L.) Thellung	slender mimosa	non-native	rare
Desmodium incanum DC.	Spanish clover	non-native	rare
Desmodium sandwicense	Spanish clover	non-native	rare
Desmodium triflorum (L.) DC.	three-flowered beggarweed	non-native	rare
Falcataria moluccana (Miq.) Barneby & Grimes	albizia	non-native	common
Indigofera suffruticosa Mill.	inikö	non-native	rare
Leucaena leucocephala (Lam.) de Wit	koa haole	non-native	common
Macroptilium lathyroides (L.) Urb.	wild bean	non-native	rare
Medicago lupulina L.	black medic	non-native	rare
Medicago polymorpha L.	bur clover	non-native	rare
Mimosa pudica L.	sensitive plant	non-native	uncommon
Neonotonia wightii (Wight & Arnott) Lackey	glycine	non-native	uncommon
Parkia timoriana (A.P. de Candolle) Merrill	drumstick tree	non-native	rare
Peltophorum pterocarpum (A.P. de Candolle) K. Heyne	yellow poinciana	non-native	rare
Stylosanthes fruticosa (Retz.) Alston	shrubby pencilflower	non-native	rare
Vigna marina (J. Burm.) Merr.	nanea	indigenous	rare
GOODENIACEAE (Goodenia Family)			
Scaevola gaudichaudiana Cham.	naupaka kuahiwi	endemic	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
GROSSULARIACEAE (Gooseberry Family)			
Brexia madagascariensis (Lamarck) Ker Gawler	brexia	non-native	rare
LAMIACEAE (Mint Family)			
Salvia officinalis L.	garden sage	non-native	rare
LAURACEAE (Laurel Family)			
Cassytha filiformis L.	kauna'oa pehu	indigenous	rare
Cinnamomum burmanni (Nees) Blume	Padang cassia	non-native	common
Persea americana Mill.	avocado	non-native	rare
LYTHRACEAE (Loosestrife Family)			
Cuphea carthagenensis (Jacq.) Macbr.	tarweed	non-native	rare
MALVACEAE (Mallow Family)			
Malvastrum coromandelianum (L.) Garckey	false mallow	non-native	rare
Melochia umbellata (Houtt.) Stapf	hierba del soldado	non-native	rare
Sida ciliaris L.	red 'ilima	non-native	rare
Sida rhombifolia L.	Cuban jute	non-native	rare
Sida spinosa L.	prickly sida	non-native	rare
Waltheria indica L.	'uhaloa	indigenous	uncommon
MELASTOMATACEAE (Melastoma Family)			
Clidemia hirta (L.) D.Don	Koster's curse	non-native	uncommon
Pterolepis glomerata (Rottb.) Miq.	false meadow beauty	non-native	rare
MELIACEAE (Mahogany Family)			
Melia azedarach L.	pride-of-India	non-native	rare
Toona ciliata M. Roem	Australian red-cedar	non-native	rare
MENISPERMACEAE (Moonseed Family)			
Cocculus orbiculatus (L.) DC.	huehue	indigenous	rare
MORACEAE (Fig Family)			
Ficus microcarpa L.	Chinese banyan	non-native	uncommon
Ficus platypoda (A.Cunn.ex Miq.)A.Cunn.ex Miq.	rock fig	non-native	uncommon

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Ficus religiosa L.	Bo tree	non-native	rare
Ficus sp.	----------	non-native	rare
MYRTACEAE (Myrtle Family)			
Corymbia citriodora (Hook.) K.D. Hill & L.A.S.Johnson	lemon gum	non-native	uncommon
Eucalyptus robusta Sm.	swamp mahogany	non-native	common
Eucalyptus rudis Endl.	desert gum	non-native	rare
Melaleuca quinquenervia (Cav.) S.T.Blake	paperbark	non-native	rare
Metrosideros polymorpha Gaud. var. *polymorpha*	'öhi'a	endemic	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
Syzygium jambos (L.) Alston	rose apple	non-native	rare
NYCTAGINACEAE (Four-o'clock Family)			
Bougainvillea spectabilis Willd.	bougainvillea	non-native	rare
OLEACEAE (Olive Family)			
Nestegis sandwicensis (A. Gray) Degener, I.Degener & L.Johnson	olopua	endemic	rare
ONAGRACEAE (Evening Primrose Family)			
Ludwigia octovalvis (Jacq.) Raven	primrose willow	non-native	rare
OXALIDACEAE (Wood Sorrel Family)			
Oxalis corniculata L.	yellow wood sorrel	Polynesian	rare
PASSIFLORACEAE (Passion Flower Family)			
Passiflora edulis Sims	passion fruit	non-native	rare
Passiflora suberosa L.	cork-bark passion flower	non-native	common
Passiflora subpeltata Ort.	white passion flower	non-native	rare
PLANTAGINACEAE (Plantain Family)			
Plantago lanceolata L.	narrow-leaved plantain	non-native	uncommon
POLYGALACEAE (Milkwort Family)			

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Polygala paniculata L.	polygala	non-native	rare
PRIMULACEAE (Primrose Family)			
Angallis arvensis L.	scarlet pimpernel	non-native	rare
PROTEACEAE (Protea Family)			
Grevillea robusta A.Cunn.ex R.Br.	silk oak	non-native	uncommon
ROSACEAE (Rose Family)			
Rubus rosifolius Sm.	thimbleberry	non-native	rare
RUBIACEAE (Coffee Family)			
Coffea arabica L.	Arabian coffee	non-native	rare
Morinda citrifolia L.	noni	Polynesian	rare
Posoqueria latifolia (Rudge) J. Roemer & J.A. Schultes	tree jasmine	non-native	rare
Psychotria mariniana (Cham.& Schlectend) Fosb.	kōpiko	endemic	rare
Psydrax odorata (G. Forst.) A.C.Smith & S.P.Darwin	alahe'e	indigenous	uncommon
Spermacoce assurgens Ruiz & Pav.	buttonweed	non-native	rare
SANTALACEAE (Sandalwood Family)			
Santalum album L.	white sandalwood	non-native	rare
Santalum freycinetianum Gaud. var. *freycinetianum*	'iliahi	endemic	rare
SAPINDACEAE (Soapberry Family)			
Dodonaea viscosa Jacq.	'a'ali'i	indigenous	rare
SAPOTACEAE (Sapodilla Family)			
Chrysophyllum mexicanus T. Brandegee	satin leaf	non-native	uncommon
SCROPHULARIACEAE (Snapdragon Family)			
Buddleia asiatica Lour.	dog tail	non-native	rare
THYMELAEACEAE ('Akia Family)			
Wikstroemia oahuensis (A. Gray) Rock	'akia	endemic	rare
URTICACEAE (Nettle Family)			
Cecropia obtusifolia Bertol.	cecropia	non-native	uncommon
VERBENACEAE (Verbena Family)			

