BOTANICAL SURVEY

LIHUE/PUHI MASTER PLAN PROJECT

LIHUE, KAUA'I

by

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EXHIBIT I

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SUMMARY

On 8 September 1988, a botanical survey was carried out on the site of the proposed Lihue/Puhi development project at Lihue, Kaua'i. The site consisted primarily of cane fields in active production, with weedy peripheral areas. These included a small gulch in the southeastern portion of the site, a landfill in the south-central portion, and the margin of the gulch that runs the full length of the study site. A total of 150 species of vascular plants were found on the site. Of these, 143 (95%) were exotic weeds or deliberately introduced plants, and 7 (5%) were native or presumed-native plants. None of the species found on the site were officially listed as endangered or threatened; nor were any species proposed or candidate for such status.

INTRODUCTION

The study site consists of approximately 400 acres of sugar cane land located just west of Lihue, Kaua'i. It is bounded on the northwest by Kaumuali'i Highway, on the northeast by Nawiliwili Road and the Kukui Grove Center, on the east by Niumalu Road, and on the southwest by the Halehake-Puali gulch system. One parcel of approximately 55 acres in the western end of the site is separated from the remainder of the site by Halehake Gulch. Almost all of the site is cane field in active production, with only small portions of the total acreage in other uses. The largest of these is a small gulch at the eastern end of the site, overgrown with weeds. In the northwestern part of the site is a small fallow area that apparently is kept clear of significant plant growth by periodic tilling. Just to the southeast of this is an active landscape nursery operation. Near the center of the site are a landfill, a sewage treatment facility, and the grounds of the old plantation manager's house, still maintained as residential. To a small degree, weedy vegetation from the gulch system bordering the study site was found to be encroaching on the margins of the cane fields.

SURVEY METHODS

A walk-through method was used for this survey. All parts of the site were easily accessible by means of the peripheral roads, as well as a system of cane-haul roads within the site. Plants were identified on sight. The few that could not be immediately recognized were brought back for comparison with the standard literature and herbarium material. Taxonomy and nomenclature of the ferns is that of Wagner and Wagner (1987), while the flowering plants generally follow Wagner, et al. (in press).

DESCRIPTION OF THE VEGETATION

Almost the entirety of the site was covered with sugar cane (Saccharum officinarum). Along roads and ditches, as well as in newly-worked fields, a large number of wayside weeds commonly associated with agricultural lands were in evidence. Though a minor component of the vegetation, they constituted some 64% of all the species listed at the end of this report. Among the most characteristic of these were nut sedge (Cyperus rotundus), finger grass (Chloris barbata and radiata), barnyard grass (Echinochloa crus-galli), Amaranthus species, ageratum (Ageratum conyzoides and houstonianum), Spanish needle (Bidens pilosa), horseweed (Conyza bonariensis and canadensis), Elephantopus mollis, emilia (Emilia coccinea and fosbergii), Pluchea symphytifolia, coatbuttons (Tridax procumbens), ironweed (Vernonia cinerea), spurge (Chamaesyce and Euphorbia species), Phyllanthus debilis, castorbean (Ricinus communis), partridge pea (Chamaecrista nictitans), rattlepod (Crotalaria incana and pallida), Desmanthus virgatus, beggars' ticks (Desmodium species), sleepinggrass (Mimosa pudica), Sida acuta and rhombifolia, yellow wood-sorrel (Oxalis corniculata), common garden plantain (Plantago major), purslane (Portulaca oleracea), Richardia brasiliensis, borreria (Spermacoce laevis), Asiatic pennywort (Centella asiatica), apium (Ciclospermum leptophyllum), and Stachytarpheta dichotoma and urticifolia, as well as a number of others. Some, such as Hippobroma longiflora and Ludwigia octovalvis showed a decided preference for water, and tended to occur predominantly in ditches.

