APPENDIX

C

TERRESTRIAL VEGETATION AND WILDLIFE SURVEYS

FINAL REPORT

Terrestrial Vegetation and Wildlife Surveys for Hōkūao 201 H Affordable Housing Development, Lānaʻi City, Hawaiʻi

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Shaping the Future

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1 Introduction

The purpose of this report is to provide information regarding the occurrence of terrestrial plants and wildlife resources in the area encompassing the proposed construction of affordable housing in Lāna'i City, Hawai'i. Cardno was tasked with conducting biological surveys and preparing a report of findings to address the results from this and previous surveys. This report will be integrated with environmental compliance documentation submitted to state and county regulatory agencies for review and support issuance of appropriate environmental entitlements.

The proposed Lāna'i City expansion comprises approximately 50 acres of land in the Kamoku Ahupua'a of Lāna'i. The irregularly shaped project area is located immediately west of and downslope from Lāna'i City center. The site is bounded on the east by Fraser Avenue and two church parcels and bounded on the north by 9th Avenue and a dirt road following tax map key (TMK) boundaries. Most of the western boundary is marked by the chain-link fence boundary of the wastewater treatment plant, while the southern boundary follows 12th Avenue and Awalua Avenue. Photos of the area appear in Appendix A.

The proposed project has been titled "Hōkūao 201 H Affordable Housing Development" identified on tax maps as TMK: (2) 4–9–002:001 por., TMK: (2) 4–9–014:001 por., and TMK: (2) 4–9–014:009 por. (Figure 1).

> TMK: (2) 4–9–002:001 is a large parcel of approximately 86,036 acres covering most of Lāna'i, and includes both the island's undeveloped lands and most of the abandoned pineapple fields.
>
> TMK: (2) 4–9–014:001 is an approximately 84 acres parcel that is used today for storage, the Pūlama Lāna'i Nursery, and community gardens for Lāna'i residents.
>
> TMK: (2) 4–9–014:009 comprises approximately 25.65 acres and is the location of the island's original, now abandoned, power plant and the graded yard used to store shipping containers.

The three parcels that comprise the proposed project area are owned by Lāna'i Resorts, LLC.

The proposed project would be located close to Dole Park to take advantage of its walkable proximity to shops, groceries, and educational and entertainment venues. The project visually and physically connects to the town via 9th Avenue and 12th Avenue road extensions, continuing the existing street grid pattern into the new development. A wide concrete bike/walk path will be located on 9th Avenue to connect the community to Fraser Avenue.

Along the east edge, bordering the school fields, the project provides a one-acre park, a 1,500-square foot community pavilion, comfort stations, and 100 parking stalls for use by residents of Hōkūao.

The proposed project would involve construction of 200 single family homes, comprised of 102 affordable homes exclusively for purchase by buyers falling within the United States (U.S.) Department of Housing and Urban Development 2018 low-income guidelines, and 98 market-rate homes. All lots will typically be a minimum of 6,000 square feet, with a few 6,100 square feet lots on irregularly shaped corners. The character of the homes will reflect the existing design vocabulary of Lāna'i City.

Most of the project area topography consists of flat to gently sloping, open, patchy forest and scrub lands. An existing drainage swale on the western boundary of the site carries stormwater away from the existing town and community center. On the western flank, the project sets back from the existing wastewater treatment plant with a 600-foot buffer between the closest lot and the wastewater treatment plant edge.

Soils and vegetation adjacent to the roadway have been disturbed by previous flooding, grading, and side-casting of asphalt and construction debris. The soils here consist predominantly of silty clay and all are well drained (USDA 2014a). None of these soils series meet the definition of a hydric soil on the current Hydric Soil List (USDA 2014b). The area is underlain by Pleistocene lava flows from the Lāna'i shield volcano (Sherrod et al. 2007). Soils at the site are predominantly "Waihuna Clay" (NRCS 2013). The area surrounding Fraser Avenue is underlain by Quaternary alluvial surficial deposits (Sherrod et al. 2007).

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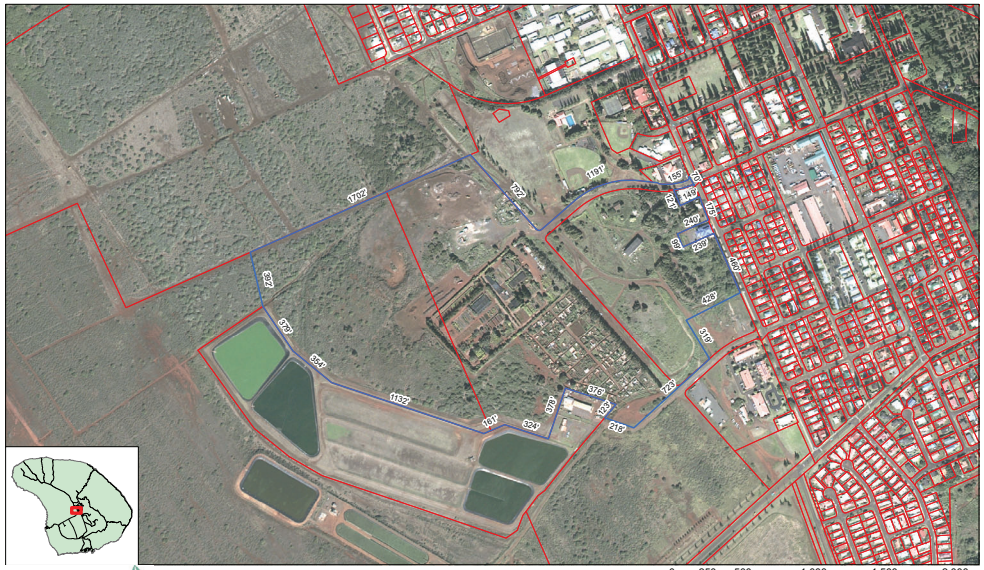
2 Methods of Study