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Citharexylum caudatum L.	fiddlewood	non-native	rare
Lantana camara L.	lantana	non-native	uncommon
Stachytarpheta australis Modenke	öwī	non-native	rare
Stachytarpheta cayennensis (Rich.) Vahl	nettle-leaved vervain	non-native	rare
Stachytarpheta jamaicensis (L.) Vahl	öwī	non-native	uncommon
Verbena littoralis kunth	öwī	non-native	rare
ZYGOPHYLLACEAE (Creosote Bush Family)			
Tribulus terrestris L.	puncture vine	non-native	rare

FAUNA SURVEY REPORT

SURVEY METHODS

A walk-through survey method was conducted in conjunction with the botanical survey. All parts of the project site 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 document any evidence of occurrence of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) in the area.

RESULTS

MAMMALS

Five species of mammals were observed during four full days and an evening on the site. Taxonomy and nomenclature follow Tomich (1986).

Feral pig (*Sus scrofa*) – Pigs were common throughout this site. Major trails were found in every gulch and diggings and droppings associated with this species were widespread. Many individuals and family groups were seen.

Mongoose (*Herpestes auropunctatus*) – Mongoose were seen throughout the site, scurrying across roads and trails.

Domestic dog (*Canis familiaris*) – Two lost hunting dogs were seen in the upper part of the site. Pig hunters frequent this area regularly with their dogs.

Rats (Rattus spp.) – One rat was seen running across a road at the site during the evening survey. Rats frequent this type of habitat, feeding on seeds, fruits and herbaceous vegetation.

Hawaiian hoary bat, 'Ope'ape'a (*Lasiurus cinereus semotus*) – A survey to detect the possible presence of the Endangered Hawaiian hoary bat was conducted on the evening of Feb. 12, 2010. A Batbox IIID detecting device, set to the range they are known to utilize (27,000 to 28,000 hertz) was employed. Surveys were conducted at five locations, four at the top of the site adjacent to the forest and one in the lower southwest corner of the site close to a reservoir (see figure 1). These are locations most likely to have nocturnal flying insect activity that would attract bats if they were in the vicinity. A few faint calls were heard at the first location near the military gate along Drum Road, and a few calls were heard closer at hand at the third location at the highest part of the property. No calls were heard at the other three locations. While this survey provides only a cursory snapshot in time, it does indicate that these bats occur on the site. This finding is consistent with historical and recent bat sightings in the northern Ko'olau Range between Kahuku and Pupukea.

Dense vegetation prevented good visibility of other ground-dwelling mammals, but a significant population of mice (*Mus domesticus*) would be expected, as they are known to frequent this type of habitat. Feral cats (*Felis catus*) are also known to frequent such habitat where they hunt for rodents and birds.

BIRDS

There was moderate avian diversity observed across the breadth of the project site during four full days and one evening of surveys. Seventeen species of birds were recorded, including fifteen non-native birds, one seasonal migrant and one possibly native owl. Taxonomy and nomenclature follow American Ornithologists' Union (2005).

Zebra dove (*Geopelia striata*) – Flocks of these small doves were seen throughout the project area feeding on seeds along roads and in grassy clearings.

Common waxbill (*Estrilda astrild*) – Sizeable flocks of these tiny birds were seen throughout the area feeding on grass seeds in the deep Guinea grass.

Common myna (*Acridotheres tristis*) – Mynas, mostly in pairs, were widespread across the site. They were most often seen in flight.

Japanese bush-warbler (*Cettia diphone*) – These birds were heard calling from underbrush and trees. They are quite secretive and seldom seen.

Kölea, Pacific golden-plover (*Pluvialis fulva*) – Plovers were regularly seen along roads and in clearings where they like to establish territory. These birds are seasonal migrants that spend the fall and winter months in Hawaii and the spring and summer months breeding in the Arctic.

Spotted dove (*Streptopelia chinensis*) – Several of these large doves were seen in flight or perched in trees on the site.

Red-vented bulbul (*Pycnonotus cafer*) – These black birds were seen and their distinctive warbling calls heard throughout most of the site.

Hwamei (*Garrulax canorus*) – These secretive thrushes were heard singing in gulch undergrowth on the site, but were seldom seen.

House finch (*Carpodacus mexicanus*) – Small groups of these finches were seen in trees and shrubbery on the site and heard making their persistent high-pitched calls.

Gray francolin (*Francolinus pondicerianus*) – Several families of these light-brown francolins were seen in the margins of open areas where they feed.

White-rumped shama (*Copsychus malabaricus*) – A few of these white-rumped shama were seen and heard in trees in gulches in the lower part of the property.

Northern cardinal (*Cardinalis cardinalis*) – A few of these cardinals were seen in gulches in the upper part of the property.

Red-crested cardinal (*Paroaria coronata*) – One group of red-headed cardinals was seen in underbrush in the lower part of the site.

Japanese white-eye (*Zosterops japonicus*) – A few pairs of these birds were seen in flight and foraging for insects in trees on the site.

Red avadavat (*Amandava amandava*) – A couple of these birds were seen in a flock of waxbills feeding in the grasslands on the site.

