APPENDIX A

Botanical Survey Report

BOTANICAL SURVEY REPORT FOR THE PROPOSED LIHUE AIRPORT MASTER PLAN IMPROVEMENTS

FOR
WILSON OKAMOTO AND ASSOCIATES, INC.
1907 SOUTH BERETANIA STREET, SUITE 400
HONOLULU, HAWAII 96826

BY
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1999

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INTRODUCTION

The botanical survey for the proposed Lihue Airport Master Plan Improvements required the examination of eleven parcels of land both on and off the airport proper (Figure 1). Together the eleven parcels consisted of approximately two-hundred thirty acres of land. The present uses of the eleven parcels are very diverse. Some are presently being used for the cultivation of sugar cane, some are maintained and landscaped and others are abandoned fields or are in pasture. As a result the vegetative cover of the parcels is variable and each parcel will be briefly described.

METHODS

Access to vegetation of all of the parcels was gained by way of existing roads and trails by a two person team using the walk through method. Data were collected to describe the major vegetation types of each parcel and to prepare a list of all plant species found on all of the sites and most importantly to determine if any listed threatened or endangered plant species are present on any of the parcels.

BOTANICAL HISTORY OF THE AREA

Since 1979 twelve proposals have been filed for projects on and around the Lihue Airport. Of these, seven have been negative declarations (ND), two have declared Finding no significant impacts (FONSI), and one road realignment project was described as having "no cumulative effect on the environment " and further declared "no, rare, threatened or endangered species habitats will be affected from this project" (DOT 1997).

The latest public document to describe the flora of the area states "Intense sugarcane cultivation in the vicinity of Lihue Airport since the late 1800's and early 1900's has replaced almost all of the native (endemic) vegetation. Further impacts on the

diversity and prevalence of native vegetation have resulted from urban development, the introduction of aggressive nonnative (exotic) species and feral animals, and the use of herbicides in agricultural activities. There are no rare or endangered plant species within the project area." (Wilson Okamoto 1998).

Recognizing all of the above mentioned negative impacts to the native vegetation it is interesting to note that at least nine species of indigenous plants were found during the survey. None are rare or endangered (see species list) and most like 'ilima (*Sida fallax* L.), naupaka (*Scaevola sericea* Vahl), beach vitex (*Vitex rotundifolia* L. fil), pa'uohi'iaka (*Jacquemontia ovalifolia* (Choisy) H. Hellier), and akulikuli (*Sesuvium portulacastrum* (L.) L.) were found along the ocean facing slopes.

RESULTS

Parcels 1 and 2 are located southwest (Parcel 1) and northeast (Parcel 2) of the present public parking lot (Figure 1). Both parcels are landscaped and well maintained. The vegetation cover is mostly mowed grasses with planting mounds that support a variety of attractive flowering trees and shrubs.

Parcel 3 is located northeast of the airport apron. The vegetation of this open site is mowed grasses.

Parcel 4 is located southwest of the airport apron (Figure 1). Here the vegetation is made up of low-growing weedy species – mostly grasses. The most common species are pitted beardgrass (*Bothriochloa pertusa* (L.) A. Camus), swollen fingergrass (*Chloris barbata* (L.) Sw.), sourgrass (*Digitaria insularis* (L.) Mez. ex Ekman), and stinkgrass (*Eragrostis cilianensis* (All.) Link.). Some of the other weedy species found on this plot of land are Mexican poinsettia (*Euphorbia cyathophora* J.A. Murry), white thunbergia

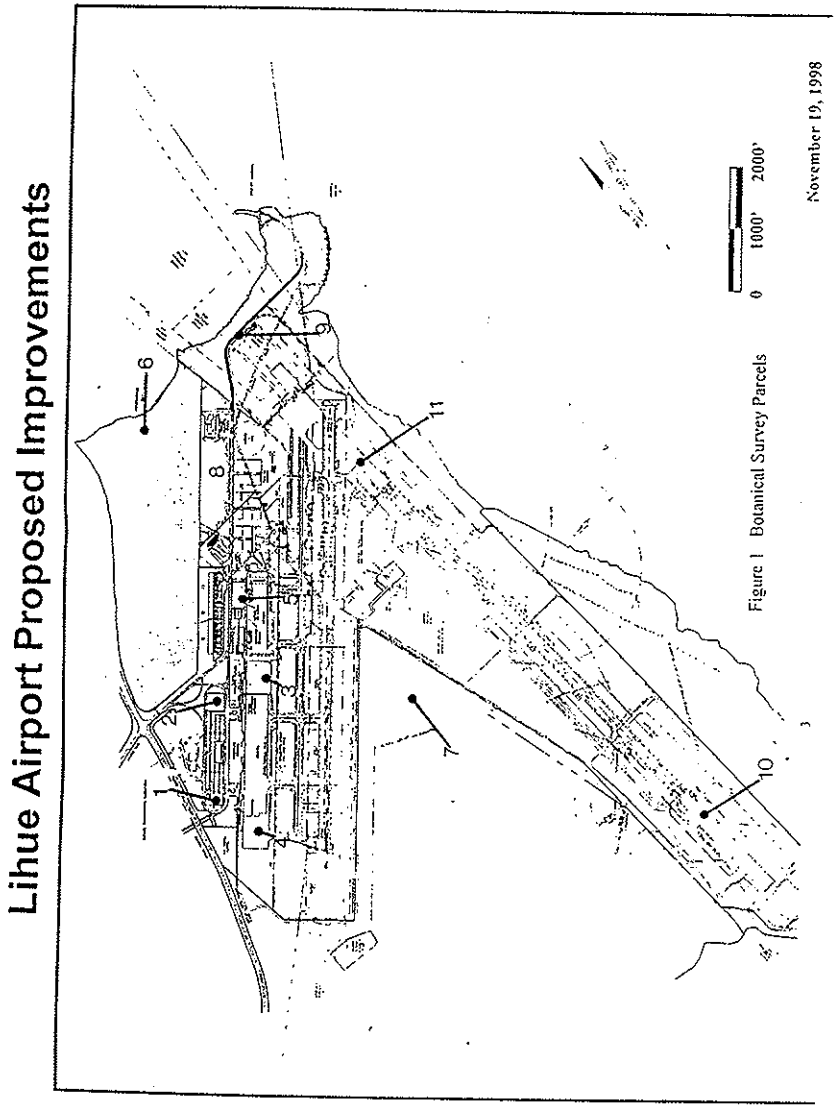

Figure 1 Botanical Survey Parcels

(*Thunbergia fragrans* Roxb.), owi (*Verbena litoralis* Kunth), wild bean (*Macroptilium* spp.), and coat buttons (*Tridax procumbens* L.).

Parcel 5 is an open field located across the street from the helicopter facility (Figure 1). Here again the grass is neatly mowed, but some weedy species are visible. There is pitted beardgrass, swollen fingergrass, stinkgrass, Guinea grass (*Panicum maximum* Jacq.), and goose grass (*Eleusine indica* (L.) Gaertn.). Other ubiquitous weedy species found on this parcel were *Bidens cynapiifolia* Kunth, sow thistle (*Sonchus oleraceus* L.), *Calyptocarpus vialis* Less., and sensitive plant (*Mimosa pudica* L.).

Parcel 6 is a forty-three acre plot of land located northwest of the Helicopter Facility along Ahukini Road. At the present time sugarcane is being grown on this land. The cane is newly planted and the field is relatively free of weeds. However, there is a dense weedy fringe along Ahukini Road and along the fence that separates the field from the Helicopter Facility. Here sour grass, pitted beardgrass, swollen fingergrass, sour grass, *Calyptocarpus vialis* Less., coat buttons, natal redtop (*Rhynchelytrum repens* (Willd.) Hubb.) can be found., and many others.

Parcel 7 is a forty-eight acre plot located where the Airport Boundary and the Emergence access Road converge (Figure 1). This parcel is fenced on all three sides and at the present time is being used to pasture several horses. The principle cover of the pasture is sourgrass with a few scattered Java plum trees (*Syzygium cumini* (L.) Skeels). Between the pasture fence, and the airport boundary fence the vegetation is a dense border of Guinea grass. Along the Emergency Access Road side of the pasture the vegetation is more varied, but still weedy. Here pitted beardgrass, Henry's crab grass (*Digitaria ciliaris* (Retz.) Koeler), goose grass and swollen fingergrass can be found with

golden crown beard (*Verbesina encelioides* (Cav.) Benth & Hook.), pualele (*Sonchus oleraceus* L.), *Bidens pilosa* L. and many many other adventive species (not native).

Parcel 8 is located between the Kauai County Refuse Transfer Station and the Maintenance Baseyard (Figure 1) and like Parcel 6, it is presently being used to grow sugarcane. The sugarcane field is fairly free of weeds, but along the edges of the field can be found a dense and varied ruderal or weed fringe. Grasses such as natal redtop, Guinea grass, swollen fingergrass, sourgrass, and star grass (*Chloris divaricata* R. Br.) share the space with Mexican poinsettia (*Euphorbia cyathophora* J. A. Murray), Christmas berry (*Schinus terebinthifolius* Raddi), maunaloa vine (*Canavalia cathartica* Thouars), *Glycine wightii* Verdc., 'uhaloa (*Waltheria indica* L), and *Macroptilium* spp. to name a few.

Parcel 9 is the northernmost and largest of the study parcels (Figure 1) It is also the most diverse. A salvage yard, a producing sugarcane field, ocean facing slopes and an abandoned sugarcane field are located here. The active sugarcane field is just north of the Kauai County Refuse Transfer Station and like the other producing cane fields, the area where the cane is being grown is fairly free of weeds, but the surrounding fringe is rich in weedy species including. a dense hedge of koa haole (*Leucaena leucocephala* (Lam.) de Wit) from two to four meters in height along its southern boundary.

The salvage yard contains stacks of thousands of used tires. The area was at one time cleared and some landscape vegetation introduced. There were Norfolk island pines (*Araucaria heterophylla* Franco), Mexican creeper (*Antigonon leptopus* (Hook. & Arnott), Bougainvillea, New Zealand spinach (*Tetragonia tetragonioides* (Pall.) Kuntze) along with the usual complement of weedy species.

The dominant species found on the ocean facing slopes of Parcel 9 is ironwood trees from fifteen to eighteen meters in height. There is practically no understory vegetation in this area except for dried Guinea grass. Along Ahukini Road down to Ahukini Landing can be found the native plants pa'uohi'iaka (*Jacquemontia ovalifolia* (Choisy) H. Hallier), naupaka (*Scaevola sericea* Vahl), akulikuli (*Sesuvium portulacastrum* (L.) L.), and 'ilima (*Sida fallax* L.). Scattered patches of these taxa were found along the inland border of the ocean facing slopes.

By far the greater portion of Parcel 9 consists of abandoned sugarcane fields. From Ahukini Road to the top of the ocean facing slopes is an area that was once cane field. Today Guinea grass, ratoon sugarcane, and koa haole are the most commonly found vegetation. There is also castor bean (*Ricinus communis* L.), Java plum, indigo (*Indigofera suffruticosa* Mill. and *I. spicata* Frossk, sourgrass, dense patches of koa haole, and the weed tree *Macaranga tanarius* (L.) Mull. Arg.

Parcel 10 is located within the airport proper at the southern end of Runway 17-35. It can be described as an open grassland. The vegetation is less than sixtycentimeters in height and is made up on many species of grasses, Pitted beardgrass, sourgrass, goose grass, stargrass, Guinea grass , and Bermuda grass (Cynodon dactylon (L.) Pers. to name a few. Scattered throughout the area can be found some flowering plants such as sensitive weed, Wedelia, 'ilima, globe amaranth (*Gomphrena globosa* L.) Lantana (*Lantana camara* L.), and koa haole. The area is frequently mowed.

Parcel 11. Is located at the northern end of Runway 17-35 (Figure 1). The vegetation of this parcel, like that of Parcel 10, is kept mowed. Many of the same grass

species are found on Parcel 11. There is also Wedelia, coat buttons, sensitive weed, koa haole, sow thistle, and 'ilima. In short, the vegetation of Parcel 11 is very similar to that of Parcel 10.

ENDANGERED SPECIES

No candidate, proposed, or listed threatened or endangered species as set forth in the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1543) are known from near the Lihue Airport and none were found during this survey.

SPECIES LIST OF THE PLANTS FOUND ON THE PROPOSED LIHUE AIRPORT MASTER PLAN IMPROVEMENTS SITE

The plant families in the following species list have been alphabetically arranged within four groups, Gymnosperms, Ferns and Fern Allies, Monocotyledons, and Dicotyledons. The genera and species are arranged alphabetically within families. The taxonomy and nomenclature follow that of Wagner, Herbst, and Sohmer (1990). For each taxon the following information is provided:

1. An asterisk before the plant name indicates a plant introduced to the Hawaiian Islands since Cook or by the aborigines.
2. The scientific name of the plant.
3. The Hawaiian name or the most widely used common name of the plant.
4. Abundance ratings are for this site only and they have the following meanings:
   Uncommon = a plant that was found less than five times.
   Occasional = a plant that was found between five and ten times.
   Common = a plant considered an important part of the vegetation.
   Locally abundant = plants found in large numbers over a limited area. For example the plants found in grassy patches.

This species list is the result of an extensive survey of this site during the wet, rainy season (January 1999) and it reflects the vegetation composition of the flora during a single season. Minor changes in the vegetation will occur due to introductions and losses and a slightly different species list would result from a survey conducted during a different growing season.

Scientific Name	Common Name	Abundance
GYMNOSPERMS		
**Araucaria heterophylla* Franco	Norfolk Island pine	Occasional
FERNS AND FERN ALLIES		
POLYPODIACEAE - Common Fern Family		
**Polypodium scolopendrium* Burm. F.	Laua'e	Locally abundant
MONOCOTYLEDONS		
AMARYLLIDACEAE – Amaryllis Family		
**Crinum asiaticum* L.	Crinum lily	Uncommon
**Hymenocallis littoralis* (Jacq.) Salisb.	Spider lily	Uncommon
ARACEAE – Arum Family		
**Monstera deliciosa* Liebm.	Monstera	Uncommon
ARECACEAE - Palm Family		
**Cocos nucifera* L.	Coconut palm	Occasional
COMMELINACEAE - Spiderwort Family		
**Commelina diffusa* N. L. Burm.	Honohono	Occasional
CYPERACEAE – Sedge Family		
**Cyperus rotundus* L.	Nut grass	Common
MUSACEAE – Banana Family		
**Heliconia* sp.	Chicken feet	Locally abundant
**Ravenala madagascariensis* J. F. Gmel.	Travellers palm	Locally abundant
POACEAE - Grass Family		
**Bothriochloa* pertusa (L.) A. Camus	Pitted beardgrass	Common
**Brachiaria mutica* (Forssk.) Stapf.	California grass	Occasional
**Cenchrus echinatus* L.	Common sandbur	Occasional

Scientific Name	Common Name	Abundance
POACEAE - Grass Family con't		
**Chloris barbata* (L.) Sw.	Swollen fingergrass	Common
**Chloris divaricata* R. Br.	Star grass	Locally abundant
**Cynodon dactylon* (L.) Pers.	Bermuda grass	Common
**Digitaria ciliaris* (Retz.) Koeler	Henry's crabgrass	Common
**Digitaria insularis* (L.) Mez. Ex Ekman	Sourgrass	Uncommon
**Eleusine indica* (L.) Gaertn.	Wiregrass	Occasional
**Eragrostis cilianensis* (All..) Link	Stinkgrass	Locally abundant
**Panicum maximum* Jacq.	Guinea grass	Common
**Paspalum fimbriatum* Kunth	Panama grass	Occasional
**Rhynchelytrum repens* (Willd.) Hubb.	Natal redtop	Common
**Saccharum officinarum* L.	Sugar	Locally abundant
**Setaria verticillata* (L.) P. Beauv.	Bristly foxtail	Locally abundant
**Sporobolus diander* (Retz.) P. Beauv.	Indian dropseed	Common
DICOTYLEDONS		
ACANTHACEAE – Acanthus Family		
**Asystasia gangetica* (L.) T. Anderson	Chinese violet	Locally abundant
**Ruellia prostrata* Poit.		Locally abundant
**Thunbergia fragrans* Roxb.	White Thunbergia	Common
AIZOACEAE – Fig-marigold Family		
Sesuvium portulacastrum (L.) L.	"Akulikuli	Locally abundant
**Tetragonia tetragonioides* Kuntze	New Zealand spinach	Locally abundant
AMARANTHACEAE – Amaranth Family		
**Amaranthus spinosus* L.	Spiny amaranth	Occasional
**Gomphrena globosa* L.	Globe amaranth	Occasional
ANACARDIACEAE – Mango Family		
**Schinus terebinthifolius* Raddi	Christmas berry	Occasional
APIACEAE – Parsley Family		
**Ciclospermum letophyllum* (Pers.) Sprague	Fir leafed celery	Occasional

Scientific Name	Common Name	Abundance
ASTERACEAE – Sunflower Family		
Bidens alba (L.) DC		Occasional
Bidens cynapiifolia Kunth		Locally abundant
Calyptocarpus vialis Less.		Common
Conyza bonariensis (L.) Cronq.	Hairy horseweed	Common
Emilia fosbergii Nicolson	Pualele	Common
Emilia sonchifolia 9L.0 DC	Flora's paintbrush	Common
Parthenium hysterophorus L.	False ragweed	Common
Pluchea indica (L.) Less.	Indian fleabane	Common
Pluchea symphytifolia (Mill.) Gillis	Sourbush	Common
Sonchus oleraceus L.	Pualele	Common
Synedrella nodiflora (L.) Gaertn.	Nodeweed	Occasional
Tridax procumbens L.	Coat buttons	Locally abundant
Verbesina encelioides (Cav.) Benth. & Hook.	Golden crown-beard	Occasional
Wedelia trilobata (L.) Hitchc.	Wedelia	Common
BORAGINACEAE – Borage Family		
Heliotropium procumbens Mill		Common
Tournefortia argentea L.	Tree heliotrope	Locally abundant
CACTACEAE – Cactus Family		
Opuntia ficus-indica(L.) Mill.	Panini	Uncommon
CASUARINACEAE – She-oak Family		
Casuarina equisetifolia L.	Ironwood	Common
CHENOPODIACEAE – Goosefoot Family		
Chenopodium murale L.	'Aheahea	Locally abundant
CLUSIACEAE – Mangosteen Family		
Clusia rosea Jacq.	Autograph tree	Uncommon
COMBRETACEAE – Indian almond Family		
Terminalia catappa L.	Tropical almond	Uncommon

Scientific Name	Common Name	Abundance
CONVOLVULACEAE – Morning glory Family		
Ipomoea cairica (L.) Sweet	Koali 'ai	Occasional
Ipomoea obscura (L.) Ker-Gawl.		Common
Ipomoea triloba L.	Little bell	Common
Jacquemontia ovalifolia (Choisy) H. Hallier	Pa'uohi'iaka	Locally abundant
Merremia aegyptia (L.) Urb.	Hairy merremia	Occasional
CUCURBITACEAE – Gourd Family		
Lagenaria siceraria (Molina) Standley	Bottle gourd	Locally abundant
Momordica charantia L.	Balsam pear	Common
EUPHORBIACEAE – Spurge Family		
Chamaesyce hirta (L.) Millsp.	Hairy spurge	Occasional
Chamaesyce hypericifolia (L.) Millsp.	Graceful spurge	Occasional
Chamaesyce hyssopifolia (L.) Small		Occasional
Chamaesyce prostrata (Aiton) Small.	Prostrate spruge	Occasional
Euphorbia cyathophora J. A. Murray	Wild poinsettia	Locally abundant
Macaranga tanarius (L.) Mull.Arg.		Occasional
Phyllanthus debilis Klien & Willd.	Niruri	Uncommon
Ricinus communis L.	Castor bean	Common
FABACEAE – Bean Family		
Acacia confusa Merr.	Formosa koa	Uncommon
Alysicarpus vaginalis (L.) DC		Uncommon
Canavalia cathartica Thouars	Maunaloa vine	Uncommon
Chamaecrista nictitans (L.) Moench	Partridge pea	Common
.*Crotalaria incana* L.	Fuzzy rattlepod	Occasional
Crotalaria retusa L.		Occasional
Desmanthus virgatus (L.) Willd.	Slender mimosa	Uncommon
Desmodium incanum DC	Spanish clover	Occasional
Desmodium triflorum (L.) DC		uncommon
Glycine wightii (Wight & Arnott) Verdc.	Glycine	Locally abundant
Indigofera spicata Forssk.	Creeping indigo	Common
Indigofera suffruticosa Mill.	Indigo	Occasional
Lablab purpureus (L.) Sweet	Hyacinth bean	Occasional
Leucaena leucocephala (Lam.) de Wit	Koa haole	Common
Macroptilium atropurpureum (DC) Urb.	Cowpea	Locally abundant
Macroptilium lathyroides (L.) Urb.	Cowpea	Locally abundant
Mimosa pudica L.	Sensitive plant	Common
Senna septemtrionalis (Viv.) H.Irwin&Barneby		Locally abundant

Scientific Name	Common Name	Abundance
GOODENIACEAE – Goodenia Family		
Scaevola sericea Vahl	Naupaka	Locally abundant
MALVACEAE – Mallow Family		
**Abutilon grandifolium* (Willd.) Sweet	Hairy abutilon	Common
**Hibiscus rosea* L.	Hau	Locally abundant
**Malva parviflora* L.	Cheese weed	Uncommon
**Malvastrum coromandelianum* (L.) Garcke	False mallow	Common
Sida fallax Walp.	'Ilima	Common
**Sida rhombifolia* L.		Occasional
**Sida spinosa* L.	Prickly sida	Occasional
MORACEAE – Fig Family		
**Ficus microcarpa* L. fil.	Chinese banyan	Common
MYRTACEAE – Myrtle Family		
**Syzygium cumini* (L.) Skeels	Java plum	Common
NYCTAGINACEAE – Four-o'clock Family		
**Boerhavia coccinea* Mill.		Uncommon
**Bougainvillea spectabilis* Willd.	Bougainvillea	Uncommon
OXALIDACEAE – Wood Sorrel Family		
Oxalis corniculata L.	Yellow wood sorrel	Occasional
PASSIFLORACEAE – Passion Flower Family		
**Passiflora edulis* Sims	Passion fruit	Uncommon
**Passiflora foetida* L.	Love-in-a-mist	Common
PHYTOLACCACEAE – Pokeweed Family		
**Rivina humilis* L.	Coral berry	Common
POLYGONACEAE – Buckwheat Family		
**Antigonon leptopus* Hook. & Arnott	Mexican creeper	Locally abundant

Scientific Name	Common Name	Abundance
PORTULACACEAE – Purslane Family		
**Portulaca oleracea* L.	Pigweed	Common
RUBIACEAE – Coffee Family		
**Morinda citrifolia* L	Noni	Occasional
**Pentas lanceolata* (Forsk.) Deflers	Penta	Locally abundant
**Spermacoce assurgens* Ruiz & Pav.	Buttonweed	Uncommon
SOLANACEAE – Nightshade Family		
**Lycopersicon esculentum* Mill.	Tomato	Uncommon
**Nicandra physalodes* (L.) Gaertn..	Apple of Peru	Uncommon
Solanum americanum Mill.	Popolo	Uncommon
STERCULIACEAE Cacao Family		
Waltheria indica L.	'Uhaloa	Common
VERBENACEAE – Verbena Family		
**Lantana camara* L.	Lantana	Common
**Stachytarpheta dichotoma* (Ruiz & Pav.) Vahl	Owi	Common
**Verbena litoralis* Kunth	Owi	Occasional
Vitex rotundifolia L. fil.	Vitex	Locally abundant

BIBLIOGRAPHY

DOT. 1997. Lihue Airport – Ahukini Road Realignment and General Aviation Subdivision. FEIS

Haselwood, E. L. and G. G. Motter. (eds.) 1976. Handbook of Hawaiian Weeds. Lyon Arboretum Association.

Neal, M. C. 1965. In Gardens of Hawaii. Bishop Museum Special Publication #65. Bis. Mus. Press.

Ripperton , J.C. and E. Y. Hosaka. 1942. Vegetation Zones of Hawaii. Hawaii Agricultural Experiment Station Bulletin Number 89. Univ. of Hawaii.

USDA. 1996. Wildlife hazard management at Lihue Airport (LIH) EA

Wagner, W. L., D. R. Herbst, & S. H. Sohmer. 1990. Manual of the Flowering Plants of Hawaii. Bishop Museum Special Publication #83. Univ. Of Hawaii Press. Vols 1 & 2.

Wilson Okamoto & Associates. 1998. Lihue Airport Master Plan EIS Preparation Notice. State of Hawaii DOT. & US DOT.

ADDENDIUM TO THE LIHUE AIRPORT BOTANICAL SURVEY REPORT

FOR
WILSON OKAMOTO CORPORATION
1907 SOUTH BERETANIA STREET, SUITE 400
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INTRODUCTION

The earlier 1999 botanical survey report did not include the one-hundred twenty-five acre proposed acquisition site. This report is offered as an addendum to that report.

The Lihue Airport Acquisition site consists of one-hundred twenty five acres of land located inland or mauka of the existing airport. It is bounded on the south west by Aukini Street and on the northeast by Kapule Highway. The Lihue Airport Acquisition site is basically flat and is surrounded by a drainage ditch that is approximately four feet wide and four feet deep. This ditch has been breached in several places affording access to central part of the site The earlier botanical survey of the Lihue Airport (Funk 1999) noted that no species of concern or proposed, threatened or listed endangered species are known from the area none were found during that survey and none were expected.

METHODS

In January 2006 a two person field team carried out a botanical survey of this large flat site using the walk through method. Data were collected by way of a periphery walk with forays into the interior of the site as well as cross site transects. Most importantly the field team searched for native and sensitive species, collected information to describe the vegetation, and lastly collected data to prepare a species list of all the species present.

RESULTS

The Lihue Airport Acquisition site was for many years used to grow sugar cane. Then for several years the land was allowed to lay fallow which resulted in a dense stand of alien or weedy plants to become established Approximately two years ago a wildfire consumed the weed cover exposing the site to invasion by the big, fire resistant, perennial grass, Panicum maximum or Guinea grass (Pers. Comm.Kyle Cockerham,

Airport Environmental Officer). Today this site is covered by a dense stand of this grass which varies in height from four to eight feet. There are widely scattered individuals of Koa haole (*Leucaena leucocephala* (Lam.) de Wit), castor bean (Ricinus communis L.) shrubs, and small *Macaranga lanarius* (L.) Mull. Arg. trees and in some places where the Guinea grass has been disturbed pockets of miscellaneous species such as natal red top grass *(Rhynchelytrum repens*(Willd.) Hubb.), beach wiregrass (*Eleusine indica* (L.) Gaertn.), two species of Chloris (*Chloris barbata* (L.) Sw.) and star grass (*Chloris divaricata* R. Br.) and Bermuda grass (*Cynodon dactylon* (L.) Pers) can be found. Other weedy species such as black flowered *Macroptilium atropurpureum* (DC) Urb., smooth rattlebox (*Crotalaria pallida* Aiton), golden crown beard (*Verbesina enceliodes* (Cav.) Benth & Hook. and various Euphorbias are coming in.

CONCLUSIONS

The collection of plants found on this study site can be found on many long abandoned sugar fields on all of the Hawaiian Islands. They are all introduced weeds and will quickly recover if the area is cleared.

ENDANGERED SPECIES

No candidate, proposed, or listed threatened or endangered species as set forth in the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1543) are known from this site and none were found during this survey.

SPECIES LIST OF THE PLANTS FOUND ON THE LIHUE AIRPORT ACQUISITION SITE

The plant families in the following species list have been alphabetically arranged within two groups Monocotyledons, and Dicotyledons. The genera and species are arranged alphabetically within families. The taxonomy and nomenclature follow that of Wagner, Herbst, and Sohmer (1990). For each taxon the following information is provided:

1. An asterisk before the plant name indicates a plant introduced to the Hawaiian Islands since Cook or by the aborigines.
2. The scientific name of the plant.
3. The Hawaiian name or the most widely used common name of the plant.
4. Abundance ratings are for this site only and they have the following meanings:
   Uncommon = a plant that was found less than fine times.
   Occasional = a plant that was found between five and ten times.
   Common = a plant considered an important part of the vegetation.
   Locally abundant = plants found in large numbers over a limited area. For example the plants found in grassy patches.

This species list is the result of an extensive survey of this site during a very dry season (December 2005) and it reflects the vegetation composition of the flora during a single season. Minor changes in the vegetation will occur due to introductions and losses and a slightly different species list would result from a survey conducted during a different growing season.

