Appendix G

Update Flora and Fauna Surveys for the Kaloko Makai Development
Rana Biological Consulting, Inc. and AECOS Consultants
May 17, 2012
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May 17, 2012
**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 Kona, North Kona District, Island of Hawai‘i. The properties are identified as TMK: (3) 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 italicised 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 Kona 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).
The Project site lies on volcanic flows disgorged from Mount Hualalai. 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 Kahiku-Honokōhau ‘ō‘o lava flow (LF1) - dates to between 1,500 and 3,000 years before the present (ybp). In the project area, this ‘ō‘o 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 Ka‘ahumanu Highway. This flow originated from within the northwest rift of Mount Hualalai. The remainder of the property is an older flow dated between 3,000 and 5,000 ybp, but with some distinct ‘ō‘o 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 Ka‘ahumanu Highway.

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 ‘ō‘o 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


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 (Gunther 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.

![Map of survey area plotted on an aerial image, showing tracks taken by the botanist over the course of the survey.](image)

**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 (*Lasiuris cinereus semotus*), or ‘ōpōʻe 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-foot 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 alphameric abundance rating. A plus sign (+) in an abundance column indicates a plant reported by Char (1995) in the indicated environment type.

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

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1 Char recognized two general vegetation types in her survey area: fountain grass grassland and ‘a’a lava flow. These correspond to our PS and LF2, respectively.
<table>
<thead>
<tr>
<th>Species</th>
<th>Abundance</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anemone</td>
<td>Low</td>
<td>Recently grazed near surface</td>
</tr>
<tr>
<td>Eelgrass</td>
<td>Moderate</td>
<td>Growing well in shaded areas</td>
</tr>
<tr>
<td>Sargassum</td>
<td>High</td>
<td>Thriving in nutrient-rich waters</td>
</tr>
<tr>
<td>Seagrass</td>
<td>Low</td>
<td>Currently under threat from pollution</td>
</tr>
</tbody>
</table>

Table 1 - Flora for Kalolo Medical North Kona, Hawaii
<table>
<thead>
<tr>
<th>Family</th>
<th>Common name</th>
<th>Status</th>
<th>Arthropod (v. 2012)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COCCINELLIDAE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Coccinella</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Coccinella septempunctata</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A total of 172 different species of plants were recorded as growing in the surveyed parcels.

2 Two species, Ailanthus and Simarouba, 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: *Nerudia ovata* and *Cyperus forierii*. Also significant are the rare natives, *uhiku* (*Caesalpinia kauensis*) and *‘iaea* (*Nothocentrum 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 ‘Ōi‘ō Lowland Dry Forest. Below about 350 feet, this flow is divided into a southern developed land (the quarry) and a narrow finger of “sparingly 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 ‘a‘a 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 Hualalai from the project area. The somewhat older ‘a‘a 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 **remnant dryland forest** on LF1 is mostly one supporting lama (* Diospyros sandwicensis*), alahe‘e (*Psidix drummondii*), Christmas berry, and ‘ohi‘a (*Metrosideros polymorpha*). Present, although to lesser extents, are ‘ewe mahai (*Polycras sandwicensis*) and hala pepe (*Pleomele hawaiiensis*). Shrubs (sometimes small trees) that are relatively common are naio (*Myrsinum sandwicensense*), pua pilo or maiapilo (*Capparis sandwicensiana*), ‘a‘ali‘i (*Dodonaea viscosa*), mamane (*Sophora chrysophylla*), and kolomona (*Senna gaudichaudii*). Very rare are *uhiku* and *‘iaea* (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 mimosaefolia*), 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 (*Coccus orbicularis*) and koali ‘owa (*Ipomoea indica*; Figure 4).

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

![Figure 4 - Scrubby trees and extensive ground cover of huehue on rugged ‘a‘a 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.](image)

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 ‘a‘a flows is, of 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 ʻa‘ali‘i, are widely scattered within this vegetation type. At low elevations on the property, ʻulu (*Acacia farnesiana*) appears as an occasional shrub and kiawe (*Prosopis pallida*) as a rare tree. 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.

