Appendix G

Update Flora and Fauna Surveys for the Kaloko Makai Development
Rana Biological Consulting, Inc. and AECOS Consultants
May 17, 2012

Update Flora and Fauna Surveys Conducted for the Kaloko Makai Development, North Kona District, Island of Hawai‘i

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Introduction and Background

Stanford Carr – TSA Kaloko Makai LLC is proposing to develop Kaloko Makai as a mixed-use development on approximately 1,139 – acres of currently undeveloped land in Kaloko and Koanaiki, North Kona District, Island of Hawai'i. The properties are identified as TMK: (3) 7-3-09:17, 25, 26, and 28.

This report describes the methods used and the results of a set of updated botanical, avian and mammalian surveys conducted on the subject property. The primary purpose of the surveys was to determine if there have been any significant changes in the habitats and/or avian, mammalian and botanical resources on the property since similar surveys were conducted on the site in 2006. We were also tasked with mapping any trust biological resources encountered on the site and to prepare maps of any such resources for inclusion in this report.

The federal and State of Hawai'i listed species status follows species identified in the following referenced documents, Department of Land and Natural Resources (DLNR) 1998; U. S. Fish & Wildlife Service (USFWS 2005a, 2005b, 2012).

Hawaiian and scientific names are italicized in the text. A glossary of technical terms and acronyms used in the document, which may be unfamiliar to the reader, are included at the end of the narrative text.

General Project and Site Descriptions

The proposed development will include the construction of up to 5,000 single and multi-family residential units at low and medium densities, centralized commercial and neighborhood retail centers, an array of recreational facilities (e.g. parks, trails and open spaces), urgent care medical facility and hospital, elementary and middle school sites and associated infrastructure (e.g. new roadways, utilities drainage, wastewater and potable and non-potable water distribution systems)(figure 1).

The site is bound to the west by Queen Ka'ahumanu Highway, by the Kaloko Light Industrial Park and undeveloped land to the south, and by the Koahanaiki Industrial Park to the north The existing Hina Lani Street transects the site in an east-to-west direction. Additionally, portions of a former rock quarry occupy the southwest corner (Figure 2). The project site slopes moderately to gently from east-to-west, from a maximum elevation of ~740 feet above sea level (ASL) at the northeastern boundary, down to ~60 feet ASL at the northwestern boundary along Queen Ka'ahumanu Highway (National Geographic, 2010).

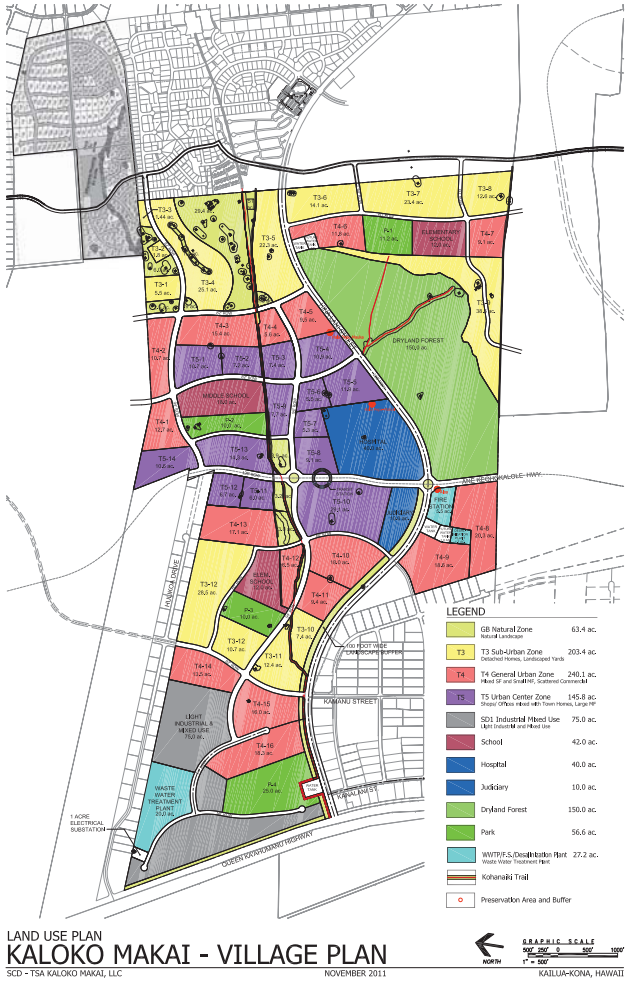

Figure 1 – Project site

The Project site lies on volcanic flows disgorged from Mount Hualālai. Within the project parcel, the different ages of the lava flows are somewhat evident from the degree of development of the vegetation. Dark red dashed lines in Figure 2 outline the various physiographic features that have significance with respect to the nature of the vegetation. These lines are based on interpretation from a satellite image and were generally confirmed in the field and matched to the geologic map of Sherrod, et al. (2007). The youngest flow-the Kaloko-Honokōhau *ʻaʻā* lava flow (LF1) - dates to between 1,500 and 3,000 years before the present (ybp). In the project area, this *ʻaʻā* flow extends down-slope along the southern side of the site (crossed by Hina Lani Street) from well upslope of the upper property boundary to below Queen Kaʻahumanu Highway. This flow originated from within the northwest rift of Mount Hualālai. The remainder of the property is an older flow dated between 3,000 and 5,000 ybp, but with some distinct *ʻaʻā* flows (LF2) present within this age range. An even older surface (5,000-11,000 ybp) is exposed on the property in the vicinity of Queen Kaʻahumana Highway.

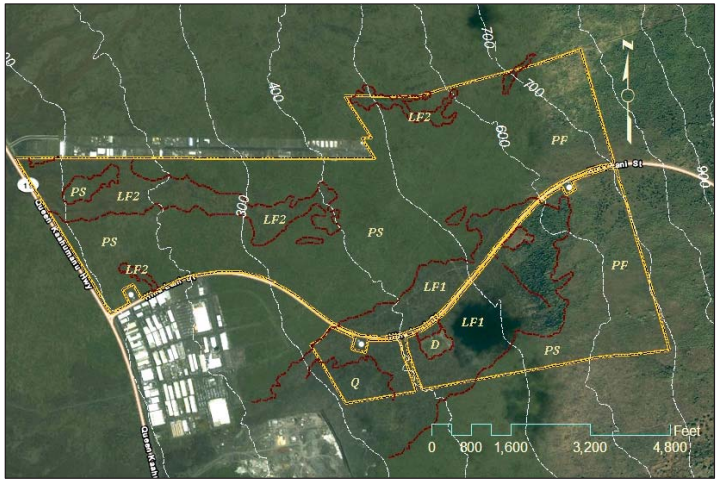

Figure 2 - Project area (outlined in yellow) on both sides of Hina Lani Street. Codes for substratum/vegetation types are as follows:
D – highly disturbed ground;
LF1 – *ʻaʻā* flow less than 3000 years old;
LF2 – *ʻaʻā* flows between 3000 and 5000 years old;
PF – *pāhoehoe* and some *ʻaʻā* with generally open forest or very dense scrub growth;
PS – mostly *pāhoehoe* with scrub vegetation;
Q – old (abandoned) quarry area.

The majority of the site, consisting mostly of old *pāhoehoe* flows, is dominated by alien vegetation: a mixture of grass and shrubs (PS). These shrubs increase in size and density in an upslope direction in response to a gradient of increasing moisture tied to elevation. At around 600 feet (180 meters) above sea level, this shrubland gradually transitions into a more closed forest (PF) in the uppermost parts of the property. The vegetation present on the youngest *ʻaʻā* flow (LF1), although sparse in cover, has a high percentage of native plant species, including several rare species. Disturbed ground (D) is associated with the roadway and an area on the south side near the middle just off Hina Lani Street that was once used as a construction base yard.

Methods

Plant names follow *Manual of the Flowering Plants of Hawaiʻi* (Wagner et al., 1990, 1999) for native and naturalized flowering plants, Palmer (2003) for ferns, and *A Tropical Garden Flora* (Staples and Herbst, 2005) for crop and ornamental plants. Some names have been changed (updated) since these sources were published, and recent accepted names are used here. The avian phylogenetic order and nomenclature used in this report follows the *AOU Check-List of North American Birds* (American Ornithologists' Union, 1998), and the 42nd through the 51st supplements to the Check-List (American Ornithologists' Union, 2000; Banks et al., 2002, 2003, 2004, 2005, 2006, 2007, 2008; Chesser et al., 2009, 2010, 2011). Mammal scientific names follow (Tomich, 1986). Place names follow (Pukui et al., 1974).