A few ornamental plants that have escaped from cultivation were also found established in and around the cane fields. These included Canna indica, asparagusfern (Asparagus setaceus), amaryllis (Hippeastrum puniceum), seedlings of royal palm (Roystonea sp.), Wedelia trilobata, and four-o'clock (Mirabilis jalapa). In addition, a number of other plants were apparently being cultivated among the sugar cane fields. Representatives of these were taro (Colocasia esculenta), sweet potato (Ipomoea batatas), bottle gourd (Lagenaria siceraria), bittermelon (Momordica charantia - now widely escaped), hyacinth bean (Lablab purpureus), and particularly asparagus bean (Vigna unguiculata).

Where cane fields abutted a gulch, a number of plants of the constituent gulch vegetation encroached on the fields. These included California grass (Brachiaria mutica), golden beard grass (Chrysopogon aciculatus), Guinea grass (Panicum maximum), Chinese violet (Asystasia gangetica), white shrimp plant (Justicia betonica), mango (Mangifera indica), Christmasberry (Schinus terebinthifolius), gomphocarpus (Asclepias physocarpa), African tulip tree (Spathodea campanulata), ironwood (Casuarina equisetifolia and stricta), kukui (Aleurites moluccana), Macaranga tanarius, maunaloa (Canavalia cathartica), koa-haole (Leucaena leucocephala), 'opiuma (Pithecellobium dulce), monkey pod (Samanea saman), cassia (Senna pendula), Abutilon grandifolium, hau (Hibiscus tiliaceus), Chinaberry (Melia azedarach), guava (Psidium guajava), Javaplum (Syzygium cumini), passion fruits (Passiflora edulis and laurifolia), silkoak (Grevillea robusta), Chrysophyllum pruniferum, and Lantana camara.

Apart from the cane fields, only the small gulch in the easternmost part of the study site had vegetation significantly different to warrant description. The lower half of this gulch was open and appeared to be at least periodically dry. Vegetation consisted mainly of grasses (California grass, Guinea grass, and Job's tears [Coix lachryma-jobi]), with scattered shrubs of koa-haole and pluchea. The upper half was covered in trees characteristic of the gulch areas, many of which are listed in the preceeding paragraph. There were four species in this gulch worthy of special mention: bananas (Musa X paradisiaca), be-still (Cascabela thevetia), panax (Polyscias guilfoylei), and

jackfruit (Artocarpus heterophyllus). These were found nowhere else on the site, and surely represent former plantings that have been allowed to revert to a weedy condition. The jackfruit is especially successful at maintaining itself, to judge by the large number of saplings and small trees present. In the forested area is a weir that impounds water from a spring somewhere near the uppermost part of the gulch. At the time of visit, there was a small but significant flow of water.

THREATENED AND ENDANGERED SPECIES

No listed, proposed, or candidate threatened and endangered species, as designated by the Federal and/or State governments (U.S. Fish and Wildlife Service, 1985; Herbst, 1987) were found on the site. There was no intact native ecosystem in or adjacent to the study site, which might be adversely affected by development. Near the southernmost point of the site, where the cane fields overlook a wetland adjacent to Niumalu, two remnants of the former vegetation were found. These were alahe'e (Canthium odoratum) and 'akia (Wikstroemia uva-ursi). They are disappearing where urbanization is proceeding, but otherwise remain common in dry areas at low elevations.

RECOMMENDATIONS

There is little of botanical interest on the project site, as most of the area has been actively cultivated for some time. The proposed development is not expected to have a significant impact on the total island populations of the species involved. The native species (both endemic and indigenous) are found in similar environmental conditions throughout the islands.

Where feasible, it might be desirable to landscape with native plants that are adapted to the local climatic conditions. Alahe'e and 'akia are already found on or adjacent to the site, and are both tough and decorative. A number of others could also be proposed if it is desired.

A number of the plantings associated with the plantation manager's house are significant due to their size and age. These include the colonades of royal palms and ancient specimens of mango, madre-de-cacao (Gliricidia sepium), wi (Spondias dulcis), and false olive (Elaeodendron orientale). It is recommended that the plantings, as much as possible, be left intact.

LITERATURE CITED

Herbst, D. 1987. Staus of endangered Hawaiian plants. Hawaiian Botanical Society Newsletter 26(2): 44-45.