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3 Possibly a consequence of the long period of drought affecting this part of the Island of Hawai‘i, nearly all of the kiawe trees observed during our survey of the project properties were deceased.
Figure 5 – Koa hoole shrubland (PF) showing mostly koa hoole 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 Honokohau 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 ‘ohi’a trees are present. In the understory, either talinum (Talinum triangulare) or air plant (Kalancheae 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 hoole forest with an understory of dense Guinea grass (Panicum maximum) immediately off the north side of Hina Lani Street; somewhat open Christmas berry/koa hoole 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 hoole scrub (cattle grazed land) with Guinea grass and scattered kukuai (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‘oolau 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 “i‘ai’ai” of the original surface remain where either ‘ohi’a or maiapilo plants are growing. The site is extensively invaded by fountain grass (Figure 6).
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>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>ST</th>
<th>RA-06</th>
<th>RA-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Golden-Plover</td>
<td>Pluvialis fulva</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spotted Dove</td>
<td>Streptopelia chinensis</td>
<td>A</td>
<td>2.22</td>
<td>1.16</td>
</tr>
<tr>
<td>Zebra Dove</td>
<td>Geopelia striata</td>
<td>A</td>
<td>3.66</td>
<td>2.97</td>
</tr>
<tr>
<td>Mitred Parakeet</td>
<td>Aratinga mitrata</td>
<td>A</td>
<td>0.91</td>
<td></td>
</tr>
<tr>
<td>Barn Owl</td>
<td>Tyto alba</td>
<td>IM</td>
<td>0.34</td>
<td>0.34</td>
</tr>
<tr>
<td>Japanese White-eye</td>
<td>Zosterops japonicus</td>
<td>A</td>
<td>3.44</td>
<td>3.22</td>
</tr>
<tr>
<td>Northern Mockingbird</td>
<td>Mimus polyglottos</td>
<td>A</td>
<td>0.22</td>
<td>0.31</td>
</tr>
<tr>
<td>Common Myna</td>
<td>Acridotheres tristis</td>
<td>A</td>
<td>2.25</td>
<td>2.31</td>
</tr>
<tr>
<td>Saffron Finch</td>
<td>Sicalis flaveolus</td>
<td>A</td>
<td>1.31</td>
<td>1.00</td>
</tr>
<tr>
<td>Yellow-billed Cardinal</td>
<td>Paroreia capitata</td>
<td>A</td>
<td>0.88</td>
<td>0.78</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>ST</th>
<th>RA-06</th>
<th>RA-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Cardinal</td>
<td>CARDINALIDAE - Cardinals Saltators &amp; Allies</td>
<td>A</td>
<td>1.56</td>
<td>1.47</td>
</tr>
<tr>
<td>Cardinals cardinalis</td>
<td>FRINGILLIDAE - Fringilline and Cardueline Finches</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&amp; Allies</td>
<td>Carduelinae - Cardueline Finches</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>House Finch</td>
<td>Carpodacus mexicanus</td>
<td>A</td>
<td>4.75</td>
<td>4.66</td>
</tr>
<tr>
<td>Yellow-fronted Canary</td>
<td>Serinus mozambicus</td>
<td>A</td>
<td>1.31</td>
<td>2.25</td>
</tr>
<tr>
<td>House Sparrow</td>
<td>Passer domesticus</td>
<td>A</td>
<td>0.66</td>
<td>0.72</td>
</tr>
<tr>
<td>Common Waxbill</td>
<td>Estrilda astrild</td>
<td>A</td>
<td>-</td>
<td>2.41</td>
</tr>
<tr>
<td>African Silverbill</td>
<td>Lonchura cantans</td>
<td>A</td>
<td>2.03</td>
<td>1.78</td>
</tr>
<tr>
<td>Nutmeg Mannikin</td>
<td>Lonchura punctulata</td>
<td>A</td>
<td>0.66</td>
<td>0.84</td>
</tr>
<tr>
<td>Java Sparrow</td>
<td>Paddo oryzivora</td>
<td>A</td>
<td>1.13</td>
<td>1.34</td>
</tr>
</tbody>
</table>

**KEY TO TABLE 2**

A Allen – 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)
* - 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 mammal 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>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
<th>ST</th>
<th>DT-06</th>
<th>DT-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hawaiian hoary bat</td>
<td>Lasius cinereus semotus</td>
<td>EE</td>
<td>A, V</td>
<td>-</td>
</tr>
<tr>
<td>Rodentia - GNNWERS</td>
<td>Muridae - Old World Rats &amp; Mice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>European house mouse</td>
<td>Mus musculus domesticus</td>
<td>A</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Carnivora - Flesh Eaters</td>
<td>Canidae - Wolves, Jackals &amp; Allies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic dog</td>
<td>Canis f. familiaris</td>
<td>A</td>
<td>T, S, Sc</td>
<td>T, Sc, Sc, A</td>
</tr>
<tr>
<td>Small Indian mongoose</td>
<td>Herpestes a. auroptatus</td>
<td>A</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>House cat</td>
<td>Felis catus</td>
<td>A</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Atriodactyla - Even-Toed Ungulates</td>
<td>Suidae - Old World Swine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pig</td>
<td>Sus scrofa</td>
<td>A</td>
<td>V, Sc, Sc</td>
<td>V, Sc, Sc</td>
</tr>
<tr>
<td>Domestic cattle</td>
<td>Bos taurus</td>
<td>A</td>
<td>S, Sc, S</td>
<td>S, Sc, Sk</td>
</tr>
<tr>
<td>Domestic goat</td>
<td>Capra h. hircus</td>
<td>A</td>
<td>S, S</td>
<td>S</td>
</tr>
<tr>
<td>Domestic sheep</td>
<td>Ovis aries</td>
<td>A</td>
<td>S, Sc, S</td>
<td>S, Sc, S</td>
</tr>
</tbody>
</table>