Botanical Survey Methods

The botanical survey was undertaken on January 18-20, February 2, and March 28, 2012 and involved wandering transects that traversed all vegetation types in the project area. For these surveys, a property boundary map was loaded into a GPS unit (Trimble, GeoXT or GeoXM) to serve as a guide, both recording the progress track of the botanist and insuring that the survey did not stray outside the project boundaries. Using the recorded track in real time also served as feedback on the adequacy of coverage of the pedestrian survey. A map of the survey tracks (white dotted lines) is presented as Figure 3. A light green route (near the center) is from an earlier survey (Guinther and David, 2010) for a County Courthouse location selection process.

In addition to tracking the course of the survey, positions (locations) of special features were also recorded with the GPS unit. For the most part these were selected rare native plants and specific locations where field notes were taken.

Plant species were identified as they were encountered and notations used to develop a qualitative sense of abundance in various environments encountered. The surveys periods encompassed the wet season and the vegetation was generally in a healthy state. Plants typical of each vegetation type, including annuals, were readily observable and identifiable. For a few species not immediately recognized in the field, photographs were taken and/or material collected for identification at the laboratory. As can be seen on the Figure 3, the

pedestrian survey concentrated on recent lava flows for the reason that these were known (and quickly found) to harbor plant species of interest (i.e., rare native species). Pedestrian surveys tend to be directed by aspects of the terrain that promise the presence of additional species or moving to trees and shrubs viewed from a distance requiring up-close confirmation (and entering position data, if of interest). Thus, in the area of greatest concentration of significant native trees, the survey route is largely directed by wandering from tree to tree as these trees are sighted at distance.

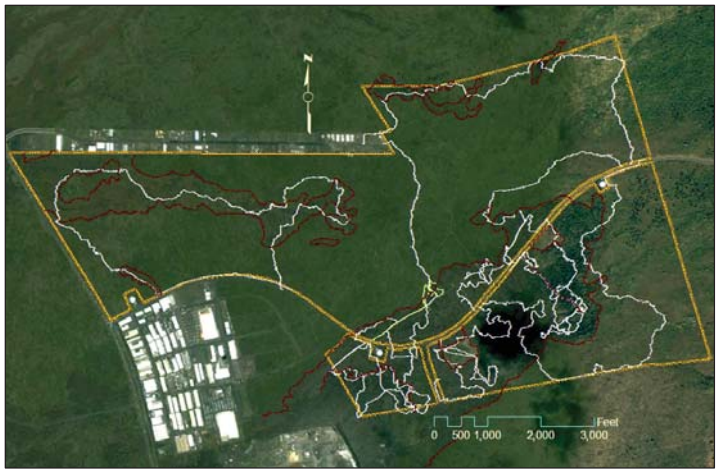

Figure 3 - Map of survey area plotted on an aerial image, showing tracks taken by the botanist over the course of the survey.

Avian Survey Methods

Thirty avian count stations were sited at approximately 300-meter intervals along four linear transects running from east-to-west through the project area. The transects and count stations were sited as close to those used during the course of the 2006 avian survey of the site as possible (David, 2006). A single six-minute avian point count was made at each of the 30 count stations. Field observations were made with the aid of Leica 8 X 42 binoculars and by listening for vocalizations. The counts and subsequent searches of the site, was conducted between 6:30 am and 11:00 am each morning. Time not spent counting

the point count stations was used to search the remainder of the sites for species and habitats not detected during the point counts. Weather conditions were ideal, with no rain, unlimited visibility on the sites and winds of between 1 and 7 kilometers an-hour, during point count periods.

Mammalian Survey Methods

With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *ʻōpeʻapeʻa* as it is known locally, all terrestrial mammals currently found on the Island of Hawai'i are alien species, and most are ubiquitous. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all terrestrial vertebrate mammalian species detected within the site. The mammalian survey was conducted concurrently with the avian surveys. This mimics the same survey techniques employed during the 2006 survey of the same property (David, 2006).

Results

Botanical Surveys

Flora — A plant checklist (Table 1) was compiled from field observations, with entries arranged alphabetically under plant family names (standard practice). Included in the list are scientific name, common name, and status (whether native or non-native) for each species observed during the 2012 survey. The listing also includes plant species identified on the same property by Whistler (2011), on the same site, but only the parcel between Queen Kaʻahumanu Highway and the 300-foott elevation by Char (1995), and more recently on a very limited part of the property by David and Guinther (2011). Notes <2>, <3>, and <1> respectively in Table 1 identify results from these other surveys. A plant species reported by either Whistler or Char, but not seen in the 2012 survey, lacks an alpha or alphanumeric abundance rating. A plus sign (+) in an abundance column indicates a plant reported by Char (1995) in the indicated environment type[1].

Note that this table is split into two parts: Table 1a presents a list of non-native species (76 species; both naturalized and ornamental) and Table 1b a list of 36 species of "native" plants (including early Polynesian introductions or so-called "canoe plants") and species thought to be either early introductions or indigenous (as ?Ind). Table 1b lists those plants of most interest to resource agencies.

In addition to identifying the plants present within the study site, qualitative estimates of plant abundance were made separately for each environment type, indicated by three

[1] Char recognized two general vegetation types in her survey area: fountain grass grassland and *ʻaʻa* lava flow. These correspond to our PS and LF2, respectively.

Table 1 – Flora for Kaloko Makai, North Kona, Hawai'i
1a – Non-native (ornamentals and naturalized) plants

Family / Species	Common name	Status	Abundance (by vegetation type) PS	LF	PF	Notes
	FERNS AND FERN ALLIES					
NEPHROLEPIDACEAE						
Nephrolepus multiflora (Roxb.) F.M. Jarrett ex C.V. Morton	sword fern	Nat	--	+ U1	--	< 2, 3>
POLYPODIACEAE						
Phymatosorus grossus (Langsd. & Fisch.) Brownlie	*lauaʻe*	Nat	--	--	U2	<2>
PTERIDACEAE						
Pityrogramma austroamericana Domin	gold fern	Nat	R	--	--	
	FLOWERING PLANTS DICOTYLEDONS					
AMARANTHACEAE						
Amaranthus viridis L.	slender amaranth	Nat	+	--	--	<2, 3>
Gomphrena globosa L.	globe amaranth	Nat	R	--	--	<4>
ANACARDIACEAE						
Schinus terebinthifolius Raddi	Christmas berry	Nat	+	+ O	AA	<1, 2, 3>
APOCYNACEAE						
Cascabella thevitia (L.) Lippold	be-still tree	Nat	R1	--	--	
Catharanthus roseus (L.) G. Don.	Madagascar periwinkle	Nat	+ R1	--	--	<1, 2, 3>
Plumeria obtusa L.	Singapore plumeria	Orn	R	--	--	<1>
Plumeria rubra L.	graveyard flower	Orn	R	--	--	<1>
ARALIACEAE						
Schefflera actinophylla (Endl.) Harms	octopus tree, umbrella tree	Nat	--	--	R	
ASCLEPIADACEAE						
Stapelia gigantea N. E. Brown	giant toad plant	Nat	R	--	R	
ASTERACEAE						
Ageratum conyzoides L.	ageratum	Nat	--	+	--	<2, 3>
Bidens cynapiifolia Kunth	West Indian beggartick	Nat	+	--	--	<3>
Emilia fosbergii Nicolson	Flora's paintbrush	Nat	--	+ R	--	<2, 3>
Pluchea carolinensis (Jacq.) G. Don	sourbush	Nat	R	+ O	R	<1, 2, 3>
Senecio madagascariensis Poir.	fireweed	Nat	--	R	--	<2>
Tridax procumbans L.	coat buttons	Nat	U	--	--	<1, 2>

columns under abundance labeled "PS", "LF", and "PF", where these correspond to: 1) shrublands on older lava flows, 2) the younger *ʻaʻā* lava flows (LF1 and LF2), and 3) upper forested areas (on lava of various types and ages) as mapped in Figure 2. Abundance values are coded in the table as explained in the Legend to Table 1 and apply to observations made in 2012. For some species, a two-level system of abundance is used, with a letter-number code indicating a species having a clustered distribution; that is, for example, a species infrequently encountered, but numerous where observed. Thus, an abundance rating of "R" indicates a plant encountered only one to three times during the entire survey of a parcel. An "R2" indicates a plant encountered in just one or two places, but with many individuals present where encountered. An "R3" would be a plant seldom encountered (i.e., rare), but locally abundant in one or more of the locations where it was encountered. Plants tagged as "ruderal" (note <3> in Table 1) are characteristic of disturbed ground typically either recently graded areas (D) or the verges of the roads and highways.

Table 1a (continued).