Terrestrial wildlife and vegetation surveys were conducted by biologists John Ford and Maya LeGrande. Prior to conducting field work, the biologists reviewed existing scientific literature, previously prepared environmental compliance documents, biological survey reports, topographic maps and images, and engineering drawings relevant to the proposed project. Previous surveys conducted in the same area by Bruner (2000), Char (2000), Guinther (2008), Hobdy (2008), ICF International (2013, 2014, and 2015), and Nagata (1986, 1990, and 1991) were also reviewed. There have been no additional terrestrial biological surveys within the project area over the past two years (Donoho 2018).

The U.S. Fish and Wildlife Service (USFWS) website was viewed to determine if any listed threatened or endangered species are known to reside within or adjacent to the project area (USFWS 2018a).

Field observations within the project area were conducted on June 30, 2016 between 10:00 a.m. and 6:15 p.m. and on July 1, 2016 between 5:30 a.m. and 10:30 a.m. Figure 2 illustrates the areal extent of the terrestrial biological studies and the relative locations of point count stations. The weather at the times of data collection was partly cloudy to overcast with light winds. All observed plant species were documented. Plant associations and distribution, disturbances, topography, substrate types, exposure, drainage, and related factors were noted. Rocky outcrops, shaded areas, and depressions that are more likely to support native plant species were intensively surveyed.

Birds were identified visually with Nikon 8 x 42 6.3-degree binoculars as well as by their vocalizations. Four 8-minute point count stations with a radius of 300 feet (Scott et al. 1986) were established at representative locations within the project area (see Table 1 and Figure 2). Additional observations were also collected as noted above. Observations of mammals, amphibians, reptiles, and insects were made incidental to the avian surveys and related surveys of vegetation.



Pūlama Lānaʻi

Date: 5/17/2016

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3 Results

3.1 Vegetation

Native plant habitats within the proposed project area have been highly modified by human activities, including commercial agricultural, road building, grading, residential construction, and the intentional and accidental introduction of alien species. The overwhelming abundance of non-native plant species throughout the project area is directly correlated to disturbances over the last several hundred years. The project area consists largely of undeveloped lands and lies adjacent to a commercial plant nursery and community gardens. A total of 156 plant species were observed within the proposed project area. Of the observed species, 153 species are alien (introduced) and three are native (two indigenous and one endemic). An inventory of all plant species observed within the project area is presented in Appendix B at the end of this report.

The undeveloped land to the west of the community gardens and to the north of the existing sewage treatment ponds (Photo 1 in Appendix A) is dominated by a mix of sourgrass (*Digitaria insularis*) and golden crown-beard (*Verbesina encelioides*) along with trees including Christmas berry (*Schinus terebinthifolius*), Formosa *koa* (*Acacia confusa*), and *koa haole* (*Leucaena leucocephala*). Other weedy species observed scattered throughout the area included lantana (*Lantana camara*), apple of Sodom (*Solanum linnaeanum*), jimson weed (*Datura stramonium*), tree tobacco (*Nicotiana glauca*), balloon plant (*Asclepias physocarpa*), spiny amaranth (*Amaranthus spinosus*), and Guinea grass (*Megathyrsus maximus*).

Two native plant species commonly found within the undeveloped lands included the indigenous *'uhaloa* (*Waltheria indica*), which was scattered along existing dirt roadways, and a single endemic *koa* (*Acacia koa*) tree that was observed near the center of the project area. Sections near the southern boundary of the project area were colonized by a nearly impenetrable forest of Formosa *koa* and Christmas berry with Guinea grass understory.

The eastern section of the undeveloped lands lies just off Fraser Avenue. Ironwood (*Casuarina equisetifolia*) is the dominant tree species in the area with a thick understory of matted ironwood needles where little else grows. Species observed along the edges of the forest include Guinea grass, balloon plant, lantana, spiny amaranth, prickly lettuce (*Lactuca serriola*), *popolo* (*Solanum americanum*), and Jamaican vervain (*Stachytarpheta jamaicensis*). Other tree species include African tulip (*Spathodea campanulata*), Chinese banyan (*Ficus microcarpa*), Formosa *koa*, and Christmas berry.

The plant nursery is located at the center of the overall project area and is dominated by ornamental species (Photo 2 in Appendix A). These species are not included in the overall species list so as to not skew the naturalized species data for the overall project area. Weedy and/or naturalized species noted along the periphery of the nursery were included in the species list. These included *laua'e* (*Phymatosorus grossus*), Chinese banyan, African tulip, pigweed (*Portulaca oleracea*), and Guinea grass. Many large ornamental trees are located within the nursery and have either become established by growing into the ground from their containers or appear to have been intentionally planted. Established tree species include Cook Island pines (*Araucaria columnaris*), orchid tree (*Bauhinia sp.*), *kukui* (*Aleurites moluccana*), coconut (*Cocos nucifera*), variegated *hau* (*Hibiscus tiliaceus*), magnolia (*Magnolia grandiflora*), mango (*Mangifera indica*), jacaranda (*Jacaranda mimosifolia*), *pua kenikeni* (*Fragraea berteroana*), and Moreton Bay fig (*Ficus macrophylla*).