U.S. Fish and Wildlife Service. 1985. Endangered and threatened wildlife and plants; Review of plant taxa for listing as Endangered and Threatened Species; Notice of review. Federal Register 50(188): 39526-39527 + 57-page table.

Wagner, W. H., Jr., and F. S. Wagner. 1987. Revised checklist of Hawaiian Pteridophytes. (Unpublished manuscript).

Wagner, W. L., D. Herbst, and S. Sohmer. In press. Manual of the Flowering Plants of the Hawaiian Islands. B. P. Bishop Museum Press.

SPECIES LIST

A list of all the vascular plants found on the site follows. Plants are organized in three groups -- ferns and fern allies, monocots, and dicots. Within each group, they are further arranged in alphabetical order by family and genus. For each species, an accepted common name is given. The Hawaiian name is given for all native plants if known, and for those exotic plants that are generally known by a Hawaiian name. Biogeographic status is indicated by a letter code. An explanation of abbreviations used (other than author citations) is given below.

SCIENTIFIC NAME

s.l. - in a broad sense

sp. - correct species name not determined

STATUS

E - endemic, native only to the Hawaiian Islands

I - indigenous, considered native to the Hawaiian Islands, but also found elsewhere

P - Polynesian, not considered native, but thought to have been introduced by the Polynesians prior to 1778