Scientific Name	Common Name	Abundance
MONOCOTYLEDONS		
POACEAE - Grass Family		
**Chloris barbata* (L.) Sw.	Swollen fingergrass	Locally abundant
**Chloris divaricata* R. Br.	Stargrass	Locally abundant
**Cynodon dactylon* (L.) Pers.	Bermuda grass	Locally abundant
**Eleusine indica* (L.) Gaertn.	Wiregrass	Locally abundant
**Eragrostis cilianensis* (All.) Link	Stinkgrass	Common
**Panicum maximum* Jacq.	Guinea grass	Common
**Rhynchelytrum repens* (Willd.) Hubb.	Natal redtop	Occasional
**Sporobolus diander* (Retz.) Beauv.	Indian dropseed	Occasional
DICOTYLEDONES		
ACANTHACEAE – Acanthus Family		
**Asystasia gangetica* (L.) T. Anderson	Chinese violet	Occasional
**Thunbergia fragrans* Roxb.		Occasional
ANACARDIACEAE – Mango Family		
**Schinus terebinthifolius* Raddi	Christmas berry	Occasional
ASTERACEAE – Sunflower Family		
**Bidens cynapiifolia* Kunth		Occasional
**Conyza bonariensis* (L.) Cronq.	Hairy horseweed	Occasional
**Parthenium hysterophorus* L.	False ragweed	Occasional
**Sonchus oleraceus* L.	Pualele	Occasional
**Tridax procumbens* L.	Coat buttons	Locally abundant
**Verbesina encelioides* (Cav.) Benth. & Hock		Locally abundant
**Vernonia cinerea* (L.) L.	Little ironweed	Occasional
BORAGINACEAE - Borage – Family		
**Heliotropium procumbens* Mill.		Uncommon
CONVOLVULACEAE – Morning glory Family		
**Ipomoea obscura* (L.) Ker-Gawl. .		Locally abundant

Scientific Name	Common Name	Abundance
CUCURBITACEAE – Gourd Family		
**Coccinia grandis* (L.) Voigt	Ivy nut gourd	Occasional
EUPHORBIACEAE – Spurge Family		
**Chamaesyce hypericifolia* (L.) Millsp.	Graceful spurge	Locally abundant
**Macaranga tanarius* (L.) Arg.		Uncommon
**Ricinus communis* L.	Castor bean	Common
FABACEAE – Bean Family		
**Acacia confusa* Merr.	Formosa koa	Uncommon
**Canavalia sericea* A. Gray	Silky jackbean	Locally abundant
**Chamaecrista nictitans* (L.) Moench.	Partridge pea	Occasional
**Crotalaria retusa* L.		Occasional
**Desmanthus virgatus* (L.) Willd.	Slender mimosa	Occasional
**Indigofera spicata* Forssk.	Creeping indigo	Occasional
**Indigofera suffruticosa* Mill.	Iniko	Occasional
**Leucaena leucocephala* (Lam.) de Wit	Koa haole	Common
**Macroptilium atropurpureum* (DC) Urb.		Locally abundant
**Mimosa pudica* L.	Sensitive plant	Occasional
MALVACEAE – Mallow Family		
**Abutilon grandifolium* (Willd.) Sweet	Hairy abutilon	Occasional
**Malvastrum coromandelianum* (L.) Garcke		Occasional
**Sida rhombifolia* L.		Uncommon
MYRTACEAE – Myrtle – Family		
**Syzygium cumini* (L.) Skeels	Java plum	Uncommon
NYCTAGINACEAE – Four-o'clock Family		
**Boerhavia coccinea* Mill.		Uncommon
SOLANACEAE – Nightshade Family		
**Lycopersicon pimpinellifolium* (Jusl.) Mill.	Currant tomato	Occasional
VERBENACEAE – Verbena Family		
**Verbena littoralis* Kunth	Owi	Occasional

APPENDIX B

Faunal Survey Report

A Survey of Avian and Terrestrial Mammalian Species for the Līhu'e International Airport Master Plan Improvements, Līhu'e District, Island of Kaua'i.

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July 26, 2006

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Introduction

The State of Hawai'i, Department of Transportation, Airports Division (HDOT-AD) is proposing to acquire approximately 180-acres of currently vacant land located between the Līhu'e International Airport and Kapule Highway, identified as TMK: 3-7-02: por. 01, as well as an approximately 48-acre parcel of land located between runways 3-21 and 17-35, identified as TMK: 3-5-01:06 (Figure 1). They are also proposing to construct various improvements to the airport facilities including:

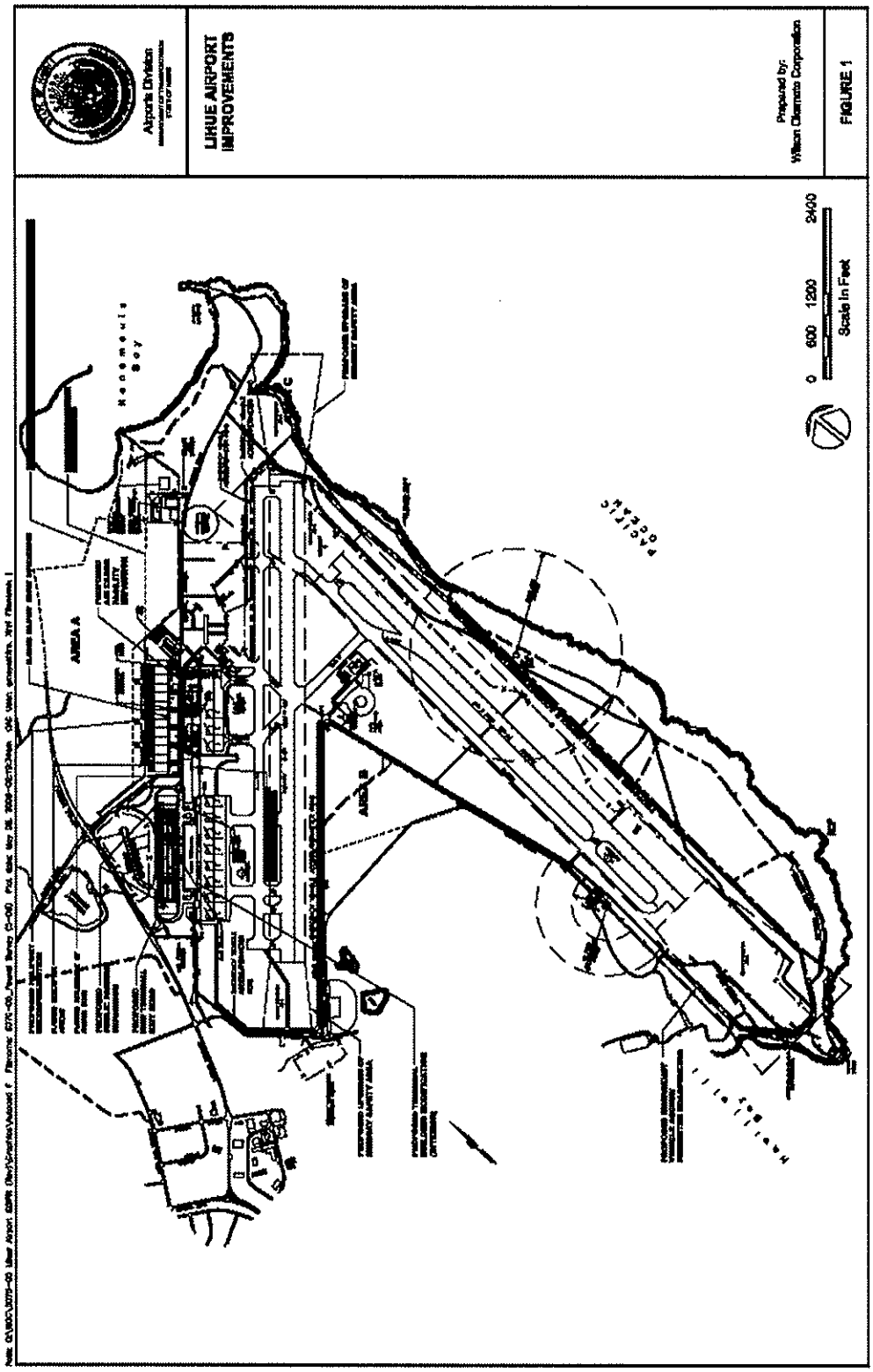
- Reconfiguring the heliport so that operations can be seen from the control tower,
- expanding the existing public parking lot,
- modifications to the existing terminal building,
- constructing a new terminal exit road, south of the parking lot onto Kapule Highway,
- expanding the existing employee parking lot,
- expanding the existing air cargo handling facility,
- upgrading the runway safety areas to the west and east of runway 3-21,
- upgrading the emergency vehicle access and perimeter fencing along runway 17-35,
- upgrading the emergency vehicle access to the western and southern boundaries of runway 3-21,
- various other minor improvements associated with the aforementioned projects.

This report summarizes the findings of an avian and mammalian survey conducted on the subject properties. Fieldwork was conducted between April 17, and 19, 2006.

The primary goal of the survey was to determine if there were any avian or mammalian species currently listed as endangered, threatened, or proposed for listing under either the Federal or State of Hawai'i endangered species statutes on, or in, the immediate vicinity of the project area. Federal and State of Hawai'i listed species status follows species identified in the following referenced documents (Department of Natural Land and Resources (DLNR) 1998, Federal Register, 1999, 2005).

The avian phylogenetic order and nomenclature used in this report follows *The American Ornithologists' Union Check-list of North American Birds 7th Edition* (American Ornithologists' Union 1998), and the 42nd through the 46th supplements to *Check-list of North American Birds* (American Ornithologists' Union 2000; Banks et al. 2002, 2003, 2004, 2005). Mammal scientific names follow *Mammals in Hawaii* (Tomich 1986). Higher native and naturalized plant names follow *Manual of the Flowering Plants of Hawai'i* (Wagner et al. and Wagner and Herbst, 1990, 1999). Place names follow *Place Names of Hawaii* (Pukui et al. 1976).

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 on page 14.


Airports Division
LIHUE AIRPORT
IMPROVEMENTS
Prepared by:
Wilson Okamoto Corporation
FIGURE 1
0 600 1200 2400
Scale In Feet
AREA A
AREA B
Nawiliwili Bay
PACIFIC OCEAN

General Site Descriptions

The180-acre parcel of land located between the airport and Kapule Highway, identified as TMK: 3-7-02: por. 01, and the 48-acre parcel located between runways 3-21 and 17-35, identified as TMK: 3-5-01:06, and the proposed safety zone improvement area east of runway 3-21, are henceforth described as areas A, B and C, respectively (Figure 1). These three areas are currently undeveloped. The remaining areas in which airport facility improvements are proposed, are all within portions of the airport which have already been built on, or are currently maintained as manicured landscaped areas within the airport boundaries (Figure 1).

Area A, is an approximately 180-acre parcel of fallow former sugar cane fields (Figure 1). This area is bound to the north by Hanamā'ulu Gulch, to the west by Kapule Highway, and to the southeast by Ahukini Road (Figure 1). Vegetation on this parcel is dominated by alien grasses and weedy species including, Guinea grass (*Panicum maximum*), pitted beardgrass (*Bothriochloa pertusa*), swollen fingergrass (*Chloris barbata*), sourgrass (*Digitaria insularis*), stinkgrass (*Eragrostis ciliansis*), sow thistle (*Sonchus oleraceus*), sensitive plant (*Mimosa pudica*), *'uhaloa* (*Waltheria indica*), *koa haole* (*Leucaena leucocephala*), and castor bean (*Ricinus communis*). Close to the edge of Hanamā'ulu Gulch there is a stand of ironwood trees (*Casuarina equisetifolia*), and a few coconut trees (*Cocos nucifera*). The vegetation and habitat present on this site is typical of that found on former sugar cane and ruderal areas on the island of Kaua'i

Area B, is an approximately 48 acre triangular shaped parcel located between runways 3-21 and 35-17. (Figure 1). This property was formerly used by the Westin Kaua'i Resort as a landscape plant nursery, green waste dump and pasturage for their Clydesdale horses. The vegetation is dominated by Guinea grass with scattered castor bean, lanatana (*Lantana camara*), and *koa haole*. The southeastern corner of this parcel has an active green waste dump on it, and the area has been repeatedly bulldozed. The vegetation on the northern and western portions of this parcel is made up of a mélange of grasses including, Guinea grass, California grass (*Brachiaria mutica*), wiregrass (*Eleusine indica*), swollen fingergrass, bufflegrass (*Cenchrus ciliaris*), Bermuda grass (*Cynodon dactylon*), dropseed grass (*Sporobolus indicus*), molasses grass (*Melinus minutiflora*), and Natal redtop (*Rhynchelytrum repens*). There are also numerous weedy herbaceous species present including, creeping indigo (*Indigofera hendecaphylla*), Spanish needle (*Bidens pilosa*), and garden spurge (*Chamaesyce hirta*). There are several stands of Christmas berry (*Schinus terebinthefolius*), scrambled egg bush (*Senna surrattenis*), silk oak, and fig trees. In addition there are scattered, *koa haole*, sourbush (*Pluchea carolinensis*), and a few guava (*Psidium guajava*) bushes. A portion of this site is currently being used as pasturage for a small mixed herd of horses (*Equus c. caballus*) and mules (*Equus asinus x E. caballus*).

Area C, extends from the end of runway 3-21 east to the shoreline. The bulk of the vegetation in this parcel is dominated by alien grasses with a similar mix to those found on the other two parcels detailed above, much of this area has been maintained by mowing. There is a small section of coastal strand vegetation within this parcel. Along

with numerous alien grass and weedy species there are a number of indigenous species within this area including, *'ilima* (*Sida fallax*), *naupaka* (*Scaaevola sericea*), beach vitex (*Vitex rotundifolia*), *pā'ūohi'iaka* (*Jacquemontia ovalifolia*) and *'ākulikuli* (*Sesuvium portulacatrum*).

Mammalian Survey Methods

All observations of mammalian species were of an incidental nature. With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *'ōpe'ape'a* as it is known locally, all terrestrial mammals currently found on the Island of Kaua'i are alien species, and most are ubiquitous. Two hours were spent within the project area on the evenings of April 17, and 18, 2006, and again in the early morning hours of April 18, and 19, 2006, in an attempt to detect Hawaiian hoary bats. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal signs. A running tally was kept of all vertebrate species observed and heard within the study area.

Mammalian Survey Results

Six mammalian species were detected during the course of this survey. All but one of the mammals recorded are considered alien to the Hawaiian Islands. Hawai'i's sole endemic terrestrial mammalian species, the endangered Hawaiian hoary bat, was detected foraging over Hanamā'ulu Gulch and bay as well as flying over the Kapule Highway bridge that spans Hanamā'ulu Stream. A maximum number of three bats were seen at one time foraging on the evening of April 18, 2006.

Several European house mice (*Mus domesticus*) were seen within Area A and B. Two dogs (*Canis f. familiaris*) were heard barking in Area C. Numerous cats (*Felis catus*) were seen within the developed airport facilities and along Aukini Road. A small mixed herd of horses, and mules were seen within Area B, close to the eastern boundary of the property. Additionally, scat and sign of dog, cat, and horse was encountered at several locations within the project site.

Avian Survey Methods

Thirteen avian count stations were established within areas A, B and C. Six-minute point counts were made at each station. Stations were each counted once. Field observations were made with the aid of Leitz© 10 X 42 binoculars and by listening for vocalizations. Counts were concentrated between 07:00 a.m. and 10:00 a.m., the peak of daily bird activity. Additionally, two hours were spent within the project area on the evenings of April 17, and 18, 2006, and again in the early morning hours of April 18, and 19, 2006, in an attempt to detect nocturnally flying seabirds over-flying the project site. Time not spent counting was used to search the area for species and habitats not detected during count sessions.

Avian Survey Results

A total of 515 individual birds of 20 species, representing 15 separate families, were recorded during station counts (Table 1). Two of these, Black-crowned Night-Heron (*Nycticorax nycticorax hactli*), and Pacific Golden-Plover (*Pluvialis fulva*), are indigenous species. The night heron, is a resident breeding species, and the plover an indigenous migratory species (Table 1). The other 18 species detected are considered to be alien species, all are commonly encountered in the low-to-mid elevation areas on the Island of Kaua'i.

Avian diversity was relatively low, though densities recorded for several species were high. Four species, Chestnut Munia (*Lonchura atricapilla*), House Finch (*Carpodacus mexicanus frontalis*), Japanese White-eye (*Zosterops japonicus*), and Common Myna (*Acridotheres tristis*), accounted for slightly more than 47% of the total number of all birds recorded during station counts. The most common avian species recorded was the Chestnut Munia, which accounted for 18% of the total number of individual birds recorded. An average of 40 birds were detected per station count. No additional species were recorded flying over the project area during the course of crepuscular and nocturnal visits to the site.

Discussion

Mammalian Resources

The findings of the mammalian survey are consistent with the results of a 1998 survey of the same area which was conducted in support of a previous iteration of the proposed airport master plan update (David 1999), as well as the findings of another recent survey conducted on portions of this property (David 2005), and with several similar surveys conducted in the recent past in the lowland areas around Līhu'e and the Kapa'a area (David 2001, 2002, 2003a, 2004).

The sighting of Hawaiian hoary bats was not unexpected, as they are regularly seen in and around the Nāwiliwili and Līhu'e areas, as well as within most of the lowland areas on the Island of Kaua'i (Tomich, 1986; David, 1995, 2001, 2003a, U.S. Fish and Wildlife Service (USFWS) 1998). Unlike nocturnally flying seabirds, which often collide with man-made structures, bats are uniquely adapted to avoid collision with 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 during crepuscular and nocturnal hours.

Although we only recorded European house mice (*Mus domesticus*) during this survey, it is likely that the other three species of rodents established in Hawai'i, roof rats (*Rattus r. rattus*), Norway rats (*Rattus norvegicus*), and Polynesian rats (*Rattus exulans hawaiiensis*) also use resources within the general project area. All of these introduced rodents are deleterious to remaining native ecosystems and the native floral and faunal species that are dependant on them for their survival.

Table 1. Avian Species Detected, Līhu'e Airport

Common Name	*Scientific Name*	*ST*	*RA*
	GALLIFORMES		
	PHASIANIDAE - Pheasants & Partridges		
	Phasianinae - Pheasants & Allies		
Red Junglefowl	*Gallus gallus*	A	1.46
Ring-necked Pheasant	*Phasianus colchicus*	A	0.15
	CICONIIFORMES		
	ARDEIDAE - Herons, Bitterns & Allies		
Cattle Egret	*Bubulcus ibis*	A	2.00
Black-crowned Night-Heron	*Nycticorax nycticorax hoactli*	IR	0.08
	CHARADRIIFORMES		
	CHARADRIIDAE - Lapwings & Plovers		
	Charadriinae - Plovers		
Pacific Golden-Plover	*Pluvialis fulva*	IM	1.85
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Spotted Dove	*Streptopelia chinensis*	A	1.15
Zebra Dove	*Geopelia striata*	A	1.69
	PASSERIFORMES		
	TURDIDAE - Thushes		
White-rumped Shama	*Copsychus malabaricus*	A	0.69
	TIMALIIDAE - Babblers		
Hwamei	*Garrulax canorus*	A	0.54
	ZOSTEROPIDAE - White-Eyes		
Japanese White-eye	*Zosterops japonicus*	A	3.38
	MIMIDAE - Mockingbirds & Thrushes		
Northern Mockingbird	*Mimus polyglottos*	A	0.31
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	2.69
	EMBERIZIDAE - Emberizids		
Red-crested Cardinal	*Paroaria coronata*	A	0.77
	CARDINALIDAE - Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	1.54
	ICTERIDAE - Blackbirds		
Western Meadowlark	*Sturnella neglecta*	A	3.62

Common Name	*Scientific Name*	*ST*	*RA*
	FRINGILLIDAE - Fringilline And Cardueline Finches & Allies		
	Carduelinae - Carduline Finches		
House Finch	*Carpodacus mexicanus*	A	5.62
	PASSERIDAE - Old World Sparrows		
House Sparrow	*Passer domesticus*	A	0.77
	ESTRILDIDAE - Estrildid Finches		
	Estrildinae - Estrildine Finches		
Nutmeg Mannikin	*Lonchura punctulata*	A	0.92
Chestnut Munia	*Lonchura atricapilla*	A	7.15
Java Sparrow	*Padda oryzivora*	A	3.23

Key to Table 1.

ST Status
IR Indigenous Resident Species
IM Indigenous Migratory Species
A Alien species
RA Relative Abundance: Number of birds detected divided by the number of count stations (13)

Discussion

Avian Resources

The findings of the avian survey are consistent with consistent with the results of a 1998 survey of the same area which was conducted in support of a previous iteration of the proposed airport master plan update (David 1999), as well as the findings of another recent survey conducted on portions of this property (David 2005), and with several similar surveys conducted in the recent past in the lowland areas around Līhu'e and the Kapa'a area (David 2001, 2002, 2003a, 2004).

A total of 20 avian species were recorded during this survey (Table 1). Two of the species recorded, Black-crowned Night-Heron and Pacific Golden-Plover, are indigenous species. The Night-Heron is a commonly occurring resident breeding species, commonly encountered close to water throughout the state. The plover is a common migratory shorebird species, which nests in the high Arctic during the late spring and summer months, returning to Hawaii and the tropical Pacific for the winter month.

No waterbirds, seabirds or owls were recorded during the course of this survey, or in fact during the 1998 survey of the same areas (David 1999). The five extant endangered waterbird species, and the two listed seabird species currently known from Kaua'i have all been recorded within the airport boundaries on numerous occasions (Table 2). The manmade water features present within the The Kaua'i Lagoons Resort Company's Mokihana and Kiele Golf Courses, and those within the adjacent Kaua'i Marriott Resort and Beach Club located to the southwest of the airport, provide foraging and nesting

habitat for four of the listed waterbird species. Hawaiian Goose (*Branta sandvicensis*), Hawaiian Duck (*Anas wyvilliana*), Common Moorhen (*Gallinula chloropus sandvicensis*), and Hawaiian Coot (*Fulica alai*), are regularly seen on these properties which are located immediately adjacent to the airport (Figure 1), (David 2005).

Table 2. Threatened and Endangered Avian Species Previously Reported from the Līhu'e Airport

Common Name – (*Hawaiian Name*)	Scientific Name	Legal Status
	ANSERIFORMES	
	ANATIDAE - Ducks, Geese & Swans	
	Anserinae - Geese & Swans	
Hawaiian Goose (*Nēnē*)	*Branta sandvicensis*	EE
	Anatinae - Ducks	
Hawaiian Duck (*Koloa*)	*Anas wyvilliana*	EE
	PROCELLARIIFORMES	
	PROCELLARIIDAE	
	Shearwaters & Petrels	
Hawaiian Petrel (*'u'au*)	*Pterodroma sandwichensis*	EE
Newell's Shearwater (Townsend's) (*'a'o*)	*Puffinus auricularis newelli*	TEs
	GRUIFORMES	
	RALLIDAE - Rails & Allies	
Common Moorhen (*alae'ula*)	*Gallinula chloropus sandvicensis*	EEs
Hawaiian Coot (*alae ke'oke'o*)	*Fulica alai*	EE
	CHARADRIIFORMES	
	RECURVIROSTRIDAE	
	Stilts & Avocets	
Black-necked Stilt (Hawaiian) (*a'eo*)	*Himantopus mexicanus knudseni*	EEs

Key to Table 2.

EE	Endangered Endemic Species
TEs	Threatened Endemic sub-species
EEs	Endangered Endemic sub-species

Over the years, Hawaiian Ducks have posed a continued Bird Air Strike Hazard (BASH) to aircraft using the Līhu'e airport. To date Hawaiian Ducks have been involved in three

BASH incidents involving commercial airliners at the airport (U.S. Department of Agriculture (USDA) 1996). The US Department of Agriculture, Wildlife Services (WS), formerly know as Animal Damage Control, has an ongoing program to haze nuisance birds from the airport. Attempts to trap and relocate problem ducks have not been successful (USDA 1996). Additionally, three other endangered waterbird species, the endemic Hawaiian sub-species of the Black-necked Stilt (*Himantopus mexicanus knudseni*), the Hawaiian Coot, and in recent years Nēnē have all been recorded within the airport boundaries. The endemic endangered sub-species of the Common Moorhen is present in both Hanamā'ulu Stream and within the Kaua'i Lagoons Resort Company's Mokihana and Kiele Golf Courses, and the adjacent Kaua'i Marriott Resort and Beach Club, and can be expected to be recorded within the airport boundaries on occasion.

Although not detected during this survey both the endangered Hawaiian Petrel (*Pterodroma sandwichensis*), and the threatened endemic sub-species of the Newell's Shearwater (*Puffinus auricularis newelli*), over-fly the airport and the project area between April and the end of November each year. Both species have been well documented crossing the northern, eastern and southern coastline of Kaua'i across a broad front and in relatively large numbers during the breeding season (Cooper and Day, 1995, 1998, Day and Cooper 1997, 1999, 2001 Day et al. 2000, 2001a, 2001b, 2003, David et al., 2002; Morgan et al. 2003, 2004).

Newell's Shearwaters were formerly common on the Island of Hawai'i (Wilson and Evans 1890–1899). This species breeds on Kaua'i, Hawai'i, and Moloka'i in extremely small numbers. Newell's Shearwater populations have dropped precipitously since the 1880s (Banko 1980b, Day et al., 2003b). This pelagic species nests high in the mountains in burrows excavated under thick vegetation, especially *uluhe* (*Dicranopteris linearis*) fern.

The primary cause of mortality in both Hawaiian Petrels and Newell's Shearwaters 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, Telfer 1979, Sincock 1981, Reed et al. 1985, Telfer et al. 1987, Cooper and Day 1998, Podolsky et al. 1998, Ainley et al. 2001). Both Hawaiian Petrels and Newell's Shearwaters have been grounded within the airport facilities on an annual basis over the past 27-years (Morgan et al. 2003, 2004, Reilly 2005).

There are no nesting colonies nor appropriate nesting habitat for either seabird species within or close to the petition area. The closest Newell's Shearwater colonies are located at Kāluahonu some nine-kilometers west-south-west of the study area, and one above Kalāheo, some 17-kilometers west of the project site. The Kāluahonu colony may no longer be active, due to major habitat changes caused by invasive alien plant species

(David et al. 2002, David 2003b). Currently the only known Hawaiian Petrel colonies are located in several north shore valleys, many kilometers away from the airport.

There is no habitat within the existing airport or in the proposed facility improvement areas that is essential for the survival of any avian or mammalian species currently listed as endangered, threatened or proposed for listing under either the Federal or State of Hawai'i endangered species programs (DLNR 1998, Federal Register, 1999, 2005).

One other seabird species, Wedge-tailed Shearwater (*Puffinus pacificus*) is known from the general project area and has been recovered by the SOS program in increasing numbers over the years. There is no suitable nesting habitat for this species within the proposed improvement areas within the airport.

Potential Impacts to Protected Species

Waterbirds

As previously discussed, five endangered waterbird species, Nēnē, Hawaiian Duck, Common Moorhen, Hawaiian Coot, and Black-necked Stilt have all been recorded within, or immediately adjacent to the airport and the proposed airport improvement areas (Figure 1). All five species are at risk of injury and mortality from interactions with private and commercial aircraft that use the airport facilities. Wildlife Services operates a bird hazing program to reduce the threat of BASH incidents at the airport on behalf of the HDOT-AD. The proposed airport improvements are not expected to increase the threat posed by airport operations to any of these species.

Seabirds

Both the endangered Hawaiian Petrel and the threatened Newell's Shearwater over-fly the airport and the proposed improvement sites between April and the end of November each year. As previously discussed, both species are at risk of being downed by interactions with unshielded lighting and collisions with man-made structures when disoriented by unshielded lights. Both species have regularly been recovered from within the Līhu'e International Airport and from within the Kaua'i Marriott Resort and Beach Club facilities by the Save our Shearwater program. The proposed airport improvements are not expected to increase the threat posed by airport operations to either listed pelagic seabird species.

Recommendations

Waterbirds

Continue to fund the WS bird hazing program at the airport, so as to reduce the threat that aircraft or airport operations result in deleterious impacts to listed waterbird species.

Seabirds

To reduce the potential for interactions between nocturnally flying Hawaiian Petrels Newell's Shearwaters, and Wedge-tailed Shearwaters with external lights and man-made structures, it is recommended that any external lighting used during construction, or that may be needed in conjunction with the proposed airport improvements be shielded as discussed in, Reed et al. (1985), and Telfer et al. (1987).

Glossary:

Alien – Introduced to Hawai'i by humans.
Crepuscular – Twilight hours either in the evening or the morning.
Endemic – Native and unique to the Hawaiian Islands.
Endangered – Listed and protected under the ESA as an endangered species.
Indigenous – Native to Hawai'i, but also found elsewhere naturally.
Nocturnal – Night-time, after dark.
Ruderal – Disturbed, rocky, rubbishy areas, such as old agricultural fields and rock piles.
Volant – Flying, capable of flight - as in flying insect.
Threatened – Listed and protected under the ESA as a threatened species.

BASH – Bird Air Strike Hazard
DLNR – Hawaii State Department of Land & Natural resources.
HDOT-AD - State of Hawai'i, Department of Transportation, Airports Division
ESA – Federal Endangered Species Act of 1973, as amended.
USDA – United States Department of Agriculture.
WS – Wildlife Services (Formerly Animal Damage Control)

Literature Cited:

Ainley, D. G, R. Podolsky, L. Deforest, G. Spencer, and N. Nur. 2001. The Status and Population Trends of the Newell's Shearwater on Kaua'i: Insights from Modeling, *in*: Scott, J. M, S. Conant, and C. Van Riper III (editors) *Evolution, Ecology, Conservation, and Management of Hawaiian Birds: A Vanishing Avifauna.* Studies in Avian Biology No. 22: Cooper's Ornithological Society, Allen Press, Lawrence, Kansas. (Pg. 108-123).

American Ornithologist's Union. 1998. *Check-list of North American Birds.* 7th edition. AOU. Washington D.C. 829pp.