A community garden lies to the southeast of the plant nursery (Photo 3 in Appendix A). It is composed of numerous small lots subdivided by makeshift fences and corrugated metal sheets and contains various structures that house farm animals, such as goats and chickens. Many of the parcels have fruits and vegetables planted including papaya (*Carica papaya*), banana (*Musa* sp.), avocado (*Persea americana*), malunggay (*Moringa oleifera*), citrus species (*Citrus* spp.), and Indian mulberry (*Morinda citrifolia*). The majority of the area is bare dirt with few weedy plants species growing within the parcels. The periphery of this area is dominated by Guinea grass, African tulip trees, and indigo (*Indigofera suffruticosa*).

The USFWS's Wetlands Mapper (USFWS 2018b) identifies a 0.78 acre freshwater pond and adjacent 0.75 acre freshwater emergent wetland approximately 1,000 feet west of the swimming pool and baseball field recreational complex, which is within the boundaries of the proposed project area. These features were mapped in 1976 based upon black and white aerial photography, and may have been related to commercial plantation operations. However, no evidence of either feature was found during the field surveys and no wetlands occur within the boundaries of the proposed housing development.

3.2 Wildlife

During the surveys, 13 species of birds were observed and/or heard during four 8-minute point counts at representative locations within the proposed project area (Table 1). Four additional species of birds were observed incidentally within the proposed project area, including the rock pigeon (*Columba livia*), cattle egret (*Bulbulcus ibis*), wild turkey (*Meleagris gallopavo*), and gray francolin (*Francolinus pondicerianus*).

The most conspicuous species observed and/or heard throughout the project area during this survey was the common mynah (*Acridotheres tristis*) (Table 1). Species commonly observed/heard within densely vegetated areas include common mynahs, Japanese white-eye (*Zosterops japonicus*), Japanese bush warbler (*Horornis diphone),* and northern cardinal (*Cardinalis cardinalis*). The most conspicuous species of birds observed/heard in open and edge habitats included common mynah, zebra dove (*Geopelia striata*), and house sparrow (*Passer domesticus*). Wild turkeys were occasionally seen around edge habitats.

Previous studies cited above that were conducted within the same general vicinity during fall and winter months reported finding some migratory winter resident species not seen including the Pacific golden plover (*Pluvialis fulva*), wandering tattler (*Tringa incana*), ruddy turnstone (*Arenaria interpres*), sanderling (*Calidris alba*). Other species reported from the vicinity of Lāna'i City in previous surveys include the red-crested cardinal (*Paroaria coronata*), barn owl (*Tyto alba*), Hawaiian short-eared owl or *pueo* (*Asio flammeus sandwichensis*), white-rumped shama (*Copsychus malabaricus*), northern mockingbird (*Mimus polyglottos*), and Java sparrow (*Padda* oryzivora), and nutmeg manikin (*Lonchura punctulata*).

All but three of the avian species observed within the project area were naturalized alien species. These findings are consistent with previous biological surveys in the vicinity of Lāna'i City. Appendix C lists all bird species observed during surveys and previously reported as being within the proposed project area.

Stations 1-4 locations are illustrated in Figure 2. Only birds observed within project boundaries are listed.

Table 1 Results of 8-minute Point Counts Within the Proposed Project Area

Common Name*	Species Name	Status	Number of Point Count Stations	RA**	Location and Number of Point Counts			
					Station 1	Station 2	Station 3	Station 4
					Number of Individals Observed			
Common mynah	*Acridotheres tristis*	A	4	7.50	8	3	7	12
House sparrow	*Passer domesticus*	A	4	1.50	3	1	1	1
Japanese bush warbler	*Horornis diphone*	A	3	2.25		4	3	2
Spotted dove	*Steptopelia chinensis*	A	3	1.25	2		2	1
Japanese white-eye	*Zosterops japonicus*	A	3	1.00	1	2		1
Red jungle fowl	*Gallus gallus*	A	2	2.75	10		1	
African silverbill	*Euodice cantans*	A	2	2.00			2	6
Zebra dove	*Geopelia striata*	A	2	1.50	1			5
Northern cardinal	*Cardinalis cardinalis*	A[1]	2	1.25		4		1
Black-crowned night heron	*Nycticorax nycticorax*	IR	1	1.25	1		4	
Wild turkey	*Meleagris gallopavo*	A	1	1.25	3			2
House finch	*Haemorhous mexicanus*	A[1]	1	0.75			3	
Skylark	*Alauda arvensis*	A	1	0.25		1		
			Total Number of Birds at Each Location		29	15	23	31

* Species listed by broadest relative distribution across 4 point count stations.
** RA=Relative abundance (total no. observations/total no. point count stations)
Key to Status: A=alien introduced by humans; IR=indigenous resident; ER=endemic resident; LE=listed endangered
[1] Denotes protection under the Migratory Bird Treaty Act (MBTA).