Family	Common name	Status	Abundance (by vegetation type)			Notes
Species			PS	LF	PF	
FABACEAE (continued)						
Senna occidentalis (L.) Link	coffee senna	Nat	+	--	R	<2, 3>
Senna surattensis (N.L. Burm.) H. Irwin & Barneby	*kolomana,* scrambled egg	Nat	R	--	--	<2>
LAMIACEAE						
Hyptis pectinata (L.) Poir.	comb hyptis	Nat	--	--	R	<2, 4>
MALVACEAE						
Abutilon grandifolium (Willd.) Sweet.	hairy abutilon	Nat	--	--	--	<2>
Malvastrum coromandelianum (L.) Garcke	false mallow	Nat	--	--	--	<2>
Sida rhombifolia L.	---	Nat	--	--	--	<2>
MYRTACEAE						
Psidium guajava L.	common guava	Nat	--	--	U	<2>
NYCTAGINACEAE						
Boerhavia coccinea Mill.	---	Nat	--	--	--	<2>
PASSIFLORACEAE						
Passiflora edulis Sims	*liliko'i*, passionfruit	Nat	--	--	R	<2, 5>
Passiflora foetida L.	love-in-a-mist, running pop	Nat	R	--	--	<1, 2>
PHYTOLACCACEAE						
Rivina humilis L.	coral berry	Nat	R	--	R	<1, 2>
PORTULACACEAE						
Portulaca oleracea L.	pig weed	Nat	+ R	--	--	<2, 3>
Portulaca pilosa L.	*'ihi*	Nat	+	--	--	<1, 2, 3>
Talinum trianglare (Jacq.) Willd.	talinum	Nat	--	+ U	A	<1, 2, 3>
PROTEACEAE						
Grevillea robusta A. Cunn. ex R. Br.	silk oak	Nat	+ R	--	C	<1, 2, 3>
SCROPHULARIACEAE						
Lophospermum erubescens D. Don	larger roving sailor	Nat	--	--	--	<2>
SOLANACEAE						
Solanum lycopersicum var. *cerasiforme* (Dunal) Spooner	cherry tomato	Nat	--	--	--	<2>
VERBENACEAE						
Lantana camara L.	lantana	Nat	+ R1	+ O	R	<1, 2, 3>
Stachytarpheta australis Moldenke	---	Nat	--	--	R	<2, 5>
Stachytarpheta cayennensis (Rich.) Vahl	---	Nat	--	--	--	<2>
	MONOCOTYLEDONES					
COMMELINACEAE						
Commelina benghalensis L.	hairy *honohono*	Nat	--	--	R	<2>

Table 1a (continued).

Family	Common name	Status	Abundance (by vegetation type)			Notes
Species			PS	LF	PF	
BIGNONIACEAE						
Jacaranda mimosifolia D. Don	jacaranda	Nat	--	R1	--	<2>
Spathodea campanulata P. Beauv.	African tulip tree	Nat	--	--	--	<2>
BUDDLEIACEAE						
Buddleia asiatica Lour.	dogtail	Nat	--	--	--	<2>
CACTACEAE						
Hylocereus undatus (Haw.) Britten & Rose	night-blooming cereus	Nat	--	R	--	<2>
Opuntia ficus-indica (L.) Mill.	prickly pear	Nat	--	+ R	--	<2, 3>
CLUSIACEAE						
Clusia rosea Jacq.	autograph tree	Nat	--	R	R	<2>
CONVOLVULACEAE						
Ipomoea obscura (L.) Ker-Gawl.	---	Nat	--	--	--	<2>
CRASSULACEAE						
Kalanchoë pinnata (Lam.) Pers.	air plant	Nat	+	U	AA	<2, 3>
Kalanchoë tubiflora (Harv.) Raym-Hamet	chandelier plant	Nat	R1	--	--	<1>
CUCURBITACEAE						
Coccinia grandis (L.) Voigt	scarlet-fruited gourd	Nat	R	--	--	<2>
Cucumis dipsaceus Ehrenb. ex. Spach	teasel gourd	Nat	+	--	--	<3>
Momordica charantia L.	wild bitter melon	Nat	--	+	R	<1, 2, 3>
EUPHORBIACEAE						
Euphorbia hirta L.	garden spurge	Nat	+ R	--	R	<1, 2, 3>
Euphorbia hyssopifolia (L.) Sm.	---	Nat	--	--	--	<2>
Macaranga tanarius (L.) Müll. Arg.	---	Nat	--	--	--	<2>
Ricinus communis L.	castor bean	Nat	R	R	--	<2>
FABACEAE						
Acacia farnesiana (L.) Willd.	*klu*	Nat	+ O	R	--	<2, 3>
Chamaecrista nictitans s(L.) Moench	patridge pea, *lauki*	Nat	+ R	R	U	<1, 2, 3, 4>
Crotalaria pallida Aiton	rattlepod	Nat	--	R	--	<1, 2, 4, 5>
Desmodium incanum DC	Spanish clover	Nat	--	--	R	<2>
Desmodium tortuosum (Sw.) DC	Florida beggarweed	Nat	+ U1	--	--	<1, 2, 3, 4>
Indigofera suffruticosa Mill.	indigo	Nat	+ U	--	--	<2, 3, 4>
Leucaena leucocephala (Lam.) deWit	*koa haole*	Nat	+ AA	+ O	AA	<1, 2, 3>
Macroptilium lathyroides (L.) Urb.	cow pea	Nat	--	--	R	<2, 4>
Pithecellobium dulce (Roxb.) Benth.	*'opiuma*	Nat	--	--	--	<2>
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	*kiawe*	Nat	+ R	--	--	<2, 3>

Family	Common name	Status	Abundance (by vegetation type)			Notes
Species			PS	LF	PF	
CONVOLVULACEAE						
Ipomoea indica (J. Burm.) Merr.	*koali'awa*	**Ind**	+	O	--	<1, 2, 3>
EBENACEAE						
Diospyros sandwicensis (A. DC.) Fosb.	*lama*	**End**	--	+	O	<2, 3>
EUPHORBIACEAE						
Aleurites moluccana (L.) Willd.	*kukui*	Pol	--	--	U1	<2>
Euphorbia celastroides Boiss.	*'akoko*	**End**	--	R	--	<2>
FABACEAE						
Caesalpinia kavaiensis H. Mann	*uhiuhi*	**End**	--	R	--	
Erythrina sandwicensis Degener	*wiliwili*	**End**	--	--	--	planted in "D"
Senna gaudichaudii (Hook. & Arn.) H. Irwin & Barneby	*kolomona*	**Ind**	--	O	--	<2>
Sophora chrysophylla (Salisb.) Seem.	*mamane*	**End**	--	O	--	<2>
Tephrosia purpurea (L.) Pers.	*'auhuhu*	**Ind**	+	--	--	<3>
GOODENIACEAE						
Scaevola sericea Vahl.	*naupaka*	**Ind**	--	R	--	<2>
LAMIACEAE						
Plectranthus parviflorus Willd.	*'ala'alawainui wahine*	**Ind**	--	R	--	<2>
MALVACEAE						
Abutilon incanum (Link) Sweet	*hoary abutilon*	**Ind**	+ R	--	--	<1, 3>
Sida fallax Walp	*'ilima*	**Ind**	+ U	U	R	<1, 2, 3>
MENISPERMACEAE						
Cocculus orbiculatus (L.) DC	*huehue*	**Ind**	+ O3	+ A	U	<1, 2, 3>
MYOPORACEAE						
Myoporum sandwicense A. Gray	*niao*	**Ind**	--	+ C	--	<1, 2, 3>
MYRTACEAE						
Metrosideros polymorpha Gaud.	*'ōhi'a*	**End**	--	+ U	--	<1, 2, 3>
NYCTAGINACEAE						
Boerhavia repens L.	*alena*	**Ind**	--	+	--	<3>
PAPAVERACEAE						
Argemone glauca (Nutt. ex Prain) Pope	*pua kala*	**End**	R	R	--	<2, 5>
PIPERACEAE						
Peperomia leptostachya Hook. & Arn.	*'ala'alawainui*	**Ind**	+ R	R	R1	<2, 3>
ROSACEAE						
Osteomeles anthyllidifolia (Sm.) Lindl.	*'ulei*	**Ind**	--	R	--	<2>
RUBIACEAE						
Morinda citrifolia Hillbr.	*noni*	Pol	U	R	U	<1, 2, 3>
Psydrax odoratum (Forst. f.) A.C. Smith & S. Darwin	*alahe'e*	**Ind**	+ O	+ R	A	<1, 2, 3>
SAPINDACEAE						
Dodonaea viscosa Jacq.	*'a'ali'i*	**Ind**	+ U	U	C	<2, 3>

Table 1a (continued).