Red-whiskered bulbul (*Pycnonotus jocosus*) – One of these birds was seen in trees in a gulch on the upper part of the site.

(unknown owl species) – Two regurgitated owl pellets of rodent hair and bones were observed on a trail on a grassy ridgetop in the upper part of the site. Owls tend to consume small rodents whole, then regurgitate the indigestible remains in these pellets. The pellets could have come from either a barn owl (*Tyto alba*) or the native pueo (*Asio flammeus sanwichensis*) which both inhabit areas similar to this portion of the site. The pueo is listed as an Endangered species on the island of O'ahu by the State of Hawaii, but is not a federally listed species. The pellets could have come from either owl species, but judging by their size (5-6 cm long x 2.5-3.0 cm wide) they are more likely to have come from the larger of the two species, the introduced barn owl.

A few other non-native bird species might occasionally utilize this property but it is not suitable habitat for Hawaii's native forest birds which occupy native forests at higher elevations beyond the range of mosquitoes and the lethal avian diseases they transmit. No native forest birds were seen even at the highest part of the property.

INSECTS

Insects in general were not tallied, but a search was made for one native sphingid moth, Blackburn's sphinx moth (*Manduca blackburni*), which is listed as an Endangered species (USFWS, 2000). Blackburn's sphinx moth was known to occur on O'ahu in the past, although it has not been found here recently. Its primary native host plants are species of 'aiea (*Nothocestrum spp.*) and alternative host plants are tobacco (*Nicotiana tabacum*) and tree tobacco (*Nicotiana glauca*). None of these host plant species were found on the site. No Blackburns' sphinx moth or their larvae were found.

DISCUSSION AND RECOMMENDATIONS

Most of the wildlife observed on the property is non-native and generally unremarkable from an environmental protection standpoint. Feral pigs are common throughout the project area and have had a negative impact on the native vegetation. They have rooted up and destroyed most of the delicate understory species and their ground disturbances have provided seed beds for numerous invasive weeds which now dominate. One native species, however, the Hawaiian hoary bat which was detected near the upper margins of the project site 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 O'ahu where only a few recent confirmed sightings have been made in the northern Ko'olaus. That it was detected here in the Kawailoa area is thus consistent. One Kahuku resident when queried about these bats mentioned that her son had seen them during the evening on more than one occasion at the Pupukea Boy Scout Camp about 2 ½ miles north of the project area (G.Roberts, personal communication). It makes sense that they would occur in such a rural part of this highly urbanized island.

The Hawaiian hoary bat is a highly mobile creature that is known to move about in response to seasonal 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 one area when flying insects are abundant and be absent when feeding opportunities have moved elsewhere. Thus no critical habitats have been established for them.

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.

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 two groups: Mammals and Birds. For each species the following information is provided:

1. Common name

2. Scientific name

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

   endemic = native only to Hawaii; not naturally occurring anywhere else in the world.
   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   non-native = all those 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.

COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE
MAMMALS			
Pig	*Sus scrofa*	non-native	common
Mongoose	*Herpestes auropunctatus*	non-native	common
Dog	*Canis familiaris*	non-native	rare
Rat	*Rattus spp.*	non-native	rare
Hawaiian Bat, *Ope'ape'a*	*Lasiurus cinereus semotus*	endemic	rare
BIRDS			
Zebra dove	*Geopelia striata*	non-native	common
Common waxbill	*Estrilda astrild*	non-native	common
Common myna	*Acridotheres tristis*	non-native	uncommon
Japanese bush-warbler	*Cettia diphone*	non-native	uncommon
Kölea, Pacific golden-plover	*Pluvialis fulva*	migratory	uncommon
Spotted dove	*Streptopelia chinensis*	non-native	uncommon
Red-vented bulbul	*Pycnonotus cafer*	non-native	uncommon
Hwamei	*Garrulax canorus*	non-native	uncommon
House finch	*Carpodacus mexicanus*	non-native	uncommon
Gray francolin	*Francolinus pondicerianus*	non-native	rare
White-rumped shama	*Copsychus malabaricus*	non-native	rare
Northern cardinal	*Cardinalis cardinalis*	non-native	rare
Red-crested cardinal	*Paroaria coronata*	non-native	rare
Japanese white-eye	*Zosterops japonicus*	non-native	rare
Red avadavat	*Amandava amandava*	non-native	rare
Red-whiskered bulbul	*Pycnonotus jocosus*	non-native	rare
(unknown owl species)	----------	?	rare