_____. 2000. Forty-second supplement to the American Ornithologist's Union *Check-list of North American Birds.* Auk 117:847-858.

Banko, W. E. 1980a. Population Histories- Species Accounts Seabirds: Hawaiian Dark rumped Petrel ('Ua'u). Cooperative National Park Resources Studies Unit, University of Hawaii at Manoa, Department of Botany, Technical Report #5B.

_____. 1980b. Population Histories- Species Accounts Seabirds: Newell's Shearwater ('A'o). Cooperative National Park Resources Studies Unit, University of Hawaii at Manoa, Department of Botany, Technical Report #5A.

Banks, R. C., C. Cicero, J. L. Dunn, A. W. Kratter, P. C. Rasmussen, J. V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2002. Forty-third supplement to the American Ornithologist's Union *Check-list of North American Birds.* Auk 119:897-906.

_____. 2003 Forty-fourth supplement to the American Ornithologist's Union *Check-list of North American Birds.* Auk 120:923-931.

_____. 2004 Forty-fifth supplement to the American Ornithologist's Union *Check-list of North American Birds.* Auk 121:985-995.

_____. 2005 Forty-sixth supplement to the American Ornithologist's Union Check-list of North American Birds. Auk 122:1026-1031.

Cooper, B. A and R. H. Day. 1995. Kauai endangered seabird study. Volume 1: Interactions of Dark-rumped Petrels and Newell's Shearwaters with utility structures on Kauai, Hawaii: Final Report, TR-105847-V1, Electric Power Research Institute, Palo Alto, California.

_____. 1998. Summer Behavior and Mortality of Dark-rumped Petrels and Newell's Shearwaters at Power Lines on Kauai. Colonial Waterbirds, 21 (1): 11-19.

David, R. E. 1995. Faunal Survey for the Princeville Master Plan Environmental Impact Statement, Hanalei District, Island of Kaua'i, Hawaii. Prepared for Group 70 & The Princeville Corporation.

_____. 1999. A Survey of Terrestrial Vertebrates for the Proposed Lihu'e Airport Expansion, Lihu'e, Island of Kaua'i, Hawai'i. Prepared for Wilson Okamoto & Associates and the State of Hawai'i Department of Transportation, Airports Division.

David, R. E. 2001. A Survey of Avian and Terrestrial Mammalian Species Ocean Bay Plantation at Hanama'ula Master Plan, Lihu'e, District, Island of Kaua'i. Prepared for: Group 70 International, Inc. & EWM Kauai, LLC.

_____. 2002. A Survey of Avian and Terrestrial Mammalian Species Conducted for the Kapa'a to Keālia Bike and Pedestrian Path Kawaihau District, Kaua'i. Prepared for SSFM Engineers International and the County of Kaua'i.

_____. 2003a. A Survey of Avian and Terrestrial Mammalian Species for the Kapa'a Bypass Road, Kuhio Highway, Kapa'a to Hanamaula, Island of Kaua'i, Hawai'i. Prepared for Kimura International and the Hawai'i Department of Transportation (HDOT).

_____. 2003b. Results of a Survey of the Newell's Shearwater Colony at Kaluahonu, Island of Kaua'i, Hawai'i, July 2003. Prepared for Planning Solutions, Inc., and Kaua'i Island Utility Cooperative.

_____. 2004. A Survey of Avian and Terrestrial Mammalian Species Conducted for the Lydgate Park to Kapa'a Bike and Pedestrian Path, Kaua'i. Prepared for: Kimura International, Inc. & The County of Kaua'i.

_____. 2005. Biological Surveys Within the Kaua'i Lagoons Resort, Lihue District, Island of Kaua'i. Prepared for: Wilson Okamoto Corporation, Ltd.

David, R. E., R. H. Day, and B. A. Cooper 2002. Results of Newell's Shearwater Surveys at the Kaluahonu, Moalepe and Anahola Memorial Colonies, Island of Kaua'i, Hawai'i, July 2002. Prepared for Planning Solutions, Inc., and Kaua'i Electric.

Day, R. H., and B. Cooper, 1997. Patterns of Movement of Dark-rumped Petrels and Newell's Shearwaters on Kauai. The Condor, **97**: 1011-1027.

_____. 1999. Results of Petrel and Shearwater Surveys on Kauai, June 1999. Unpublished report, prepared for: University of Hawaii, Pacific Cooperative Studies Unit.

_____. 2001. Results of Petrel and Shearwater Surveys on Kauai, June 2001. Unpublished report, prepared for: University of Hawaii, Pacific Cooperative Studies Unit.

Day, R. H., R. E. David, and B. A. Cooper. 2001a. Results of Radar and Night Vision Surveys of Petrels and Shearwaters Near the Lihu'e Energy Service Center Powerline on Kaua'i, June 2001. Prepared for: Planning Solutions, Inc., and Kaua'i Electric.

Day, R. H., R. E. David, and B. A. Cooper. 2001b. Results of Radar and Night Vision Surveys of Petrels and Shearwaters Near the Lihu'e Energy Service Center Powerline on Kaua'i, October 2001. Prepared for: Planning Solutions, Inc., and Kaua'i Electric.

Day, R. H., B. Cooper, and R. J. Blaha. 2003a. Movement Patterns of Hawaiian Petrels and Newell's Shearwaters on the Island of Hawai'i. Pacific Science, 57, 2:147-159.

Day, R. H., B. Cooper, and T. C. Telfer. 2003b. Decline of Townsend's (Newell's Shearwaters (*Puffinus auricularis newelli*) on Kauai, Hawaii. The Auk 120: 669-679.

Day, R. H., T. J. Mabee, and B. Cooper, 2000. Results of Petrel and Shearwater Surveys on Kauai, June 2000. Unpublished report, prepared for: University of Hawaii, Pacific Cooperative Studies Unit.

Department of Land and Natural Resources (DLNR). 1998. Indigenous Wildlife, Endangered And Threatened Wildlife And Plants, And Introduced Wild Birds. Department of Land and Natural Resources. State of Hawaii. Administrative Rule §13-134-1 through §13-134-10, dated March 02, 1998.

Federal Register 1999a. Department of the Interior, Fish and Wildlife Service, Endangered and Threatened Wildlife and Plants. 50CFR 17:11 and 17:12 – December 3, 1999.

_____. 2005. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. Review of Species That Are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petition; Annual Description of Progress on Listing Actions. Federal Register, 70 No. 90 (Wednesday, May 11, 2005): 24870-24934.

Hadley, T. H. 1961. Shearwater calamity on Kauai. Elepaio 21:60.

Hue, D., C. Glidden, J. Lippert, L. Schnell, J. MacIvor and J. Meisler. 2001. Habitat Use and Limiting Factors in a Population of Hawaiian Dark-rumped Petrels on Mauna Loa, Hawai'i. , *in:* : Scott, J. M, S. Conant, and C. Van Riper III (editors) *Evolution, Ecology, Conservation, and Management of Hawaiian Birds: A Vanishing Avifauna.* Studies in Avian Biology No. 22. Cooper's Ornithological Society, Allen Press, Lawrence, Kansas (Pg. 234-242).

Morgan, C., P. White, and R. E. David. 2003. Habitat Conservation Plan: Kaua'i Island Utility Cooperative: Working Paper No. 2 - Data Analysis: Interpreting the Save Our Shearwaters Bird Recovery Database (1979-2002) for Habitat Conservation Planning. Prepared for: Kaua'i Island Utility Cooperative.

Morgan, C., P. White, and R. E. David. Habitat Conservation Plan: Kaua'i Island Utility Cooperative: Data Report and Analysis: Save Our Shearwaters Bird Program 2003 Update. Prepared for: Kaua'i Island Utility Cooperative.

Podolsky, R., D.G. Ainley, G. Spencer, L. de Forest, and N. Nur. 1998. "Mortality of Newell's Shearwaters Caused by Collisions with Urban Structures on Kaua'i". Colonial Waterbirds 21:20-34.

Pukui , M. K., S. H. Elbert, and E. T. Mookini 1976. *Place Names of Hawaii.* University of Hawaii Press. Honolulu, Hawai'i. 289 pp.

Reed, J. R., J. L Sincock, and J. P. Hailman 1985. Light Attraction in Endangered Procellariform Birds: Reduction by Shielding Upward Radiation. Auk 102: 377-383.

Reilly, S. 2005. Unpublished SOS recovery data for the 2005 season.

Simons, T. R., and C. N. Hodges. 1998. Dark-rumped Petrel (Pterodroma phaeopygia). *In* A. Poole and F. Gill (editors). The Birds of North America, No. 345. The Academy of Natural Sciences, Philadelphia, PA. And the American Ornithologists Union, Washington, D.C.

Sincock, J. L. 1981. Saving the Newell's Shearwater. Pages 76-78 in Proceedings of the Hawaii Forestry and Wildllife Conference, 2-4 October 1980. Department of Land and Natural Resources, State of Hawaii, Honolulu.

Telfer, T. C. 1979. Successful Newell's Shearwater Salvage on Kauai. 'Elepaio 39:71

Telfer, T. C. , J. L. Sincock, G. V. Byrd, and J. R. Reed. 1987. Attraction of Hawaiian seabirds to lights: Conservation efforts and effects of moon phase. Wildlife Society Bulletin 15:406-413.

Tomich, P.Q. 1986. *Mammals in Hawaii*. Bishop Museum Press. Honolulu, Hawaii. 375 pp.

United States Department of Agriculture (USDA) 1996. Environmental Assessment: Wildlife Hazard Management at Lihue Airport (LIH).

U.S. Fish & Wildlife Service (USFWS) 1983. Hawaiian Dark-Rumped Petrel & Newell's Manx Shearwater Recovery Plan. U.S. Fish & Wildlife Service, Portland, Oregon.

_____. 1998. Recovery Plan for the Hawaiian Hoary Bat. U.S. Fish & Wildlife Service, Portland, Oregon.

Wagner, W.L., D.R Herbst, and S.H. Sohmer 1990. *Manual of the Flowering Plants of Hawai'i*. University of Hawaii Press, Honolulu, Hawaii 1854 pp.

Wagner, W.L. and D.R. Herbst. 1999. *Supplement to the Manual of the flowering plants of Hawai'i*, pp. 1855-1918. *In:* Wagner, W.L., D.R. Herbst, and S.H. Sohmer, Manual of the flowering plants of Hawai'i. Revised edition. 2 vols. University of Hawaii Press and Bishop Museum Press, Honolulu.

Wilson, S. B., and A. H. Evans. 1890-1899. *Aves Hawaiiensis: The birds of the Sandwich Islands*. R. H. Porter, London.

APPENDIX C

Acoustic Study

ACOUSTIC STUDY
FOR THE
LIHUE AIRPORT IMPROVEMENTS
LIHUE, KAUAI, HAWAII

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JANUARY 2007

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CHAPTER 1. INTRODUCTION AND SUMMARY

The existing and future traffic noise levels in the vicinity of Lihue Airport in Lihue, Kauai were evaluated for their potential impact on noise sensitive receptors in the project environs. The future traffic noise levels along the primary access roadways to the airport under the Do Nothing and Action Scenarios were calculated for 2010 and 2020.

Risks of future traffic noise impacts resulting from the proposed Lihue Airport Improvements are considered to be low due to the relatively small increases in traffic noise associated with the Action Alternative. The largest increases in traffic noise attributable to the Lihue Airport Improvements are anticipated to occur along Kapule Highway, and the forecast increase are less than 0.5 DNL (Day-Night Average Sound Level) from CY 2004 to CY 2020. These changes in traffic noise levels will be very difficult to detect over the 16 year period of the proposed improvements, and risks of traffic noise impacts from the Lihue Airport Improvements should be very low. Traffic noise level increases associated with the Action Alternative are not expected to exceed the Hawaii State Department of Transportation, Highways Division (DOTH) "greater than 15 dB increase" criteria. Along all roadways in the airport environs, risks of adverse traffic noise impacts are expected to be minimal due to the relatively small increases in traffic volumes anticipated. Along the section of Ahukini Road east of Kapule Highway, which primarily services Lihue Airport, future traffic noise level increases of approximately 5 DNL are expected to be the highest among the roadways in the project environs with or without implementation of the proposed Lihue Airport Improvements. However, the land uses along this roadway do not contain any noise sensitive uses. For these reasons, adverse traffic noise impacts are not expected to result from the implementation of the Lihue Airport Improvements.

By current federal criteria for identifying aircraft noise impacts, the Lihue Airport Improvements should not result in adverse noise impacts within the Lihue Airport environs. New land use incompatibilities should not occur as a result of increases in airport noise levels under the Do Nothing or Action Alternatives. The primary reason for this is that the mix of quieter Stage 3 aircraft is expected to increase to 100 percent of the total interisland air carrier fleet by CY 2020. Therefore, even with increasing aircraft operations at Lihue Airport, the resulting noise contours at the airport are not expected to result in new land use incompatibilities.

With or without the implementation of the proposed Lihue Airport Improvements, the near term (2011) airport 60 DNL noise contour will continue to enclose the Veterans Center, Lihue Judicary Complex, and future public facilities along Kapule Highway. These facilities were or are being constructed with provisions for noise attenuation features. Future near term increases in aircraft noise levels in these noise sensitive areas should not exceed the FAA's 1.5 DNL criteria for significant change. Following conversion of the entire interisland air carrier jet aircraft from the noisier Stage 2 to the quieter Stage 3 aircraft, all existing noise sensitive land uses should be located outside the 60 DNL contour.

Future residences and resort units in the Molokoa Village and Kauai Lagoons Resort areas are planned, and may be located within the existing and near term 60 DNL contours. If so, these developments may not qualify for sound attenuation treatment under the Federal Aviation Regulations (FAR) Part 150 Program Update for Lihue Airport since these units were not in place prior to October 1, 1998. Future aircraft noise levels in these planned development areas are not expected to increase by 1.5 DNL with or without implementation of the proposed Lihue Airport Improvements.

Unavoidable, but temporary, noise impacts may occur during construction activities at Lihue Airport and at any outlying roadway improvement project sites. Because construction activities are predicted to be audible at adjoining properties, the quality of the acoustic environment may be degraded to unacceptable levels during periods of construction. Mitigation measures to reduce construction noise to inaudible levels will not be practical in all cases. For this reason, the use of quiet equipment and construction curfew periods as required under the State Department of Health noise regulations are recommended to minimize construction noise impacts.

CHAPTER 2. PURPOSE

The objectives of this study were to describe the existing and future noise environment in the environs of the Lihue Airport at Lihue on the island of Kauai. The future noise environment and potential noise impacts were examined for the Do Nothing and Action Scenarios of the proposed Lihue Airport Improvements using aircraft operations forecasts for the Years 2011 and 2020, and using motor vehicle traffic forecasts for 2010 and 2020. The selection of the airport operations forecast year of 2011 instead of 2010 was dictated by the FAR Part 150 Noise Compatibility Program Update for Lihue Airport, which was being conducted concurrently with the evaluation of the Lihue Airport Improvements. Both motor vehicle and aircraft noise level increases and impacts associated with the various improvement scenarios were to be determined within the project environs. A specific objective was to determine future road traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases. Assessments of possible impacts from noise resulting from fixed and rotary wing aircraft operations at Lihue Airport were included in the study objectives. In addition, assessments of potential impacts from short term construction noise at the project site were also included in the noise study objectives. Recommendations for minimizing these noise impacts were also to be provided as required.

CHAPTER 3. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies to assess environmental noise is the Day-Night Average Sound Level (DNL). This descriptor incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard Sound Level Meter. The maximum A-Weighted sound level occurring while an aircraft is flying past a listener (i.e., the maximum sound level from a "single event") is referred to as the "Lmax value". The mathematical product (or integral) of the instantaneous sound level times the duration of the event is known as the "Sound Exposure Level", or Lse, which is analogous to the energy of the time-varying sound levels associated with a single event.

The DNL contours represent the average noise during a typical day of the year. DNL exposure levels of 55 or less are typical of quiet rural or suburban areas. DNL exposure levels of 55 to 65 are typical of urbanized areas with medium to high levels of activity and street traffic. DNL exposure levels above 65 are representative of densely developed urban areas and areas fronting high volume roadways.

By definition, the minimum averaging period for the DNL descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the DNL descriptor. Because of the averaging used, DNL values in urbanized areas typically range between 50 and 75 DNL. In comparison, the typical range of intermittent noise events may have maximum Sound Level Meter readings between 75 and 105 dBA. A more complete list of noise descriptors is provided in Appendix B to this report. In Appendix B, the Ldn descriptor symbol is used in place of the DNL descriptor symbol.

Table 3-1, derived from Reference 1, presents current federal noise standards and acceptability criteria for residential land uses. Land use compatibility guidelines for various levels of environmental noise as measured by the DNL descriptor system are shown in Figure 3-1. As a general rule, noise levels of 55 DNL or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, DNL levels generally range from 55 to 65 DNL, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 DNL, and as high as 75 DNL when the roadway is a high speed freeway. Due to noise shielding effects from intervening structures, interior lots are usually exposed to 3 to 10 DNL lower noise levels than the front lots which are not shielded from the traffic noise.

For the purposes of determining noise acceptability for funding assistance from federal agencies, an exterior noise level of 65 DNL or lower is considered acceptable. These federal agencies include the Federal Aviation Administration (FAA), Department

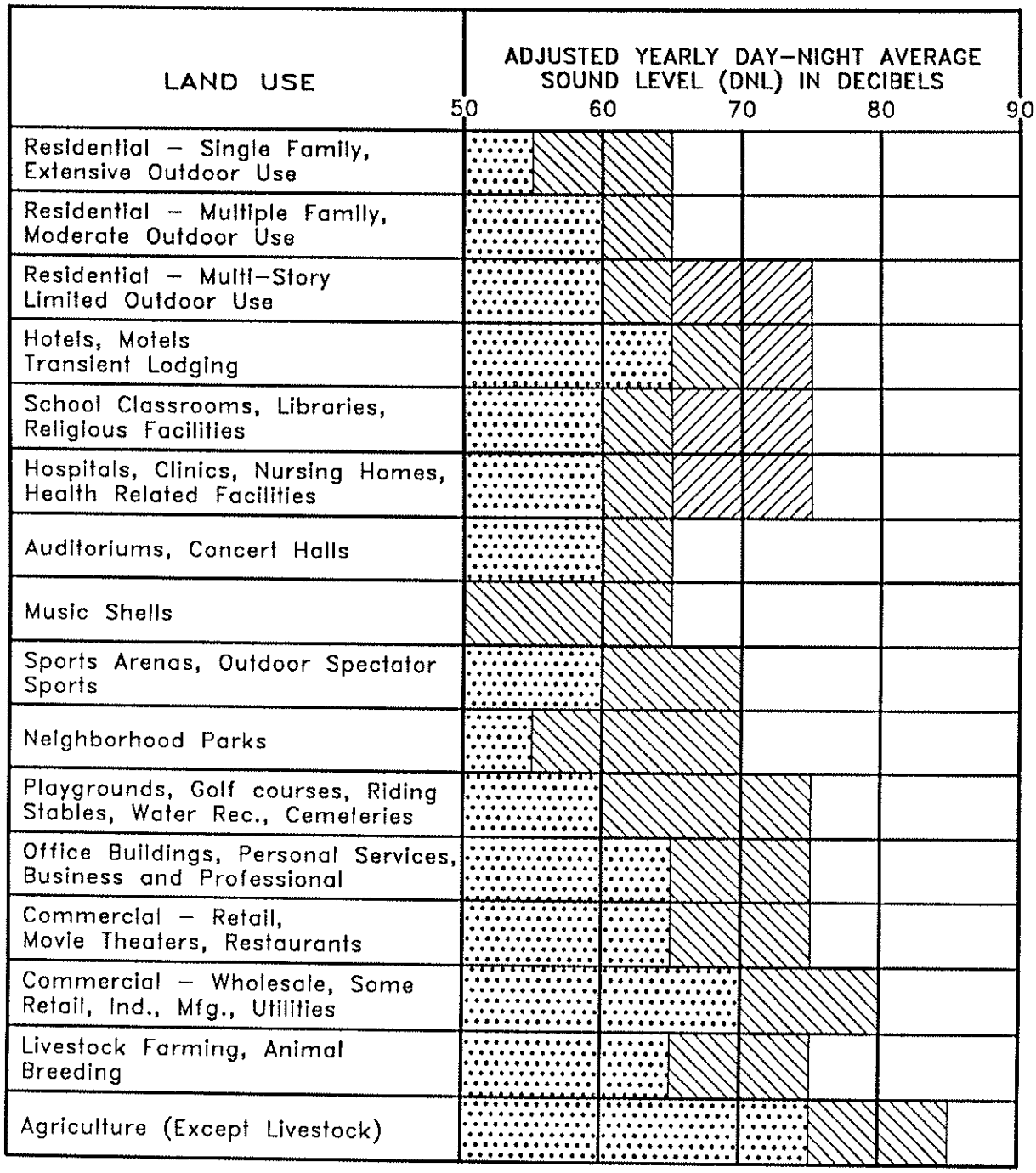
TABLE 3–1

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

NOISE EXPOSURE CLASS	DAY–NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL (1) STANDARD
Minimal Exposure	Not Exceeding 55 DNL	Not Exceeding 55 Leq	Unconditionally Acceptable
Moderate Exposure	Above 55 DNL But Not Above 65 DNL	Above 55 Leq But Not Above 65 Leq	Acceptable(2)
Significant Exposure	Above 65 DNL But Not Above 75 DNL	Above 65 Leq But Not Above 75 Leq	Normally Unacceptable
Severe Exposure	Above 75 DNL	Above 75 Leq	Unacceptable

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) FHWA uses the Leq instead of the Ldn descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 Leq.



LAND USE COMPATIBILITY WITH YEARLY AVERAGE DAY-NIGHT AVERAGE SOUND LEVEL (DNL) AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED.
(Source: American National Standards Institute S12.9-1998/Part 5)

FIGURE 3-1

of Defense (DOD); Federal Housing Administration, Housing and Urban Development (FHA/HUD), and Veterans Administration (VA). This standard is applied nationally (see Reference 2), including Hawaii.

Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 DNL does not eliminate all risks of noise impacts. Because of these factors, a lower level of 55 DNL is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise (see Reference 3). For typical, naturally ventilated structures in Hawaii, an exterior noise level of 55 DNL results in an interior level of approximately 45 DNL, which is considered to be the "Unconditionally Acceptable" (or "Near-Zero Risk") level of interior noise. However, after considering the cost and feasibility of applying the lower level of 55 DNL, government agencies such as FHA/HUD and VA have selected 65 DNL as a more appropriate regulatory standard.

For aircraft noise, the State of Hawaii Department of Transportation, Airports Division (DOTA), has recommended that 60 DNL be used as the common level for determining land use compatibility in respect to noise sensitive uses near its airports. Table 3-2 summarizes the recommendations for compatible land uses at various levels of aircraft noise. For those noise sensitive land uses which are exposed to aircraft noise greater than 55 DNL, the division recommends that disclosure of the aircraft noise levels be provided prior to any real property transactions. Reference 4 requires that such disclosure be provided prior to real property transactions concerning properties located within Air Installation Compatibility Use Zones (AICUZ) or located within airport noise maps developed under Federal Aviation Regulation Part 150 - Airport Noise Compatibility Planning (14 CFR Part 150).

Traffic noise associated with public roadways and federally financed highways are evaluated in respect to the Federal Highways Administration (FHWA) and the Hawaii State DOT, Highways Division (DOTH) noise abatement criteria. For noise sensitive land uses, an hourly traffic noise level of 66 Leq(h) [Hourly Equivalent or Average Sound Level] is considered to be the level at and above which traffic noise is considered to be unacceptable see Table 3-3. The 66 Leq(h) DOTH criteria is approximately 1 Leq unit lower than the FHWA noise abatement criteria (see Reference 5), and is applied on all federally funded highway projects in the State of Hawaii.

Other noise sources, such as stationary machinery and construction equipment, are regulated by the State Department of Health (DOH) noise regulations (Reference 6). The DOH noise regulations for stationary machinery and construction noise sources (Reference 6) apply on the island of Kauai, and throughout the State of Hawaii. These DOH community noise regulations limit stationary machinery noise levels to approximately 55 DNL and 60 DNL when operating near single family and multifamily residences, respectively. The DOH noise rules also regulate noise during construction activities.

TABLE 3-2

HAWAII STATE DEPARTMENT OF TRANSPORTATION RECOMMENDATIONS FOR LOCAL LAND USE COMPATIBILITY WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVELS (DNL)

TYPE OF LAND USE	**** Yearly Day-Night Average Sound Level ****					
	< 60	60-65	65-70	70-75	75-80	80-85
RESIDENTIAL						
Low density residential, resorts, and hotels (outdoor facil.)	Y(a)	N(b)	N	N	N	N
Low density apartment with moderate outdoor use	Y	N(b)	N	N	N	N
High density apartment with limited outdoor use	Y	N(b)	N(b)	N	N	N
Transient lodgings with limited outdoor use	Y	N(b)	N(b)	N	N	N
PUBLIC USE						
Schools, day-care centers, libraries, and churches	Y	N(c)	N(c)	N(c)	N	N
Hospitals, nursing homes, clinics, and health facilities	Y	Y(d)	Y(d)	Y(d)	N	N
Indoor auditoriums and concert halls	Y(c)	Y(c)	N	N	N	N
Government services and office buildings serving the general public	Y	Y	Y(d)	Y(d)	N	N
Transportation and Parking	Y	Y	Y(d)	Y(d)	Y(d)	Y(d)
COMMERCIAL AND GOVERNMENT USE						
Offices - government, business, and professional	Y	Y	Y(d)	Y(d)	N	N
Wholesale and retail - building materials, hardware and heavy equipment	Y	Y	Y(d)	Y(d)	Y(d)	Y(d)
Airport businesses - car rental, tours, lei stands, ticket offices, etc.	Y	Y	Y(d)	Y(d)	N	N
Retail, restaurants, shopping centers, financial institutions, etc.	Y	Y	Y(d)	Y(d)	N	N
Power plants, sewage treatment plants, and base yards	Y	Y	Y(d)	Y(d)	Y(d)	N
Studios without outdoor sets, broadcasting, production facilities, etc.	Y(c)	Y(c)	N	N	N	N
MANUFACTURING, PRODUCTION, AND STORAGE						
Manufacturing, general	Y	Y	Y(d)	Y(d)	Y(d)	N
Photographic and optical	Y	Y	Y(d)	Y(d)	N	N
Agriculture (except livestock) and forestry	Y	Y(e)	Y(e)	Y(e)	Y(e)	Y(e)
Livestock farming and breeding	Y	Y(e)	Y(e)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL						
Outdoor sports arenas and spectator sports	Y	Y(f)	Y(f)	N	N	N
Outdoor music shells, amphitheaters	Y(f)	N	N	N	N	N
Nature exhibits and zoos, neighborhood parks	Y	Y	Y	N	N	N
Amusements, beach parks, active playgrounds, etc.	Y	Y	Y	Y	N	N
Public golf courses, riding stables, cemeteries, gardens, etc.	Y	Y	N	N	N	N
Professional/resort sport facilities, locations of media events, etc.	Y(f)	N	N	N	N	N
Extensive natural wildlife and recreation areas	Y(f)	N	N	N	N	N

Numbers in parentheses refer to notes.

KEY TO TABLE 3-2:

Y(Yes) = Land Use and related structures compatible without restrictions.
N(No) = Land Use and related structures are not compatible and should be prohibited.

TABLE 3-2 (CONTINUED)

HAWAII STATE DEPARTMENT OF TRANSPORTATION RECOMMENDATIONS FOR LOCAL LAND USE COMPATIBILITY WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVELS (DNL)

NOTES FOR TABLE 3-2:

(a) A noise level of 60 DNL does not eliminate all risks of adverse noise impacts from aircraft noise. However, the 60 DNL planning level has been selected by the State Airports Division as an appropriate compromise between the minimal risk level of 55 DNL and the significant risk level of 65 DNL.

(b) Where the community determines that these uses must be allowed, Noise Level Reduction (NLR) measures to achieve interior levels of 45 DNL or less should be incorporated into building codes and be considered in individual approvals. Normal local construction employing natural ventilation can be expected to provide an average NLR of approximately 9 dB. Total closure plus air conditioning may be required to provide additional outdoor to indoor NLR, and will not eliminate outdoor noise problems.

(c) Because the DNL noise descriptor system represents a 24-hour average of individual aircraft noise events, each of which can be unique in respect to amplitude, duration, and tonal content, the NLR requirements should be evaluated for the specific land use, interior acoustical requirements, and properties of the aircraft noise events. NLR requirements should not be based solely upon the exterior DNL exposure level.

(d) Measures to achieve required NLR must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(e) Residential buildings require NLR. Residential buildings should not be located where noise is greater than 65 DNL.

(f) Impact of amplitude, duration, frequency, and tonal content of aircraft noise events should be evaluated.

TABLE 3–3

FHWA & DOTH NOISE ABATEMENT CRITERIA
[Hourly A–Weighted Sound Level––Decibels (dBA)]

ACTIVITY CATEGORY	LEQ (h)*	DESCRIPTION OF ACTIVITY CATEGORY
A	57 (Exterior)	Lands on which serenity and quiet are of extra–ordinary significance and serve an important public need and where the preservation of those qualities is essential if the areas are to continue to serve their intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, activity sports areas, parks, residences, motels, hotels, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	------	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

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* The Hawaii State Department of Transportation, Highways Division, utilizes Leq criteria levels which are 1 Leq unit less than the FHWA values shown.