Family	Common name	Status	Abundance (by vegetation type)			Notes
Species			PS	LF	PF	
COMMELINACEAE (continued)						
Tradescantia spathacea Swartz	oyster plant	Nat	--	--	R1	
POACEAE (GRAMINEAE)						
Cenchrus ciliaris L.	buffllegrass	Nat	R	--	--	<4>
Cenchrus echinatus L.	sandbur	Nat	--	--	--	<2>
Chloris barbata (L.) Sw.	swollen fingergrass	Nat	U2	--	--	<2, 4>
Dactyloctenium aegypticum (L.) Willd.	beach wiregrass	Nat	+	--	--	<2, 3>
Digitaria ciliaris (Retz.) Koeler	large crabgrass	Nat	--	--	--	<2>
Eragrostis tenella (L.) P. Beauv ex Roem. & Schult.	lovegrass	Nat	--	--	--	<2>
Melinus minutifloras P. Beauv.	molasses grass	Nat	R	--	--	<2>
Melinus repens (Willd.) Zizka	Natal redtop	Nat	+ R	+	U	<1, 2, 3, 4>
Panicum maximum Jacq.	Guinea grass	Nat	+		AA	<2, 3>
Pennisetum setaceum (Forssk.) Chiov.	fountain grass	Nat	+ AA	+ O	AA	<1, 2, 3>

Table 1b. Native (and early Polynesian introduced) Plants

FERNS AND FERN ALLIES

NEPHROLEPIDACEAE						
Nephrolepus exaltata hawaiiensis Wagner	sword fern	**End**	--	--	U2	
PTERIDACEAE						
Doryopteris decipiens (Hook.) J. Sm.	*kumuniu*	**End**	+ R	--	--	<2, 3>
Doryopteris decora Brack	---	**End**	--	R	--	
PSILOTACEAE						
Psilotum nudum (L.) P. Beauv.	*moa*	**Ind**	--	R	--	<2>

FLOWERING PLANTS
DICOTYLEDONS

ARALIACEAE						
*Polyscias sandwicensis (*A. Gray) Lowry & G. M. Plunkett	*'ohe makai*	**End**	--	+ O	--	<1, 2, 3>
ASTERACEAE						
Bidens micrantha ctenophylla (Sherff) Nagata & Ganders	---	**End**	--	O	--	<2>
Melanthera populifolia (Sherff) Wagner & Rob	*nehe*	**End**	--	R	--	<2>
CAPPARACEAE						
Capparis sandwichiana DC	*maiapilo*	**End**	+	+ O	R	<1, 2, 3>

Table 1b (continued).

Table 1b (continued).

Family / Species	Common name	Status	Abundance (by vegetation type) PS	LF	PF	Notes
SOLANACEAE						
Nothocestrum breviflorum A. Gray	*'aiea*	**End**	--	R	--	
Solanum americanum Mill.	*pōpolo*	Ind?	+ R	--	--	<1, 3>
STERCULIACEAE						
Waltheria indica L.	*'uhaloa*	Ind?	+ U3	+ O	--	<1, 2, 3, 4>
	MONOCOTYLEDONS					
AGAVACEAE						
Pleomele hawaiiensis Deg. & Deg.	*halapepe*	**End**	--	U	--	<2>
DIOSCOREACEAE						
Dioscorea bulbifera L.	bitter yam	Pol	--	--	--	<2>
POACEAE						
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	*pili*	**Ind**	+	--	--	<2, 3>

Legend to Table 1

Status = distributional status

E**nd** = endemic; native to Hawai'i and found naturally nowhere else.

I**nd** = indigenous; native to Hawai'i, but not unique to the Hawaiian Islands.

Nat = naturalized, exotic, plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established outside of cultivation.

Abundance = occurrence ratings for plants on property in March 2008

R - Rare - only one or two plants seen.

U - Uncommon - several to a dozen plants observed.

O - Occasional - found regularly, but not abundant anywhere.

C - Common - considered an important part of the vegetation and observed numerous times.

A - Abundant - found in large numbers; may be locally dominant.

AA - Abundant - very abundant and dominant; defining vegetation type.

Numbers (as in R3) offset occurrence ratings (1 – several plants; 2 – many plants; 3 – abundant in a limited area) in cases where distribution across the survey area may be limited, but individuals seen are more than indicated by the occurrence rating alone.

Notes:

<1> Reported at "Site A" (Kaloko Makai) in David and Guinther (2011).

<2> Recorded by Whistler (2006).

<3> Recorded by Char (1995) on an adjacent property.

<4> Ruderal, on highway verge and other highly disturbed areas.

<5> Plant lacking flowers or fruit at time of survey; identification uncertain.

A total of 112 different species of plants were recorded as growing on the surveyed parcels. Of these, 33 species (29.5 percent) are recognized as truly native (indigenous or endemic species), a little more than half (~18 or 54 percent) moderately common[2] indigenous plants (defined as native to both Hawai'i and elsewhere in the Pacific Basin), but with 15 (45 percent) endemic species (plant species uniquely native to the Hawaiian Islands). Three early Polynesian introductions (*kukui* or *Aleurites moluccana*, *noni* or *Morinda cirtifoloia*, and bitter yam or *Discorea bulbifera*) have been recorded in recent surveys. These results are rather atypical for lowland surveys in the Hawaiian Islands in the high percentage of native species recorded. David and Guinther (2011) surveyed ten sites of roughly comparable size for the new Kona Courthouse site selection process. Total species recorded combining all ten sites in the North Kona area was 68. Of these, 17 (25 percent) were native, with 6 (9 percent) endemics. Most botanical surveys in the lowlands of any of the main Hawaiian Islands typically yield less than 12 percent native species including early Polynesian introductions (and less than 1 percent if biomass of native and non-native plants is compared).

The survey by Char (1995) was for only the 224-acre portion of the site below 300-feet elevation (TMK: [3] 7-3-09:017) and therefore extensive comparisons with either Whistler (2006) or the present survey would not be particularly instructive. Whistler, on the other hand, surveyed all five of the project parcels, so a comparison with the present survey undertaken some five years later could be useful. We also have a rare plant inventory map prepared by Hawaii Forest Industry Association (undated) covering much of the LF1 part of the project and this will be reviewed further on in our report. Whistler developed a list of 93 plant species for the project property, all of which are included in our Table 1. He observed 17 species of naturalized plants not seen in 2011 and two species of native or early Polynesian plants (*pili* or *Heteropogon contortus* and *hoi or bitter yam*) not seen in 2012. Thus, 74 species were observed in common between the 2006 and 2012 surveys. A majority (~12) of the naturalized species recorded by Whistler and not seen in 2012 are herbs and could easily be missed if conditions were drier in 2012 than in 2006. Many of the naturalized herbs are mentioned as characterizing his managed land vegetation type (that is, disturbed land). *Pili* grass is mentioned in association with the lowland *Leucaena* scrub and was likely overlooked in this area in 2012. Three of the species are trees (African tulip or *Spathodea campanulata*, *Macaranga tanarius*, and *'opiuma* or *Pithecellobium dulce*), but no indication is given as to where these were observed. The first two would require conditions on the wet side and thus could only occur in the uppermost, forested (PF) area.

Curiously the larger roving sailor (*Lophospermum erubescens*) described as a "common" escaped ornamental vine on the LF1 lava flow by Whistler in 2006, was not observed at all in 2012. *Lophospermum* is described in Wagner, Herbst, and Sohmer (1999) as sparingly naturalized in "dry forest, alien grassland, and shrubland on O'ahu and Hawai'i." Possibly, the implication that this alien species was common (Whistler, 2006, p. 6) is at the root of the discrepancy. This species was recorded by Nishida (1993) from the LF1 area. We expect

[2] Two species, *kolomona* and *'auhuhu* (seen only by Char in 1995), are not very common in the Islands.

that there would be year-to-year differences in the presence of many herbaceous species, often dependent upon rainfall amounts.

Of significance in terms of native species not seen by either Whistler (2006) or the present survey are the listed plants: *Neraudia ovata* and *Cyperus fauriei*. Also significant are the rare natives, *uhiuhi* (*Caesalpinia kavaiensis*) and *ʻaiea* (*Nothocestrum breviflorum*), variously recorded from the area in the past, but not observed by Whistler. We recorded single individuals of each in 2011—and, as evidenced by flagging and fencing, are clearly well-known to be present. Rare natives and their general distribution on the project site are considered further in the Discussion section.