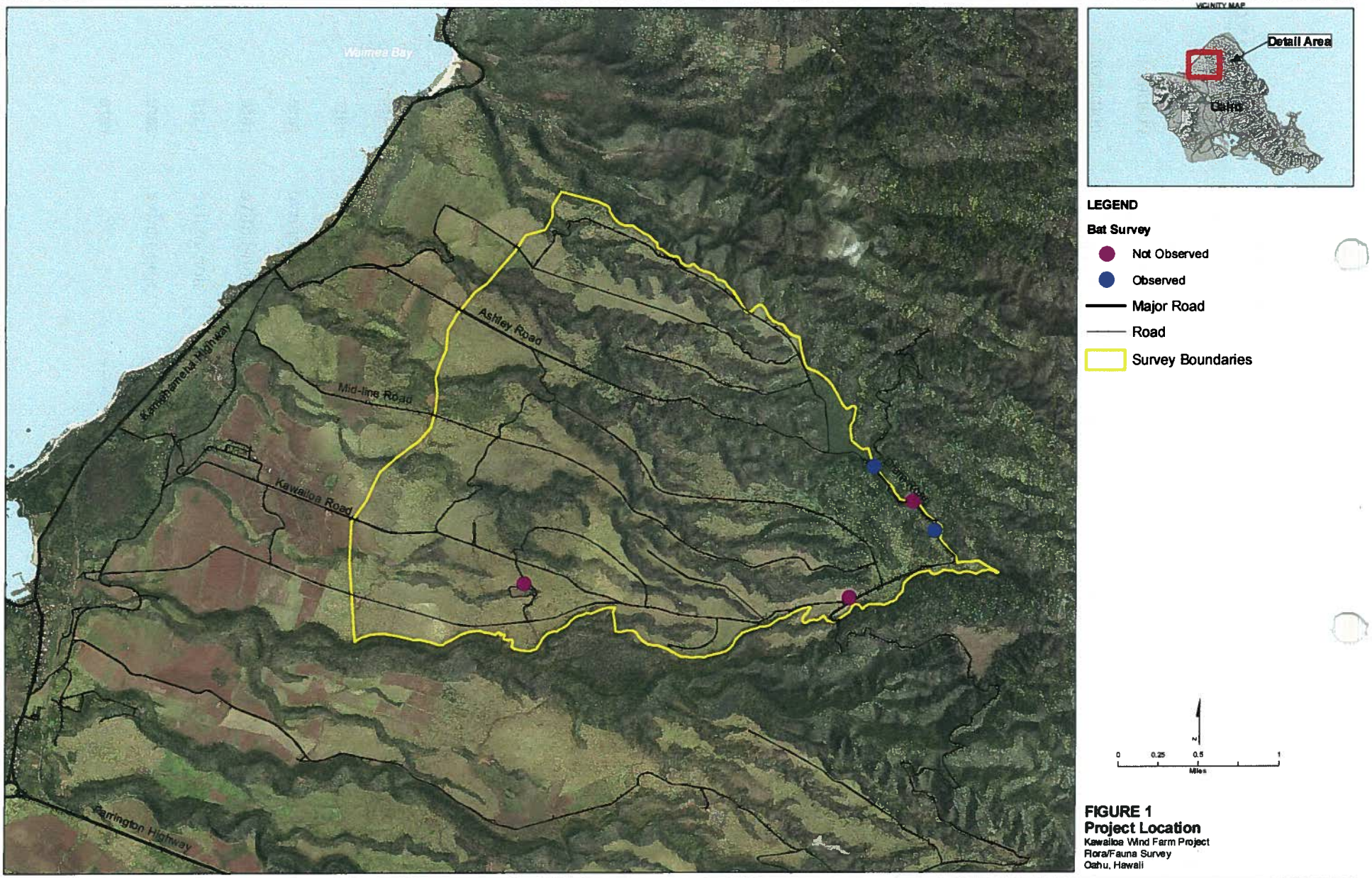

FIGURE 1
Project Location
Kawailoa Wind Farm Project
Flora/Fauna Survey
Oahu, Hawaii

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BIOLOGICAL RESOURCES SURVEY

FOR THE

FIRST WIND KAWAILOA WIND FARM PROJECT

CANE HAUL ROAD, COLLECTOR LINE ROUTE

AND O & M BUILDING SITE

KAWAILOA, WAIALUA, O'AHU

By: Robert W. Hobdy
Environmental Consultant
August 2010

For: CH2MHILL

TABLE OF CONTENTS

INTRODUCTION

The proposed project lies along a corridor of approximately 4.4 miles running laterally and upward along old cane access roads between the Kawailoa Solid Waste Transfer Station and the west rim of Waimea Valley, TMKs 6-1-05:1, 19, 20, 21, 22 and TMK 6-1-06:1 (por.). It passes along Kawailoa Ranch pastures and through abandoned cane lands. This document summarizes the results of a biological study that was initiated by management in fulfillment of environmental requirements of the planning process for this wind farm.

SITE DESCRIPTION

The project corridor consists of 1.5 miles on the upper coastal plain that was a major cane haul road, 2.9 miles that climbs up the coastal escarpment and ascends gradually, crossing two gulches, and ends on a ridge overlooking Waimea Valley at an elevation of 400 feet. Another few acre area just above Kamehameha Highway near the Ashley Road gate that is planned as an Operations and Maintenance building, rounds out the components of the project.

The soils on the flat ridge tops consist of deep silty clays of the Waialua, Ewa, Helemano, Wahiawa, and Leilehua Series. The soils on the coastal escarpment and in the gulches have rocky outcrops and large amounts of loose stone (Foote et al, 1972). Rainfall averages about 40 inches per year with the bulk falling during the winter months (Armstrong, 1983). Vegetation consists mostly of open grasslands on the ridge tops and dense forests in the gulches.

BIOLOGICAL HISTORY

In pre-contact times these slopes would have been forested with native 'öhi'a (*Metrosideros polymorpha*) and koa (*Acacia koa*) trees with a dense understory of smaller native trees, shrubs, ferns and vines in great diversity and profusion. Gulches would have had an even denser growth of delicate shade-loving species.

In the late 1800s the area was cleared and converted to sugar cane agriculture. The fields were plowed, burned, harvested and planted in continuous cycles for about 100 years. Some of the broader gulches were used to pasture plantation horses and mules. These uses greatly reduced the numbers and overall diversity of native plants, and these were gradually replaced by increasing numbers of non-native agricultural and pasture plants. A number of tree species were planted along the edges of fields to serve as windbreaks. Other species deemed to be useful or ornamental were also planted in gulches and along ditches. Many of these have proliferated and some have become invasive. Feral pigs have spread throughout the area and have had a negative impact on native vegetation. They also are an important vector for the spread of weed species throughout the forests.

Today, little remains of native plant diversity in the project area. A few native species persist on steep gulch slopes in the upper parts of the corridor, but most of the area is covered with invasive non-native species.

SURVEY OBJECTIVES

This report summarizes the findings of a flora and fauna survey of the proposed Kawailoa Wind Farm Project - Cane Haul Road, Collector Line Route and O & M Building Site which was conducted during July, 2010. 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.

5. Note which aspects of the proposed development pose significant concerns for plants or for wildlife and recommend measures that would mitigate or avoid these problems.