X - exotic, not native, introduced after 1778

SPECIES LIST

SCIENTIFIC NAME	COMMON NAME	BIOGEOGRAPHIC STATUS
FERNS AND FERN ALLIES		
Adiantaceae		
Pityrogramma calomelanos (L.) Link	silver fern	X
Pteris vittata L.	brake fern	X
Aspleniaceae		
Blechnum occidentale L.	blechnum	X
Nephrolepis multiflora (Roxb.) Jarret ex Morton	sword fern	X
Thelypteris dentata (Forsk.) E. St. John	wood fern	X
Polypodiaceae		
Phymatosorus scolopendria (Burm.) Pichi Sermolli	lau'ae	X
FLOWERING PLANTS		
MONOCOTS		
Araceae		
Colocasia esculenta L.	taro	P
Epipremnum pinnatum (L.) Engl.	taro vine	X
Cannaceae		
Canna indica L.	canna	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Commelinaceae		
Commelina diffusa N.L. Burm	dayflower	X
Cyperaceae		
Cyperus rotundus L.	nut sedge	X
Kyllinga brevifolia Rottb.	kyllinga	X
Pycreus polystachyos (Rottb.) Beauv.	pycreus	I
Gramineae		
Brachiaria mutica (Forsk.) Stapf	California grass	X
Cenchrus echinatus L.	sandbur	X
Chloris barbata (L.) Sw.	finger grass	X
Chloris radiata (L.) Sw.	finger grass	X
Chrysopogon aciculatus (Retz.) Trin.	golden beard grass	X
Coix lachryma-jobi L.	Job's tears	X
Cynodon dactylon (L.) Pers.	Bermuda grass	X
Digitaria insularis (L.) Mez ex Ekman	sour grass	X
Digitaria sp. 1	crab grass	X
Digitaria sp. 2	crab grass	X
Echinochloa crus-galli (L.) Beauv.	barnyard grass	X
Eleusine indica (L.) Gaertn.	goose grass	X
Panicum maximum Jacq.	Guinea grass	X
Panicum repens L.	quack grass	X
Paspalum conjugatum Berg.	Hilo grass	X
Paspalum dilatatum Poir.	Dallis grass	X
Paspalum fimbriatum H.B.K.	paspalum	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Paspalum scrobiculatum L.	rice grass	X
Paspalum urvillei Steud.	Vasey grass	X
Rhynchelytrum repens (Willd.) C. E. Hubb.	Natal redtop	X
Saccharum officinarum L.	sugarcane	P
Setaria gracilis Kunth. in Humb. & Bonpl.	foxtail	X
Sporobolus sp.	dropseed	X
Liliaceae, s.l.		
Asparagus setaceus (Kunth) Jessup	asparagusfern	X
Cordyline terminalis (L.) Kunth	ti	P
Hippeastrum puniceum (Lam.) Urb.	Barbados lily, amaryllis	X
Musaceae		
Musa X *paradisiaca* L.	banana, mai'a	P
Palmae		
Roystonea sp.	royal palm	X
DICOTS		
Acanthaceae		
Asystasia gangetica (L.) T. Anders.	Chinese violet, asystasia	X
Justicia betonica L.	white shrimp plant	X
Thunbergia fragrans Roxb.	white thunbergia	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Amaranthaceae		
Amaranthus lividus L.	amaranthus	X
Amaranthus spinosus L.	spiny pigweed	X
Amaranthus viridus L.	amaranthus	X
Anacardiaceae		
Mangifera indica L.	mango	X
Schinus terebinthifolius Raddi	Christmasberry	X
Apocynaceae		
Cascabela thevetia (L.) Lippold	be-still	X
Plumeria rubra L.	plumeria	X
Araliaceae		
Polyscias guilfoylei (Bull) Bailey	panax	X
Schefflera actinophylla (Endl.) Harms	octopus tree	X
Asclepiadaceae		
Asclepias physocarpa (E. Mey.) Schlechter	gomphocarpus	X
Bignoniaceae		
Spathodea campanulata Beauv.	African tulip tree	X
Boraginaceae		
Heliotropium amplexicaule Vahl	heliotrope	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Caricaceae		
Carica papaya L.	papaya	X
Casuarinaceae		
Casuarina equisetifolia Stickm.	ironwood	X
Casuarina stricta Dryand. in Ait.	ironwood	X
Compositae		
Ageratum conyzoides L.	ageratum	X
Ageratum houstonianum Mill.	ageratum	X
Bidens pilosa L.	Spanish needle	X
Conyza bonariensis (L.) Cronquist	hairy horseweed	X
Conyza canadensis (L.) Cronquist	horseweed	X
Crassocephalum crepidioides (Benth.) S. Moore	crassocephalum	X
Eclipta alba (L.) Hassk.	eclipta	X
Elephantopus mollis H.B.K.	elephantopus	X
Emilia coccinea (Sims) G. Don	orange-flowered emilia	X
Emilia fosbergii D. H. Nicolson	red-flowered emilia	X
Pluchea indica (L.) Less.	pluchea	X
Pluchea symphytifolia (Miller) Gillis	pluchea	X
Sigesbeckia orientalis L.	sigesbeckia	X
Sonchus oleraceus L.	sowthistle	X
Synedrella nodiflora (L.) Gaertn.	synedrella	X
Tridax procumbens L.	coatbuttons	X
Vernonia cinerea (L.) Less.	ironweed	X
Wedelia trilobata (L.) Hitchc.	wedelia	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Xanthium strumarium L.	cocklebur	X
Youngia japonica (L.) DC.	youngia	X
Convolvulaceae		
Ipomoea batatas (L.) Poir.	sweet potato, 'uala	P
Ipomoea indica (Burm.) Merr.	koali-'awahia	I
Ipomoea obscura (L.) Ker-Gawl.	yellow bindweed	X
Ipomoea triloba L.	pink bindweed	X
Merremia tuberosa (L.) Rendle	woodrose	X
Cucurbitaceae		
Lagenaria siceraria (Molina) Standl.	bottle gourd	X
Momordica charantia L.	bittermelon	X
Euphorbiaceae		
Aleurites moluccana (L.) Willd.	kukui	P
Chamaesyce hirta (L.) Millsp.	hairy spurge	X
Chamaesyce hypericifolia (L.) Millsp.	spurge	X
Euphorbia cyathophora Murr.	summer poinsettia	X
Euphorbia heterophylla L.	spurge	X
Macaranga tanarius (Stickm.) Muell.-Arg.	macaranga	X
Manihot glaziovii Muell.-Arg. in Mart.	Ceara rubber tree	X
Pedilanthes sp.	pedilanthes	X
Phyllanthus debilis Klein ex Willd.	phyllanthus	X
Ricinus communis L.	castorbean	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Labiatae		
Hyptis pectinata (L.) Poit.	comb hyptis	X
Leguminosae		
Canavalia cathartica Thouars	maunaloa	X
Chamaecrista nictitans (L.) Moench.	partridge pea, lau-ki	X
Crotalaria incana L.	rattlepod	X
Crotalaria pallida Aiton	rattlepod	X
Desmanthus virgatus (L.) Willd.	desmanthus	X
Desmodium incanum DC.	beggars' ticks	X
Desmodium tortuosum (Sw.) DC.	beggars' ticks	X
Desmodium triflorum (L.) DC.	beggarweed	X
Desmodium sandwicense E. Mey.	beggars' ticks	X
Indigofera suffruticosa Mill.	indigo	X
Lablab purpureus (L.) Sw.	hyacinth bean, lablab	X
Leucaena leucocephala (Lam.) deWit	koa-haole	X
Macroptilium lathyroides (L.) Urb.	wild bush-bean	X
Mimosa pudica L.	sleepinggrass	X
Pithecellobium dulce (Roxb.) Benth.	'opiuma	X
Samanea saman (Jacq.) Merr.	monkey pod	X
Senna occidentalis (L.) Link	coffee senna	X
Senna pendula (Humb. & Bonpl. ex Willd.) Irwin & Barneby	cassia	X
Vigna unguiculata (L.) Walp.	asparagus bean	X
Lobeliaceae		
Hippobroma longiflora (L.) G. Don	hippobroma	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Lythraceae		
Cuphea carthagenensis (Jacq.) Macbr.	tarweed	X
Malvaceae		
Abutilon grandifolium (Willd.) Sweet	abutilon	X
Hibiscus tiliaceus L.	hau	I
Malvastrum coromandelianum (L.) Garcke	malvastrum	X
Sida acuta Burm.	sida	X
Sida rhombifolia L.	sida	X
Meliaceae		
Melia azedarach L.	Chinaberry	X
Moraceae		
Artocarpus heterophyllus Lam.	jackfruit	X
Ficus microcarpa L. f.	Chinese banyan	X
Myrtaceae		
Psidium guajava L.	guava	X
Syzygium cumini (L.) Skeels	Javaplum	X
Nyctaginaceae		
Mirabilis jalapa L.	four o'clock	X
Onagraceae		
Ludwigia octovalvis (Jacq.) Raven	ludwigia	P?