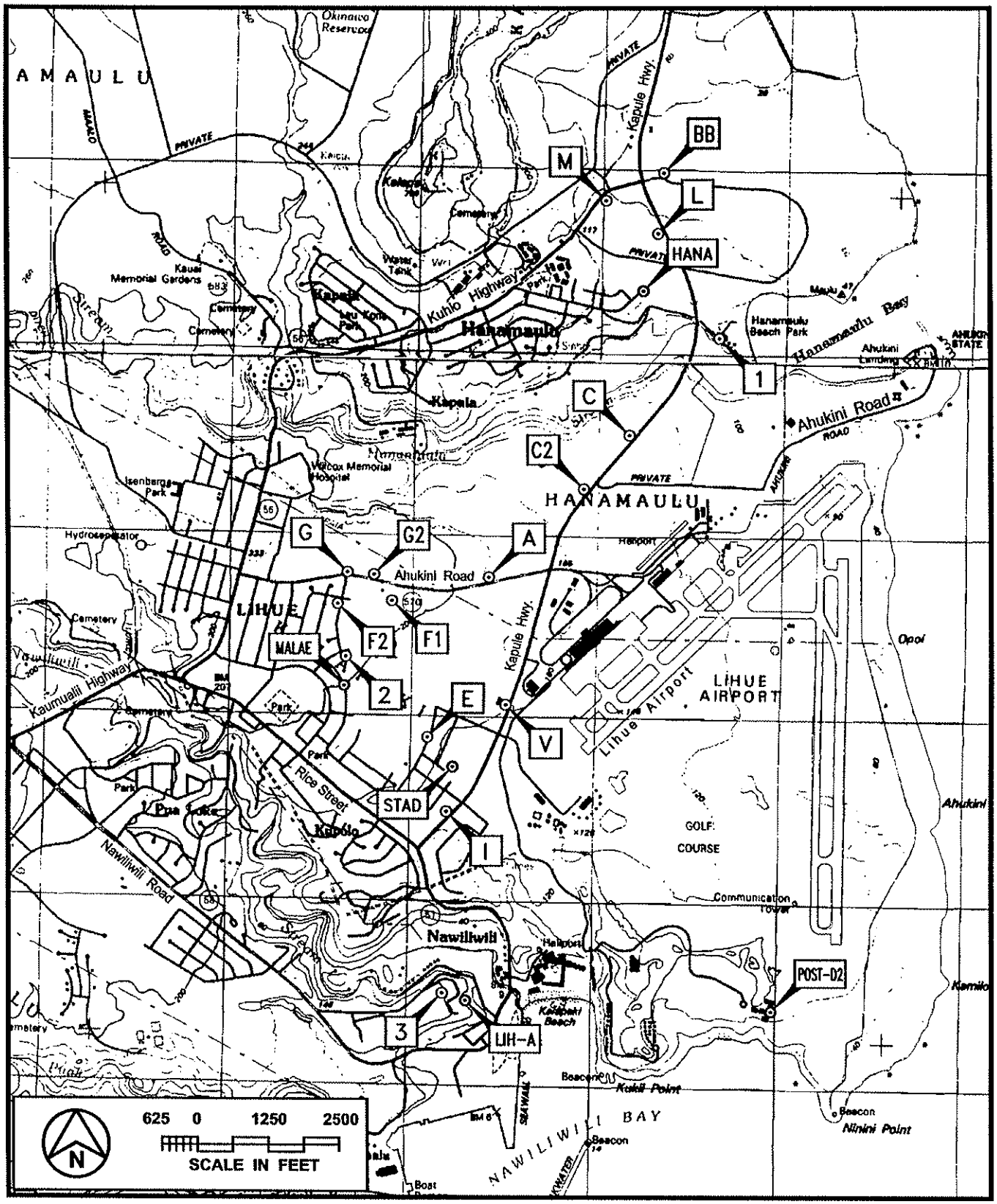
CHAPTER 4. GENERAL STUDY METHODOLOGY

Noise Measurements. Existing traffic levels were measured at eight locations in the project environs to provide a basis for calculating the traffic noise levels along the two primary access roadways which service Lihue Airport: Kapule Highway; and Ahukini Road. Aircraft noise levels were measured at thirteen additional noise monitoring sites in the Nawiliwili, Lihue, Hanamaulu, and Hanamaulu Beach areas. The traffic and aircraft monitoring data at these twenty-one sites were used to supplement those previously measured and used for traffic noise model and aircraft noise model validation efforts (see References 7 and 8). The locations of the measurement sites are shown in Figure 4-1. Traffic noise measurements were obtained at sites A, C, G, I, L, G2, V, and C2. Aircraft noise measurements were obtained at Sites HANA, STAD, POST-D2, MALAE, LIH-A, 1, 2, 3, A, BB, C, E, F1, F2, and M. The noise measurements were performed during July and August of 1999 and during April of 2006.

Road Traffic Noise Analysis. Traffic noise calculations for the existing conditions as well as noise predictions for the future conditions with and without the project were performed using the Federal Highway Administration (FHWA) Traffic Noise Model (TNM), Version 2.5 (see Reference 9). Traffic data entered into the noise prediction model were: hourly traffic volumes, average vehicle speeds, estimates of traffic mix, and loose soil propagation loss factor. The results from the traffic study for the project (Reference 10) and Hawaii State Department of Transportation counts on Kapule Highway and Ahukini Road (References 11 through 13), were the primary sources of data inputs to the model. For existing and future traffic, it was assumed that the average noise levels, or Leq(h), during the PM peak hour were equal to the 24 hour DNL along each roadway segment. The AM peak hour Leq(h) was assumed to be approximately 1 dB less than the 24 hour DNL along each roadway segment. These assumptions were based on computations of both the hourly Leq and the 24-hour DNL of traffic noise on Kapule Highway and Ahukini Road (see Figures 4-2 through 4-6).

The traffic noise measurement results, and their comparisons with TNM computer model predictions of existing traffic noise levels are summarized in Table 4-1. The results of the traffic noise measurements were compared with calculations of existing traffic noise levels to validate the computer model used.

Traffic noise calculations for both the existing (2004) and future (2010 and 2020) conditions in the project environs were developed for ground level receptors without the benefit of shielding effects. Traffic assignments with and without the project were obtained from the project's traffic study (Reference 10). The forecast increases in traffic noise levels over existing levels were calculated for both the Do Nothing and Action Alternatives, and noise impact risks evaluated. The relative differences between the traffic noise levels resulting from the Do Nothing and Action Alternatives were calculated, and an evaluation was made of possible traffic noise impacts resulting from the Action Alternatives. The FHWA (67 Leq) and DOTH (66 Leq) traffic noise abatement criteria were used to evaluate these traffic noise impacts, and to recommend possible mitigation measures. The DOTH noise abatement criteria for significant

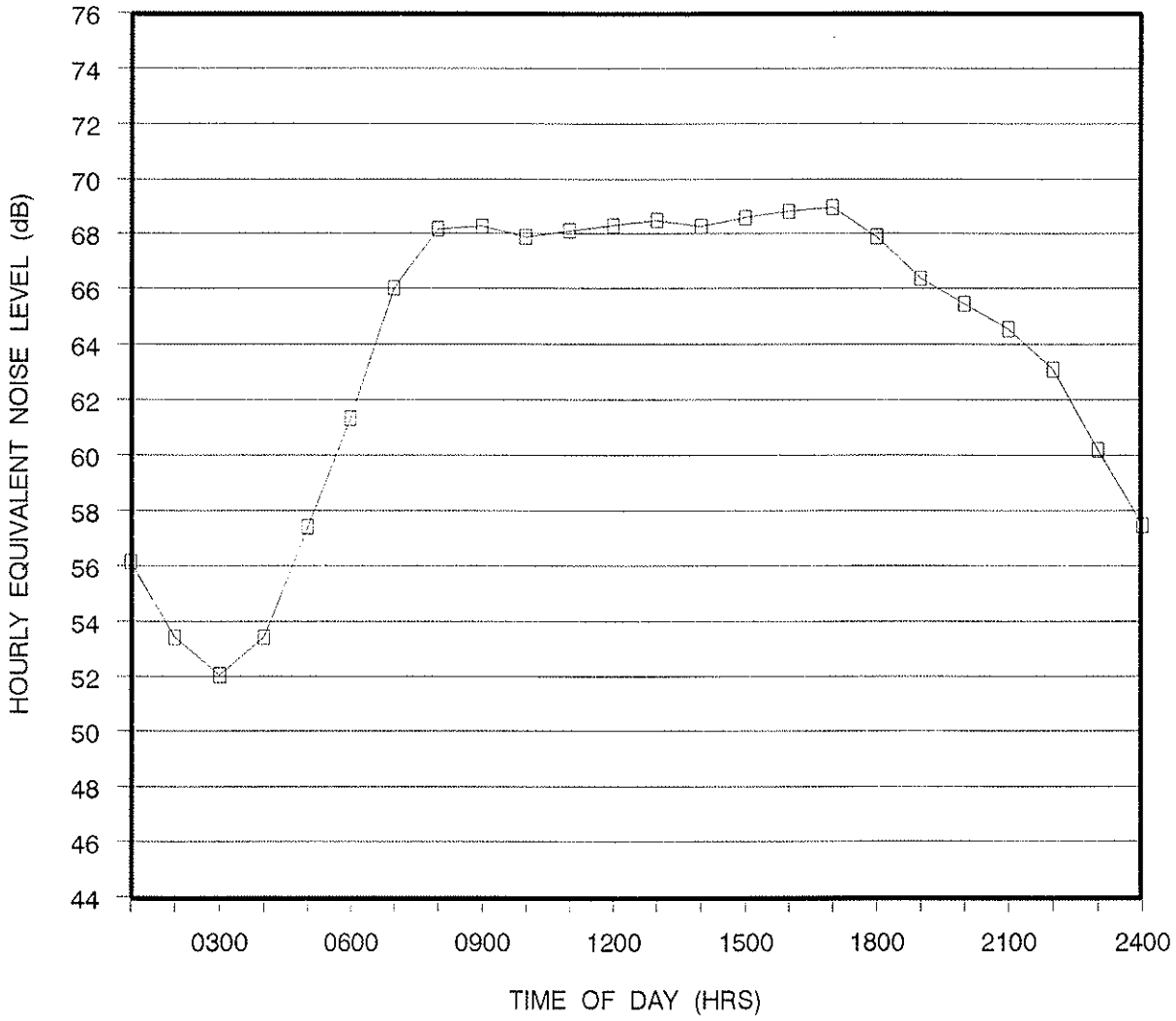


LOCATIONS OF NOISE MEASUREMENT SITES

FIGURE 4-1

FIGURE 4–2

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF KAPULE HIGHWAY SOUTH OF AHUKINI ROAD (SEPTEMBER 16, 2003)



□ 50 FT from Roadway Centerline (68.6 DNL)

FIGURE 4–3

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF KAPULE HIGHWAY NORTH OF AHUKINI ROAD (SEPTEMBER 15, 2003)

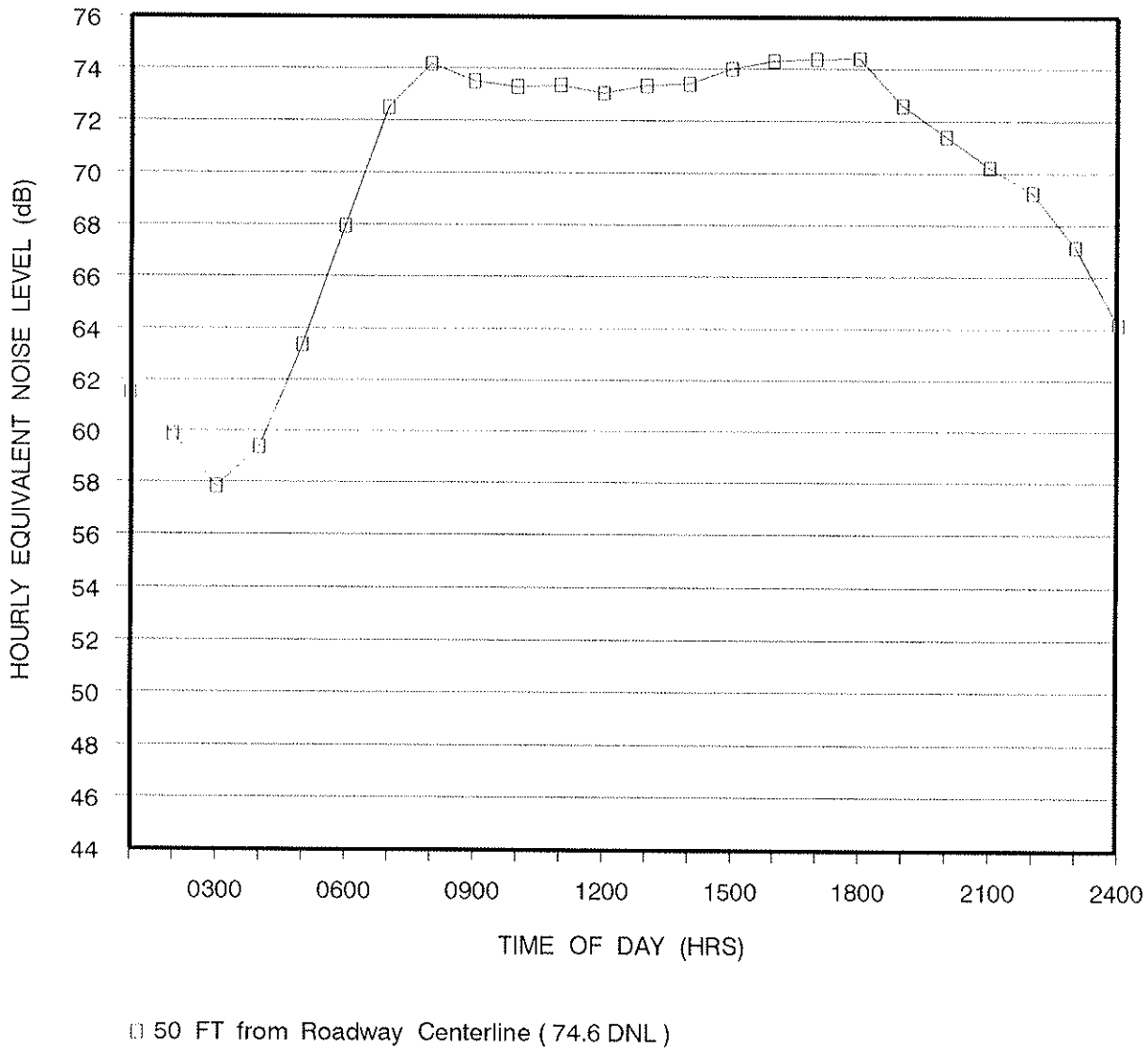
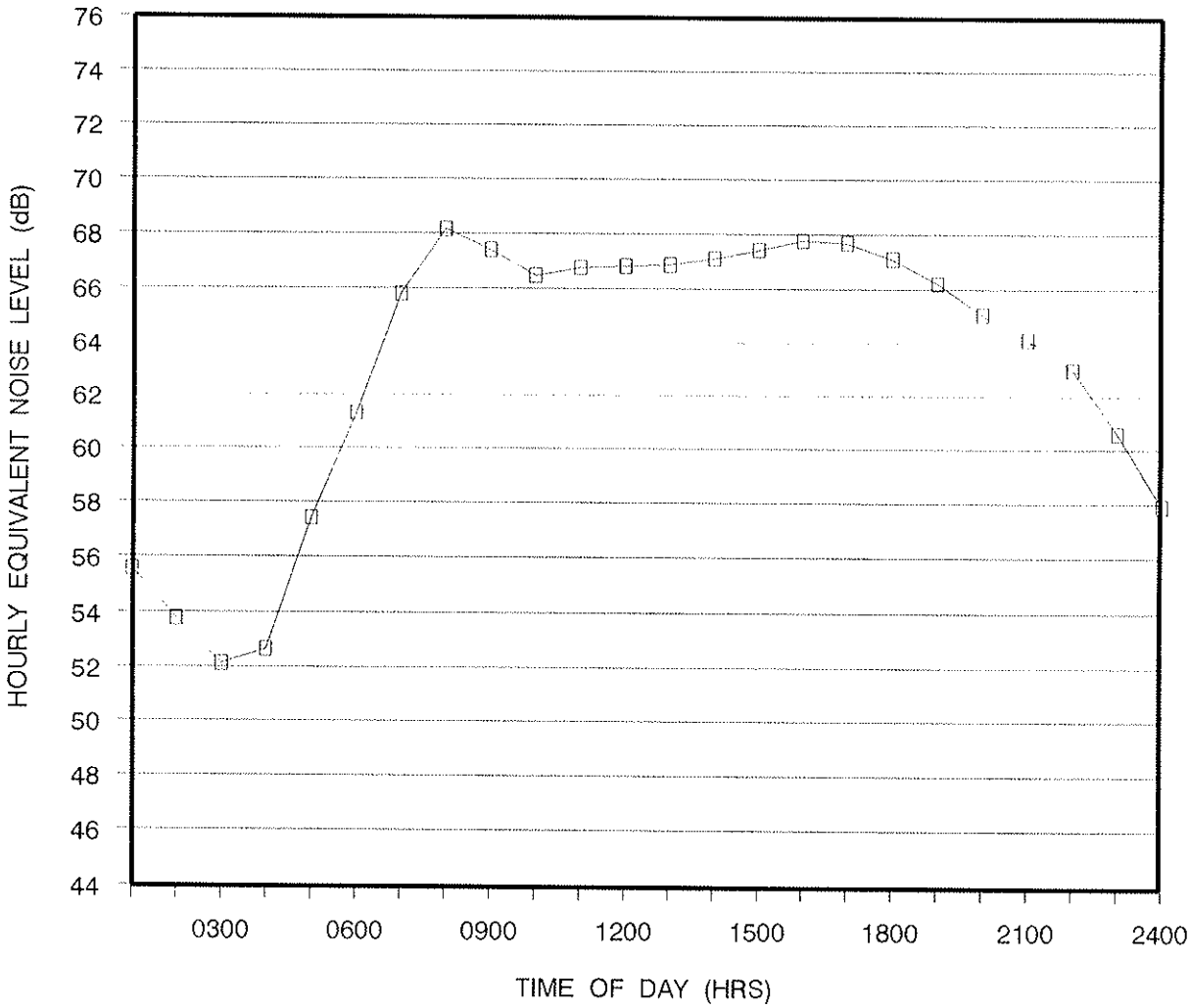


FIGURE 4–4

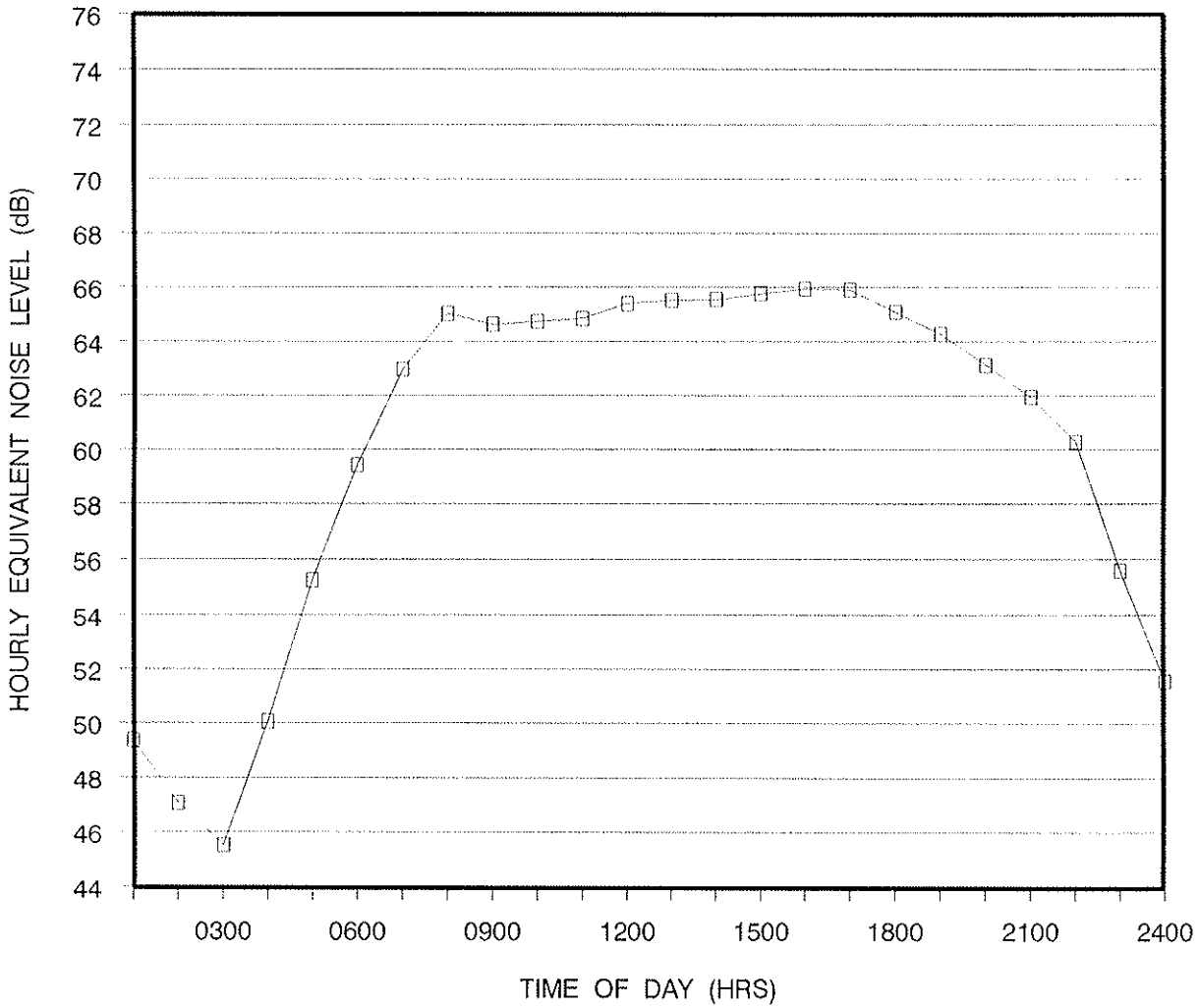
HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF KAPULE HIGHWAY EAST OF KUHIO HIGHWAY (SEPTEMBER 16, 2003)



□ 50 FT from Roadway Centerline (68.1 DNL)

FIGURE 4–5

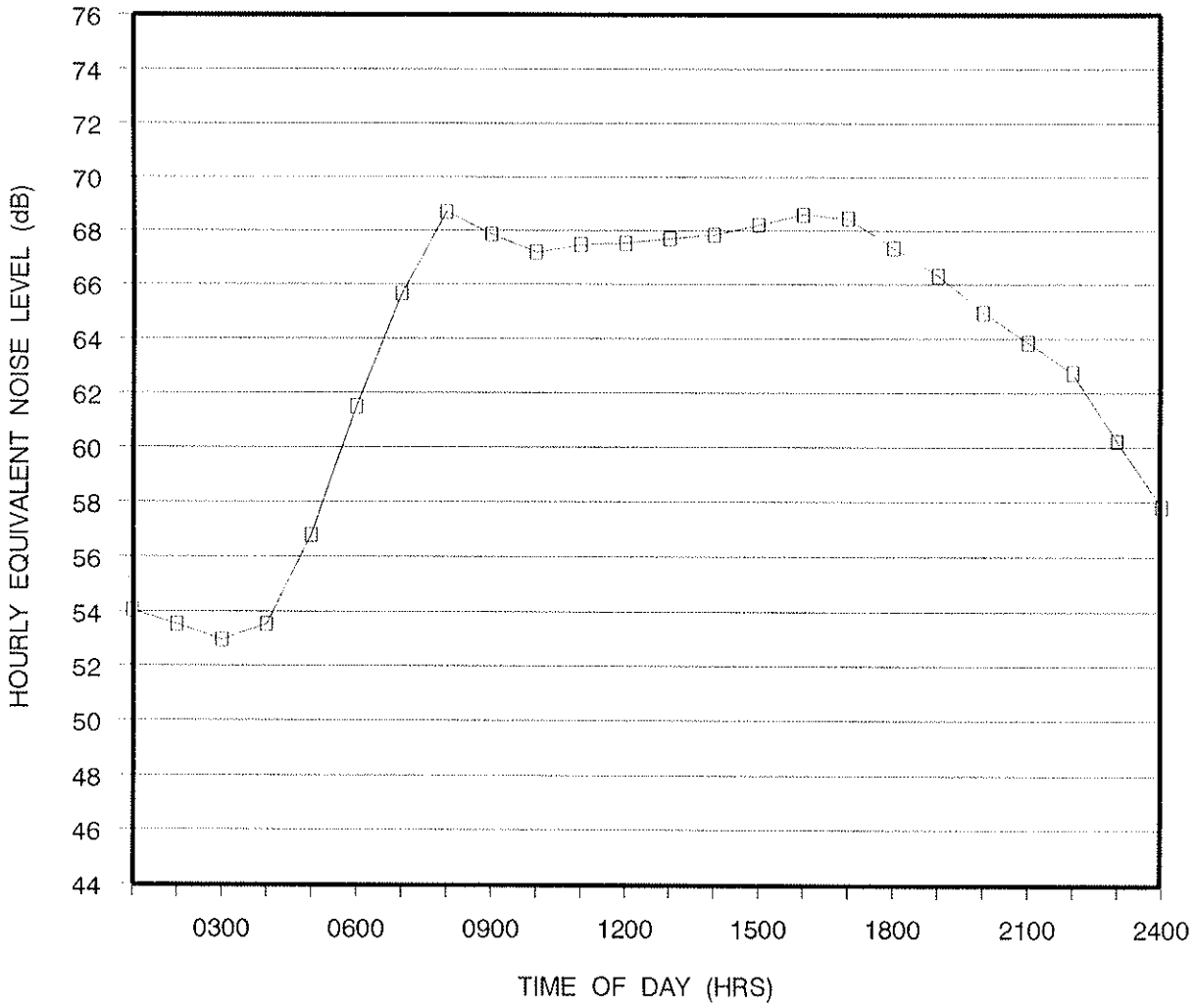
HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF AHUKINI ROAD EAST OF KUHIO HIGHWAY (SEPTEMBER 17, 2003)



□ 50 FT from Roadway Centerline (65.5 DNL)

FIGURE 4–6

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF AHUKINI ROAD WEST OF KAPULE HIGHWAY (SEPTEMBER 16, 2003)



□ 50 FT from Roadway Centerline (68.3 DNL)

TABLE 4-1

TRAFFIC NOISE MEASUREMENT RESULTS

LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	-------- Hourly Traffic Volume --------- AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
G2. 50 FT from the center-line of Ahukini Rd. east of Palai St. (4/3/06)	1431 TO 1531	50	897	27	14	68.5	68.6
V. 50 FT from the center-line of Kapule Hwy. (4/3/06)	1541 TO 1641	47	1,208	62	24	69.6	69.9
C2. 50 FT from the center-line of Kapule Hwy. (4/10/06)	1517 TO 1616	60	1,522	41	27	73.2	73.3
G2. 50 FT from the center-line of Ahukini Rd. east of Palai St. (4/11/06)	1520 TO 1620	55	918	26	7	69.6	69.7
V. 50 FT from the center-line of Kapule Hwy. (4/12/06)	1500 TO 1600	55	1,046	63	20	71.0	71.0
I. 50 FT from the center-line of Kapule Hwy. at Stadium (7/26/99)	0930 TO 1035	47	989	27	25	68.5	68.5

TABLE 4-1 (CONTINUED)

TRAFFIC NOISE MEASUREMENT RESULTS

LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	-------- Hourly Traffic Volume --------- AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
I. 50 FT from the center-line of Kapule Hwy. at Stadium (7/26/99)	1602 TO 1705	47	1,280	11	4	68.4	68.8
C. 50 FT from the center-line of Kapule Hwy. (7/27/99)	0847 TO 1001	55	1,067	37	17	71.6	70.7
L. 50 FT from the center-line of Kapule Hwy. (7/27/99)	1040 TO 1153	46	1,212	33	23	69.5	68.9
L. 50 FT from the center-line of Kapule Hwy. (7/27/99)	1607 TO 1721	46	1,677	12	5	68.8	69.4
G. 50 FT from the center-line of Ahukini Rd. at Palai St. (7/28/99)	0707 TO 0810	45	760	16	2	66.0	65.9
A. 50 FT from the center-line of Ahukini Rd. (7/28/99)	0840 TO 0943	50	579	14	4	66.2	66.3

TABLE 4-1 (CONTINUED)

TRAFFIC NOISE MEASUREMENT RESULTS

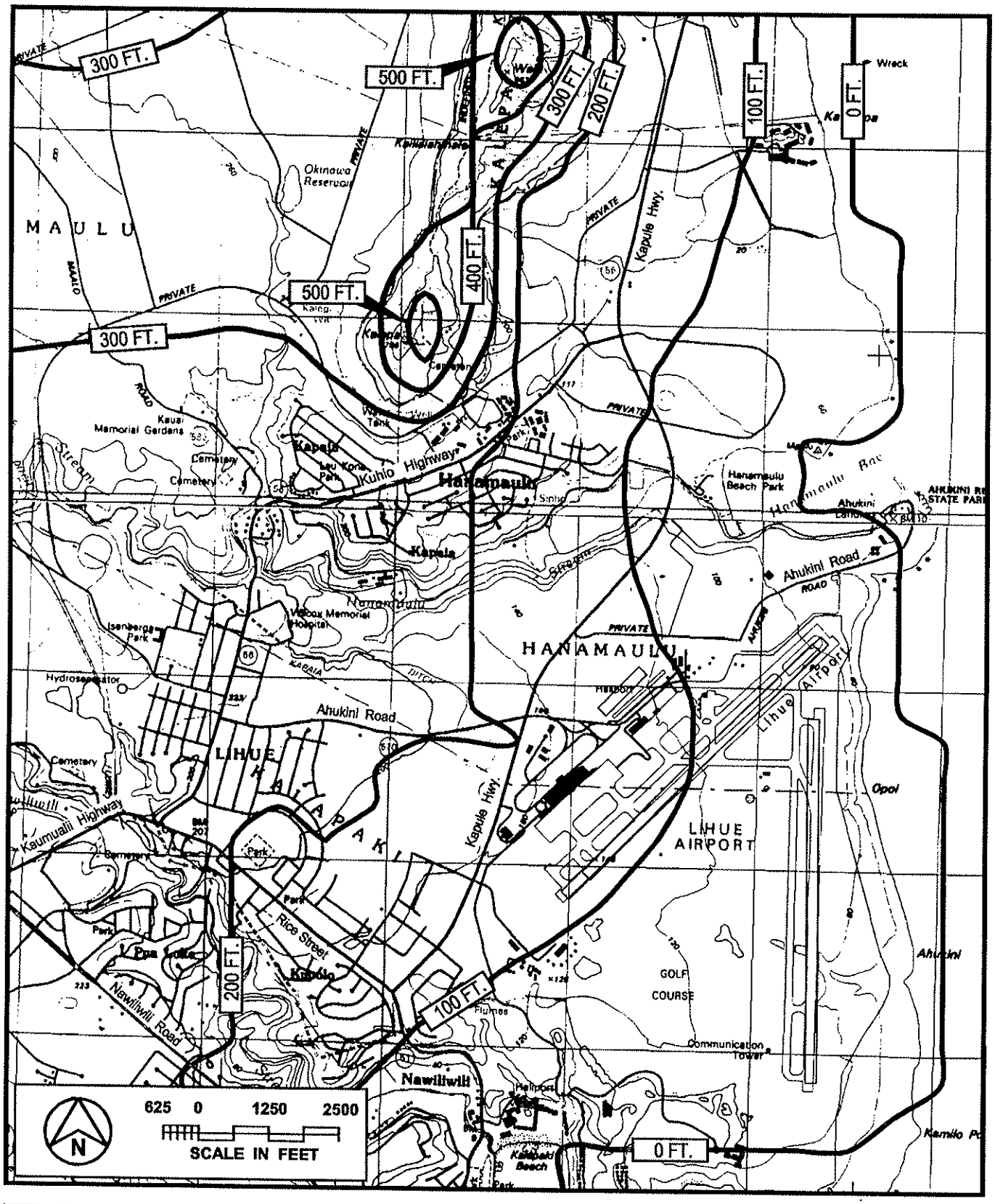
LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	-------- Hourly Traffic Volume --------- AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
G. 50 FT from the center-line of Ahukini Rd. at Palai St. (7/28/99)	1540 TO 1644	45	929	13	4	66.0	66.7
C. 50 FT from the center-line of Kapule Hwy. (7/28/99)	1700 TO 1823	55	1,293	11	8	70.9	70.9
A. 50 FT from the center-line of Ahukini Rd. (7/29/99)	1600 TO 1658	50	545	5	2	66.1	65.7

increase in existing traffic noise levels by 15 dBA was not applied on this project since all increases in future traffic noise levels were less than 5 dBA.