BOTANICAL SURVEY REPORT

SURVEY METHODS

A walk-through botanical survey method was used on a 100 foot wide corridor along the 4.4 mile route, and within a few acre stretch where the proposed Operations and Maintenance Building is to be situated. Areas most likely to harbor native plants, such as gulches, steep slopes and rocky outcrops, were more intensively examined. Notes were made on species, distribution and abundance as well as on terrain and substrate.

DESCRIPTION OF THE VEGETATION

The vegetation on the project site is a mixture of aggressive weedy species that have taken over since the abandonment of sugar cane agriculture, but there are a few native species that persist in gulches and especially along the rim of Waimea Valley at the upper, eastern edge of the site.

One grass species, Guinea grass (*Megathyrsus maximus*), dominates most of the habitats on the site. Also common are Christmas berry (*Schinus terebinthifolius*), autograph tree (*Clusia rosea*), koa haole (*Leucaena leucocephala*), glycine (*Neonotonia wightii*) and Chinese banyan (*Ficus microcarpa*).

A total of 107 plant species were recorded during the course of the survey. Of this total 7 species were common native species. Two are endemic to Hawaii: Ko'oko'olau (*Bidens sandvicensis*) and 'akia (*Wikstroemia oahuensis*), and 5 are indigenous in Hawaii as well as to other Pacific islands: pala'ä (*Sphenomeris chinensis*), pilipili'ula (*Chrysopogon aciculatus*), 'uhaloa (*Waltheria indica*), ülei (*Osteomeles anthyllidifolia*) and alahe'e (*Psydrax odorata*). None of these are rare species and all occur on more than one island. Two species were of Polynesian origin: kukui (*Aleurites moluccana*) and 'ihi (*Oxalis corniculata*). The remaining 98 species were non-native plants that are agricultural weeds, windbreak trees or ornamentals.

DISCUSSION AND RECOMMENDATIONS

The vegetation along this 4.4 mile corridor and within the O & M building site is dominated by non-native species. A small number of common native species are concentrated along Waimea Valley rim on the upper, eastern end of the corridor.

No federally listed Endangered or Threatened plant species (USFWS, 2009) were found on the project corridor, nor were any found that are candidates for such status. No special native plant habitats or communities were identified. Due to the lack of any protected species or habitats, there is little of botanical concern with regard to this project area, and the proposed project is not expected to have a significant negative impact on the botanical resources in this part of O'ahu.

If, however, there is any re-vegetation planned along road cuts or landscaping around the O & M Building site it is recommended that some dryland native plants, including the 7 listed above, be used for planting.

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 = native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.
   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   non-native = all those plants brought to the islands intentionally or accidentally after western contact.

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			
LINDSAEACEAE (Lindsaea Fern Family)			
Sphenomeris chinensis (L.) Maxon	pala'ä	indigenous	rare
POLYPODIACEAE (Polypody Fern Family)			
Phlebodium aureum (L.) J. Sm.	rabbit's foot fern	non-native	rare
Phymatosorus grossus (Langsd. & Fisch.) Brownlie	laua'e	non-native	uncommon
PTERIDACEAE (Brake Fern Family)			
Adiantum hispidulum Sw.	rough maidenhair fern	non-native	rare
THELYPTERIDACEAE (Marsh Fern Family)			
Christella parasitica (L.) H. Lev.	----------	non-native	rare
MONOCOTS			
ARECACEAE (Palm Family)			
Phoenix x dactylifera	hybrid date palm	non-native	rare
Washingtonia robusta H. Wendl.	Mexican washingtonia	non-native	rare
ASPARAGACEAE (Asparagus Family)			
Sanseviera trifasciata Prain	sanseviera	non-native	rare
CYPERACEAE (Sedge Family)			
Cyperus rotundus L.	nut sedge	non-native	rare
POACEAE (Grass Family)			
Andropogon virginicus L.	broomsedge	non-native	rare
Axonopus fissifolius (Raddi) Kuhlm.	narrow-leaved carpetgrass	non-native	rare
Chloris barbata (L.) Sw.	swollen fingergrass	non-native	uncommon
Chrysopogon aciculatus (Retz.) Trin.	pilipili ula	indigneous	rare
Digitaria insularis (L.) Mez ex Ekman	sourgrass	non-native	rare
Eleusine indica (L.) Gaertn.	wiregrass	non-native	rare
Melinis minutiflora P. Beauv.	molasses grass	non-native	rare
Oplismenus hirtellus (L.) P. Beauv.	bamboo grass	non-native	rare
Megathyrsus maximus (Jacq.) Simon & Jacobs	Guinea grass	non-native	abundant
Paspalum conjugatum Bergius	Hilo grass	non-native	rare
Urochloa mutica (Forssk.) T.Q. Nguyen	California grass	non-native	rare
DICOTS			
ACANTHACEAE (Acanthus Family)			
Barleria lupulina Lindl.	hophead	non-native	rare
AMARANTHACEAE (Amaranth Family)			
Alternanthera pungens Kunth	Khaki weed	non-native	uncommon
Amaranthus spinosus L.	spiny amaranth	non-native	rare
Amaranthus viridis L.	slender amaranth	non-native	rare
ANACARDIACEAE (Mango Family)			
Schinus terebinthifolius Raddi	Christmas berry	non-native	common