Vegetation — A vegetation map prepared by Nishida (1993) for an approximately 0.5-mile wide swath through the project area between the 300 and 400-feet elevation contours provides an early take by Bishop Museum botanists on vegetation types, at least for the lower elevations. The map distinguishes LF1 above 350 feet elevation as an ʻŌhiʻa Lowland Dry Forest. Below about 350 feet, this flow is divided into a southern developed land (the quarry) and a narrow finger of "sparsely vegetated lava flow." The latter designation is also applied to our LF2. The remainder of the land mapped by Nishida is an alien plant dominated, Koa Haole/Fountaingrass association corresponding to our PS.

Whistler (2006) recognized four types of vegetation on the property: (1) managed land vegetation; (2) *Leucaena* or *koa haole* scrub; (3) Christmas berry scrub; and (4) dryland forest. While these are accurate in their descriptions, our take on the vegetation distinguishes (4) as a remnant dry land forest on recent *ʻaʻa* lava (LF1) below about the 600-feet elevation, above which the forest becomes a mixed one (PF) dominated by non-native trees on the same lava flow, which extends well up the slope of Hualālai from the project area. The somewhat older *ʻaʻā* flows (LF2) also support a sparse vegetation that is a mixture of native and naturalized species, but the diversity of natives is small in comparison with that on LF1 and the reasons for this are not entirely clear. Both lava flows have sparse grass cover (minimizing fire hazards) and rough terrain presumably discouraging to ungulates, such as goats.

The **remanant dryland forest** on LF1 is mostly one supporting *lama* (*Diospyros sandwicensis*), *alahe'e* (*Psydrax odoratum*), Christmas berry, and *ʻōhiʻa* (*Metrosideros polymorpha*). Present, although to lesser extents; are *ʻohe makai* (*Polyscias sandwicensis*) and *hala pepe* (*Pleomele hawaiiensis*). Shrubs (sometimes small trees) that are relatively common are *naio* (*Myoporum sandwicense*), *pua pilo* or *maiapilo* (*Capparis sandwichiana*), *ʻaʻaliʻi* (*Dodonaea viscosa*), *mamane* (*Sophora chrysophylla*), and *kolomona* (*Senna gaudichaudii*). Very rare are *uhiuhi* and *ʻaiea* (mentioned above). In the dry conditions that prevail here, the distinction between shrubs and trees is not easily made. In general, the forest is very open with low shrubs and ground-covering herbs predominate. Non-natives invasive species in this dry forest are *koa haole*, jacaranda (*Jacaranda mimosifolia*), and Christmas berry. The latter species seems to be particularly well suited to the habitat and consequently the most serious pest species here. The ground cover on LF1 is notably dominated by *huehue* (*Cocculus orbiculatus*) and *koali ʻawa* (*Ipomoea indica;* Figure 4).

Fountain grass (*Pennisetum setaceaum*), lantana (*Lantana camara*), and sword fern (*Nephrolepis multiflora*) are present in scattered locations, as is *koʻokoʻolau* (*Bidens micrantha ctenophylla*).

Figure 4 - Scrubby trees and extensive ground cover of *huehue* on rugged *ʻaʻā* in more open parts of the LF1 lava flow. Plants recognizable in the photo are *maiapilo*, *koa haole*, sparse fountain grass, and scattered *lama* and Christmas berry.

The land between the lava flows (Whistler's ***Leucaena*** or ***koa haole*** scrub; PS in Figure 2) stands out in contrast to the sparse vegetation on the *ʻaʻa* flows is, of course, older and mostly *pāhoehoe* flows (Figure 5). A combination of better water retention near the surface on *pāhoehoe* and a longer period of time for soil formation provide conditions whereby these areas support moderately dense growths of fountain grass and short *koa haole* as a dry shrubland. Native shrubs, especially *alahe'e* and *aʻaliʻi*, are widely scattered within this vegetation type. At low elevations on the property, *klu* (*Acacia farnesiana*) appears as an occasional shrub and *kiawe* (*Prosopis pallida*) as a rare tree[3]. Whistler points out that because of the dense fountain grass, this scrub vegetation is subject to damaging fires, which may well have eliminated many of the native species over time.

[3] Possibly a consequence of the long period of drought effecting this part of the Island of Hawaiʻi, nearly all of the *kiawe* trees observed during our survey of the project properties were deceased.

Figure 5 – *Koa haole* shrubland (PF) showing mostly *koa haole* with very scattered *alahe'e.*

The relationship between vegetation and the nature of the substratum becomes more complex above about 600 feet on the site, and while we designate this area as PF in Figure 2, it is a complex of scrub and forest vegetation types extending across the *mauka* or uppermost part of the property. This area is far more heterogeneous with respect to substratum age and type, and composition of the vegetation, than is the case downslope. The reasons for this are certainly related to rainfall. Rainfall records for Honokōhau Ranch nearby at 1275 feet suggest an annual rainfall of around 1230 mm (48 inches); rainfall at the old Kona Airport at 15 feet above sea level 550 mm (21.6 inches). This moisture gradient is evident in the nature of vegetation from the low end of the project area to the top end, with grasses and short stature shrubs mostly at the low end, and trees of increasing stature becoming evident above about the middle. At around the 550 to 600-foot elevation, the young lava flow is no longer clearly visible in aerial/satellite images; the forest is too dense to readily distinguish this feature from adjacent, much older surfaces. For this reason, we lump this vegetation under PF in Fig. 2. However, inside a forest dominated by Christmas berry (presumably, in part, Whistler's **Christmas Berry Scrub**), silk oak (*Grevillea robusta*), *lama*, *alahe'e*, and *'ōhi'a* trees are present. In the understory, either talinum (*Talinum triangulare*) or air plant (*Kalanchoë pinnata*) can be very abundant. In some places grasses are abundant, in other areas bare lava is present.

The following plant associations demonstrate the heterogeneity of the area designated PF vegetation type along the *mauka* border of the property:

dense *koa haole* forest with an understory of dense Guinea grass (*Panicum maximum*) immediately off the north side of Hina Lani Street; somewhat open Christmas berry/*koa haole* forest with dense air plant understory merging gradually into dry land forest type (LF1), downslope and found east and west of Hina Lani Street; Christmas berry savanna with fountain grass (northeast corner of the property); *koa haole* scrub (cattle grazed land) with Guinea grass and scattered *kukui* (*Aleurites moluccana*) in the southeast corner of the property.

In all but the first and last subtypes above, Christmas berry tends to be the most abundant tree, and natives as described for the Christmas berry scrub are present or, in places, common.

Managed land vegetation corresponds to our vegetation on disturbed ground (ruderal vegetation), represented by the extensive verges along Hina Lani Street, other areas where the *'a'a* flow has been graded (D), and a quarry operation (Q) in the southwest corner of the site. These places support mostly ruderal weeds and several other introduced species not observed elsewhere on the property. An exception to the near exclusively non-native aspect of disturbed areas is the presence of *ko'oko'olau* along the interface between the undisturbed (LF1) and disturbed parts of the quarry. Disturbed ground is readily invaded by fountain grass (Figure 6). *'Uhaloa* (*Waltheria indica*) is a native plant that is common in disturbed places. The now abandoned quarry area represents a part of the Kaloko-Honokahau *'a'a* lava flow that has been extensively graded and material removed. A few "islets" of the original surface remain where either *'ōhi'a* or *maiapilo* plants are growing. The site is extensively invaded by fountain grass (Figure 6).

Figure 6 – Fountain grass invading along the edge of the *ʻaʻa* flow,

Avian Surveys

A total of 967 individual birds of 21 species, representing 12 separate families, were recorded during the station counts. Only one of the species detected during this survey, Pacific Golden-Plover (*Pluvialis fulva*) is a native species. Pacific Golden-Plover is an indigenous migratory shorebird species. One species Chicken (Red Junglefowl) [*Gallus gallus*] is a domesticated species that is not established in the wild on the Island of Hawai'i. The remaining 19 species detected are considered to be alien to the Hawaiian Islands (Table 2).

No avian species currently protected or proposed for protection under either the federal or State of Hawai'i endangered species programs were detected during the course of this survey (DLNR, 1998; USFWS, 2005a, 2005b, 2012).

Avian diversity and densities were in keeping with the habitat present on the site. And were comparable to the results of the survey conducted by David on the site in 2006 (see the discussion section of this report for a more detailed discussion on the comparison between the results of the two surveys). Four species, House Finch (*Carpodacus mexicanus*), Zebra Dove (*Geopelia striata*), Japanese White-eye (*Zosterops japonicus*), and Common Waxbill (*Estrilda astrild*), accounted for slightly less than 44 percent of all birds recorded during the

station counts. House Finch was most frequently recorded species, accounting for 18 percent of the total number of individual birds recorded during station counts. We recorded an average of 30 birds per station count. This is a relatively large number.