Aircraft Noise Analysis. The aircraft noise analysis was performed in accordance with FAA requirements (FAA Order 1050.1E, Reference 14) using DOTA land use compatibility guidelines contained in Table 3-2. The regulations governing the preparation of airport Environmental Impact Statements (FAA Order 1050.1E, June 8, 2004) and FAR Part 150 Airport Noise Compatibility Programs (14 CFR 150, January 1, 1995) require that noise contours be prepared using an approved computer model such as the Integrated Noise Model (INM) or an approved equivalent. The use of a model with wide public availability is intended to provide interested parties the opportunity to substantiate the results of the noise modeling. Version 6.1 of the Integrated Noise Model (Reference 15) [the most current FAA approved noise model available] was used to model aircraft noise and to construct the existing and future airport noise contours for Lihue Airport.

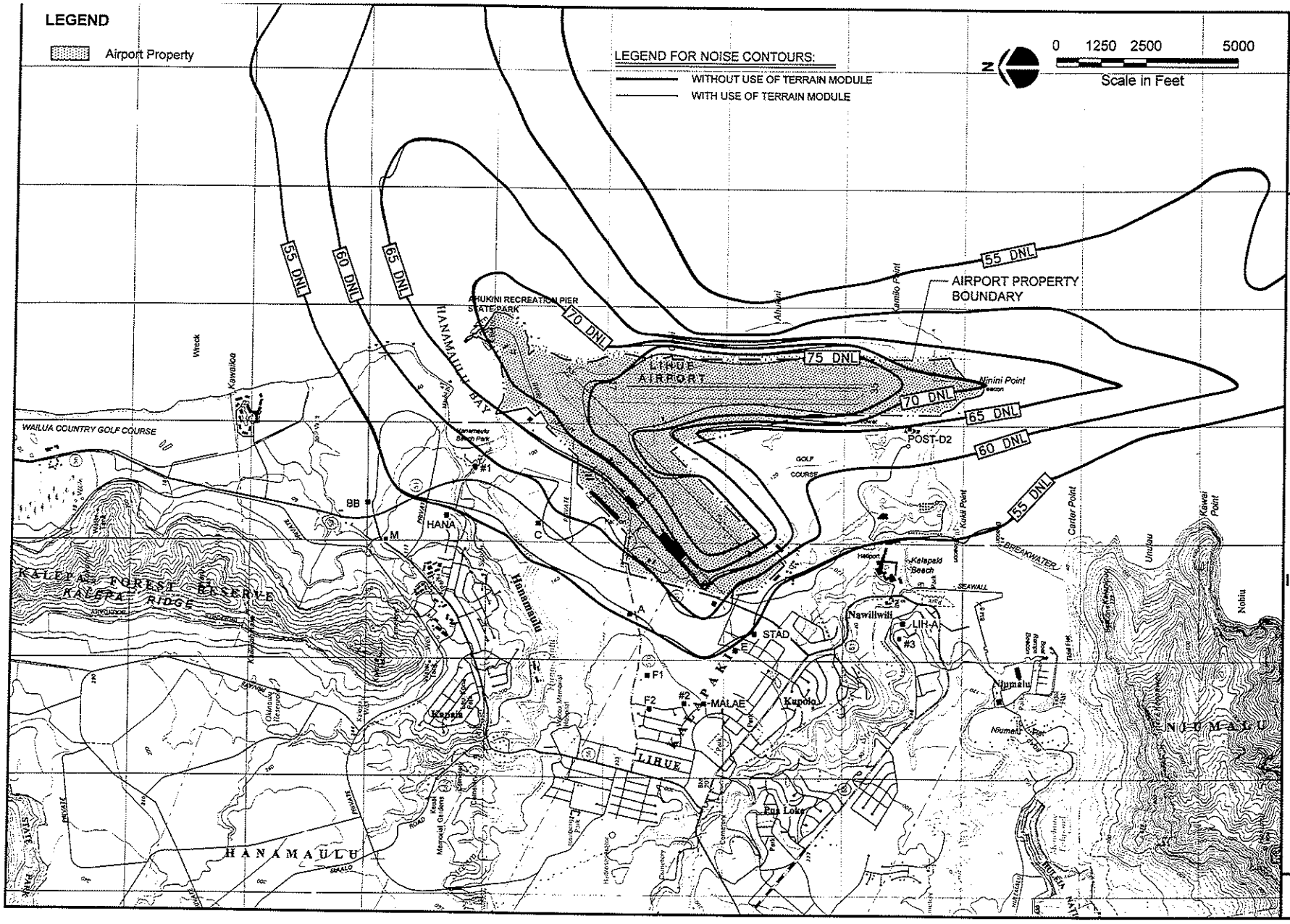
The INM contains its own data base of noise curves for fixed wing aircraft and a specific set of noise attenuation assumptions. Generalized procedures for calculating such things as excess sound attenuation effects from shielding (by aircraft fuselage, terrain, and man-made structures), ground interference effects when both receptor and aircraft are at or near ground level, and directional effects at rearward aspect angle from the aircraft during start-to-roll, are built into the model and are employed even when unusual circumstances might make it inappropriate to do so. Version 6.1 of the INM is also supplied with a limited capability to account for the effects of actual ground elevation and terrain features within the region covered by the noise contours. This feature ("Terrain") was evaluated for conditions at Lihue Airport, and was determined to not provide an accurate depiction of the terrain features surrounding Lihue Airport. A comparison of the FAA INM terrain assumptions with the actual topographic map of the area is shown in Figure 4-7. In addition, a comparison of the Year 2005 airport noise contours with and without use of the INM's Terrain Module (as shown in Figure 4-8) indicated that use of the INM's Terrain Module at Lihue Airport would result in an unusual "bump" in the 60 DNL noise contour west of the heliport. The 75 DNL contour in the sideline areas of Runway 17-35 was smaller with use of the Terrain Module. Because the modeling of terrain features in the Lihue Airport environs was not precise (see Figure 4-7), because the use of the Terrain Module did not seem to produce lower noise levels in the Hanamaulu Bay area, and because of the unusual "bump" in the 60 DNL contour produced by the Terrain Module near the heliport, the FAA INM's Terrain Module was not used in the development of the noise contours for Lihue Airport.

In order to determine if the aircraft noise curves incorporated in the INM Version 6.1 data base are representative of the B-717(200) and B-737(200) aircraft that operate at Lihue Airport (and control the size of the noise contours), the INM model's noise predictions were compared with a set of noise monitoring data of the aircraft measured



COMPARISONS OF TOPOGRAPHIC CONTOURS OF FAA INM 6.1'S "TERRAIN" MODULE WITH U.S.G.S. TOPOGRAPHIC MAP

FIGURE 4-7



Airports Division
DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII

LIHUE AIRPORT

COMPARISON OF 2005 AIRCRAFT NOISE CONTOURS WITH AND WITHOUT USE OF THE FAA INM TERRAIN MODULE

Prepared by:
WILSON OKAMOTO CORPORATION
ARIES CONSULTANTS LTD.
Y. EBISU & ASSOCIATES

FIGURE 4-8

at Lihue Airport in July and August 1999 and April 2006, as well as those reported in Reference 8. The locations of these monitoring stations are shown in Figure 4-1. The aircraft data from Lihue Airport were obtained at noise monitoring Sites HANA, STAD, POST-D2, MALAE, LIH-A, 1, 2, 3, A, BB, C, E, F1, F2, and M near Lihue Airport, and the measurement results are summarized in Tables 4-2 through 4-17. In the tables, the maximum (or Lmax) aircraft noise level during a flyby event, and the Sound Exposure Level (or Lse) of the noise events are shown, with the averages of the measured data also indicated. Included in the tables are the FAA INM Version 6.1 model predictions without the "Terrain" adjustment feature.

The INM does not have a data base of helicopter noise levels. Noise levels for helicopters in flight are normally entered into the INM as user defined noise levels. Except for areas directly under the helicopter ingress and egress routes and near the Lihue Airport 55 and 60 DNL contours, the noise contour levels at Lihue Airport are primarily controlled by fixed wing, interisland operations by B-717(200) and B-737(200) jet aircraft.

The inputs to the INM were developed for this study using aircraft noise measurements, visual observations of aircraft in flight, air carrier and commuter schedules, DOTA operational records, the aircraft operations contained in Reference 16, and historical weather data. Standard takeoff profiles included in the FAA INM Version 6.1 data base were used as inputs to the INM. For the purposes of approach noise modeling of fixed wing aircraft, a standard 3-degree approach glide slope was used. The methods and assumptions used in their derivation are described in earlier sections as well as in the remainder of this chapter.

A detailed analysis of wind conditions at Lihue Airport was performed during the 1989 FAR Part 150 study (Reference 8) to develop the runway use frequencies for the daytime and nighttime periods. Table 4-18 summarizes the results of this analysis with the daytime and nighttime wind direction and speed frequencies in relationship to each of the two runway orientations at Lihue Airport. The wind speeds at the seaward Runway 17-35 were estimated to be 2 knots greater than wind speeds at the inland Runway 3-21. This determination was made after comparing data from the old (pre-1983) anemometer location to the data from the current (post-1983) anemometer location.

The daytime and nighttime periods used in the wind data analysis did not correspond exactly to the periods used in DNL calculations because the time increments during which the historical wind data were averaged differed from the 7:00 AM to 10:00 PM start and stop times of the DNL descriptor. Nevertheless, the results of the wind data analysis shown in Table 4-18 indicated that the runway use frequencies at Lihue Airport are probably as follows:

- During the daytime hours of 7:00 AM to 10:00 PM, Runway 35 is used for landings approximately 84.4 percent of the time. Runway 3 is used in lieu of

TABLE 4-2

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "HANA" (APRIL 2006)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-717(200) (RWY 3 DEP.)	61.3; (AVE.=61.3)	71.8; (ENERGY AVE.=71.8; PRED.=70.6)
B-737(200) (RWY 3 DEP.)	65.7; 80.0; 77.0; 78.2; (AVE.=75.2)	73.3; 85.4; 83.5; 84.7; (ENERGY AVE.=83.5; PRED.=86.2)
B-757(200) (RWY 3 DEP.)	72.6; 77.1; 66.6; 72.3; (AVE.=72.2)	74.8; 82.5; 72.5; 78.6 (ENERGY AVE.=78.7; PRED.=73.6)
HELICOPTER (LANDING)	63.6; 73.3; 71.7; 70.9; 71.1; 72.1; 72.6; 66.8; 72.0; 71.5; 74.5; 74.4; 73.0; 71.0; 68.7; 69.6; 69.7; 70.9; 69.6; 73.9; 71.0; 71.8; 75.6; 71.8; 67.6; 72.4; 69.1; 67.8; 71.3; 71.0; 71.7; 74.1; 72.8; 79.1; 74.2; 71.0; 75.1; 73.0; 73.6; 75.8; 69.8; 70.5; 68.5; 74.0; 72.7; (AVE.=71.7)	79.5; 83.0; 78.9; 74.2; 75.5; 80.2; 80.9; 74.2; 78.3; 77.4; 79.6; 82.8; 75.8; 78.6; 71.7; 77.9; 75.4; 75.7; 70.3; 80.9; 75.5; 73.7; 82.7; 77.3; 76.8; 80.6; 80.2; 74.6; 80.3; 82.4; 80.7; 82.0; 82.8; 83.5; 83.2; 78.2; 81.9; 81.4; 82.0; 81.6; 79.0; 79.1; 77.3; 81.6; 81.5; (ENERGY AVE.=79.9; PRED.=82.2)
C-130 (LANDING)	57.1; (AVE.=57.1)	63.5; (ENERGY AVE.=63.5; PRED.=53.7)
C-130 (TAKEOFF)	65.9; 63.4; 62.5; (AVE.=63.9)	72.5; 70.1; 68.0; (ENERGY AVE.=70.6; PRED.=80.0)
C-130 (TOUCH & GO)	56.6; (AVE.=56.6)	64.3; (ENERGY AVE.=64.3; PRED.=81.2)

TABLE 4-3

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "STAD" (APRIL 2006)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-717(200) (RWY 3 DEP.)	68.3; 69.5; 62.6; 64.3; 67.7; 63.7; (AVE.=66.0)	76.1; 74.3; 67.0; 74.4; 76.8; 70.0; (ENERGY AVE.=74.2; PRED.=75.1)
B-737(200) (RWY 3 DEP.)	84.4; 87.3; 83.0; 84.8; 81.3; 82.0; (AVE.=83.8)	92.6; 93.3; 92.4; 92.6; 89.4; 90.7; (ENERGY AVE.=92.0; PRED.=90.7)
B-757(200) (RWY 3 DEP.)	75.5; 76.7; 74.8; (AVE.=75.7)	80.4; 84.1; 83.4; (ENERGY AVE.=82.9; PRED.=78.0)
HELICOPTER (LANDING)	61.3; 78.2; 63.2; 64.7; 66.8; 65.6; (AVE.=66.6)	69.5; 84.3; 70.7; 71.5; 72.3; 70.2; (ENERGY AVE.=77.4; PRED.=59.8)
HELICOPTER (TAKE OFF)	68.0; 64.6; 82.6; 64.1; (AVE.=69.8)	75.9; 71.7; 91.4; 70.0; (ENERGY AVE.=85.6; PRED.=65.8)
HELICOPTER (FLY BY)	70.5; (AVE.=70.5)	77.5; (ENERGY AVE.=77.5; PRED.=65.8)
DHC-8 (2 ENG.PROP.)	74.9; 74.8; (AVE.=74.9)	80.5; 78.8; (ENERGY AVE.=79.7; PRED.=90.7)

TABLE 4-4

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "POST-D2" (APRIL 2006)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-717(200) (RWY 3 DEP.)	66.0; (AVE.=66.0)	70.5; (ENERGY AVE.=70.5; PRED.=67.0)
B-717(200) (RWY 35 LAND.)	65.1; 68.8; 65.3; 69.2; (AVE.=67.1)	73.0; 74.3; 73.4; 74.6; (ENERGY AVE.=73.9; PRED.=74.0)
B-737-(200) (RWY 3 DEP.)	70.5; 66.5; 68.6; 68.1; 73.5; (AVE.=69.4)	76.9; 69.1; 77.6; 74.5; 79.4; (ENERGY AVE.=76.6; PRED.=83.0)
B-737-(200) (RWY 35 LAND.)	73.5; 67.8; 81.5; (AVE.=74.3)	78.8; 73.4; 84.7; (ENERGY AVE.=81.2; PRED.=82.2)
B-757-(200) (RWY 35 LAND.)	74.0; 71.2; 69.8; (AVE.=71.7)	80.2; 78.2; 78.1; (ENERGY AVE.=78.9; PRED.=74.0)
HELICOPTER (TAKE OFF)	71.7; 73.6; 72.3; 71.9; 70.2; 71.2; 66.5; 69.2; 67.0; 72.3; 64.7; 76.5; 69.5; 66.7; 74.0; 68.9; 69.0; 71.2; 72.2; 65.4; 73.7; 72.5; 70.2; 71.0; 69.8; 70.1; 71.3; 71.1; 69.6; 70.0; 72.2; 70.5; 72.8; 69.6; 70.6; 66.8; 71.6 (AVE.=70.5)	80.0; 81.4; 81.2; 78.7; 79.3; 78.2; 76.7; 76.1; 78.0; 81.1; 72.0; 80.8; 77.7; 76.4; 82.2; 79.0; 78.1; 77.9; 78.7; 73.3; 81.2; 79.2; 79.2; 79.6; 78.3; 78.4; 80.6; 77.9; 78.8; 77.8; 80.2; 77.5; 80.9; 78.9; 79.3; 74.7; 79.3 (ENERGY AVE.=79.1; PRED.=80.6)
HELICOPTER (FLYBY)	69.7; 69.7; 66.3; (AVE.=68.6)	77.3; 78.4; 76.3; (ENERGY AVE.=77.4; PRED.=80.6)
GA-1 (RWY 3 LAND.)	73.3; 64.3; (AVE.=68.8)	80.3; 66.8; (ENERGY AVE.=77.5; PRED.=52.5)
GA-1 (TAKE OFF)	58.5; 63.2; 66.7; 67.2; 62.8; (AVE.=63.7)	66.2; 71.6; 73.6; 77.8; 70.0; (ENERGY AVE.=73.5; PRED.=53.0)
DHC-8 (RWY 35 LAND.)	68.0; 62.3; (AVE.=65.2)	74.4; 70.9; (ENERGY AVE.=73.0; PRED.=67.6)
C-130 (TOUCH & GO)	77.3; 75.5; 75.0; (AVE.=75.9)	81.9; 81.6; 81.0; (ENERGY AVE.=81.5; PRED.=80.3)

TABLE 4-5

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "1" (APRIL 2006)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-717(200) (RWY 3 DEP.)	68.5; 70.3; 64.2; 72.3; 70.3; (AVE.=69.1)	75.2; 75.8; 68.8; 79.7; 75.1; (ENERGY AVE.=76.1; PRED.=75.7)
B-737(200) (RWY 3 DEP.)	85.1; 87.2; 85.0; 87.5; (AVE.=86.2)	93.5; 91.5; 91.3; 93.5; (ENERGY AVE.= 92.6; PRED.=91.3)
B-757(200) (RWY 3 DEP.)	78.1; 75.9; 79.0; (AVE.=77.7)	82.3; 79.8; 85.8; (ENERGY AVE.=83.3; PRED.=79.0)
DHC-8 (RWY 3 DEP.)	65.2; (AVE.=65.2)	73.8; (ENERGY AVE.=73.8; PRED.=68.4)
C-130 (RWY 35 DEP.)	76.0; 80.0; 73.3; (AVE.=76.4)	83.6; 84.0; 79.8; (ENERGY AVE.=82.8; PRED.=86.0)
HELICOPTER (DEP.)	80.7; (AVE.=80.7)	86.3; (ENERGY AVE.=86.3; PRED.=80.5)
HELICOPTER (LANDING)	81.9; 77.2; 80.8; 76.4; 81.8; 85.0; 79.3; 78.3; 79.8; 80.7; 81.9; 81.0; 82.6; 83.4; 75.7; 78.0; 79.0; 81.5; 81.1; 78.5; 76.6; 63.9; 78.3; 78.5; 78.1; 84.6; 83.2; 74.2; 75.4; 75.8; 77.4; 78.0; 75.0; 80.8; 83.0; 75.7; 76.3; 75.9; 76.9; 76.1; (AVE.=78.7)	88.3; 84.9; 86.6; 84.7; 85.2; 89.0; 86.7; 84.6; 84.0; 86.7; 87.0; 85.7; 87.9; 87.9; 82.6; 84.0; 86.5; 86.4; 87.4; 85.3; 84.1; 70.7; 84.2; 84.5; 85.3; 88.1; 89.1; 82.7; 81.5; 81.1; 82.2; 82.9; 81.9; 85.0; 87.8; 82.3; 83.3; 83.9; 83.9; 82.7; (ENERGY AVE.=85.5; PRED.=85.4)

TABLE 4-6

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "MALAE" (APRIL 2006)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-717(200) (RWY 3 DEP.)	60.9; 60.9; (AVE.=60.9)	72.7; 67.7; (ENERGY AVE.=70.9; PRED.=69.6)
B-717(200) (RWY 35 LAND.)	61.8; 60.4; (AVE.=61.1)	66.1; 66.7; (ENERGY AVE.=66.4; PRED.=47.4)
B-737(200) (RWY 3 DEP.)	77.4; 57.5; 81.1; 59.9; 86.0; 82.7 (AVE.=72.4)	83.2; 62.6; 87.8; 67.1; 88.0; 86.8; (ENERGY AVE.=85.1; PRED.=85.8)
B-737(200) (RWY 35 LAND.)	62.7; 61.0; (AVE.=61.9)	70.3; 67.5; (ENERGY AVE.=69.1; PRED.=55.8)
B-757(200) (RWY 3 DEP.)	61.5; 66.5; 69.1; (AVE.=65.7)	68.5; 73.6; 75.0; (ENERGY AVE.=73.1; PRED.=72.5)
DHC-8 (RWY 3 DEP.)	62.3; 59.1; (AVE.=60.7)	67.7; 67.3; (ENERGY AVE.=67.5; PRED.=61.5)
DHC-8 (RWY 3 LAND.)	67.0; 61.3; (AVE.=64.2)	71.8; 66.4; (ENERGY AVE.=69.9; PRED.=52.5)
GA-1 (RWY 3 DEP.)	58.9; 60.6; 66.2; (AVE.=61.9)	69.6; 68.1; 71.4; (ENERGY AVE.=69.9; PRED.=54.0)
GA-1 (RWY 3 LAND.)	63.1; 57.7; 60.2; 59.6; (AVE.=60.2)	65.6; 64.2; 65.7; 66.4; (ENERGY AVE.=65.5; PRED.=50.2)
HELICOPTER (DEP.)	66.6; 66.6; 60.9; 62.0; 59.6; 59.5; 53.6; 61.2; 60.6; 58.2; 61.6; 63.8; 62.6; 61.2; 59.6; 58.1; 62.6; 62.3; 62.5; 63.3; 62.8; 62.4; 60.9; (AVE.=61.4)	75.1; 73.1; 71.0; 69.3; 64.2; 67.0; 62.8; 68.7; 68.7; 65.7; 66.1; 67.1; 71.4; 68.1; 68.4; 65.4; 68.5; 69.9; 67.1; 67.1; 68.2; 67.7; 66.2; (ENERGY AVE.=69.1; PRED.=60.5)
HELICOPTER (LANDING)	76.2; 62.9; 63.9; 60.8; 61.1; 57.1; 53.0; 66.2; 57.5; 59.9; 66.0; 57.8; 60.4; 60.3; 61.9; 67.5; 62.9; 58.0; 60.3; (AVE.=61.8)	85.4; 71.4; 70.5; 67.9; 70.5; 65.8; 61.1; 71.0; 63.8; 67.0; 71.9; 68.4; 66.5; 68.3; 69.1; 71.3; 69.2; 63.3; 68.1; (ENERGY AVE.=74.1; PRED.=59.8)

TABLE 4-7

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "LIH-A" (APRIL 2006)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-717(200) (RWY 35 LAND.)	60.0; 60.6; 73.1; 59.9; 63.8 (AVE.=63.5)	67.7; 66.9; 80.5; 68.7; 66.2; (ENERGY AVE.=74.3; PRED.=50.8)
B-737(200) (RWY 3 DEP.)	72.4; 78.4; 69.2; 73.8; (AVE.=73.5)	78.2; 83.0; 74.3; 78.6; (ENERGY AVE.= 79.6; PRED.=77.3)
B-737(200) (RWY 35 LAND.)	62.5; 60.9; 59.4; (AVE.=60.9)	63.5; 62.8; 65.6; (ENERGY AVE.= 64.1; PRED.=60.2)
B-757(200) (RWY 3 DEP.)	59.7; (AVE.=59.7)	64.7; (ENERGY AVE.=64.7; PRED.=63.8)
B-757(200) (RWY 3 LAND.)	58.1; 59.2; 57.8; (AVE.=58.4)	64.4; 66.6; 63.4; (ENERGY AVE.=65.0; PRED.=54.9)
GA-1 (RWY 3 DEP.)	73.7; 55.5; (AVE.=64.6)	79.3; 61.4; (ENERGY AVE.=76.4; PRED.=46.1)
GA-1 (RWY 3 LAND.)	80.4; 76.1; 78.4; 61.8; (AVE.=74.2)	86.8; 80.0; 85.5; 66.4; (ENERGY AVE.=83.7; PRED.=75.4)
DHC-8 (RWY 3 LAND.)	61.9; 80.2; (AVE.=71.1)	65.4; 86.5; (ENERGY AVE.=83.5; PRED.=80.5)
HELICOPTER (DEP.)	62.6; 58.4; 66.7; 65.4; 70.2; 64.1; 59.9; 64.5; 62.4; 61.2; 60.3; 62.2; 65.1; 62.7; 64.2; 59.5; 58.8; 61.0; 60.6; 63.8; 65.9; 60.6; 62.3;,60.9; 62.9; 62.9; 68.2; 65.8; 59.5; 62.0; 67.0; (AVE.=63.0)	67.4; 68.2; 70.6; 67.6; 75.3; 73.9; 64.1; 69.1; 67.3; 69.3; 68.8; 67.9; 68.5; 66.1; 69.5; 65.7; 63.4; 65.0; 64.1; 67.3; 70.0; 63.7; 62.8; 65.9; 67.2; 67.8; 72.0; 66.6; 65.1; 63.6; 69.9; (ENERGY AVE.=68.7; PRED.=73.1)
DHC-8 (RWY 3 DEP.)	61.9; (AVE.=61.9)	65.7; (ENERGY AVE.=65.7; PRED.=53.5)
C-130 (RWY 35 LAND.)	64.2; 56.7; (AVE.=60.5)	66.8; 62.8; (ENERGY AVE.=65.2; PRED.=56.7)

TABLE 4-8

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "1" (1999)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200) (RWY 3 DEP.)	85.0; 87.8; 84.9; 82.2; 85.1; 80.8; 84.1; 82.8 ;86.3; 83.7 (AVE.=84.3)	90.7; 91.4; 90.5; 88.8; 90.0; 87.6; 90.1; 88.6; 90.7; 89.3 (ENERGY AVE.=89.9; PRED.=91.5)
DC-9(50) (RWY 3 DEP.)	90.8; 87.5; 86.4; 84.9; 85.8; 87.7 (AVE.=87.1)	95.2; 91.7; 91.3; 91.9; 88.1; 92.4 (ENERGY AVE.=92.2; PRED.=94.0)
HELICOPTER (LANDING)	76.6; 74.0; 75.5; 76.96; 72.2; 77.3; 73.1; 76.8 (AVE.=75.3)	81.8; 79.3; 82.2; 84.2; 78.0; 84.5; 78.3; 83.1 (ENERGY AVE.=82.0; PRED.=85.3)

TABLE 4-9

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "2" (1999)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200) (RWY 3 DEP.)	82.5; 87.7*; 84.2*; 79.8; 76.6; 81.6; (AVE.=82.1)	90.0; 94.9*; 91.3*; 85.9; 83.5; 87.7; (ENERGY AVE.=90.4; PRED.=85.5)
B-737(200) (LANDING)	62.9; 72.6*; 64.7 (AVE.=66.7)	67.2; 77.4*; 70.3 (ENERGY AVE.=73.7; PRED.=53.4)
DC-9(50) (RWY 3 DEP.)	88.6*; 94.4*; 83.4; 81.0; 81.1; 80.8 (AVE.=84.9)	94.4*; 98.2*; 91.2; 86.9; 86.8; 87.4 (ENERGY AVG.=93.1; PRED.=88.5)
DC-9(50) (LANDING)	64.0; 70.4*; 53.4 (AVE.=62.6)	70.1; 78.4*; 61.5 (ENERGY AVE.=74.3; PRED.=53.6)
HELICOPTER (LANDING)	52.8; 61.3; 52.8; 55.1; 69.1**; 54.7; 52.9 (AVE.=57.0)	60.2; 67.8; 60.5; 64.7; 75.7**; 63.6; 66.1 (ENERGY AVE.=68.9; PRED.=60.0)

Notes:

* High sound levels probably due to thermal ducting between 6:30 and 7:30 am on August 13, 1999.
** High sound level due to overlfight of noise measurement location.