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
APIACEAE (Parsley Family)			
Ciclospermum leptophyllum (Pers.) Sprague	fir-leaved celery	non-native	rare
APOCYNACEAE (Dogbane Family)			
Alstonia sp.	----------	non-native	rare
ARALIACEAE (Ginseng Family)			
Schefflera actinophylla (Endl.) Harms	octopus tree	non-native	rare
ASTERACEAE (Sunflower Family)			
Bidens alba (L.) DC.	----------	non-native	uncommon
Bidens sandvicensis Less	ko'oko'olau	endemic	rare
Conyza bonariensis (L.) Cronq.	hairy horseweed	non-native	rare
Cyanthillium cinereum (L.) H. Rob.	little ironweed	non-native	rare
Emilia fosbergii Nicolson	red pualele	non-native	rare
Pluchea carolinensis (Jacq.) G. Don	sourbush	non-native	uncommon
Verbesina encelioides (Cav.) Benth. & Hook.	golden crown-beard	non-native	rare
BASELLACEAE (Basella Family)			
Anredera cordifolia (Ten.) Steenis	Madeira vine	non-native	rare
BIGNONIACEAE (Bignonia Family)			
Spathodea campanulata P. Beauv.	African tulip tree	non-native	uncommon
BORAGINACEAE (Borage Family)			
Heliotropium procumbens Mill.	fourspike heliotrope	non-native	rare
BRASSICACEAE (Mustard Family)			
Lepidium virginicum L.	pepperwort	non-native	rare
CACTACEAE (Cactus Family)			
Hylocereus undatus (Haw.) Britton & Rose	night-blooming cereus	non-native	rare
CANNABACEAE (Hemp Family)			
Trema orientalis (L.) Blume	gunpowder tree	non-native	rare
CARICACEAE (Papaya Family)			
Carica papaya L.	papaya	non-native	rare
CASUARINACEAE (She-oak Family)			
Casuarina equisetifolia L.	common ironwood	non-native	uncommon
Casuarina glauca Sieber ex Spreng.	longleaf ironwood	non-native	rare
CLUSIACEAE (Mangosteen Family)			
Clusia rosea Jacq.	autograph tree	non-native	common
CONVOLVULACEAE (Morning Glory Family)			
Ipomoea obscura (L.) Ker-Gawl	----------	non-native	rare
Ipomoea triloba L.	little bell	non-native	rare
CUCURBITACEAE (Gourd Family)			
Coccinia grandis (L.) Voigt	ivy gourd	non-native	rare
Cucumis dipsaceus Ehrenb. ex Spach	hedgehog gourd	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Momordica charantia L.	bitter melon	non-native	rare
EUPHORBIACEAE (Spurge Family)			
Aleurites moluccana (L.) Willd.	kukui	Polynesian	rare
Chamaesyce hirta (L.) Millsp.	hairy spurge	non-native	uncommon
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	non-native	uncommon
Chamaesyce prostrata (Aiton) Small	prostrate spurge	non-native	uncommon
Phyllanthus debilis Klein ex Willd.	niruri	non-native	rare
Ricinus communis L.	Castor bean	non-native	uncommon
FABACEAE (Pea Family)			
Acacia confusa Merr.	Formosa koa	non-native	uncommon
Acacia farnisiana (L.) Willd.	klu	non-native	rare
Chamaecrista nictitans (L.) Moench	partridge pea	non-native	rare
Crotalaria incana L.	fuzzy rattlepod	non-native	rare
Crotalaria pallida Aiton	smooth rattlepod	non-native	rare
Desmanthus pernambucanus (L.) Thellung	slender mimosa	non-native	rare
Desmodium incanum DC.	ka'imi clover	non-native	rare
Falcataria moluccana (Miq.) Barneby & Grimes	albizia	non-native	uncommon
Indigofera hendcaphylla Jacq.	creeping indigo	non-native	uncommon
Indigofera suffruticosa Mill.	inikö	non-native	rare
Leucaena leucocephala (Lam.) de Wit	koa haole	non-native	common
Neonotonia wightii (Wight & Arnott) Lackey	glycine	non-native	common
Pithecellobium dulce (Roxb.) Benth.	'opiuma	non-native	rare
Prosopis pallida (Humb. & Bonpl. ex Willd) Kunth	kiawe	non-native	uncommon
Samanea saman (Jacq.) Merr.	monkeypod	non-native	rare
Senna surattensis (N.L.Burm.) H.Irwin & Barneby	kolomona	non-native	rare
LAMIACEAE (Mint Family)			
Hyptis pectinata (L.) Poit.	comb hyptis	non-native	rare
Leonotis nepetifolia (L.) R. Br.	lion's ear	non-native	uncommon
Salvia officînalis L.	garden sage	non-native	rare
MALVACEAE (Mallow Family)			
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	non-native	rare
Malva parviflora L.	cheese weed	non-native	rare
Malvastrum coromandelianum (L.) Garcke	false mallow	non-native	rare
Sida ciliaris L.	red 'ilima	non-native	rare
Sida cordifolia L.	heart-leaved sida	non-native	rare
Sida spinosa L.	prickly sida	non-native	uncommon
Triumfetta semitriloba Jacq.	Sacramento bur	non-native	rare
Waltheria indica L.	'uhaloa	indigenous	uncommon

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
MELASTOMATACEAE (Melastoma Family)			
Clidemia hirta (L.) D.Don	Koster's curse	non-native	rare
MELIACEAE (Mahogany Family)			
Melia azedarach L.	pride of India	non-native	uncommon
MORACEAE (Mulberry Family)			
Broussonetia luzonica (Blanco) Bureau	alokon, Phillipine spinach	non-native	rare
Ficus microcarpa L. fil.	Chinese banyan	non-native	common
Ficus platypoda (A.Cunn.ex Miq.)	rock fig	non-native	rare
MYRTACEAE (Myrtle Family)			
Psidium guajava L.	common guava	non-native	rare
Syzygium cumini (L.) Skeels	Java plum	non-native	uncommon
NYCTAGINACEAE (Four-o'clock Family)			
Boerhavia coccinea Mill.	scarlet spiderling	non-native	rare
OXALIDACEAE (Wood Sorrel Family)			
Oxalis corniculata L.	ihi,yellow wood sorrel	Polynesian	rare
PASSIFLORACEAE (Passion Flower Family)			
Passiflora edulis Sims	passion fruit	non-native	rare
Passiflora suberosa	cork bark passion flower	non-native	rare
PHYTOLACCACEAE (Pokeweed Family)			
Rivina humilis L.	coral berry	non-native	rare
PORTULACACEAE (Purslane Family)			
Portulaca pilosa L.	----------	non-native	rare
PROTEACEAE (Protea Family)			
Grevillea robusta A. Cunn. ex R. Br.	silk oak	non-native	rare
ROSACEAE (Rose Family)			
Osteomeles anthyllidifolia (Sm.) Lindl.	'ülei	indigenous	rare
RUBIACEAE (Coffee Family)			
Psydrax odorata (G. Forst.) A.C. Smith & S.P.Darwin	alahe'e	indigenous	rare
RUTACEAE (Rue Family)			
Citrus aurantiifolia (Cristmann) Swingle	lime	non-native	rare
SOLANACEAE (Nightshade Family)			
Nicandra physalodes (L.) Gaertn.	apple of Peru	non-native	rare
Solanum seaforthianum Andr.	Brazilian nightshade	non-native	rare
THYMELAEACEAE ('Akia Family)			
Wikstroemia oahuensis (A. Gray) Rock	'akia	endemic	rare
VERBENACEAE (Verbena Family)			
Lantana camara L.	lantana	non-native	rare
Stachytarpheta cayennensis (Rich.) Vahl	nettle-leaved vervain	non-native	rare
Stachytarpheta jamaicensis (L.) Vahl	Jamaica vervain	non-native	uncommon