None of the project area is encumbered by critical habitat for endangered species (USFWS 2016). No listed threatened or endangered species of birds were found within the boundaries of the proposed project; however, six listed endangered Hawaiian black-necked stilt (*Himantopus mexicanus knudseni*) and four listed endangered Hawaiian coot (*Fulica alai*) were observed foraging in the sewage treatment ponds at dawn approximately 600 feet beyond the southwestern boundary of the proposed project area. At the same time, at least 50 indigenous resident black-crowned night herons (*Nycticorax nycticorax hoactli*) were observed foraging in the northernmost wastewater treatment pond outside the boundary of the proposed project area. These three species are also protected under the Migratory Bird Treaty Act.

Axis deer (*Axis axis*) were frequently seen during this survey, particularly in scrub forest habitat on the northern portion of the project area along the boundary road. The entire project area is crisscrossed with deer trails, tracks, and scat. Deer were also reported within the project area during previous studies (ICF 2015, 2013a, 2013b). Cats (*Felis catus)* and dogs (*Canis familiaris*) were observed at residences within Lāna‘i City along the northeastern margin of the project area.

Numerous metallic skinks (*Lampropholis delicata*) were observed in leaf litter and exposed bedrock along the edges of house lots and drainage ways. The Bishop Museum’s Hawaiian herpetology checklist (Bishop Museum Hawaii Biological Survey 2018) recognizes only two species of geckos on Lāna‘i: the common house gecko (*Hemidactylus frenatus*) and mourning gecko (*Lepidodactylus lugubris*). Although no geckos were observed within the project area, their calls were occasionally heard.

4 Discussion

The results represent a one-time snapshot of the wildlife and plants inhabiting the project area. As such, these data cannot be considered a definitive list of all species that utilize habitats within the project area. Many species are diminutive and cryptic in nature making observation difficult. Other species are nocturnal and/or may use the area infrequently depending upon season, weather, interaction with other species, and dynamic changes in their populations. Other species may be itinerant or accidental visitors to the site. However, when considered together with the results of historical records, a reasonably accurate description of the environment and biota of the project area can be compiled.

The nature of the land and its present and historical disturbances very much limit the natural botanical resources anticipated to occur here. The results of the surveys substantiate this prediction. The rare frequency of native plant species is an indication that because of constant disturbances (i.e., habitat modification, invasive plant species, feral ungulates), only species adapted to such conditions can survive, with few exceptions. Only two widespread indigenous plant species were observed during the survey, *popolo* and *‘uhaloa*. The single endemic species, *koa*, was most likely planted at the existing location. None of the plant species observed are listed as threatened or endangered.

The native avifauna of Lāna‘i has changed radically since the early 1900s. Hirai (1978) described the native birds of Lāna‘i, none of which were observed during the surveys. Hobdy (1993) chronicled the decline in indigenous birds and other species of endemic wildlife and plants on Lāna‘i due to interactions with alien species, habitat loss, and disease. Lepage (2018) lists a total of 106 species of birds reported from Lāna‘i, of which 3 are endemic, 14 are globally threatened, 4 are extinct, and 28 are introduced aliens. Many sightings are considered as rare or accidental visitors.

No listed endangered endemic land snails (*Partula variabilis* or *P. semicarinata*) were observed during the surveys. Populations of these two species have been decimated through a long history of predation by non-native animals, loss of native host plants due to grazing and trampling by Axis deer, mouflon sheep, cattle, goats, and pigs (USFWS 2013). They have also suffered from habitat loss by clearing for agriculture and urban development. Their native habitats included wet lowland, mesic, and cliff forests, and their distribution was usually limited to endemic and indigenous plants; although, they have been found on introduced guava (*Psidium guajava*) and New Zealand tea (*Cordyline australis*) plants in relatively undisturbed forests.

Although none were observed during the surveys, the native *pueo* or Hawaiian short-eared owl is common on Lāna‘i and forages in open grassy areas. It is reasonable to assume that the proposed project area represents potential foraging habitat for them.

Axis deer are found throughout the project areas. Their grazing limits the native plant species that might otherwise be expected to occur on Lāna‘i. Feral cats are found on Lāna‘i and constitute a serious threat to nesting seabirds on Lanaihale. Norway rats (*Rattus norvegicus*), Polynesian rats (*Rattus exulans hawaiiensis*) and European house mice (*Mus domesticus*) are present on Lāna‘i (Tomich 1986) and are likely to occur within the proposed project area, although none were observed. These introduced predators are known to have detrimental impacts upon populations of native wildlife and also serve as a means of passive transport for propagules of invasive and noxious plants.

No listed endangered Hawaiian hoary bats, or *‘ope‘ape‘a* (*Lasiurus cinereus semotus*) were observed. Their populations on Lāna‘i are believed to be very low (Tetra Tech 2008), and scientists have speculated that bats found on Lāna‘i are most likely itinerants from neighboring islands with higher elevations.

Although endangered Hawaiian petrels or *‘ua‘u* (*Pterodroma sandwichensis*) do not nest within or near the project area, a breeding colony was found in 2006 (Tetra Tech 2008) at Lanaihale approximately three miles to the east southeast of the center of the proposed development. *‘Ua‘u* attend the colony at night and nest in burrows in the ground, under dense *uluhe* (*Dicranopertis linearis)* ferns. Fledgling petrels are known to be confused by bright lights and have collided with man-made structures (Division of Forestry and Wildlife [DOFAW] 2005). In studies conducted in 2007, Hawai‘i DOFAW biologists found that petrels fledged from the Lanaihale

colony between early November and December. Collisions with lights by seabirds have been reported on Lāna'i in the past (Costales 2013); therefore, the use of shaded lighting to minimize detrimental impacts to seabirds is warranted.