TABLE 4-10

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "3" (1999)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200) (RWY 3 DEP.)	73.8; 73.5; 74.2; 79.0; 79.3; 79.2; 77.7 (AVE.=76.7)	80.5; 80.6; 81.5; 85.9; 85.6; 86.1; 83.7 (ENERGY AVE.=84.0; PRED.=78.4)
B-737(200) (LANDING)	62.4; 60.3 (AVE.=61.4)	68.5; 72.1 (ENERGY AVE.=70.7; PRED.=60.7)
DC-9(50) (RWY 3 DEP.)	78.1; 78.5; 86.0 ;77.9; 75.3; 77.6 (AVE.=78.9)	86.4; 84.9; 89.4; 85.7; 84.4; 85.5 (ENERGY AVE.=86.4; PRED.=81.4)
DC-9(50) (LANDING)	61.6; 63.1 (AVE.=62.4)	68.8; 71.9 (ENERGY AVE.=70.6; PRED.=59.7)
HELICOPTER (DEPARTURES)	66.0; 65.0; 59.0; 62.6; 65.4; 60.9; (AVE.=63.2)	65.6; 72.5; 66.4; 69.4; 70.9; 71.9; (ENERGY AVE.=70.2; PRED.=74.0)

TABLE 4-11

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "A" (1999)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200) (RWY 3 DEP.)	74.3; 78.4; 77.7; 80.7; 77.8; 73.6; 76.5; 81.1 (AVE.=77.5)	83.5; 83.8; 87.6; 86.5; 85.0; 83.7; 82.0; 89.1 (ENERGY AVE.= 85.8; PRED.=88.6)
B-737(300) (RWY 3 DEP.)	69.9; 69.1 (AVE.=69.5)	76.0; 76.5 (ENERGY AVE.=76.3; PRED.=79.1)
DC-9(50) (RWY 3 DEP.)	81.5; 79.4; 81.1; 81.9; 82.4; 83.8; 80.1 (AVE.=81.5)	89.2; 87.5; 90.0; 89.8; 87.9; 90.1; 88.6 (ENERGY AVE.=89.1; PRED.=91.8)
HELICOPTER (LANDING)	67.3; 73.1; 78.7; 67.8; 68.4; 68.0; 67.9; 75.8; 70.3; 69.1; 72.0; 67.7; 68.0; 68.4; 68.5; 69.5; 65.9; 72.3; 66.4; 66.7; 67.5; 65.4; 69.8; 68.2; 68.0; 66.1; 68.4; 67.6; 68.4; 70.1; 66.6; 71.3; 69.0; 66.6; 70.9; 69.7; 66.0; 64.4; 67.7; 72.8; 67.9; 72.9; 71.4; 67.7; 65.1; 69.0 (AVE.=68.9)	74.7; 77.4; 73.9; 71.4; 74.3; 75.6; 74.1; 83.7; 72.5; 74.2; 76.8; 72.6; 74.2; 73.1; 72.7; 71.4; 73.0; 77.6; 71.9; 72.9; 71.7; 74.5; 76.7; 71.8; 76.9; 74.7; 71.1; 69.3; 72.7; 72.7; 71.0; 75.3; 73.4; 75.0; 76.1; 75.8; 74.8; 72.6; 71.8; 76.7; 70.5; 74.9; 76.2; 74.8; 71.8; 75.6 (ENERGY AVE.=75.0; PRED.=73.6)

TABLE 4-12

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "BB" (1999)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200) (RWY 3 DEP.)	75.9	81.4 (PRED.=84.2)
B-737(300) (RWY 3 DEP.)	69.9	78.7 (PRED.=78.5)
DC-9(50) (RWY 3 DEP.)	81.6; 77.7 (AVE.=79.7)	86.5; 83.8 (ENERGY AVE.=85.4; PRED.=87.3)
HELICOPTER (LANDING)	74.8; 73.9; 74.2; 74.6; 72.6; 74.4; 75.6; 75.6; 72.7; 75.9; 69.2; 68.6; 76.9 (AVE.=73.8)	81.2; 82.2; 81.2; 81.5; 81.2; 81.3; 84.0; 83.6; 81.5; 82.6; 79.7; 76.5; 82.7 (ENERGY AVE.=81.8; PRED.=73.6)

TABLE 4-13

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "C" (1999)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200) (RWY 3 DEP.)	76.5; 81.2; 78.7; 81.0 (AVE.=79.4)	85.5; 86.9; 87.4; 85.3 (ENERGY AVE.=86.4; PRED.=88.2)
B-737(300) (RWY 3 DEP.)	67.6; 74.4 (AVE.=71.0)	76.5; 80.5 (ENERGY AVE.=78.9; PRED.=71.7)
DC-9(50) (RWY 3 DEP.)	81.9; 79.3; 81.7; 84.0; 79.8 (AVE.=81.3)	85.9; 87.6; 88.7; 89.9; 88.1 (ENERGY AVE.=88.2; PRED.=90.3)
HELICOPTER (LANDING)	85.8; 77.8; 86.6; 78.7; 78.3; 73.2; 76.6; 78.0; 75.7; 73.9; 83.1; 79.4; 73.2; 81.2; 77.3; 82.0; 90.6; 79.9; 76.7; 82.9; 76.1; 77.5; 73.6; 79.9; 79.9; 83.0; 78.6; 83.0; 80.3; 82.8; 78.2; 80.1; 75.8; 73.7; 77.3; 78.3; 88.1; 80.6; 79.2; 81.2; 75.2; 75.6; 77.7; 77.7; 80.5; 74.3; 74.9; 79.6; 78.3 (AVE.=79.0)	89.4; 85.2; 92.6; 87.8; 85.5; 78.5; 82.0; 83.9; 82.9; 77.6; 88.9; 85.4; 82.0; 88.1; 83.6; 88.4; 93.8; 86.3; 84.3; 88.8; 83.3; 84.8; 80.5; 85.8; 86.0; 89.6; 84.6; 86.6; 86.3; 88.3; 84.4; 86.2; 84.2; 80.0; 84.3; 85.5; 91.0; 84.6; 84.8; 87.8; 84.0; 82.9; 84.1; 84.6; 85.1; 81.7; 83.2; 86.6; 83.3 (ENERGY AVE.=86.5; PRED.=88.9)

TABLE 4-14

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "E" (1999)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200) (RWY 3 DEP.)	85.2; 81.0; 82.1; 87.6; 90.4; 88.7; 84.5; 86.0; 88.5; 86.4; 83.2; 79.8; 82.2; 89.1; 85.9; 87.3; 89.4; 87.5 (AVE.=85.8)	91.0; 95.3; 90.6; 91.9; 95.4; 96.0; 93.4; 94.2; 96.7; 93.6; 91.5; 88.9; 89.2; 93.2; 95.2; 93.5; 95.1; 96.1 (ENERGY AVE.=93.9; PRED.=90.4)
B-737(200) (LANDING)	62.8; 76.5; 68.9; 65.0; 64.2 (AVE.=67.5)	70.5; 78.6; 73.4; 68.9; 75.8 (ENERGY AVE.=74.8; PRED.=57.4)
DC-9(50) (RWY 3 DEP.)	84.8; 88.8; 88.4; 95.6; 85.0; 90.5 93.0; 84.9; 84.4; 89.3; 90.3; 86.0 (AVE. =88.4)	92.2; 92.5; 97.5; 99.8; 95.1; 96.1 97.5; 89.8; 94.3; 97.2; 97.5; 96.2 (ENERGY AVE.=96.2; PRED.=93.1)
DC-9(50) (LANDING)	64.5; 62.4; 68.4 (AVE.=65.1)	69.4; 71.8; 77.2 (ENERGY AVE.=74.1; PRED.=57.4)
HELICOPTER (LANDING)	60.1; 62.3; 57.3; 58.4; 57.1; 63.4; 59.3 (AVE.=59.7)	66.7; 70.3; 64.5; 65.6; 64.9; 72.8; 65.3 (ENERGY AVE.=68.3; PRED.=59.5)

TABLE 4-15

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "F1" (1999)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200) (RWY 3 DEP.)	77.1; 78.7; 74.7; 72.0; 75.5; 74.7 77.9; 78.2 (AVE.= 76.1)	84.3; 84.5; 81.9; 81.1; 84.8; 82.4 84.2; 86.7 (ENERGY AVE.=84.1; PRED.=86.3)
B-737(300) (RWY 3 DEP.)	66.2	74.5 (PRED.= 75.0)
DC-9(50) (RWY 3 DEP.)	83.5; 78.0; 78.0; 74.3; 80.9; 77.3 (AVE. = 78.7)	90.3; 85.1; 86.5; 85.2; 86.3; 85.7 (ENERGY AVE.=86.9; PRED.=89.3)

TABLE 4-16

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "F2" (1999)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200) (RWY 3 DEP.)	73.2; 74.8; 73.2; 74.8; 76.5; 68.8; 70.4; 72.8; 73.5 (AVE.=73.1)	79.6; 82.5; 79.4; 80.4; 82.1; 77.2; 78.3; 78.9; 81.2 (ENERGY AVE.=80.3; PRED.=84.2)
B-737(200) (LANDING)	57.9; 57.0; 55.0 (AVE.=56.6)	65.3; 67.1; 64.4 (ENERGY AVE.=65.7; PRED.=51.7)
DC-9(50) (RWY 3 DEP.)	78.0; 77.2; 75.2; 76.9; 75.3; 74.2 (AVE.=76.1)	83.1; 83.8; 83.1; 84.1; 82.5; 82.2 (ENERGY AVE.=83.2; PRED.=87.3)
DC-9(50) (LANDING)	59.2; 61.3; 63.5 (AVE.=61.3)	66.3; 65.9; 71.0 (ENERGY AVE.=68.4; PRED.=52.0)
HELICOPTER (LANDING)	62.1; 58.1; 49.8; 57.5; 52.7; 51.6 (AVE.=55.3)	67.9; 66.2; 56.9; 67.5; 60.9; 60.7 (ENERGY AVE.=65.0; PRED.=61.4)

TABLE 4-17

SUMMARY OF AIRCRAFT NOISE MEASUREMENTS AT SITE "M" (1999)

AIRCRAFT TYPE	MAXIMUM SOUND LEVELS Lmax (in dB)	SOUND EXPOSURE LEVELS Lse (in dB)
B-737(200) (RWY 3 DEP.)	78.2; 76.8; 76.7; 77.1; 81.0 78.1; 79.4; 81.1; 78.6; 79.7; 74.4; 82.2 (AVE.=78.6)	81.8; 84.7; 83.5; 85.7; 87.7; 85.9; 85.2; 87.4; 86.4; 87.4; 82.6; 89.0 (ENERGY AVE.=86.1; PRED.=82.4)
DC-9(50) (RWY 3 DEP.)	82.7; 76.6; 82.7; 81.1; 77.8; 77.3 (AVE.=79.7)	87.1; 83.1; 85.5; 87.4; 87.9; 87.8 (ENERGY AVE.=86.8; PRED.=85.2)
HELICOPTER (LANDING)	73.6; 78.5; 77.3; 76.7; 78.5; 80.0; 81.1; 80.0; 80.9 (AVE.=78.5)	77.3; 84.1; 86.0; 84.5; 80.3; 83.0; 85.5; 86.6; 85.8 (ENERGY AVE.=84.4; PRED.=81.3)

TABLE 4-18

SUMMARY OF WIND AND TRAFFIC PATTERN CONDITIONS AT LIHUE AIRPORT

A. ANNUALIZED, DAYTIME (9 AM TO 8 PM) PERCENTAGES FOR WINDS ALIGNED TO RWY 3-21:

DIRECTION	CALM	1 TO 6 KTS	7 TO 10 KTS	> 10 KTS
Trade	0.6%	7.4%	31.6%	47.4%
Kona	-	5.0%	4.8%	3.2%

B. ANNUALIZED, NIGHTTIME (9 PM TO 8 AM) PERCENTAGES FOR WINDS ALIGNED TO RWY 3-21:

DIRECTION	CALM	1 TO 6 KTS	7 TO 10 KTS	> 10 KTS
Trade	0.6%	7.4%	29.0%	37.8%
Kona	-	15.8%	8.0%	1.4%

C. ANNUALIZED, DAYTIME (9 AM TO 8 PM) PERCENTAGES FOR WINDS ALIGNED TO RWY 17-35:

DIRECTION	CALM	1 TO 6 KTS	7 TO 10 KTS	> 10 KTS
Trade	0.2%	1.2%	5.6%	74.2%
Kona	-	1.0%	2.8%	8.6%
East C.W.	-	0.2%	0.8%	4.2%
West C.W.	-	0.2%	0.8%	0.2%

D. ANNUALIZED, NIGHTTIME (9 PM TO 8 AM) PERCENTAGES FOR WINDS ALIGNED TO RWY 17-35:

DIRECTION	CALM	1 TO 6 KTS	7 TO 10 KTS	> 10 KTS
Trade	0.4%	2.0%	9.0%	63.8%
Kona	-	0.8%	3.8%	4.6%
East C.W.	-	0%	0.4%	3.8%
West C.W.	-	1.2%	6.2%	4.0%

Notes:

1. Average wind speeds are probably 2 knots higher across Runway 17-35 than across Runway 3-21.
2. East C.W. and West C.W. are the crosswinds from the east and the west sides of Runway 17-35.

Runway 35 approximately 3.2 percent of the daytime hours due to strong crosswinds from the east. Runways 21 and 17 are used for landings approximately 12.4 percent of the daytime hours.

- Runways 3 and 35 are used for departures 87.6 percent of the daytime hours, and Runways 21 and 17 are used for departures 12.4 percent of the daytime hours.

- During the nighttime hours of 10:00 PM to 7:00 AM, Runway 35 is used for landings approximately 85.2 percent of the time. The use of Runway 3 for landings due to high crosswinds on Runway 35 was estimated at 2.8 percent of the nighttime hours. Runway 21 is used for landings approximately 12.0 percent of the nighttime hours.

- Runway 17 is used for departures approximately 12.0 percent of the nighttime hours.

Airport noise contours were developed for 2005 to describe the existing aircraft noise levels in the Lihue Airport environs. Airport noise contours were also developed for 2011 and 2020, and these contours were used to describe the future aircraft noise levels in the project environs associated with the various phases of the improvement projects. The future Lihue Airport Improvement scenarios and the noise contours which were developed were:

- Utilize Runways 17-35 and 3-21 without additional runway improvements to accommodate only domestic flights. Noise contours for 2011 and 2020 were developed for the future conditions with Runway 17-35 and Runway 3-21 at their current lengths of 6,500 feet.

- For 2020, include a reconfiguration of the existing heliport to improve visibility of helicopter operations between the passenger loading/unloading aprons and the touchdown and liftoff areas from the Air Traffic Control Tower.

The 2011 and 2020 aircraft operations forecasts for Lihue Airport (Reference 16) were used to develop the future aircraft noise contours, and to model future conditions at Lihue Airport. The aircraft operations forecasts included the mix of future aircraft types, and the daytime and nighttime splits of the future operations.

The aircraft noise contours associated with the 2011 and 2020 forecast periods were compared and evaluated for their potential impacts on the surrounding community. Risks of adverse noise impacts associated with the forecast operations were evaluated by examining the relationship of the aircraft noise contours to the noise sensitive land uses in the airport environs. In addition, the relationships of the forecast 2011 and 2020 airport noise contours to existing (2005) contours were also examined. Possible aircraft noise mitigation measures, in addition to those contained in the 1989

FAR Part 150 Noise Compatibility Program for Lihue Airport (Reference 17), were also discussed.

The FAA criteria of 1.5 DNL increase in aircraft noise level at noise sensitive properties was used in defining noise impacts resulting from increases in aircraft noise exposure associated with the forecast operations. Although this criteria was originally intended for use within the 65 DNL noise contour (see Reference 14), the 1.5 DNL criteria was used for all noise sensitive uses within the 60 DNL noise contour. In order to be consistent with the FAR Part 150 study and the DOTA recommendations, the 60 DNL contour was used to identify noise levels which were considered to be incompatible with noise sensitive land uses (dwellings, schools, day care centers, other public use facilities, hotels, etc.). The relative degrees of noise impacts resulting from forecast aircraft operations were compared by examining the increase in noise levels at noise sensitive properties located within the 60 DNL contours.

CHAPTER 5. EXISTING NOISE ENVIRONMENT

Traffic Noise. The existing (2004) traffic noise levels along the roadways which service Lihue Airport and which are in the immediate vicinity of the airport are in the "Moderate Exposure, Acceptable" and "Significant Exposure, Normally Unacceptable" categories at 50 FT setback distance from the roadways' centerlines. The roadways where noise levels exceed 65 DNL and 66 Leq at 50 feet distance from the roadways' centerlines include Ahukini Road west of Kapule Highway, Kapule Highway north and south of Ahukini Road, and Rice Street east of Kapule Highway. Calculations of existing traffic noise levels during the AM or PM peak traffic hours are presented in Table 5-1. Appendix C presents the existing (Base Year or 2004) and future traffic volumes which were used to develop Table 5-1. The hourly Leq (or Equivalent Sound Level) contributions along each roadway section in the project environs were calculated for comparison with forecast traffic noise levels with and without the project. The existing setback distances from the roadways' centerlines to their associated 66 and 71 Leq contours were also calculated as shown in Table 5-2. By current DOTH noise abatement criteria (see Table 3-3), a traffic noise level less than 66 Leq is considered to be acceptable for residential and other noise sensitive uses, and a level less than 71 Leq is considered to be acceptable for commercial and industrial uses. The critical noise level setback distances indicated in Table 5-2 do not take into account noise shielding effects or the additive contributions of traffic noise from intersecting street sections. The setback distances of the existing 65 DNL traffic noise contours are larger than the setback distances to the 66 Leq contours.

The Kauai County zoning of lands which were located in the Lihue Airport environs during 2005 are shown in Figure 5-1. The Molokoa Village subdivision (which is under development), Hanamaulu Town, Hanamaula Bay, Downtown Lihue, Kupolo, Kukii Point, and Nawiliwili are the closest areas to Lihue Airport where noise sensitive receptors are located. In addition, public use facilities, such as Vidinha Memorial Stadium, Kauai Veterans Center, State Judiciary and Civic Center, King Kaumualii Elementary School, Kauai Intermediate and High Schools, Wilcox Elementary School, Immaculate Conception School, various churches, and Wilcox Memorial Hospital are also located within 2 miles of the Airport. The Kauai Lagoons/Kauai Marriott Resort and the Kauai Beach Resort are hotels which are located within the airport environs.

The lands fronting the high volume roadways which service the airport, such as Kapule Highway, the section of Ahukini Road west of Kapule Highway, and Kapule Highway north and south of Ahukini Road do not contain residential properties. Existing residences are located along the west section of Ahukini Road near Kuhio Highway and along Rice Street, and are located within 42 to 60 feet from the centerlines of these roadways. Current traffic noise levels at the residences which front Ahukini Road and Rice Street may exceed 66 Leq(h) if they are not shielded by sound attenuating walls. Those residences which are located at greater than 46 and 68 feet setback distances

TABLE 5-1

COMPARISONS OF CY 2004, 2010, AND 2020 TRAFFIC NOISE LEVELS ALONG ROADWAYS IN THE PROJECT ENVIRONS AND AT VARIOUS DISTANCES FROM ROADWAYS' CENTERLINES

LOCATION	SPEED (MPH)	TOTAL VPH	***** HOURLY LEQ IN dB ****** @ 50'	@ 100'	@ 200'
EXISTING (CY 2004) PEAK HOUR:					
Kapule Highway (South, PM)	47	1,343	69.5	63.8	57.6
Kapule Highway (North, AM)	55	1,731	72.6	66.9	60.5
Ahukini Rd. East of Kapule Hwy. (PM)	40	654	63.8	58.4	52.5
Ahukini Rd. West of Kapule Hwy. (AM)	50	1,028	68.6	62.8	56.2
Ahukini Rd. East of Kuhio Hwy. (PM)	40	824	64.8	59.4	53.0
Rice St. West of Kapule Hwy. (PM)	35	979	64.1	58.9	52.9
Rice St. East of Kapule Hwy. (AM)	35	1,276	65.3	60.1	54.0
FUTURE (CY 2010) PM PEAK HOUR (ACTION SCENARIO):					
Kapule Highway (South, PM)	47	2,051	71.3	65.7	59.4
Kapule Highway (North, PM)	55	2,745	74.6	68.9	62.5
Ahukini Rd. East of Kapule Hwy. (PM)	40	712	64.2	58.8	53.1
Ahukini Rd. West of Kapule Hwy. (PM)	50	1,632	70.6	64.8	58.2
Ahukini Rd. East of Kuhio Hwy. (PM)	40	1,796	68.1	62.7	56.3
Rice St. West of Kapule Hwy. (PM)	35	1,247	65.2	59.9	53.9
Rice St. East of Kapule Hwy. (PM)	35	1,858	66.9	61.7	55.6
FUTURE (CY 2020) PEAK HOUR (ACTION SCENARIO):					
Kapule Highway (South, PM)	47	2,808	72.7	67.0	60.8
Kapule Highway (North, PM)	55	3,538	75.7	70.0	63.6
Ahukini Rd. East of Kapule Hwy. (PM)	40	875	65.1	59.8	54.0
Ahukini Rd. West of Kapule Hwy. (PM)	50	2,359	72.2	66.4	59.8
Ahukini Rd. East of Kuhio Hwy. (PM)	40	2,564	69.7	64.3	57.9
Rice St. West of Kapule Hwy. (PM)	35	1,678	66.5	61.2	55.3
Rice St. East of Kapule Hwy. (PM)	35	2,469	68.2	62.9	56.9

Notes:

1. The following assumed traffic mixes of autos, medium trucks, and heavy vehicles were used for existing and future conditions:
   (a) Kapule Highway (South): 94.9% Autos; 3.5% Medium Trucks; and 1.6% Heavy Trucks and Buses.
   (b) Kapule Highway (North): 96.8% Autos; 2.0% Medium Trucks; and 1.2% Heavy Trucks and Buses.
   (c) Ahukini Road: 97.5% Autos; 1.9% Medium Trucks; and 0.6% Heavy Trucks and Buses.
   (d) Rice Street: 97.0% Autos; 2.0% Medium Trucks; and 1.0% Heavy Trucks and Buses.

2. All distances shown are from centerline of roadway.

3. DNL assumed to be equal to PM Peak Hour Leq or 1 dB greater than AM Peak Hour Leq .

TABLE 5-2

EXISTING, 2010, AND 2020 DISTANCES TO 66 AND 71 Leq CONTOURS

STREET SECTION	66 Leq SETBACK (FT)			71 Leq SETBACK (FT)		
	EXISTING	2010	2020	EXISTING	2010	2020
Kapule Highway (South, PM)	77	96	112	42	52	61
Kapule Highway (North, AM & PM)	110	137	154	61	77	89
Ahukini Rd. East of Kapule Hwy. (PM)	38	40	44	20	21	23
Ahukini Rd. West of Kapule Hwy. (AM & PM)	68	87	104	38	48	58
Ahukini Rd. East of Kuhio Hwy. (PM)	43	65	80	23	34	42
Rice St. West of Kapule Hwy. (PM)	39	45	53	20	23	28
Rice St. East of Kapule Hwy. (AM & PM)	46	56	67	23	29	35

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See Table 5-1 for traffic volume, speed, and mix assumptions.
(3) Setback distances are for unobstructed line-of-sight conditions.
(4) Loose soil ground conditions assumed along all roadways.

LEGEND

USE AND MINIMUM LOT SIZE

RESIDENTIAL

- R-1 / ST-P — Residential, 1,000 sq.ft/unit/ Special Treatment District - Public Facilities
- R-4 / ST-P — Residential, 4,000 sq.ft/unit/ Special Treatment District - Public Facilities
- R-6 / ST-P — Residential, 6,000 sq.ft/unit/ Special Treatment District - Public Facilities
- R-2 — Residential, 2,000 sq.ft/unit
- R-4 — Residential, 4,000 sq.ft/unit
- R-6 — Residential, 6,000 sq.ft/unit
- R-8 — Residential, 8,000 sq.ft/unit
- R-10 — Residential, 10,000 sq.ft/unit
- R-20 — Residential, 20,000 sq.ft/unit

OPEN

- O — Open, Park, Recreational
- O / ST-C — Open, Park, Recreational/ Special Treatment District - Comm. Facilities
- O / ST-R — Open, Park, Recreational/ Special Treatment District - Rec. Facilities
- O / ST-P — Open, Park, Recreational/ Special Treatment District - Public Facilities
- C — Conservation

AGRICULTURAL

- A — Agriculture
- AG — General Agriculture

COMMERCIAL

- CG — General Commercial
- CN — Neigborhood Commercial
- CG / ST-P — General Commercial Special Treatment District - Public Facilities
- RR — Resort
- RR-10 — Resort, 10,000 sq.ft/unit
- RR-20 — Resort, 20,000 sq.ft/unit

INDUSTRIAL

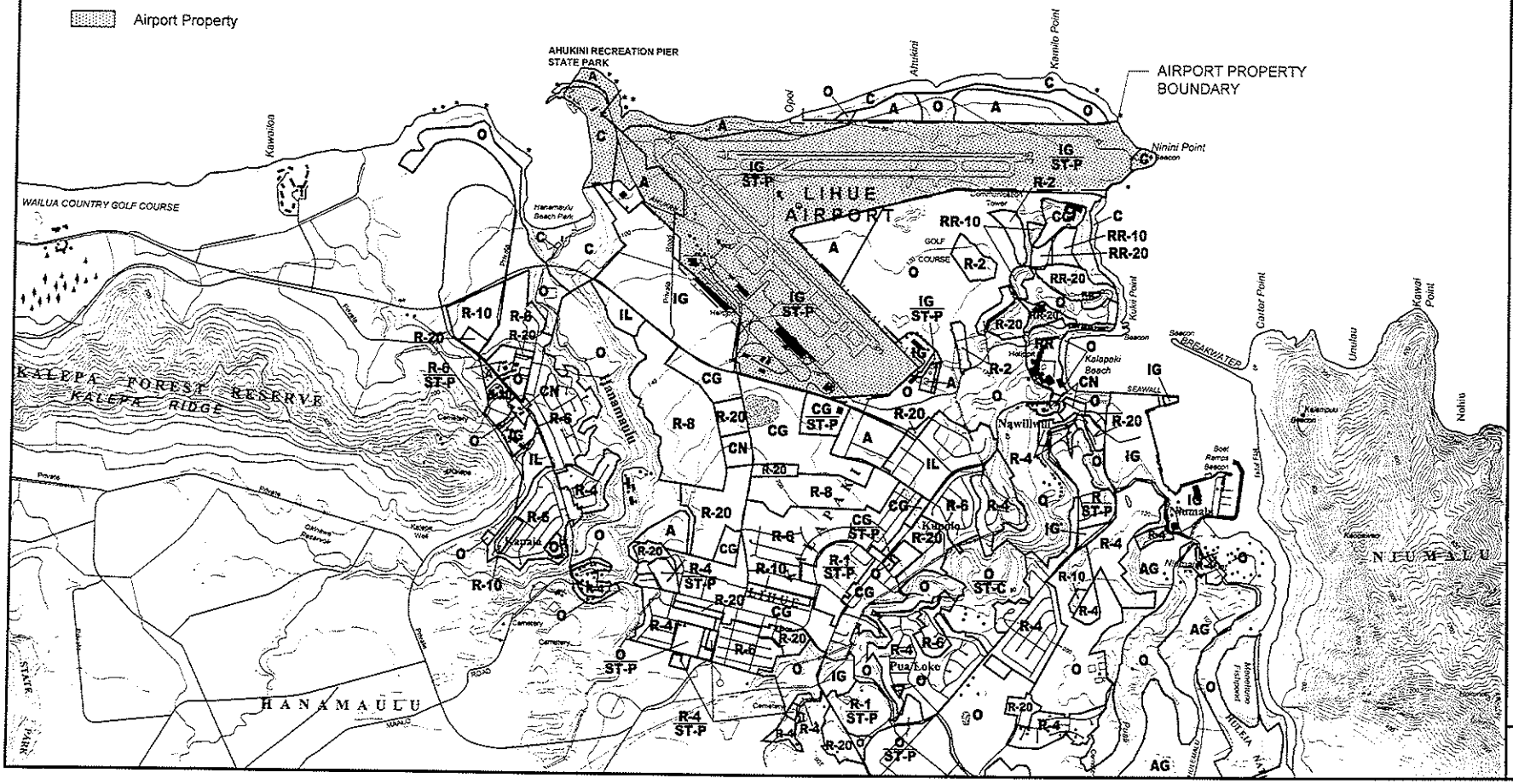
- IL — Limited Industrial
- IG — General Industrial

Airport Property

N

0 1250 2500 5000

Scale in Feet



Airports Division
DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII

LIHUE AIRPORT

COUNTY ZONING IN AIRPORT ENVIRONS

Prepared by:
WILSON OKAMOTO CORPORATION
ARIES CONSULTANTS LTD.
Y. EBISU & ASSOCIATES

FIGURE 5-1

from the centerlines of Rice Street and Ahukini Road, respectively, or which are shielded by sound attenuating walls, currently experience traffic noise levels which are less than 66 Leq(h) .