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
ZYGOPHYLLACEAE (Creosote Bush Family)			
Tribulus terrestris L.	puncture vine	non-native	rare

FAUNA SURVEY REPORT

SURVEY METHODS

A walk-through survey method was conducted in conjunction with the botanical survey. All parts of the project corridor 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 document any evidence of occurrence of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) in the area.

RESULTS

MAMMALS

Six species of non-native mammals were observed during two site visits to the area. Taxonomy and nomenclature follow Tomich (1986).

Horse (*Equus caballus*) – Several horses were pastured along the lower corridor.

Dog (*Canis familiaris*) – A few domestic dogs from nearby properties were seen on the lower corridor.

Cat (*Felis catus*) – Signs of cats were seen along the western end of the corridor near the Kawailoa Solid Waste Transfer Station.

Cattle (*Bos Taurus*) – A few cattle were pastured along the lower corridor.

Pig (*Sus scrofa*) – Feral pig trails and tracks were seen in a gulch on the eastern side of the corridor.

Mongoose (*Herepestes auropunctatus*) – One mongoose was seen on the margin of the corridor during the early evening.

Dense vegetation prevented good visibility of other ground dwelling mammals, but a significant population of mice (*Mus domesticus*) and rats (*Rattus* spp.) would be expected in this type of habitat where they feed on seeds, fruits and herbaceous vegetation.

An evening survey was conducted at two sites along the corridor to see if any Endangered Hawaiian hoary bats were present. A Batbox IIID was employed, set to the frequency of 27,000 Hertz at which these bats are known to use for echolocation. No bat calls were detected at either

site using this device. Bats have been detected at higher elevations in the northern Ko'olau Range but were not found at these low elevation sites during this survey.

BIRDS

There was moderate avian diversity observed along the corridor during one full day and an evening. Twelve species of non-native birds were recorded from the area. Taxonomy and nomenclature follow American Ornithologists' Union (2010).

Red-vented bulbul (*Carpodacus mexicanus)* – Bulbuls were quite abundant along the entire corridor.

House finch (*Caropdacus mexicanus*) – House finches were seen in small flocks here and there along the corridor.

Zebra dove (*Geopelia striata*) – These small doves were fairly common along the corridor and in trees.

Spotted dove (*Streptopelia chinensis*) – Several of these large doves were seen in trees or in flight in the lower part of the corridor.

Common myna (*Acidotheres tristis*) – Several pairs of mynas were seen during the day time and into the early evening.

Northern cardinal (*Cardinalis cardinalis*) – These cardinals were seen and heard in trees in the lower corridor and in gulches.

Nutmeg manikin (*Lonchura punctulata*) – Two flocks of these tiny birds were seen feeding on seeds in the grasslands.

Japanese white-eye (*Zosterops japonicas*) – A few of these tiny green birds were seen and heard twittering in trees in the gulches.

House sparrow (*Passer domesticus*) – A few sparrows were seen in the lower part of the corridor near structures and equipment.

Gray francolin – (*Francolinus pondicerianus*) – A few gray francolins were seen in field margins and heard making their loud, distinctive calls.

White-rumped shama (*Copsychos malabricus*) – Two of these melodius singers were seen and heard in dense forests in gulches.

Red-crested cardinal (*Paroaria coronata*) – One of these bright red-headed cardinals was seen in a tree in the middle of the corridor.

A few other non-native bird species might be expected to utilize the project area, but it is not suitable habitat for Hawai'i's native forest birds which occupy native forests at higher elevations beyond the range of mosquitoes and the lethal avian diseases they transmit. No native birds were seen.

No sightings or signs of any native seabirds such as the wedge-tailed shearwater (*Puffinus pacificus*) or the Threatened Newell's shearwater (*Puffinus newelli*) were detected, and the habitat is not suitable for their nesting burrows. The Newell's shearwaters, however, could fly over this area in the evenings and early morning hours to reach their burrows that are typically located high in the wet forest ridge tops.

INSECTS

Insects in general were not tallied but they were observed and any Endangered and Threatened species were kept in mind. O'ahu has 6 Endangered and Threatened fruit fly species in the genus *Drosophila* and 6 candidates for such status among the native damselflies in the genus *Megalagrion*. The *Drosophila* species live in mesic to wet native forests at higher altitudes and the *Megalagrion* species frequent aquatic habitats or wet forests. None of these habitats occur within the project corridor and none of these species or their kin were seen.

DISCUSSION AND RECOMMENDATIONS

Six non-native mammals and twelve non-native birds were recorded along the 4.4 mile project corridor during the survey. No native mammals, birds, insects or snails were seen. Thus there were no Endangered or Threatened wildlife present and no candidates for such status.

No Endangered Hawaiian hoary bats were detected at two evening survey locations. It is possible, however, that these highly mobile bats could be present for short periods at the outset of the wet season when insect populations spike. There is nothing associated with this project that would pose a significant threat to these nocturnal flying mammals.