The USFWS listed five species of endemic Hawaiian yellow-faced bees as endangered on Lāna'i: *Hylaeus anthracinus, H. assimulans, H. facilis, H. hilaris, and H. longiceps* (USFWS 2016). Historically, 15 species were known from Lāna'i (Daly and Magnacca 2003); however, none of these have been reported recently from the project area in Lāna'i City. Eight of these species have been reported on Lāna'i between dry shrublands at sea level to mesic and wet forest habitats up to the summit area of the island at 3,000 feet elevation (Magnacca 2007). Seven of the eight species recently recorded are known from coastal, dry forest and shrubland habitats (Magnacca 2007). Magnacca (2007) stated that solitary native bees are known to utilize many different plants as food sources at any given time. Recent molecular studies by Wilson, et al. (2010) suggested a high degree of fidelity in pollen foraging behavior on native plant species by these native bees. No native Hawaiian yellow-faced bees were observed during surveys of the project area.

5 Recommendations

Care should be taken during site clearing and construction to reduce the risk of introducing noxious weeds or other invasive alien species to the island of Lāna'i. At this time, no equipment is planned to be brought from off island. However, if construction equipment is planned to be brought from off island, it should be cleaned of mud, soil, seeds, insects, and amphibians and their eggs prior to their use at the project sites.

All materials imported to the project site, including gravel, soil, rock, and sand, should be free of invasive plants. All materials should be stockpiled at a designated staging area to prevent their contamination.

Graded sites should be re-vegetated as soon as practicable with plants from Lāna'i. Imported plants used in landscaping should first be quarantined in an enclosed location away from the project site. All imported plants should be inspected to ensure that they are free from invasive species that could arrive inadvertently, such as coqui frogs (*Eleutherodactylus coqui*), little fire ants (*Wasmannia auropunctata*), and *Miconia* (*Miconia calvescens*) seedlings. A list of invasive plant and animal species of particular concern in Hawai'i may be found on the Hawai'i Invasive Species Council website: http://dlnr.hawaii.gov/hisc/info/invasive-species-profiles/.

If seed mixtures are to be applied by hydro-seeding and hydro-mulching, they should be free of non-native weeds. Any species of plants other than those intended to be in the hydro-seed/hydro-mulch should be removed. In particular, plant species that are not known to occur on Lāna'i and those that are actively being controlled on Lāna'i should be removed.

To the maximum extent possible, landscaping should be done with indigenous and endemic flora which is known from elevations and climate regimes on Lāna'i and/or elsewhere in Hawai'i similar to that of the proposed project area. It would be beneficial to retain as many of these large mature trees within the project area as possible during the construction of the housing.

Industry standard best management practices (BMPs) should be employed when working within drainage ways to minimize the risk of soil erosion into adjacent drainage ways. These may include but not be limited to the use of silt curtains, coir logs and/or blankets, sediment traps, slope and inlet protection, temporary stabilization, and dust control.

Maintenance of a 600-foot buffer from the existing sewage treatment ponds should be sufficient to prevent disturbance to listed endangered Hawaiian black-necked stilt and coot, and should not interfere with seasonal foraging by migratory shorebirds and waterfowl at the ponds. Additional fencing associated with the proposed project will help deter disturbance of the waterbirds at the sewage ponds by humans and house pets.

All lighting associated with the construction of new homes for the proposed project will need to be designed with accepted federal, state, and county mitigation measures to help prevent the fallout of fledgling seabirds, which can be confused by stray lighting, from their burrows on nearby Lanaihale (Telfer et al., 1987). Relevant information is available in the Maui County Code of Ordinances Title 20 Chapter 35. Additional guidance is provided by the International Dark Sky Association that can assist in finding acceptable lighting fixtures for virtually all applications: http://darksky.org/fsa/fsa-products/. Appendix D provides additional information provided by the USFWS for use in selecting lighting for the proposed housing project.

In accordance with current USFWS guidance for mitigation of impacts to Hawaiian hoary bats, the project should avoid or minimize the removal of trees over 15 feet in height and prohibit clearing of these tress from June 1 to September 15 to help ensure that non-volant Hawaiian hoary bat pups are not harmed.

6 Glossary

Alien	Introduced by humans
BMP	Best Management Practice
DOFAW	Department of Land and Natural Resources Division of Forestry and Wildlife
EA	Environmental Assessment
Endangered	Formally protected by applicable Federal and/or State laws
Endemic	Native species occurring only in the Hawaiian Islands
Feral	Domesticated, non-native species established in the wild
GAP	National Gap Analysis Program
Incidental Observation	Observations of species made outside formal point counts
Indigenous species	Hawaiian native species naturally occurring elsewhere
Itinerant species	Species native to other regions that make occasional visits to Hawai'i
Invasive species	Species not native to Hawai'i that are harmful to the environment, economy, and/or public health
Nocturnal	Referring to night time
Non-volant	Young bats or birds not yet able to fly and escape harm
TMK	Tax Map Key
U.S.	United States
USFWS	U.S. Fish and Wildlife Services

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Appendix A Site Photographs

Photo 1. Undeveloped lands to the west of the community gardens and nursery consist of fallow pineapple fields crisscrossed with shallow swales and bounded by jeep trails.

Photo 2. The company nursery occupies an area of approximately 10 acres near the center of the proposed housing development.