Along the now vacant sections of Ahukini Road and Kapule Highway, existing traffic noise levels exceed 66 Leq(h) at setback distances of 68 and 77 to 110 feet, respectively, from the roadways' centerlines. Existing traffic noise levels along both roadways are highest at the lots which front the roadways. At the interior lots, traffic noise levels decrease to less than 66 Leq(h) due to their larger setback distances from the high volume roadways and the noise shielding effects of intervening structures between the high volume roadways and the interior lots. At these interior lots, local traffic or aircraft noise may be the dominant noise source. Between road traffic or aircraft noise events, background ambient noise levels drop to a range of 45 to 50 dB, and can go below 45 dB during calm periods. The steady background ambient noise levels at these interior locations are controlled by distant traffic, birds, and foliage movement with the wind.

Aircraft Noise. Aircraft noise sources in the project environs are associated with fixed and rotary wing aircraft operations at Lihue Airport. Table 5-3 contains a detailed breakdown of average day operations by aircraft at Lihue Airport during 2005. For the purposes of this study, Aircraft Base Year operations were derived from historical data collected from January 2005 through December 2005. During 2005, air carrier aircraft operations (arrivals plus departures) averaged approximately 83 operations per day. These air carrier flights were primarily provided by Aloha and Hawaiian Airlines utilizing B-737(200) and B-717(200) 2-engine, jet aircraft. United Airlines, American Airlines, and America West also provided scheduled air carrier service with their B-757 aircraft. Commuter, general aviation, air taxi, tour helicopter, and military aircraft operations averaged about 214 operations per day in 2005. General aviation operations were conducted by a mix of twin and single propeller aircraft as well as business jet aircraft. Tour helicopter aircraft operations numbered approximately 138 operations per day. Military operations were primarily conducted by P-3, C-130, and rotary wing aircraft.

During 2005, the majority of scheduled air carrier operations were by two-engine, jet aircraft operating primarily between Lihue Airport on Kauai and Honolulu International Airport on the island of Oahu. In addition to scheduled aircraft operations, nonscheduled business jet, tour helicopter, and single and twin-engined general aviation and air taxi aircraft also operated at Lihue Airport during the Base Year. Estimates of the frequency of their operations are shown in Table 5-3. Military C-130 and P-3 propeller aircraft and military helicopters (UH-1, UH-60, and CH-53) also used the airfield, but at relatively infrequent intervals as shown in Table 5-3.

The departure, approach, and training (or local) flight tracks used to depict existing (2005) conditions at Lihue Airport are shown in Figures 5-2, 5-3, and 5-4, respectively. Table 5-4 contains a brief narrative description of the 21 flight tracks and of the aircraft types utilizing each of them. The assignments of aircraft operations to

TABLE 5-3. AVERAGE DAILY OPERATIONS BY ALL AIRCRAFT AT LIHUE AIRPORT DURING 2005

LIHUE CY 2005 LANDINGS/DAY:

A/C	TOTAL DAILY LANDINGS	TRADE RWY 35 (TR9I)	TRADE RWY 3	KONA RWY 17 (TR8H)	KONA RWY 21 (TR8)
B-767(300)/A-310/A-300	0.05	0.04		0.00	0.01
B-757(200)/A-320	4.90	4.26		0.03	0.61
DC-8(70s)	0.00	0.00		0.00	0.00
Sub-total (Day):	4.95	4.30		0.03	0.62
B-767(300)/A-310/A-300	0.00	0.00		0.00	0.00
B-757(200)/A-320	0.00	0.00		0.00	0.00
DC-8(70s)	0.00	0.00		0.00	0.00
Sub-total (Night):	0.00	0.00		0.00	0.00

A/C	TOTAL DAILY LANDINGS	TRADE RWY 35 (TR9)	TRADE RWY 35 (TR9I)	TRADE RWY 3 (TR5)	TRADE RWY 3 (TR6)	KONA RWY 17 (TR8H)	KONA RWY 21 (TR8)
B-737(200)	12.97	10.40	0.32	0.00	0.56	0.00	1.69
B-737(200QC)	0.74	0.60	0.02	0.00	0.03	0.00	0.10
B-717(200)	13.94	11.18	0.35	0.00	0.61	0.00	1.81
Bomb CRJ 200	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DHC-8	4.13	1.80	0.00	1.80	0.00	0.00	0.54
Sub-total (Day):	31.78	23.98	0.69	1.80	1.20	0.00	4.14
B-737(200)	1.00	0.34	0.34	0.00	0.08	0.00	0.25
B-737(200QC)	2.00	0.68	0.68	0.00	0.15	0.00	0.50
B-717(200)	2.00	0.68	0.68	0.00	0.15	0.00	0.50
Bomb CRJ 200	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DHC-8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub-Total (Nite):	5.00	1.70	1.70	0.00	0.38	0.00	1.25

A/C	TOTAL DAILY LANDINGS	TRADE RWY 35 (TR9)	TRADE RWY 35 (TR9I)	TRADE RWY 3 (TR5)	KONA RWY 21 (TR8)
CESSN 208	3.18	0.00	0.00	2.76	0.41
SHORTS 330	1.61	0.00	0.00	1.40	0.21
Sub-total (Day):	4.78	0.00	0.00	4.16	0.62
Sub-total (Nite):	0.00	0.00	0.00	0.00	0.00

TABLE 5-3 (Continued). AVERAGE DAILY OPERATIONS BY ALL AIRCRAFT AT LIHUE AIRPORT DURING 2005

A/C	TOTAL DAILY LANDINGS	--------TRADE--------		---------KONA----------	
		RWY 3 (TR5)	RWY 35	RWY 21 (TR8)	RWY 17
CESSN 414	1.38	1.20	0.00	0.18	
BEECH 1900	1.92	1.67	0.00	0.25	
Sub-total (Day):	3.30	2.87	0.00	0.43	
		(TR10)	(TR16)	(TR15)	
HELICOPTER	68.84	5.99	53.90	8.95	
Sub-total (Day):	68.84	5.99	53.90	8.95	
Sub-total (Nite):	0.00	0.00	0.00	0.00	

A/C	TOTAL DAILY LANDINGS	--------TRADE--------		---------KONA--------	
		RWY 35 (TR9)	RWY 35 (TR9I)	RWY 21 (TR8)	RWY 17
GULFSTREAM IV	0.34	0.15	0.15	0.04	
CESSN 750/FALCON	0.32	0.14	0.14	0.04	
Sub-total (Day):	0.66	0.29	0.29	0.08	

		--------TRADE--------		---------KONA---------	
		RWY 3 (TR5)	LOCAL (TR17)	RWY 21 (TR8)	LOCAL (TR18)
COMTEP	2.14	0.99	0.88	0.15	0.13
COMSEP	19.29	3.63	13.15	0.54	1.97
Sub-total (Day):	21.43	4.62	14.03	0.69	2.10

		--------TRADE--------		---------KONA--------	
		RWY 35 (TR9I)	LOCAL (TR17)	RWY 21 (TR8)	LOCAL (TR18)
C-130	2.88	1.50	1.00	0.22	0.15
P-3C	2.88	1.50	1.00	0.22	0.15
MIL HELO	1.99	1.04	0.69	0.16	0.10
Sub-total (Day):	7.75	4.04	2.69	0.60	0.40

TABLE 5-3 (Continued). AVERAGE DAILY OPERATIONS BY ALL AIRCRAFT AT LIHUE AIRPORT DURING 2005

LIHUE CY 2005 DEPARTURES/DAY:

A/C	TOTAL DAILY DEPART.'S	TRADE RWY 35 (TR3)	TRADE RWY 3 (TR1A)	KONA RWY 17 (TR4)	KONA RWY 21
B-767(300)/A-310/A-300	0.05		0.04	0.01	
B-757(200)/A-320	1.90		1.65	0.25	
DC-8(70s)	0.00		0.00	0.00	
Sub-total (Day):	1.95		1.69	0.26	
B-767(300)/A-310/A-300	0.00		0.00	0.00	
B-757(200)/A-320	3.00		2.25	0.75	
DC-8(70s)	0.00		0.00	0.00	
Sub-total (Night):	3.00		2.25	0.75	

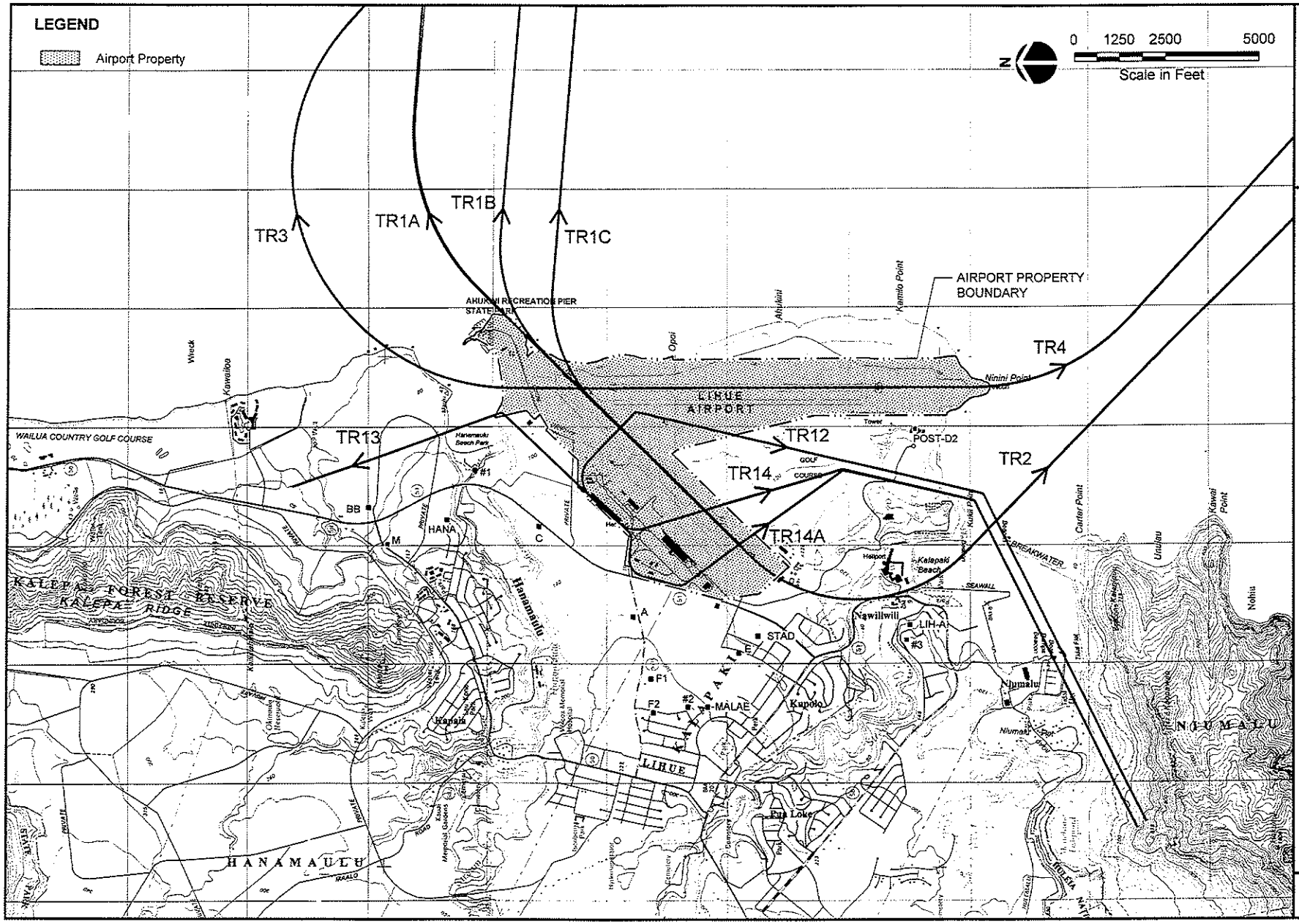
A/C	TOTAL DAILY DEPART'S	TRADE RWY 3 (TR1A)	TRADE RWY 3I (TR1A)	TRADE RWY 3 (TR1B)	KONA RWY 17 (TR4)	KONA RWY 21 (TR2)
B-737(200)	12.97	11.28	0.00	0.00	1.69	0.00
B-737(200QC)	0.74	0.65	0.00	0.00	0.10	0.00
B-717(200)	14.94	13.00	0.00	0.00	1.94	0.00
Bomb CRJ 200	0.00	0.00	0.00	0.00	0.00	0.00
DHC-8	4.13	0.00	1.80	1.80	0.50	0.04
Sub-total (Day):	32.78	24.93	1.80	1.80	4.23	0.04
B-737(200)	1.00	0.75	0.00	0.00	0.25	0.00
B-737(200QC)	2.00	0.00	1.50	0.00	0.50	0.00
B-717(200)	1.00	0.75	0.00	0.00	0.25	0.00
Bomb CRJ 200	0.00	0.00	0.00	0.00	0.00	0.00
DHC-8	0.00	0.00	0.00	0.00	0.00	0.00
Sub-Total (Nite):	4.00	1.50	1.50	0.00	1.00	0.00

A/C	TOTAL DAILY DEPART'S	TRADE RWY 3 (TR1B)	TRADE RWY 3 (TR1C)	KONA RWY 17 (TR4)	KONA RWY 21 (TR2)
CESSN 208	3.18	1.38	1.38	0.04	0.37
SHORTS 330	1.61	0.70	0.70	0.02	0.19
Sub-total (Day):	4.78	2.08	2.08	0.06	0.56
Sub-total (Nite):	0.00	0.00	0.00	0.00	0.00

TABLE 5-3 (Continued). AVERAGE DAILY OPERATIONS BY ALL AIRCRAFT AT LIHUE AIRPORT DURING 2005

A/C	TOTAL DAILY DEPART'S	--------TRADE--------		---------KONA---------	
		RWY 3 (TR1B)	RWY 3 (TR1C)	RWY 17 (TR4)	RWY 21 (TR2)
CESSN 414	1.38	0.60	0.60	0.02	0.16
BEECH 1900	1.92	0.84	0.84	0.03	0.23
Sub-total (Day):	3.30	1.44	1.44	0.05	0.39
		(TR12)	(TR13)	(TR14)	(TR14A)
HELICOPTER	68.84	59.29	0.60	8.95	0.00
Sub-total (Day):	66.77	57.22	0.60	8.95	0.00
Sub-total (Nite):	2.07	2.07	0.00	0.00	0.00

A/C	TOTAL DAILY DEPART'S	--------TRADE--------		---------KONA---------	
		RWY 3 (TR1A)	RWY 35	RWY 21 (TR2)	RWY 17 (TR4)
GULFSTREAM IV	0.34	0.30		0.00	0.04
CESSN 750/FALCON	0.32	0.27		0.00	0.04
Sub-total (Day):	0.66	0.57		0.00	0.08
		--------TRADE---------		---------KONA---------	
		RWY 3 (TR1C)	LOCAL (TR17)	RWY 21 (TR2)	LOCAL (TR18)
COMTEP	2.14	0.99	0.88	0.15	0.13
COMSEP	19.29	3.63	13.15	0.54	1.97
Sub-total (Day):	21.43	4.62	14.03	0.69	2.10
		--------TRADE---------		---------KONA--------	
		RWY 35 (TR3)	LOCAL (TR17)	RWY 17 (TR4)	LOCAL (TR18)
C-130	2.88	1.50	1.00	0.22	0.15
P-3C	2.88	1.50	1.00	0.22	0.15
MIL HELO	1.99	1.04	0.69	0.16	0.10
Sub-total (Day):	7.75	4.04	2.69	0.60	0.40



Airports Division
DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII

LIHUE AIRPORT

2005 DEPARTURE FLIGHT TRACKS

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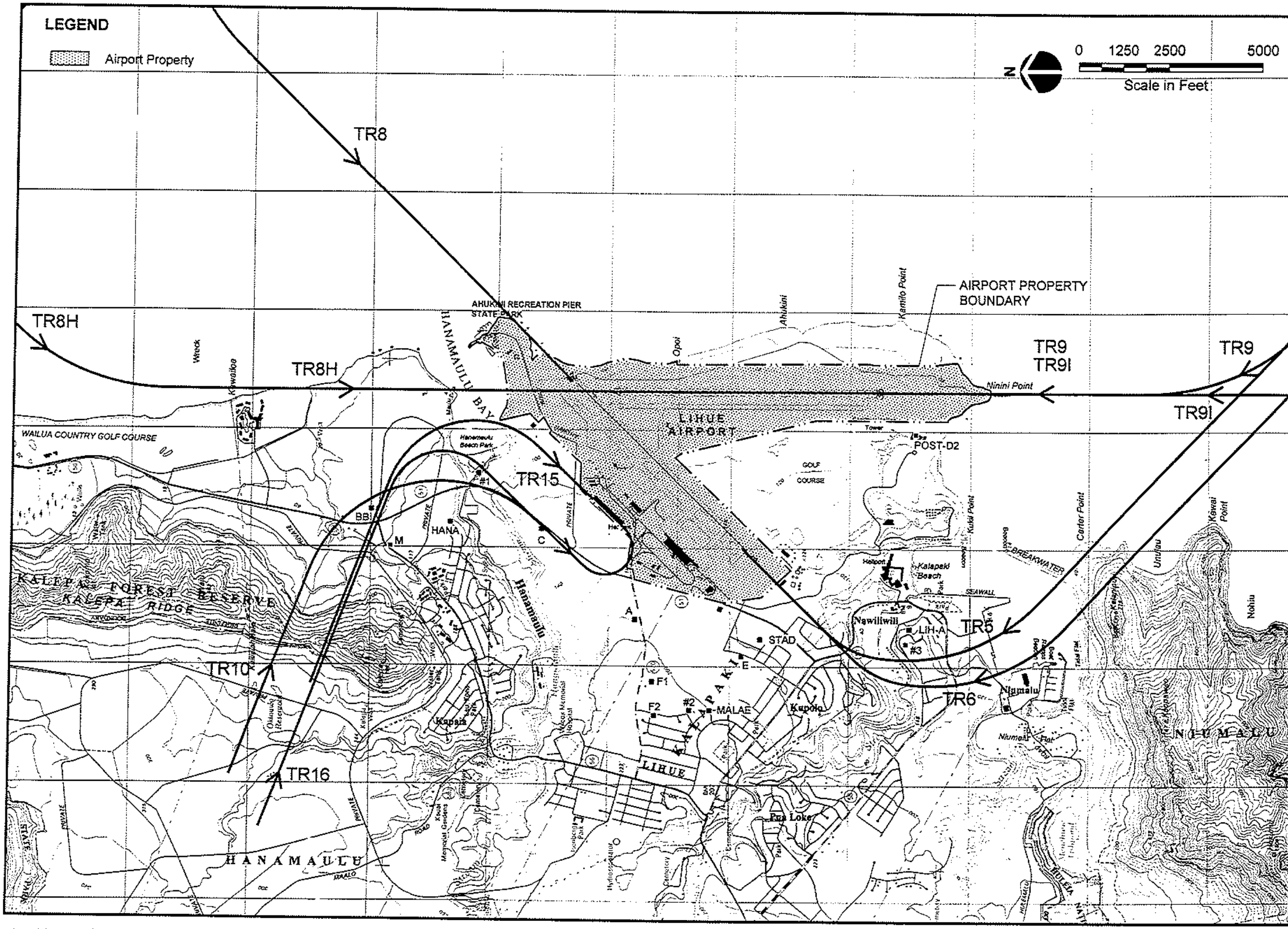
Y. EBISU & ASSOCIATES

FIGURE 5-2



Airports Division
DEPARTMENT OF TRANSPORTATION
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LIHUE AIRPORT

2005 ARRIVAL FLIGHT TRACKS

Prepared by:
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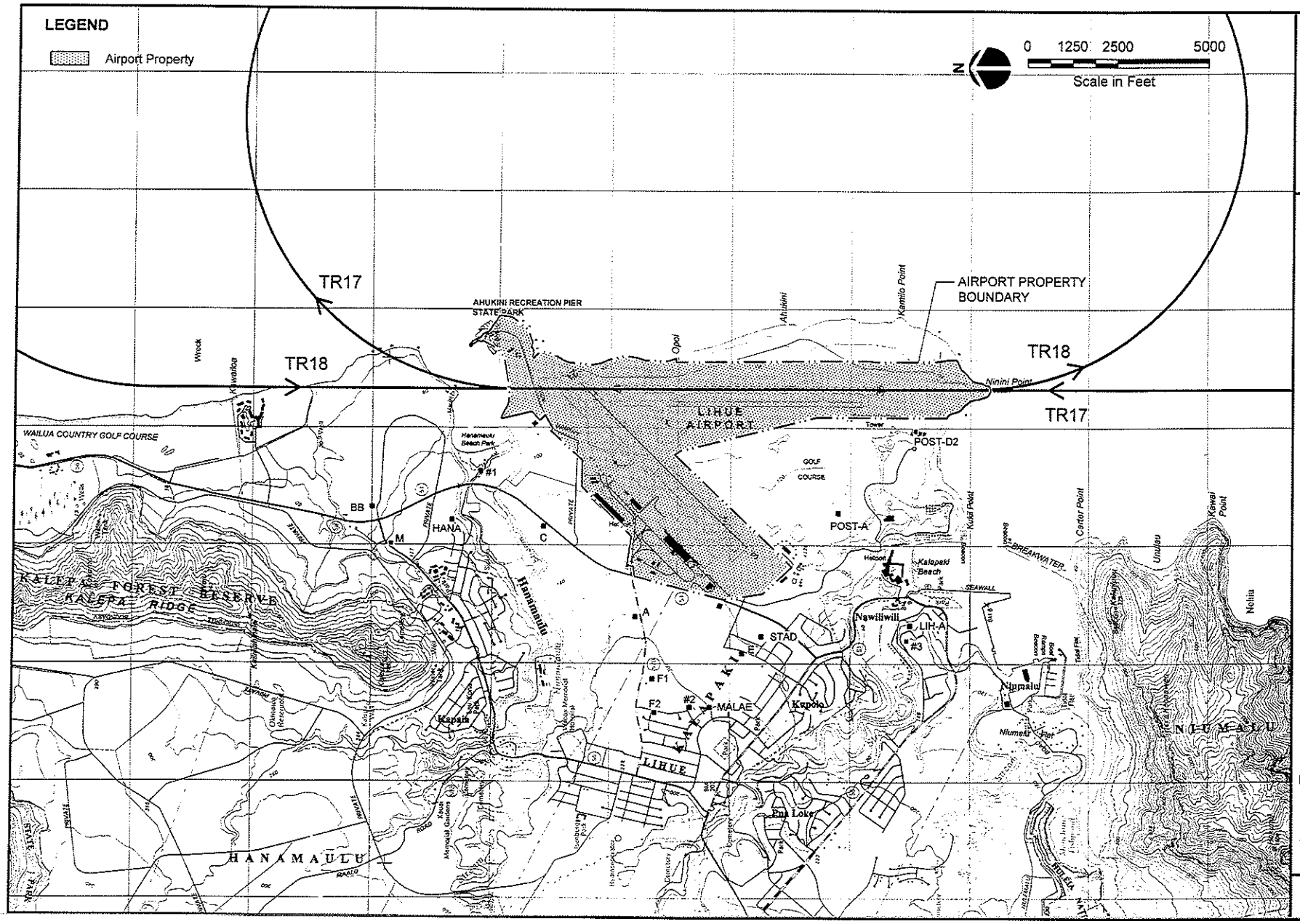
Y. EBISU & ASSOCIATES

FIGURE 5-3



Airports Division
DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII

LIHUE AIRPORT

2005 TRAINING FLIGHT TRACKS

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FIGURE 5-4

TABLE 5-4

DESCRIPTION OF FLIGHT TRACKS USED TO GENERATE YEAR 2005 NOISE CONTOURS (LIHUE AIRPORT)

TRACK NAME	TRACK DESCRIPTION
DEPARTURES:	
TR1A	RWY 3 itinerant departure track for overseas and interisland jet and large propeller aircraft.
TR1B	RWY 3 itinerant departure track for light, civil propeller aircraft.
TR1C	RWY 3 itinerant departure track for light, civil propeller aircraft.
TR2	RWY 21 itinerant departure track for light, civil propeller aircraft.
TR3	RWY 35 itinerant departure track for overseas and military aircraft.
TR4	RWY 17 itinerant departure track for all aircraft.
TR12	Itinerant tradewind departure track for rotary wing, tour aircraft toward Nawiliwili Harbor.
TR13	Itinerant departure track for rotary wing, tour aircraft toward Hanamaulu Bay.
TR14	Itinerant kona departure track for rotary wing, tour aircraft toward Nawiliwili Harbor.
TR14A	Alternate kona departure track for rotary wing, tour aircraft toward Nawiliwili Harbor.
ARRIVALS:	
TR5	RWY 3 itinerant approach track for light propeller aircraft from the south over Nawiliwili.
TR6	RWY 3 itinerant approach track for interisland jet aircraft from the south over Nawiliwili.
TR8	RWY 21 itinerant approach track for all aircraft.
TR8H	RWY 17 itinerant approach track for overseas and military aircraft.
TR9	RWY 35 itinerant approach track for all non-ILS approaches.
TR9I	RWY 35 itinerant approach track for all ILS approaches.
TR10	Itinerant approach track for rotary wing, tour aircraft from Kalepa Forest (or saddle) during tradewinds.
TR15	Itinerant approach track for rotary wing, tour aircraft from Kalepa Forest (or saddle) during kona winds.
TR16	Itinerant approach track for rotary wing, tour aircraft from Kalepa Forest (or saddle) during tradewinds.
TRAINING:	
TR17	RWY 35 local departure and ILS approach tracks for all aircraft.
TR18	RWY 17 local departure and visual approach tracks for all aircraft.

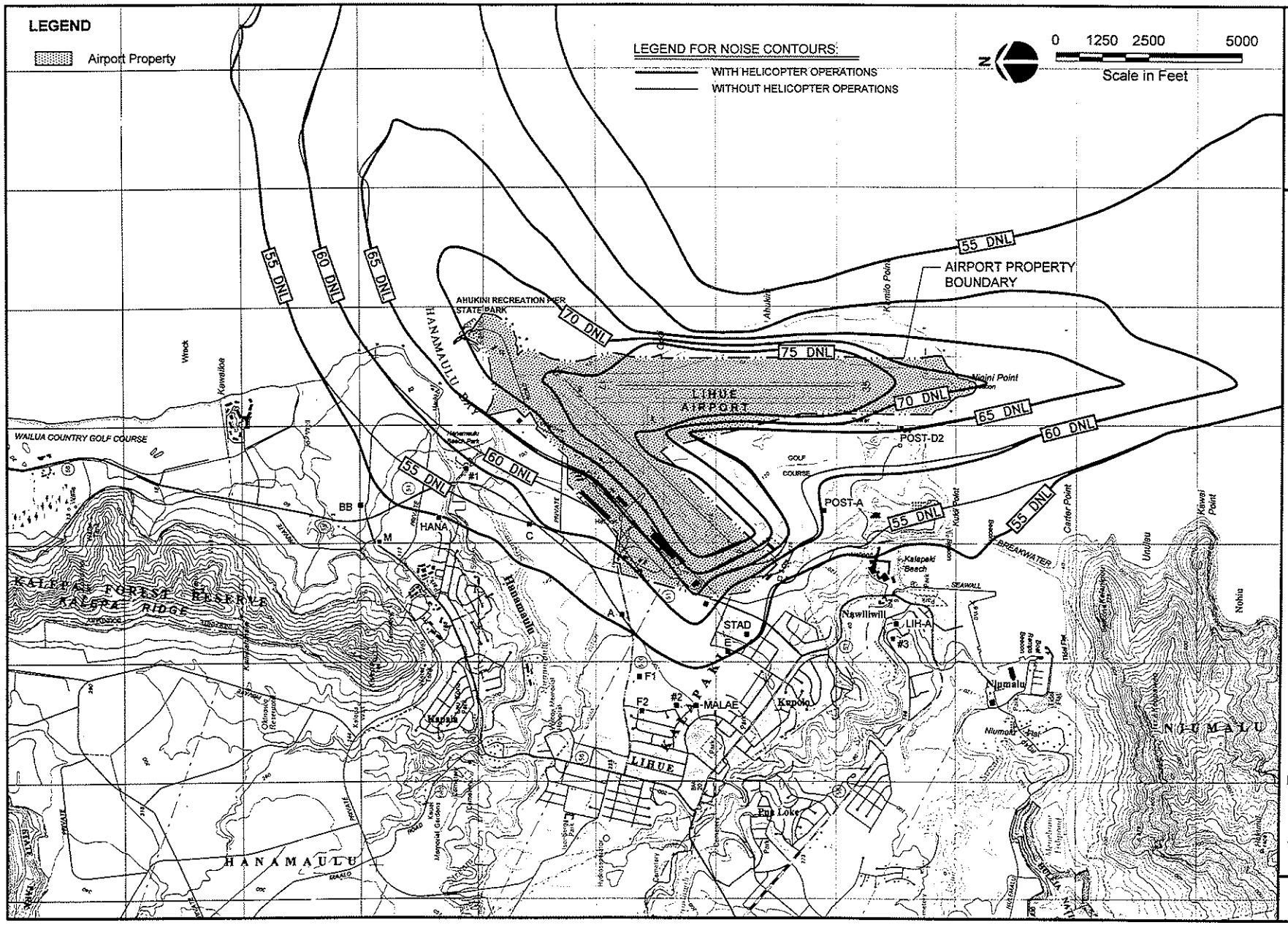
the flight tracks for 2005 are shown in Table 5-3 for civil and military aircraft. These assignments were developed for both the daytime and nighttime periods using data collected from airline landing reports and schedules, from the traffic pattern usage frequencies developed from the wind data, from the existing noise abatement procedures, from visual observations during aircraft noise monitoring, and from the information provided in Reference 16. The annual records were converted to average daily operations by dividing by 365 days.