As a protective measure for protected seabirds that are often attracted to bright lights during the evening and early morning hours where they can crash and be injured or killed, it is recommended that any outdoor flood lights around the Operations and Maintenance Building be hooded to direct the light downwards to mitigate this threat.

With the above recommended measure in place, there is nothing about this project that is expected to have a significant negative impact on the wildlife resources in this part of O'ahu.

ANIMAL SPECIES LIST

Following is a checklist of the animal species inventoried during the field work. Animal species are arranged in descending abundance within two groups: Mammals and Birds. For each species the following information is provided:

1. Common name

2. Scientific name

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

   endemic = native only to Hawaii; not naturally occurring anywhere else in the world.
   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   non-native = all those 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.

COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE
MAMMALS			
Horse	*Equus caballus*	non-native	uncommon
Dog	*Canis familiaris*	non-native	uncommon
Cat	*Felis catus*	non-native	rare
Cattle	*Bos taurus*	non-native	rare
Pig	*Sus scrofa*	non-native	rare
Mongoose	*Herpestes auropunctatus*	non-native	rare
BIRDS			
Red-vented bulbul	*Pycnonotus cafer*	non-native	abundant
House finch	*Carpodacus mexicanus*	non-native	common
Zebra dove	*Geopelia striatus*	non-native	common
Spotted dove	*Streptopelia chinensis*	non-native	uncommon
Common myna	*Acridotheres tristis*	non-native	uncommon
Northern cardinal	*Cardinalis cardinalis*	non-native	uncommon
Nutmeg mannikin	*Lonchura punctulata*	non-native	uncommon
Japanese white-eye	*Zosterops japonicus*	non-native	rare
House sparrow	*Passer domesticus*	non-native	rare
Gray francolin	*Francolinus pondicerianus*	non-native	rare
White-rumped shama	*Copsychus malabaricus*	non-native	rare
Red-crested cardinal	*Paroaria coronata*	non-native	rare

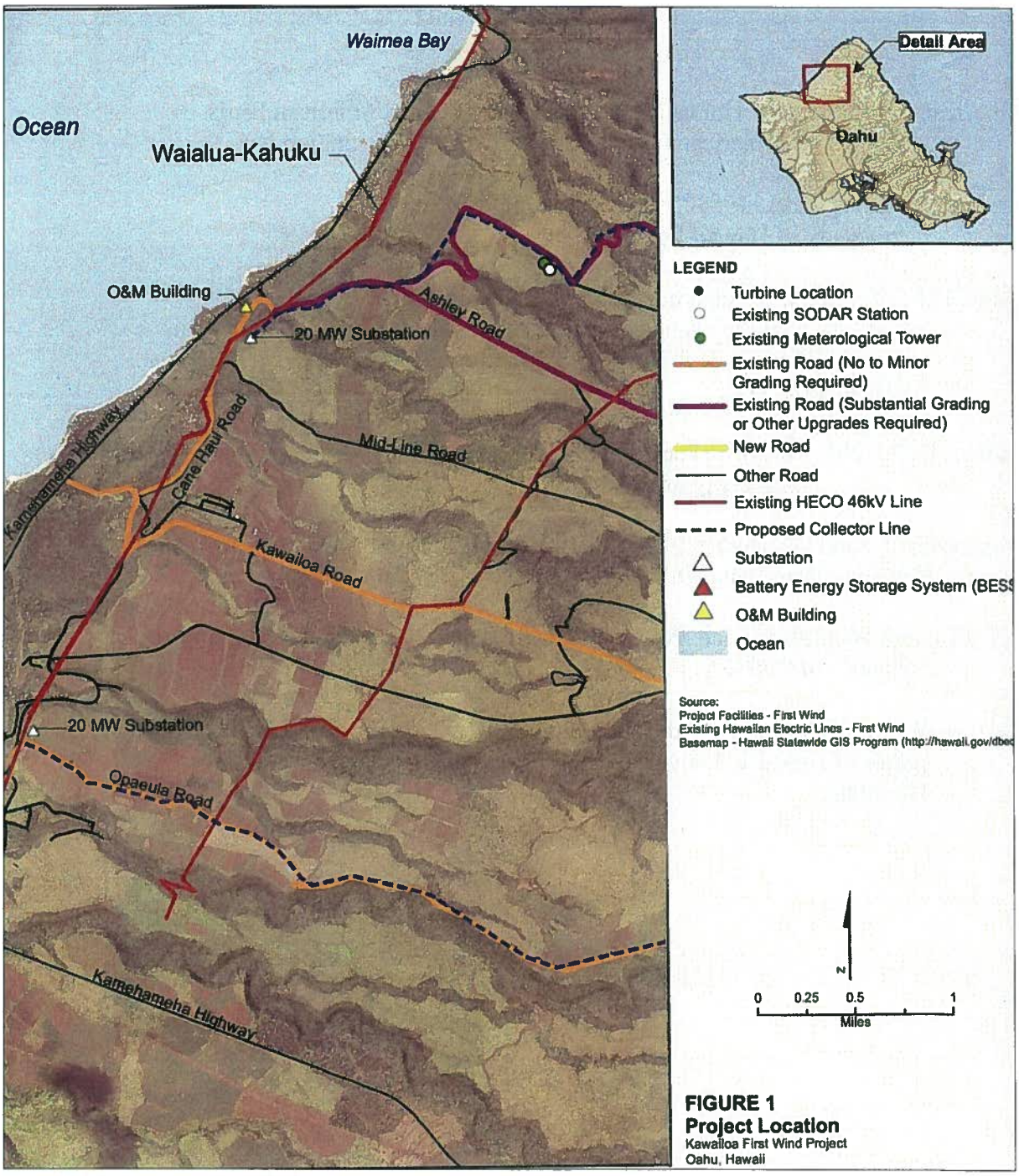

FIGURE 1
Project Location
Kawailoa First Wind Project
Oahu, Hawaii

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