Photo 3. This open corridor of disturbed habitat lies between the tall trees that line the boundaries of the community gardens on the left and tall Guinea grass and mixed scrub forest on the right.

Appendix B Plant Species List

The following checklist is an inventory of all the plant species observed within the Hōkūao 201 H Affordable Housing Development area. The plant names are arranged alphabetically by family and then by species into each of four groups: Pteridophytes, Gymnosperms, Monocots, and Dicots. The taxonomy and nomenclature of the flowering plants (Monocots and Dicots) are in accordance with Wagner et al. (1990), Wagner and Herbst (1999), and Staples and Herbst (2005). Recent name changes are those recorded in the Hawai'i Biological Survey series (Evenhuis and Eldredge, eds., 1999-2002). For each species, the following name is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name(s), when known.
3. Biogeographic status. The following symbols are used:

   E = endemic = native only to the Hawaiian Islands.

   I = indigenous = native to the Hawaiian Islands and elsewhere.

   X = introduced or alien = plants brought to the Hawaiian Islands by humans, intentionally or accidentally, after western contact (i.e., Cook's arrival in the islands in 1778).

SCIENTIFIC NAME	COMMON NAME	STATUS
PTERIDOPHYTES		
POLYPODIACEAE		
Phymatosorus grossus (Langsd.&Fisch.) Brownlie	*laua'e*	X
GYMNOSPERMS		
ARAUCARIACEAE		
Araucaria columnaris (G.Forst) D.Hooker	Cook Island pine	X
MONOCOTS		
AGAVACEAE		
Cordyline fruticosa (L.) A.Chev.	*ti, ki*	X
ALOEACEAE		
Aloe vera (L.) N.L.Burm.	aloe	X
ARECACEAE		
Caryota mitis L.	fish tail palm	X
Cocos nucifera L.	coconut	X
Phoenix dactylifera L.	date palm	X
Veitchia merrillii (Beccari) H.E.Moore	Manila palm	X
COMMELINACEAE		
Commelina benghalensis L.	hairy dayflower	X
Commelina diffusa N.L. Burm	dayflower	X
CYPERACEAE		
Cyperus rotundus L.	*kili 'o'opu*	X
POACEAE		
Brachiaria mutica (Forssk.) Stapf	California grass	X
Cenchrus ciliaris L.	buffelgrass	X
Cenchrus echinatus L.	common sandbur	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Chloris radiata (L.) Sw.	radiate fingergrass	X
Chloris barbata (L.) Sw.	swollen fingergrass	X
Cynodon dactylon (L.) Pers	*mānienie*	X
Digitaria insularis (L.) Mez ex Ekman	sourgrass	X
Eleusine indica (L.) Gaertn.	beach wiregrass	X
Eragrostis amabilis (L.) Wight&Arnott	lovegrass	X
Eragrostis tenella (L.) P.Beauv. Ex Roem.&Schult.		X
Melinus minutiflora P.Beauv.	molasses grass	X
Melinus repens (Willd.) Zizka	natal redtop	X
Megathyrsus maximus (Jacq.) B.K. Simon & S.W.L. Jacobs	Guinea grass	X
Paspalum urvillei Steud.	Vasey grass	X
Setaria verticillata (L.) P.Beauv.	bristly foxtail	X
DICOTS		
ACANTHACEAE		
Asystasia gangetica (L.) T. Anderson	Chinese violet	X
Justicia betonica	white shrimp plant	X
Thunbergia alata Bojer ex Sims	Black-eyed susan	X
Thunbergia fragrans Roxb.	White thunbergia	X
AIZOACEAE		
Tetragonia tetragonioides (Pall.) Kuntze	New Zealand spinach	X
AMARANTHACEAE		
Achyranthes aspera L.		X
Alternanthera pungens Kunth	khaki weed	X
Amaranthus spinosus L.	spiny amaranth	X
Amaranthus viridis L.	slender amaranth	X
ANACARDIACEAE		
Mangifera indica L.	mango	X
Schinus terebinthifolius Raddi	Christmas berry	X
APIACEAE		
Ciclospermum leptophyllum (Endl.) Sprague	fir-leaved celery	X
APOCYNACEAE		
Thevetia peruviana (Pers.) K.Schum.	be-still tree	X
ARALIACEAE		
Schefflera actinophylla (Endl.) Harms	octopus tree	X
ASCLEPIADACEAE		
Asclepias physocarpa (E.Mey.) Schltr.	balloon plant	X
ASTERACEAE		
Ageratum conyzoides L.	Ageratum	X
Bidens alba (L.) DC. var. radiata Ballard ex Melchert	beggar tick	X
Bidens pilosa L.	Spanish needle	X
Conyza bonariensis (L.) Cronq.	hairy horseweed	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Crassocephalum crepidioides (Benth.) S.Moore	crassocephalum	X
Emilia fosbergii Nicolson	red *pualele*	X
Lactuca serriola L.	prickly lettuce	X
Pluchea carolinensis (Jacq.) G. Don	sourbush	X
Pluchea indica (L.) Less.	Indian fleabane	X
Senecio madagascariensis Poir.	fireweed	X
Sonchus oleraceus L.	*pualele*	X
Sphagneticola trilobata (L.) Pruski	wedelia	X
Synedrella nodiflora (L.) Gaertn.	nodeweed	X
Tridax procumbens (L.)	coat buttons	X
Verbesina encelioides (Cav.) Benth. & Hook	golden crown-beard	X
Xanthium strumarium var. canadense Mill.	cocklebur	X
BASELLACEAE		
Anredera cordifolia L.	Madeira vine	X
BIGNONIACEAE		
Spathodea campanulata P. Beauv.	African tulip	X
BORAGINACEAE		
Heliotropium procumbens Mill. var. *depressum*		X
BRASSICACEAE		
Capsella rubella Reut.	shepherd's purse	X
Cardamine flexuosa With.	bittercress	X
Coronopus didymus (L.) Small	swinecress	X
Lepidium virginicum L.	pepperwort	X
CACTACEAE		
Hylocereus undatus (Haw.) Britton & Rose	night blooming cereus	X
CARICACEAE		
Carica papaya L.	papaya	X
CASUARINACEAE		
Casuarina equisetifolia L.	ironwood	X
CHENOPODIACEAE		
Atriplex semibaccata R.Br.	Australian saltbush	X
Chenopodium murale L.	*'āheahea*	X
CLUSIACEAE		
Clusia rosea Jacq.	autograph tree	X
COMBRETACEAE		
Terminalia cattapa L.	tropical almond	X
CONVOLVULACEAE		
Ipomoea cairica (L.) Sweet	ivy leaved morning glory	X
Ipomoea obscura (L.) Ker Gawl.		X
Ipomoea triloba L.	little bell	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Merremia aegyptia (L.) Urb.	hairy merremia	X
Merremia tuberosa (L.) Rendle	wood rose	X
CUCURBITACEAE		
Coccinea grandis (L.) Voigt	ivy gourd	X
Cucumis dispaceus Ehrenb. Ex Spach	hedgehog gourd	X
Momordica charantia L.	balsam pear	X
EUPHORBIACEAE		
Aleurites moluccana (L.) Willd.	*kukui*	X
Chamaesyce hirta (L.) Millsp.	hairy spurge	X
Chamaesyce hypercifolia (L.) Millsp.	graceful spurge	X
Chamaesyce prostrata (Aiton) Small	prostrate spurge	X
Euphorbia heterophylla L.	*kaliko*	X
Ricinus communis L.	castor bean	X
FABACEAE		
Acacia confusa Merr.	Formosa koa	X
Acacia farnesiana (L.) Willd.	klu, aroma, *kolū*	X
Acacia koa A.Gray	*koa*	E
Bauhina x blakeana	Hong Kong orchid tree	X
Cassia sp.	shower tree	X
Chamaecrista nictitans (L.) Moench	partridge pea	X
Crotalaria incana L.	fuzzy rattlepod	X
Crotalaria pallida Aiton	smooth rattlepod	X
Desmanthus pernambucanus (L.) Thell.	slender or virgate mimosa	X
Desmodium tortuosum (Sw.) DC	Florida beggarweed	X
Indigofera hendecaphylla Jacq.	creeping indigo	X
Indigofera suffritocosa Mill.	*'inikō*	X
Leucaena leucocephala (Lam.) de Wit	*koa haole*	X
Macroptilium atropurpureum (DC) Urb.		X
Macroptilium lathyroides (L.) Urb.	wild bean	X
Medicago polymorpha L.	bur clover	X
Mimosa pudica var. *unijuga* Duchass.	sensitive plant	X
Neonotonia whightii (Whight&Arnott) Lackey		X
Pithecellobium dulce (Roxb.) Benth.	opiuma	X
Prosopis pallida (Humb. & Bonpl. Ex Willd.) Kunth	*kiawe*, algaroba	X
Samanea saman (Jacq.) Merr.	monkeypod	X
Senna surattensis (Burm.f.)	*kolomona*	X
Tamarindus indica L.	tamarind	X
LAMIACEAE		
Hyptis pectinata (L.) Poit.	comb hyptis	X
Leonotis nepetifolia (L.) R.Br.	lion's ear	X
Ocimum gratissumum L.	wild basil	X
LAURACEAE		
Cinnamomum burmanii L.	Padang cassia	X
Persea americana Mill.	avocado	X