Table 2 - Avian Species Detected Within the Kaloko Properties Study Site

Common Name	*Scientific Name*	*ST*	*RA-06*	*RA-12*
	GALLIFORMES			
	PHASIANIDAE - Pheasants & Partridges			
	Phasianinae - Pheasants & Allies			
Gray Francolin	*Francolinus pondicerianus*	A	0.84	0.91
Black Francolin	*Francolinus francolinus*	A	0.56	0.59
Erckel's Francolin	*Francolinus erckelii*	A	0.06	0.13
Red Junglefowl	*Gallus gallus*	D	0.06	0.13
Kalij Pheasant	*Lophura leucomelanos*	A	0.09	-
	CHARADRIIFORMES			
	CHARADRIIDAE - Lapwings & Plovers			
	Charadriinae - Plovers			
Pacific Golden-Plover	*Pluvialis fulva*	IM	0.34	0.34
	COLUMBIFORMES			
	COLUMBIDAE - Pigeons & Doves			
Spotted Dove	*Streptopelia chinensis*	A	2.22	1.16
Zebra Dove	*Geopelia striata*	A	3.66	2.97
	PSITTACIFORMES			
	PSITTACIDAE - Lories Parakeets, Macaws & Parrots			
	Arinae - New World Parakeets, Macaws & Parrots			
Mitred Parakeet	*Aratinga mitrata*	A		0.91
	STRIGIFORMES			
	TYTONIDAE - Barn Owls			
Barn Owl	*Tyto alba*	A	**I-1**	**-**
	PASSERIFORMES			
	ZOSTEROPIDAE - White-eyes			
Japanese White-eye	*Zosterops japonicus*	A	3.44	3.22
	MIMIDAE - Mockingbirds & Thrashers			
Northern Mockingbird	*Mimus polyglottos*	A	0.22	0.31
	STURNIDAE - Starlings			
Common Myna	*Acridotheres tristis*	A	2.25	2.31
	EMBERIZIDAE - Emberizids			
Saffron Finch	*Sicalis flaveola*	A	1.31	1.00
Yellow-billed Cardinal	*Paroaria capitata*	A	0.88	0.78

Table 2 (continued)

Common Name	*Scientific Name*	*ST*	*RA-06*	*RA-12*
	CARDINALIDAE - Cardinals Saltators & Allies			
Northern Cardinal	*Cardinalis cardinalis*	A	1.56	1.47
	FRINGILLIDAE - Fringilline and Carduleline Finches & Allies			
	Carduelinae - Carduline Finches			
House Finch	*Carpodacus mexicanus*	A	4.75	4.66
Yellow-fronted Canary	*Serinus mozambicus*	A	1.31	2.25
	PASSERIDAE - Old World Sparrows			
House Sparrow	*Passer domesticus*	A	0.66	0.72
	ESTRILDIDAE - Estrildid Finches			
	Estrildinae - Estrildine Finches			
Common Waxbill	*Estrilda astrild*	A	-	2.41
African Silverbill	*Lonchura cantans*	A	2.03	1.78
Nutmeg Mannikin	*Lonchura punctulata*	A	0.66	0.84
Java Sparrow	*Padda oryzivora*	A	1.13	1.34

KEY TO TABLE 2

ST Status

A Alien – Introduced to the Hawaiian Islands by humans

D Domesticated – Species not considered to be established in the wild on the Island of Hawai'i

IM Indigenous Migratory – native but not unique to the Hawaiian Islands, does not breed in Hawai'i

RA-06 Relative Abundance 2006 – Number of birds detected divided by the number of count stations (32)

RA-12 Relative Abundance 2012 – Number of birds detected divided by the number of count stations (32)

I - Incidental - A species recorded as an incidental observation while transiting between count station, followed by the number of individuals detected

Mammalian Survey Results

Eight terrestrial mammalian species were detected during the course of this survey. Which species were detected during the course of this and the previous survey conducted in 2006 are presented in table 3. The table also contains information on how the individual species were detected.

Table 3 - Mammalian Species Detected Within the Kaloko Properties Study Site

Common name	*Scientific name*	ST	DT-06	DT-12
	CHIROPTERA - BATS			
	VESPERTILIONIDAE - Common Bats			
Hawaiian hoary bat	*Lasiurus cinereus semotus*	**EE**	A,V	-
	RODENTIA - GNAWERS			
	Muridae - Old World Rats & Mice			
European house mouse	*Mus musculus domesticus*	A	V	V
	CARNIVORA- FLESH EATERS			
	Canidae - Wolves, Jackals & Allies			
Domestic dog	*Canis f. familiaris*	A	T, Si,Sc	T,Sc,Sc, A
	Viverridae - Civets & Allies			
Small Indian mongoose	*Herpestes a. auropunctatus*	A	V	V
	Felidae- Cats			
House cat	*Felis catus*	A	V	V
	ATRIODACTYLA - EVEN-TOED UNGULATES			
	Suicidae - Old World Swine			
Pig	*Sus s. scrofa*	A	V,Sci,Sc	V,Sci,Sc
	Bovidae- Hollow-horned Ruminants			
Domestic cattle	*Bos taurus*	A	Sc,Sk	Sc,Sk
Domestic goat	*Capra h. hircus*	A	V,Sci,Sc,A, Sk	V,Sci,Sc,A, Sk
Domestic sheep	*Ovis aries*	A	Sc,Sk	Sc,Sk

KEY TO TABLE 3

EE Endangered Endemic – Native and unique to the Hawaiian Islands

A Alien – Introduced to the Hawaiian Islands by humans

DT-06 Detection Type 2006 survey

DT-12 Detection Type 2012 survey

A Audio – Species detected aurally

V Visual – Species detected visually

Sci Sci – Species detected animal sign

Sc Sc – Species detected by the presence of scat (fecal material)

Sk Sk – Species detected by observing skeletal remains

Hawai'i's sole endemic terrestrial mammalian species, the endangered Hawaiian hoary bat, was not detected during this survey. This species was detected during the 2006 survey of the same site (Table 3; David, 2006). All of the alien mammalian species recorded during this survey are deleterious to avian and floristic components of the remaining native ecosystems present on the Island.

Discussion

Botanical Resources

Plants found on the property and considered to be of special interest (rare and/or listed natives) were recorded when encountered using the GPS unit. The five species plotted in Figure 7 (and the coding used) are:

- *'aiea – Nothocestrum breviflorum* (Nb) Endangered
- *hala pepe - Pleomele hawaiiensis* (Ph) Endangered
- *ko'oko'olau – Bidens micrantha ctenophylla* (Bm) "Candidate"[4]
- *'ohe makai – Polycias sandwicensis* (Rs) Not listed
- *uhiuhi – Caesalpinia kavaiensis* – (Ck) Endangered

Not one of these species was found on the property outside of the LF1 vegetation zone (essentially the most youthful *'a'ā* flow) with the exception of *ko'oko'olau* which occurs occasionally around the edges of the LF1 and in the extension of the lava flow upslope into the lower part of the PF. Figure 7 shows only a limited portion of the project (and survey) area because none of the selected species plotted was recorded outside of this map area. Most numerous in the plot are *'ohe makai* trees (93 individuals noted). Next most numerous are 66+ *ko'oko'lau* plants (in one instance, notes record "*numerous juvenile Bidens*"). The number of *hala pepe* recorded is 16. The single *'aiea* and *uhiuhi* are marked with red diamonds in Figure 7.

We can compare our Figure 7 with the Hawaii Forest Industry Association (HFIA, undated) map, which covers most, although not all of the area in Figure 7. This map shows feature positions (locations) of some 38 *hala pepe*, all to the southeast of Hina Lani. Over 100 locations for *ko'oko'olau* are indicated. Attempting to visually match up HFIA positions of *hala pepe* to those shown in Figure 7 suggests only some are clearly the same individual plants. There are *hala pepe* indicated on both maps that lack a corresponding plant on the other map. Since *hala pepe* is a moderately large and slow growing tree-like monocot, it is difficult to explain these discrepancies. We did see a number of dead *hala pepe* and the locations of these were not recorded. Our survey in the LF1 was largely driven by moving from special tree to special tree and low growing *ko'oko'olau* could easily be missed.

Ko'oko'olau (specifically, *B. m.* ssp. *ctenophylla*) is presently a candidate species for listing (USFWS, 2011). The HFIA map shows the plant to widely distributed across the Kaloko-Honokōhau *'a'ā* lava flow above the Ane Keohokalole Highway construction corridor at the 400-ft elevation. Nishida (1993) noted the plant to be *"...common on the Kaloko-Honokohau 'a'a flow above an elevation of ca. 90 meters (300 ft)..."*

[4] Candidate species are species which the USFWS has under consideration for possible listing in the future and for which the Service has sufficient information to support listing. Species noted as Candidates are not legally protected until listed, and not all Candidate species end up being listed under the ESA.