**KEY TO TABLE 3**

EE Endangered Endemic – Native and unique to the Hawaiian Islands
A Allen – 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
Sd Sd – Species detected animal sign
Sc Sc – Species detected by the presence of scat (fossil material)
Sk Sk – Species detected by observing skeletal remains

Hawaii’s sole endemic terrestrial mammal 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 mammal 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:

- 'aiaea – Nothocestrum breviflorum (Nh) Endangered
- hala pepe - Pleomele hawaiiensis (Ph) Endangered
- ko'oko'olau – Bidens micrantha ctenophylla (Bm) "Candidate"4
- 'ohe makai – Polycus sandwichensis (Rc) Not listed
- uhuihi – Canna pipinio hawaiiensis – (Ek) Endangered

Not one of these species was found on the property outside of the LFI vegetation zone (essentially the most youthful 'a'ia flow) with the exception of ko'oko'olau which occurs occasionally around the edges of the LFI 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'olau plants (in one instance, notes record "numerous juvenile Bidens"). The number of hala pepe recorded is 16. The single 'aiaea and uhuihi 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 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 LFI 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, R. m. xerophylla) is presently a candidate species for listing (USFWS, 2011). The HFIA map shows the plant to widely distributed across the Kaloko-Honokōhau 'a'ia lava flow above the Keokukule Highway construction corridor at the 400-ft elevation. Nishida (1993) noted the plant to be "...common on the Kaloko-Honokōhau 'a'ia flow above an elevation of ca. 90 meters (300 ft)..."

It is clear that the uhuihi on the HFIA map is the same tree we recorded. Nishida (1993) observed na uhuihi in the LFI area of their survey (below 350-foot elevation), but relates that Ken Nagata collected uhuihi 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 'aiaea tree. Nishida (1993) describes two 'aiaea trees from the same area "...on the Kaloko-Honokōhau 'a'ia flow at 100 meters (360 feet) in elevation..." A hand drawn USFWS map (2003) also shows two 'aiaea 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 Hawaiian endemics: Cyperus fairiei (no common name) and Neraudia ovata (ma'aula). Both are listed endangered species previously recorded from the LFI lava flow (Nishida, 1993; USFWS, 2002a), but not recorded as present by Whistler (2006). The distribution of Neraudia 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) fairiei coincident with Neraudia ovata and Nothocestrum breviflorum in this area. The sedge, C. fairiei was reported present on LFI in the project area by Nishida (1993). Five plants were seen on a single boulder at about the 300-ft (115-m) elevation. This would put the location downslope of Ano Keohokale Highway, presently under construction through the LFI lava flow at the 400-ft elevation. Also recorded from the same area as ma'aula and C. fairiei was the rare (but not listed) sedge, Fimbristylis hawaiensis (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 LFI vegetation type as mapped on Figure 2 (and outlined in Figure 7). The LFI 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.

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.
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 Hawai‘i and the Tropical Pacific to spend the fall and winter months each year. They usually leave Hawai‘i 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 Mottled Parakeet (Aratinga mitrata), and Common Wadhill (Estrilda astrild), (Table 2). Both species are alien to the Hawaiian Islands. The parakeets roost on Mount Hi‘ialakai 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 Wadhills are a recently introduced species to the Island of Hawai‘i, which is rapidly becoming 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 Peahant (Lophura leucomelanos), and Barn Owl (Tyto alba). Kalij Peahans 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 linearis) 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 Hawai‘i. 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; Telles 1979; Sincok 1981; Reed et al., 1985; Telfer et al., 1987; Cooper and Day, 1998; Rodosky 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 Guenther, 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 hawaiensis) 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 fumal 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:

- ' alea – Nothocestrum breviflorum (Endangered)
- hala pepe - Pseomele hawaiensis (Endangered)
- mu'ama - Nerodia ovata (Endangered)
- sedge – Cyperus fauriei (Endangered)

- uhihi – Caesalpinia hawaiensis – (Endangered)

As was the case with the previous Whistler survey in 2006, 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‘ō 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‘ō 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, ‘ainu tree west of the Ano Keokokole Highway corridor and two hula pepe plants on the north side of Hina Lani Street. Only the more makau 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 Ano Keokokole 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 jungle 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

3 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'ā lava flow for native plant conservation. The two (or possibly three) listed plant specimens (i.e. *one bula pepe* and one *'ai'eo 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'o liao* and *'ohe makai* plants, in addition to possibly supporting two rare sedges: *Cyperus fouriei* and *Fimbriarhis 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

‘A‘i – Clinker lava formed by slow moving lava flows
Alien – Introduced to Hawai‘i by humans
Commensal – Animals that share human food and lodgings, such as rats and mice.
Endangered – Feral species, not considered established in the wild on the Island of Hawai‘i.
Endemic – Native and unique to the Hawaiian Islands
Indigenous – Native to the Hawaiian Islands, but also found elsewhere naturally
Molai – Down-slope, towards the ocean
Moku’a – Uplioppe, 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
‘Ope’ape’a – Endemic endangered Hawaiian hoary bat (Lasiurus cinereus semotus)
Plihelohe – 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 States Fish & Wildlife Service

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