SCIENTIFIC NAME	COMMON NAME	STATUS
MALVACEAE		
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	X
Hibiscus sp.	hibiscus	X
Malva parviflora L.	cheese weed	X
Malvastrum coromandelianum (L.) Garcke	false mallow	X
Sida acuta subsp. *carpinifolia* (L.f.) Borss.Walk.		X
Sida ciliaris L.		X
Sida rhombifolia L.		X
Sida spinosa L.	prickly sida	X
Sidastrum micranthum (St.Hil.) Fryx.		X
Thespesia populnea (L.) Sol. Ex Correa	*milo*	X
MELIACEAE		
Khaya sengalensis L.	mahogany	X
Melia azedarach L.	chinaberry	X
MORACEAE		
Artocarpus atilis (Z) Fosberg	breadfruit	X
Ficus benghalensis L.	Indian banyan	X
Ficus macrophylla L.	Moreton Bay fig	X
Ficus microcarpa L.f.	Chinese banyan	X
Ficus religiosa	Bo tree	X
MYRTACEAE		
Eucalyptus citriodora Hook.	lemon gum	X
Eucalyptus crebra F.v. Muell.	narrow leaved ironbark	X
Psidium guajava L.	guava	X
Syzygium cuminii (L.) Skeels	Java plum	X
NYCTAGINACEAE		
Boerhavia coccinea Mill.		X
Bougainvillea sp. A.L. Jussieu	bougainvillea	X
OXALIDACEAE		
Oxalis corniculata L.	yellow wood sorrel	X
PASSIFLORACEAE		
Passiflora foetida L.	love-in-a-mist	X
PHYTOLACCACEAE		
Rivina humilis L.	coral berry	X
PLANTAGINACEAE		
Plantago major L.	common plantain	X
POLYGONACEAE		
Antigonon leptopus Hook&Arnott	Mexican creeper	X
Coccoloba uvifera	sea grape	X
PORTULACACEAE		
Portulaca oleracea L.	pigweed	X