It is clear that the *uhiuhi* on the HFIA map is the same tree we recorded. Nishida (1993) observed no *uhiuhi* in the LF1 area of their survey (below 350-feett elevation), but relates that Ken Nagata collected *uhiuhi* material from this area (at 270 and 320 feet elevations) previous to their 1992 survey. These plants are presumably no longer present.

The HFIA survey area did not include the location of the *'aiea* tree. Nishida (1993) describes two *'aiea* trees from the same area *"...on the Kaloko-Honokohau 'a'a flow at 100 meters (360 feet) in elevation..."* A hand drawn USFWS map (2003) also shows two *'aiea* trees located between the "Pit" and the water tank to the west. Only one of these trees is still present (see Figure 7).

Other species of plants that would be of concern, but were not observed during our survey are two Hawai'i endemics: *Cyperus fauriei* (no common name) and *Neraudia ovata* (*ma'aloa*). Both are listed endangered species previously recorded from the LF1 lava flow (Nishida, 1993; USFWS, 2002a), but not recorded as present by Whistler (2006). The distribution of *Neraudi*a is indicated on a hand-drawn map by USFWS as being in 5 locations to the south and west of a feature labeled as "Pit" but clearly the disturbed area used as a base yard for the construction of Hina Lani Street ("D" in Figure 2; "base yard" in Figure 7). Whistler relates that Rex Palmer had seen *Neraudia* in 2003 under trees near to where homeless people were known to camp (area directly SSE of the "base yard"). This area was searched in 2012 (although "near" is an uncertain term) without the species being located. The recorded position of a single *Neraudia* on the HFIA map is some 24 m west from one 2012 track and 26 m east from another. At these distances trees and large shrubs would be easy to "discover" but not necessarily small shrubs if hidden within the jumble of lava rocks or under trees (such as Christmas berry) that were not approached.

A map prepared by USFWS (2002) shows *Mariscus* (=*Cyperus*) *fauriei* coincident with *Neraudia ovata* and *Nothocestrum breviflorum* in this area. The sedge, *C. fauriei* was reported present on LF1 in the project area by Nishida (1993). Five plants were seen on a single boulder at about the 380-ft (115-m) elevation. This would put the location downslope of Ane Keohokalole Highway, presently under construction through the LF1 lava flow at the 400-ft elevation. Also recorded from the same area as *ma'aloa* and *C. fauriei* was the rare (but not listed) sedge, *Fimbristylis hawaiiensis* (Nishida, 1993).

Obviously changes in plant numbers and distribution are always occurring and we do not offer up our effort as a complete inventory of the rare species that were mapped. More important is the obvious distribution, or more correctly, limited distribution of these valuable botanical resources to the LF1 vegetation type as mapped on Figure 2 (and outlined in Figure 7). The LF1 flow itself, below ~600-ft elevation and excluding most of the former quarry area is the important feature that would need to be preserved to the extent possible to conserve these particular species populations.

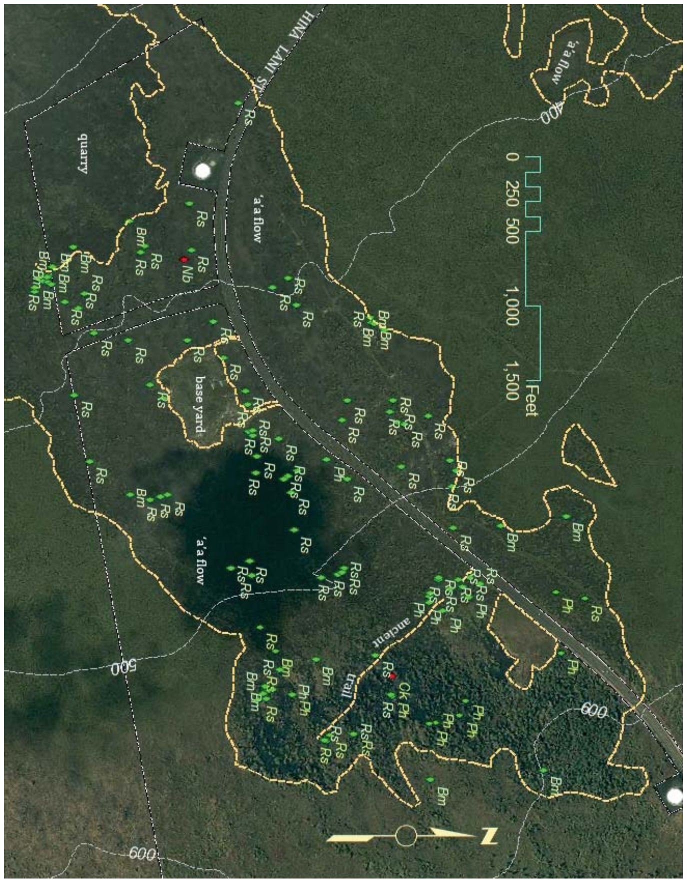

Figure 7 - Plot of selected rare plants in the project area.
(Nb) *ʻaiea – Nothocestrum breviflorum* - Endangered
(Ph) *hala pepe - Pleomele hawaiiensis* - Endangered
(Ck) *uhiuhi – Caesalpinia kavaiensis* - Endangered
(Bm) *koʻokoʻolau – Bidens micrantha ctenophylla* - Candidate
(Rs) *ʻohe makai – Polycias sandwicensis* - Not listed

Avian Resources

The findings of the avian survey are consistent with the location of the site, and the habitat present on it. As well as two previous surveys of the same site conducted by David in 1995 and 2006 (David, 1995, 2006), and with two surveys conducted on portions of the land (David, 2007; David and Guinther, 2011) with several surveys on lands immediately adjacent to portions of the site (David, 2000a 2000b, 2004a, 2004b, 2005).

All but one of the 21 avian species detected during the 2012 survey, are alien species (Table 2). The lone native species detected, Pacific Golden-Plover is an indigenous migratory shorebird species, which nests in the high Arctic during the late spring and summer months, returning to Hawaiʻi and the Tropical Pacific to spend the fall and winter months each year. They usually leave Hawaiʻi for their trip back to the Arctic in late April or the very early part of May.

During the course of this survey we detected two avian species not detected during the 2006 survey of the site, namely Mitred Parakeet (*Aratinga mitrata*), and Common Waxbill (*Estrilda astrild*), (Table 2). Both species are alien to the Hawaiian Islands, The parakeets roost on Mount Hūalalai and fly over the coastal Kona area in search of foraging resources in the early morning, and then fly back upslope in the late afternoon to their night roosts. Common Waxbills are a recently introduced species to the Island of Hawaiʻi, which is rapidly become established in large numbers. It is a ubiquitous species on all of the other main Islands in the state. During the course of the 2006 survey of the site I detected two species not detected during this current survey, namely, Kalij Pheasant (*Lophura leucomelanos*), and Barn Owl (*Tyto alba*). Kalij Pheasants are usually found in wetter forests than is present on this site, and Barn Owls are an irruptive species, which are currently undergoing one of its low density years in the Kona area. From a statistical perspective the findings of these two surveys are not significantly different from each other (David, 2006, and current document), (Table 2).

Although no seabirds were detected during either the 2006 or this survey, it is probable that both the endangered Hawaiian Petrel (*Pterodroma sandwichensis*), and the threatened endemic sub-species of the Newell's Shearwater (*Puffinus auricularis newelli*), over-fly the project area in small numbers between April and the middle of December each year. Both species have been recorded flying to and from their nesting colonies over the greater Kona area (Day et al., 2003; David 2011). Both of these pelagic seabird species nest high in the mountains in burrows excavated under thick vegetation, especially *uluhe* (*Dicranopteris* linerais) fern. There is no suitable nesting habitat for either of these seabird species on, or close to this site.

The primary cause of mortality in the two aforementioned seabird species is thought to be predation by alien mammalian species at the nesting colonies (USFWS 1983; Simons and Hodges 1998; Ainley et al., 2001). Collision with man-made structures is considered to be the second most significant cause of mortality of these seabird species in Hawaiʻi. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall,

can become disoriented by exterior lighting. When disoriented, seabirds often collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals (Hadley 1961; Telfer 1979; Sincock 1981; Reed et al., 1985; Telfer et al., 1987; Cooper and Day, 1998; Podolsky et al. 1998; Ainley et al., 2001; Hue et al., 2001; Day et al., 2003).