SCIENTIFIC NAME	COMMON NAME	STATUS
Oxalidaceae		
Oxalis corniculata L.	yellow wood-sorrel	I?
Passifloraceae		
Passiflora edulis Sims	passion fruit, liliko'i	X
Passiflora laurifolia L.	yellow granadilla	X
Plantaginaceae		
Plantago major L.	plantain	X
Portulacaceae		
Portulaca oleracea L.	common purslane	X
Proteaceae		
Grevillea robusta A. Cunningh. in R. Br.	silkoak	X
Rubiaceae		
Canthium odoratum (Forst. f.) Seem.	alahe'e	I
Richardia brasiliensis Gomez	richardia	X
Spermacoce laevis Lam.	borreria	X
Sapindaceae		
Cardiospermum halicacabum L.	balloon vine	X
Sapotaceae		
Chrysophyllum pruniferum F. von Muell.	chrysophyllum	X

SCIENTIFIC NAME	COMMON NAME	STATUS
Solanaceae		
Lycopersicon esculentum Mill.	tomato	X
Solanum seaforthianum Andr.	solanum	X
Sterculiaceae		
Waltheria indica L. var. *americana* (L.) R. Br. ex Hosaka	'uhaloa, hi'aloa	I?
Thymelaeaceae		
Wikstroemia uva-ursi Gray	'akia	E
Umbelliferae		
Centella asiatica (L.) Urban	Asiatic pennywort	X
Ciclospermum leptophyllum (Pers.) Sprague	apium	X
Verbenaceae		
Lantana camara L.	lantana	X
Stachytarpheta dichotoma (Ruiz & Pavon) Vahl	stachytarpheta	X
Stachytarpheta urticifolia (Salisb.) Sims	stachytarpheta	X