SCIENTIFIC NAME	COMMON NAME	STATUS
PROTEACEAE		
Grevillea robusta A.Cunn. Ex R.Br.	silk oak	X
RUBIACEAE		
Spermacoce assurgens Ruiz&Pavon	buttonweed	X
RUTACEAE		
Citrus sp.	orange/pummel	X
Murraya paniculata (L.) Jack	mock orange	X
SOLANACEAE		
Datura stramonium L.	jimson weed	X
Nicotiana glauca Graham	tree tobacco	X
Nicandra physalodes (L.) Gaertn.	apple of Peru	X
Solanum americanum Mill.	glossy nightshade, popolo	I
Solanum lycopersicum L. var. cerasiforme (Dunal) Spooner, G.J. Anderson & R.K. Jansen	cherry tomato	X
Solanum linnaeanum Andrews	Apple of Sodom	X
STERCULIACEAE		
Waltheria indica L.	*'uhaloa*	I
VERBENACEAE		
Lantana camara L.	Lantana	X
Stachytarpheta australis Moldenke		X
Stachytarpheta jamaicensis (L.) Vahl	Jamaican vervain	X

Appendix C Avian Species List

The following checklist is an inventory of all the bird species observed June 30 through July 1, 2016 within the area proposed for the Hōkūao 201 H Affordable Housing Development. It also includes the results of previous studies in areas immediately adjacent to, and sometimes overlapping, the current project area. Nomenclature follows Chesser, et al (2018) at http://checklist.aou.org/taxa; last accessed October 3, 2018. The following symbols are used to describe biogeographic status of each species (based upon Pyle and Pyle 2009, http://hbs.bishopmuseum.org/birds/rlp-monograph/PrimaryChecklist.htm):

R - Resident (Endemic or Indigenous)
N - Naturalized (non-native) resident (established and breeding)
n - Naturalized (non-native) visitor from other islands
B - Breeding Visitor
W - Winter Resident (some may migrate through the islands)
* - Species protected under the Migratory Bird Treaty Act

SCIENTIFIC NAME	COMMON NAME	CARDNO SURVEY	PREVIOUS SURVEYS
GALLIFORMES			
PHASANIDAE			
Francolinus pondicerianus	Gray francolin (N)	X	✓
Meleagris gallopavo	Wild turkey (N)	X	✓
Gallus gallus	Red junglefowl (N)	X	✓
PELECANIFORMES			
ARDEIDAE			
Bulbulcus ibis	Cattle Egret (N)*	X	✓
Nycticorax nycticorax hoactli	Black-crowned night heron (R)	X	✓
CHARADRIIFORMES			
CHARADRIIDAE			
Pluvialis fulva	Pacific Golden Plover (W)*		✓
SCOLOPACIDAE			
Tringa incana	Wandering tattler (W)*		✓
Arenaria interpres	Ruddy turnstone (W)*		✓
Calidris alba	Sanderling (W)*		✓
COLUMBIFORMES			
COLUMBIDAE			
Columba livia	Rock pigeon (N)	X	✓
Streptopelia chinensis	Spotted dove (N)	X	✓
Geopelia striata	Zebra dove (N)	X	✓
STRIGIFORMES			
TYTONIDAE			
Tyto alba	Barn owl (N)*		✓

SCIENTIFIC NAME	COMMON NAME	CARDNO SURVEY	PREVIOUS SURVEYS
STRIGIDAE			
Asio flammeus sandwichensis	Hawaiian short-eared owl (R)*		✓
PASSERIFORMES			
CETTIIDAE			
Horornis diphone	Japanese bush warbler (N)	X	✓
ZOSTEROPIDAE			
Zosterops japonicus	Japanese white-eye (N)	X	✓
MUSCICAPIDAE			
Copsychus malabaricus	White-rumped shama (N)	X	✓
MIMIDAE			
Mimus polyglottos	Northern mockingbird (N)*	X	✓
STURNIDAE			
Acridotheres tristis	Common mynah (N)	X	✓
EMBERIZIDAE			
Paroaria coronata	Red-crested cardinal (N)		✓
CARDINALIDAE			
Cardinalis cardinalis	Northern cardinal (N)*	X	✓
FRINGILIDAE			
Carpodacus mexicanus	House finch (N)*	X	✓
Passer domesticus	House sparrow (N)	X	✓
Padda oryzivora	Java sparrow (N)	X	✓
ESTRILDIDAE			
Euodice cantans	African silverbill (N)	X	✓
Lonchura punctulata	Nutmeg mannikin (N)	X	✓

Appendix D Seabird-friendly Lighting Solutions

SEABIRD-FRIENDLY LIGHTING SOLUTIONS

Help eliminate seabird light attraction. Select the best fixture for your application using this guide. Avoid uplighting, always shield floodlights, and aim downlights carefully to avoid light trespass. For more information go to www.kauai-seabirdhcp.info.