Mammalian Resources

The findings of the mammalian survey are consistent with the location of the site, and the habitat present on it. As well as two previous surveys of the same site conducted by David in 1995 and 2006 (David, 1995, 2006), and with two surveys conducted on portions of the land (David, 2007; David and Guinther, 2011) with several surveys on lands immediately adjacent to portions of the site (David, 2000a, 2000b, 2004a, 2004b, 2005).

All of the terrestrial mammalian species recorded during the course of this current survey of the site are alien to the Hawaiian Islands (Table 3). During the course of the 2006 survey of the site a lone Hawaiian hoary bat was seen "*flying down-slope, (makai), from above the eastern boundary of the site towards the ocean*." (David, 2006). Hawaiian hoary bats are regularly seen *mauka* of the project site and also *makai* of the subject property in the Kaloko-Honokōhau National Historical Park and above the Honokōhau small boat harbor on a seasonal basis (Jacobs 1994, David 2006, 2012). Unlike nocturnally flying seabirds, which often collide with man-made structures, bats are uniquely adapted to avoid collision with most obstacles, man-made or natural. They navigate and locate their prey primarily by using ultrasonic echolocation, which is sensitive enough to allow them to locate and capture small volant insects at night.

Although only European house mice were detected during the course of both this survey and the one conducted in 2006 (David, 2006), it is probable that the other three established *muridae* known from the Island of Hawai'i, roof rat (*Rattus r. rattus*), Norway rat (*Rattus norvegicus*), and possibly Polynesian rat (*Rattus exulans hawaiiensi*) use resources within the subject property at least occasionally. Especially since the site is bound to the north and south by light industrial developments that likely harbor these human commensal species. All of these introduced rodents are deleterious to native ecosystems and the native faunal species that are dependant on them.

Potential Impacts to Protected Species

Botanical

The following listed species of plants have been reported from the project site:

- *'aiea – Nothocestrum breviflorum* (Endangered)
- *hala pepe - Pleomele hawaiiensis* (Endangered)
- *ma'aloa – Neraudia ovata* (Endangered)
- sedge – *Cyperus fauriei* (Endangered)

- *uhiuhi – Caesalpinia kavaiensis* – (Endangered)

As was the case with the previous Whistler survey in 2006[5], no listed plant species were found in the areas of disturbed scrub and forest vegetation (PS and PF areas in Figure 2). Likewise, no species of any particular concern were seen in the older *'a'ā* flows (LF2), although these features supported more commonly occurring native plants. In contrast, all five endangered species of plants are presently known from or have been previously recorded as occurring in the remnant dry land forest area (LF1 in our Figure 2).

Based upon the distribution of listed plant species (Figure 7), the proposed 150-acre Dry Land Forest conservation area (Figure 1) would preserve most of the habitat associated with the LF1 vegetation zone (Kaloko-Honokōhau *'a'ā* lava flow between the 400 and 650-ft elevations south of Hina Lani Street). Whistler (2006) relates that the dry land forest is some 200-ac in extent based upon conversation with USFWS. Potentially critical areas not included in the planning map are the location of an, *'aiea* tree west of the Ane Keohokalole Highway corridor and two *hala pepe* plants on the north side of Hina Lani Street. Only the more *mauka* specimen could be located in our survey. The dry land forest habitat north of Hina Lani is far more degraded than is the case south of the thoroughfare, the lava surface having been graded over much of the areas and having an old unimproved road running through it parallel to Hina Lani. On the other hand, the area west of Ane Keohokalole and south of Hina Lani down to the vicinity of the water tank is the most rugged part of the lava flow remaining intact. This area is such a jumble of large lava boulders, that very few plants of any kind grow here, and a level of relative protection from ungulate browsing and wild fires is provided by the natural substrate.

Seabirds

The principal potential impact that construction and operation of the proposed development poses to protected seabirds is the increased threat that birds will be downed after becoming disoriented by lights associated with the project during the nesting season. The two main areas that outdoor lighting could pose a threat to these nocturnally flying seabirds is if, 1) during construction it is deemed expedient, or necessary to conduct nighttime construction activities, 2) following build-out, the potential operation of streetlights and security lighting during the seabird nesting season.

Hawaiian hoary bat

The principal potential impact that the development of the proposed development poses to bats is during the clearing and grubbing phases of construction as vegetation is removed. The removal of vegetation within the project site may temporarily displace individual bats, which may use the vegetation as a roosting location. As bats use multiple roosts within their home territories, the potential disturbance resulting from the removal of the vegetation is likely to be minimal. During the pupping season female carrying their pups may be less able

[5] And we may note that the same result was reported by Nishida (1993) surveying a 0.5-mile wide swath through the property between the 300 and 400-ft elevations, covering parts of the LF1, LF2, PS, and Q mapped vegetation types of our survey.

to rapidly vacate a roost site as the vegetation is cleared, additionally adult female bats sometimes leave their pups in the roost tree while they themselves forage, very small pups may be unable to flee a tree that is being felled. Potential adverse effects from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15-feet), between June 1 and September 15, the period in which bats are potentially at risk from vegetation clearing. With that said there is little vegetation present on the site that is suitable bat roosting habitat.

Recommendations

- If nighttime construction activity or equipment maintenance is proposed during the construction phases of the project, all associated lights should be shielded, and when large flood/work lights are used, they should be placed on poles that are high enough to allow the lights to be pointed directly at the ground.

- Following build-out it is recommended that any streetlights or facility security lighting that may be required for public safety reasons be shielded (Reed et al. 1985, Telfer et al. 1987). This minimization measure would serve the dual purpose of minimizing the threat of disorientation and downing of Hawaiian Petrels and Newell's Shearwaters, while at the same time complying with the Hawai'i County Code § 14 – 50 *et seq.* which requires the shielding of exterior lights so as to lower the ambient glare caused by unshielded lighting to the astronomical observatories located on Mauna Kea.

- It is recommended that to minimize potential impacts to roosting Hawaiian hoary bats, woody vegetation taller than 4.6 meters (15-feet) high not be cleared between June 1 and September 15.

- It is recommended that, where appropriate and practicable, native plant species be used in landscaping efforts. Not only is this ecologically prudent, but also if the appropriate plants are used, it will also likely save maintenance and water costs over the long term.

- The proposed 150-acre Dryland Forest conservation area will preserve the most significant parts of the lowland Kaloko-Honokōhau *a`a* lava flow for native plant conservation. The two (or possibly three) listed plant specimens (i.e. one *hala pepe* and one *`aiea* tree) that occur outside of this designated preservation area will be preserved in place with a 50 foot visible orange screened buffer surrounding each endangered species. The area south of the dryland forest, although separated by a new roadway, an area of 10 to 18 ac between Ane Keohokalole and the old quarry to the southern property boundary includes a number of *ko`oko`olau* and *`ohe makai* plants, in addition to possibly supporting two rare sedges: *Cyperus fauriei* and *Fimbrisylis hawaiiensis*. This separated piece could potentially serve as an area of more intensive management (for example, fencing against ungulates, removal of non-native invasive plants, experimental plantings of rare native plants, etc).

Critical Habitat

There is no federally delineated Critical Habitat present on or adjacent to this property. Thus the development and operation of the proposed development will not result in impacts to federally designated Critical Habitat. There is no equivalent statute under State law.

Glossary

ʻAʻā – Clinker lava formed by slow moving lava flows
Alien – Introduced to Hawaiʻi by humans
Commensal – Animals that share human food and lodgings, such as rats and mice.
Domesticated – Feral species, not considered established in the wild on the Island of Hawaiʻi.
Endangered – Listed and protected under the Endangered Species Act of 1973, as amended (ESA) as an endangered species
Endemic – Native and unique to the Hawaiian Islands
Indigenous – Native to the Hawaiian Islands, but also found elsewhere naturally
Makai – Down-slope, towards the ocean
Mauka – Upslope, towards the mountains
Muridae – Rodents, including rats, mice and voles, one of the most diverse family of mammals
Naturalized – A plant or animal that has become established in an area that it is not indigenous to
Nocturnal – Night-time, after dark
ʻŌpeʻapeʻa – Endemic endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*)
Pāhoehoe – Sheet lava formed by relatively fast moving lava flows
Pelagic – An animal that spends its life at sea – in this case seabirds that only return to land to nest and rear their young
Ruderal – Disturbed, rocky, rubbishy areas, such as old agricultural fields and rock piles
Sign – Biological term referring tracks, scat, rubbing, odor, marks, nests, and other signs created by animals by which their presence may be detected
Threatened – Listed and protected under the ESA as a threatened species
Volant – Flying, capable of flight - as in flying insect

DLNR – Department of Land and Natural resources
DOFAW – Division of Forestry and Wildlife
ESA – Endangered Species Act of 1973, as amended
TMK – Tax Map Key
USFWS – United State Fish & Wildlife Service

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