The aircraft flight tracks depicted in Figures 5-2 through 5-4 during CY 2005, were reported in Volume 1 of the FAR Part 150 study report (Reference 8). No significant changes in aircraft flight tracks have occurred between 1986 (the Base year of the FAR Part 150 study) and 2005. The most significant changes in aircraft operations at Lihue Airport between 1986 and 2005 have been: the use of the 500 foot extension of Runway 3-21 toward the southwest for tradewind departures by interisland and overseas jet aircraft; the replacement of the noisier DC-9(50) aircraft with quieter B-717(200) aircraft by Hawaiian Airlines; the fifty two percent increase in nighttime jet operations by Hawaiian and Aloha Airlines; the eighteen percent reduction in tour helicopter operations; and the thirty two percent reduction in military operations at Lihue Airport.

Figure 5-5 depicts the CY 2005 Noise Exposure Map (or aircraft noise contours) for Lihue Airport. The locations of the aircraft noise monitoring sites are also shown in the figure. Figure 5-6 depicts existing noise sensitive land uses in the Airport environs on a map of identical scale to Figure 5-5. The size and extent of the aircraft noise contours in CY 2005 were 0 to 2 DNL units smaller than the FAR Part 150 1986 Base Year Map in the sideline areas of Hanamaulu and Lihue Town. Southwest of the airport, the noise contours have expanded by 0 to 2 DNL units due to the extension of Runway 3-21 toward the southwest. North of the airport toward Hanamaulu Bay, the noise contours of 2005 were smaller by 3 to 5 DNL units than those of 1986 due to the replacement of the DC-9(50) aircraft with B-717(200) aircraft. As was the situation in CY 1986, the communities of Malae, Kupolo, Nawiliwili, Kukii Point, Hanamaulu, and Hanamaulu Bay continue to be noise sensitive receptor areas which are exposed to aircraft noise from Lihue Airport.

Also depicted (with the thin contour lines) in Figure 5-5 are the Lihue Airport noise contours for conditions without tour helicopter operations. The expansion of the airport's 55 and 60 DNL contours due to tour helicopter operations are depicted near the tour helicopter facility, near Kapule Highway, under the ingress route from Kalepa Ridge to Hanamaulu Bay, and under the egress route at Nawiliwili Harbor.

Tables 4-2 through 4-17 summarize the results of the more recent aircraft noise measurements at Lihue Airport. Additional measurement results are contained in Appendix A of the FAR Part 150 Report, Volume 1 (Reference 8). Maximum jet aircraft noise levels (Lmax) were typically between 60 to 86 dB at the measurement sites shown in Figure 4-1. For the purposes of comparison, typical maximum noise levels of



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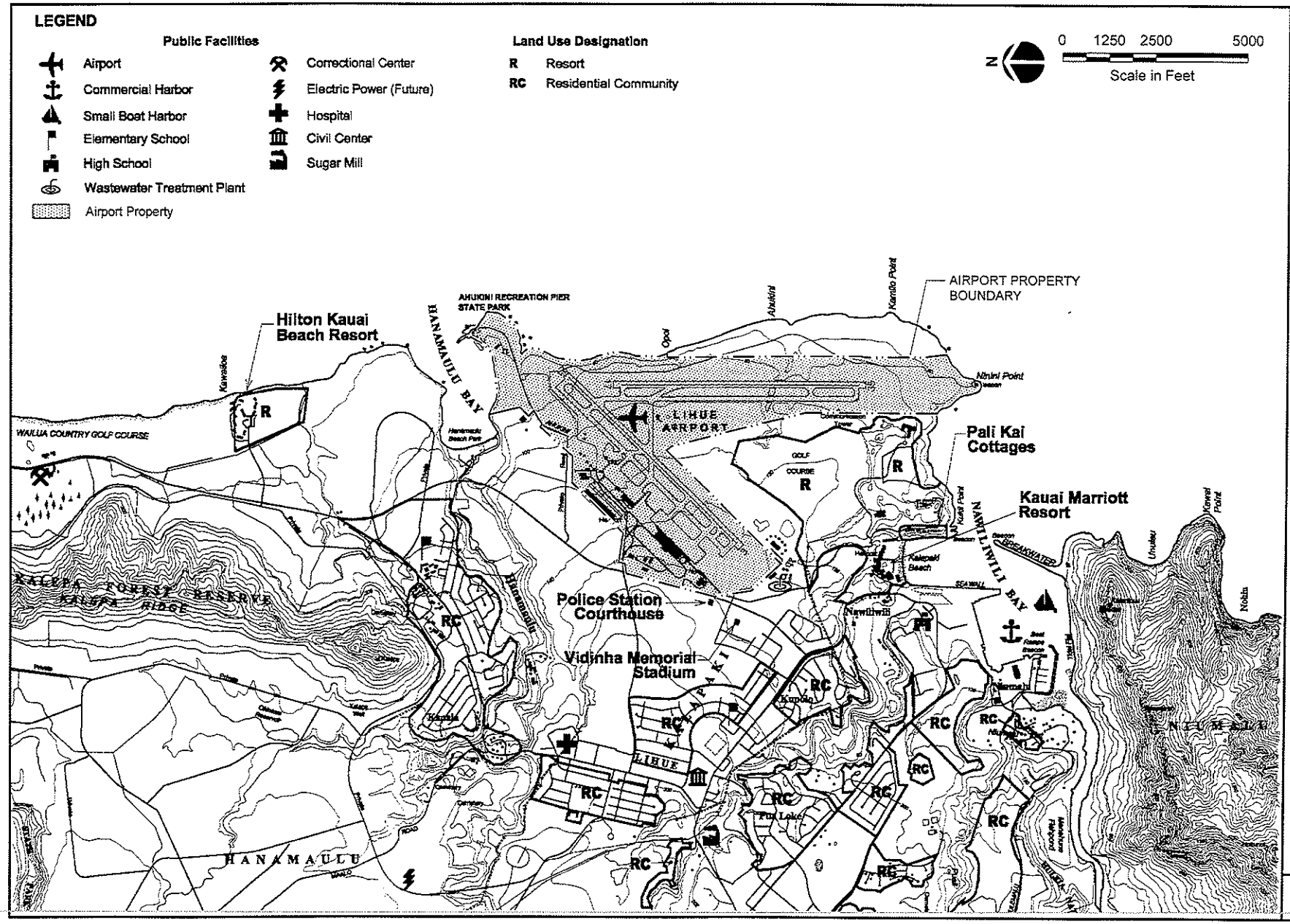
LIHUE AIRPORT

COMPARISON OF 2005 AIRCRAFT NOISE CONTOURS WITH AND WITHOUT HELICOPTER OPERATIONS

Prepared by:
WILSON OKAMOTO CORPORATION
ARIES CONSULTANTS LTD.
Y. EBISU & ASSOCIATES

FIGURE 5-5



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LIHUE AIRPORT

EXISTING LAND USES IN AIRPORT ENVIRONS

FIGURE 5-6

heavy trucks are in the order of 80 to 85 dB at 50 FT distance. At noise sensitive locations in Hanamaulu which are outside the 55 DNL contour, typical maximum noise levels associated with jet aircraft and helicopter flyby events are similar, and typically range between 70 and 75 dB. In the Hanamaulu Bay area, the noisier B-737(200) jet aircraft noise levels (at 85 to 90 dB) are typically higher than helicopter noise levels (at 72 to 82 dBA). Unusually louder (by as much as 14 dB) aircraft noise events can occur during the nighttime and early morning hours due to thermal ducting effects. These louder noise events were measured in the Malae area during an early morning departure of a DC-9(50) aircraft from Runway 3 in August of 1999 (see Table 4-9).

In the 1989 FAR Part 150 program for Lihue Airport, those noise sensitive land uses within the 60 DNL contour were considered to be exposed to incompatible levels of aircraft noise. The degree of adverse health and welfare impacts resulting from aircraft noise depends upon the sound attenuation properties of the structures containing the noise sensitive uses. For the purposes of this Environmental Impact Statement study, it was assumed that all noise sensitive properties can be considered to be adversely impacted by aircraft noise if they are located within the 60 DNL aircraft noise contour and if they are not specially treated to reduce interior noise levels to 45 DNL or less. Total closure and air conditioning is generally required for structures located within the 60 DNL contour in order to achieve the 45 DNL interior noise criteria.

As shown in Figure 5-5, the existing aircraft noise levels at Lihue Airport are generally compatible with the surrounding land uses. Noise sensitive land uses which were located within the 60 DNL contour during the Base Year included the Kauai Veterans Center and the Kauai Judiciary Building. Sound attenuation treatment have been incorporated into the new facilities, since the locations of these facilities within the Lihue Airport noise contours were previously disclosed during the 1989 FAR Part 150 program. Planned residential developments and resort facilities of Kauai Lagoons Resort are also located within the 60 DNL contour.

No existing or planned residences are located within the 2005 65 DNL contour. Only a portion of the Kauai Lagoons Resort between Ninini Point and Kukii Point is located within the existing 65 DNL contour. This area is planned for future resort development, and is encumbered by noise and avigation easements granted to the DOTA.

CHAPTER 6. FUTURE NOISE ENVIRONMENT

Traffic Noise. Predictions of future traffic noise levels were made using the traffic volume assignments of Reference 10 for 2010 and 2020 for the Do Nothing and Action Scenarios. Included under the Action Scenario was the reconfiguration of the existing tour helicopter facility by 2020. No improvements to the roadways outside the Airport boundaries are included in the proposed Lihue Airport Improvements.

The changes in traffic noise levels between the Do Nothing and the Action Scenarios were calculated and evaluated. For the purposes of this traffic noise analysis, traffic volumes and noise levels associated with the Do Nothing Scenario were considered to be base levels, and the incremental increases in noise levels associated with the Action Scenarios were considered to be attributable to the proposed Lihue Airport Improvements.

Calculations of forecast traffic noise levels along the roadway sections previously evaluated in Chapter 5 - Existing Noise Environment are shown in Table 5-1 for the peak hours of traffic. Appendix C lists the peak hour traffic volumes for the Do Nothing and Action Alternatives in 2010 and 2020. The future traffic volumes in Table 5-1 represent future assignments under the Action Alternative in 2010 and 2020. Table 5-2 depicts the future increases in setback distances to the 66 Leq and 71 Leq traffic noise contours in 2010 and 2020 resulting from both project (Lihue Airport Improvements) and non-project traffic.

Table 6-1 presents the project and non-project contributions to traffic noise level increases along the roadways near Lihue Airport. The largest increases in future traffic noise levels are expected to occur along Ahukini Road between Kapule Highway and Kuhio Highway and along Kapule Highway. Along Ahukini Road east of Kapule Highway, traffic noise increases are predicted to range between 0.4 to 1.3 Leq, which are well below the DOTH criteria of 15 dB for significant increase in traffic noise levels. In addition, no noise sensitive uses are located along this section of Ahukini Road between Kapule Highway and the Lihue Airport entrance. All other increases in future traffic noise levels attributable to the Lihue Airport Improvements are less than the DOTH criteria of 15 dB for significant increase in traffic noise, and are less than 0.5 Leq.

Along the west section of Ahukini Road and along Rice Street, future traffic noise levels at existing residences could exceed the DOTH 66 Leq(h) noise abatement criteria if the dwellings are located within the future 66 Leq setback distances shown in Table 5-2. For the most part, the exceedances of the 66 Leq(h) DOTH criteria level are attributable to existing and future non-project traffic and are not associated with the Lihue Airport Improvements. Where existing or forecasted traffic noise levels exceed DOTH or FHWA noise abatement criteria, traffic noise mitigation measures (such as highway noise barriers) are normally constructed by individual property owners or are included within any roadway improvement project where existing and forecast traffic

TABLE 6-1

CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (2010 AND 2020)

STREET SECTION	NOISE LEVEL INCREASE (Leq) DUE TO NON-PROJECT TRAFFIC (2010)	NOISE LEVEL INCREASE (Leq) DUE TO PROJECT TRAFFIC (2010)	NOISE LEVEL INCREASE (Leq) DUE TO NON-PROJECT TRAFFIC (2020)	NOISE LEVEL INCREASE (Leq) DUE TO PROJECT TRAFFIC (2020)
Kapule Highway (South, PM)	1.8	0.0	2.8	0.4
Kapule Highway (North, AM & PM)	2.0	0.0	3.1	0.0
Ahukini Rd. East of Kapule Hwy. (PM)	0.5	-0.1	1.2	0.1
Ahukini Rd. West of Kapule Hwy. (AM & PM)	2.0	0.0	3.5	0.1
Ahukini Rd. East of Kuhio Hwy. (PM)	3.3	0.0	4.8	0.1
Rice St. West of Kapule Hwy. (PM)	1.0	0.1	2.3	0.1
Rice St. East of Kapule Hwy. (AM & PM)	1.6	0.0	2.8	0.1

noise levels justify those mitigation measures. The inclusion of traffic noise mitigation measures within the proposed Lihue Airport Improvements should not be required since improvements to the off-airport roadways (Ahukini Road, Kapule Highway, Kuhio Highway, or Rice Street) are not part of the proposed Lihue Airport Improvements.

Aircraft Noise - Do Nothing or Action Scenario: The average daily aircraft operations forecast for 2011 and 2020 are shown in Tables 6-2 and 6-3, and are applicable for both the Do Nothing and Action Scenarios. Aircraft flight tracks under the Do Nothing and Action Scenarios were assumed to be identical to those shown in Figures 5-2 through 5-4, since they are associated with the existing runways. The noise contours associated with the Do Nothing or Action Scenario for 2011 and 2020 are shown in Figures 6-1 and 6-2. The aircraft noise monitoring locations are also shown in Figures 6-1 and 6-2. Figure 6-3 depicts the major landowners and proposed developments in the Airport environs with the 2020 DNL contours.

Table 6-4 summarizes the forecast changes in aircraft noise levels at the various aircraft noise monitoring sites from 2005 noise levels. By CY 2011, aircraft noise levels at Lihue Airport are expected to increase by 0.0 to 1.0 DNL above CY 2005 levels. In the Public Precinct area near the Lihue Judiciary Building, increases in aircraft noise levels of 0.5 to 1.0 DNL are predicted to occur between CY 2005 and 2011. New incompatible land uses are not expected to result from the growth in the airport noise contours by CY 2011. Where increases in aircraft noise levels are expected to occur under the Do Nothing or Action Scenario by 2011, the magnitude of the increases are less than the FAA's 1.5 DNL criteria for significant increase. For this reason, it was concluded that additional aircraft noise mitigation measures for improving the land use compatibility situation at Lihue Airport would not be required in 2011 under the Do Nothing or Action Scenario.

The forecast changes in aircraft noise levels at the various aircraft noise monitoring sites between 2005 and 2020 are also shown in Table 6-4. By CY 2020, aircraft noise levels at Lihue Airport are expected to decrease by 0 to 7.3 DNL below CY 2005 levels. Noise sensitive land uses in the Public Precinct area are expected to be removed from the 60 DNL airport noise contours by CY 2020 under the Do Nothing or Action Scenario. For this reason, it was concluded that additional aircraft noise mitigation measures for improving the land use compatibility situation at Lihue Airport would not be required in 2020 under the Do Nothing or Action Scenario.

The forecast replacement of the older B-737(200) aircraft with quieter Stage 3 aircraft by 2020 will result in significant shrinkage of the airport noise contours. The exact date of the replacement is not known. It is anticipated that the airport noise contours will remain similar to those shown in Figure 6-1 until the actual date of aircraft replacement. With the new aircraft in operation, the loudest single event noise levels during takeoff are predicted to decrease by 10 to 12 dB below existing single event levels. These single event noise reductions will be noticeable, and should be similar to the reductions which occurred when the DC-9(50) aircraft were replaced with the B-717(200) aircraft.

TABLE 6-2. FORECAST AVERAGE DAILY OPERATIONS BY ALL AIRCRAFT AT LIHUE AIRPORT DURING 2011

LIHUE CY 2011 LANDINGS/DAY:

A/C	TOTAL DAILY LANDINGS	TRADE RWY 35 (TR9I)	TRADE RWY 3	KONA RWY 17 (TR8H)	KONA RWY 21 (TR8)
B-767(300)/A-310/A-300	0.52	0.45		0.00	0.06
B-757(200)/A-320	7.00	6.09		0.05	0.86
DC-8(70s)	0.00	0.00		0.00	0.00
Sub-total (Day):	7.52	6.54		0.05	0.92
B-767(300)/A-310/A-300	0.00	0.00		0.00	0.00
B-757(200)/A-320	0.00	0.00		0.00	0.00
DC-8(70s)	0.00	0.00		0.00	0.00
Sub-total (Night):	0.00	0.00		0.00	0.00

A/C	TOTAL DAILY LANDINGS	TRADE RWY 35 (TR9)	TRADE RWY 35 (TR9I)	TRADE RWY 3 (TR5)	TRADE RWY 3 (TR6)	KONA RWY 17 (TR8H)	KONA RWY 21 (TR8)
B-737(200)	13.00	10.42	0.32	0.00	0.57	0.00	1.69
B-737(200QC)	1.00	0.80	0.02	0.00	0.04	0.00	0.13
B-717(200)	14.00	11.22	0.35	0.00	0.61	0.00	1.82
Bomb CRJ 200	5.00	4.01	0.12	0.00	0.22	0.00	0.65
DHC-8	5.00	2.18	0.00	2.18	0.00	0.00	0.65
Sub-total (Day):	38.00	28.63	0.81	2.18	1.44	0.00	4.94
B-737(200)	1.00	0.34	0.34	0.00	0.08	0.00	0.25
B-737(200QC)	2.00	0.68	0.68	0.00	0.15	0.00	0.50
B-717(200)	2.00	0.68	0.68	0.00	0.15	0.00	0.50
Bomb CRJ 200	1.00	0.34	0.34	0.00	0.08	0.00	0.25
DHC-8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub-Total (Nite):	6.00	2.04	2.04	0.00	0.46	0.00	1.50

A/C	TOTAL DAILY LANDINGS	TRADE RWY 35 (TR9)	TRADE RWY 35 (TR9I)	TRADE RWY 3 (TR5)	KONA RWY 21 (TR8)
CESSN 208	3.00	0.00	0.00	2.61	0.39
SHORTS 330	2.00	0.00	0.00	1.74	0.26
Sub-total (Day):	5.00	0.00	0.00	4.35	0.65
Sub-total (Nite):	0.00	0.00	0.00	0.00	0.00

TABLE 6-2 (Continued). F0RECAST AVERAGE DAILY OPERATIONS BY ALL AIRCRAFT AT LIHUE AIRPORT DURING 2011

A/C	TOTAL DAILY LANDINGS	--------TRADE--------		---------KONA----------	
		RWY 3 (TR5)	RWY 35	RWY 21 (TR8)	RWY 17
CESSN 414	2.00	1.74	0.00	0.26	
BEECH 1900	2.00	1.74	0.00	0.26	
Sub-total (Day):	4.00	3.48	0.00	0.52	
		(TR10)	(TR16)	(TR15)	
HELICOPTER	80.42	7.00	62.97	10.46	
Sub-total (Day):	80.42	7.00	62.97	10.46	
Sub-total (Nite):	0.00	0.00	0.00	0.00	

A/C	TOTAL DAILY LANDINGS	--------TRADE--------		---------KONA--------	
		RWY 35 (TR9)	RWY 35 (TR9I)	RWY 21 (TR8)	RWY 17
GULFSTREAM IV	0.51	0.22	0.22	0.07	
CESSN 750/FALCON	0.51	0.22	0.22	0.07	
Sub-total (Day):	1.02	0.44	0.44	0.14	

		--------TRADE--------		---------KONA--------	
		RWY 3 (TR5)	LOCAL (TR17)	RWY 21 (TR8)	LOCAL (TR18)
COMTEP	1.48	0.64	0.65	0.10	0.10
COMSEP	13.26	1.78	9.76	0.27	1.46
Sub-total (Day):	14.74	2.41	10.41	0.36	1.56

		--------TRADE--------		---------KONA--------	
		RWY 35 (TR9I)	LOCAL (TR17)	RWY 21 (TR8)	LOCAL (TR18)
C-130	2.74	1.43	0.95	0.21	0.14
P-3C	2.74	1.43	0.95	0.21	0.14
MIL HELO	1.78	0.93	0.62	0.14	0.09
Sub-total (Day):	7.26	3.79	2.52	0.56	0.37

TABLE 6-2 (Continued). F0RECAST AVERAGE DAILY OPERATIONS BY ALL AIRCRAFT AT LIHUE AIRPORT DURING 2011

LIHUE CY 2011 DEPARTURES/DAY:

A/C	TOTAL DAILY DEPART.'S	--------TRADE-------- RWY 35 (TR3)	RWY 3 (TR1A)	---------KONA--------- RWY 17 (TR4)	RWY 21
B-767(300)/A-310/A-300	0.52	0.00	0.45	0.07	
B-757(200)/A-320	4.00	0.00	3.48	0.52	
DC-8(70s)	0.00	0.00	0.00	0.00	
Sub-total (Day):	4.52	0.00	3.93	0.59	
B-767(300)/A-310/A-300	0.00	0.00	0.00	0.00	
B-757(200)/A-320	3.00	2.25	0.00	0.75	
DC-8(70s)	0.00	0.00	0.00	0.00	
Sub-total (Night):	3.00	2.25	0.00	0.75	

A/C	TOTAL DAILY DEPART'S	----------TRADE---------- RWY 3 (TR1A)	RWY 3I (TR1A)	RWY 3 (TR1B)	---------KONA--------- RWY 17 (TR4)	RWY 21 (TR2)
B-737(200)	13.00	11.31	0.00	0.00	1.69	0.00
B-737(200QC)	0.00	0.00	0.00	0.00	0.00	0.00
B-717(200)	15.00	13.05	0.00	0.00	1.95	0.00
Bomb CRJ 200	5.00	4.35	0.00	0.00	0.65	0.00
DHC-8	5.00	0.00	2.18	2.18	0.60	0.05
Sub-total (Day):	38.00	28.71	2.18	2.18	4.89	0.05
B-737(200)	1.00	0.00	0.75	0.00	0.25	0.00
B-737(200QC)	3.00	0.00	2.25	0.00	0.75	0.00
B-717(200)	1.00	0.00	0.75	0.00	0.25	0.00
Bomb CRJ 200	1.00	0.00	0.75	0.00	0.25	0.00
DHC-8	0.00	0.00	0.00	0.00	0.00	0.00
Sub-Total (Nite):	6.00	0.00	4.50	0.00	1.50	0.00

A/C	TOTAL DAILY DEPART'S	--------TRADE-------- RWY 3 (TR1B)	RWY 3 (TR1C)	---------KONA--------- RWY 17 (TR4)	RWY 21 (TR2)
CESSN 208	3.00	1.31	1.31	0.04	0.35
SHORTS 330	2.00	0.87	0.87	0.03	0.23
Sub-total (Day):	5.00	2.18	2.18	0.07	0.59
Sub-total (Nite):	0.00	0.00	0.00	0.00	0.00

TABLE 6-2 (Continued). F0RECAST AVERAGE DAILY OPERATIONS BY ALL AIRCRAFT AT LIHUE AIRPORT DURING 2011

A/C	TOTAL DAILY DEPART'S	--------TRADE-------- RWY 3 (TR1B)	RWY 3 (TR1C)	---------KONA--------- RWY 17 (TR4)	RWY 21 (TR2)
CESSN 414	2.00	0.87	0.87	0.03	0.23
BEECH 1900	2.00	0.87	0.87	0.03	0.23
Sub-total (Day):	4.00	1.74	1.74	0.06	0.46
		(TR12)	(TR13)	(TR14)	(TR14A)
HELICOPTER	80.42	69.27	0.70	7.84	2.61
Sub-total (Day):	78.01	66.86	0.70	7.84	2.61
Sub-total (Nite):	2.41	2.41	0.00	0.00	0.00

A/C	TOTAL DAILY DEPART'S	--------TRADE--------- RWY 3 (TR1A)	RWY 35	---------KONA--------- RWY 21 (TR2)	RWY 17 (TR4)
GULFSTREAM IV	0.51	0.44		0.00	0.07
CESSN 750/FALCON	0.51	0.44		0.00	0.07
Sub-total (Day):	1.02	0.88		0.00	0.14
		---------TRADE-------- RWY 3 (TR1C)	LOCAL (TR17)	---------KONA--------- RWY 21 (TR2)	LOCAL (TR18)
COMTEP	1.48	0.64	0.65	0.10	0.10
COMSEP	13.26	1.78	9.76	0.27	1.46
Sub-total (Day):	14.74	2.41	10.41	0.36	1.56
		--------TRADE-------- RWY 35 (TR3)	LOCAL (TR17)	---------KONA-------- RWY 17 (TR4)	LOCAL (TR18)
C-130	2.74	1.43	0.95	0.21	0.14
P-3C	2.74	1.43	0.95	0.21	0.14
MIL HELO	1.78	0.93	0.62	0.14	0.09
Sub-total (Day):	7.26	3.79	2.52	0.56	0.37

TABLE 6-3. FORECAST AVERAGE DAILY OPERATIONS BY ALL AIRCRAFT AT LIHUE AIRPORT DURING 2020

LIHUE CY 2020 LANDINGS/DAY:

A/C	TOTAL DAILY LANDINGS	TRADE RWY 35 (TR9I)	TRADE RWY 3	KONA RWY 17 (TR8H)	KONA RWY 21 (TR8)
B-767(300)/A-310/A-300	3.00	2.61		0.02	0.37
B-757(200)/A-320	8.00	6.96		0.05	0.99
DC-8(70s)	0.00	0.00		0.00	0.00
Sub-total (Day):	11.00	9.57		0.07	1.36
B-767(300)/A-310/A-300	0.00	0.00		0.00	0.00
B-757(200)/A-320	0.00	0.00		0.00	0.00
DC-8(70s)	0.00	0.00		0.00	0.00
Sub-total (Night):	0.00	0.00		0.00	0.00

A/C	TOTAL DAILY LANDINGS	TRADE RWY 35 (TR9)	TRADE RWY 35 (TR9I)	TRADE RWY 3 (TR5)	TRADE RWY 3 (TR6)	KONA RWY 17 (TR8H)	KONA RWY 21 (TR8)
B-737(400/700)	14.00	11.22	0.35	0.00	0.61	0.00	1.82
B-737(400)	0.42	0.34	0.01	0.00	0.02	0.00	0.06
B-717(200)	15.00	12.03	0.37	0.00	0.65	0.00	1.95
Bomb CRJ 200	7.00	5.61	0.17	0.00	0.30	0.00	0.91
DHC-8	7.00	3.05	0.00	3.05	0.00	0.00	0.91
Sub-total (Day):	43.42	32.25	0.90	3.05	1.58	0.00	5.65
B-737(400/700)	1.00	0.34	0.34	0.00	0.08	0.00	0.25
B-737(400)	3.00	1.01	1.01	0.00	0.23	0.00	0.75
B-717(200)	2.00	0.68	0.68	0.00	0.15	0.00	0.50
Bomb CRJ 200	1.00	0.34	0.34	0.00	0.08	0.00	0.25
DHC-8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub-Total (Nite):	7.00	2.37	2.37	0.00	0.54	0.00	1.75

A/C	TOTAL DAILY LANDINGS	TRADE RWY 35 (TR9)	TRADE RWY 35 (TR9I)	TRADE RWY 3 (TR5)	KONA RWY 21 (TR8)
CESSN 208	3.00	0.00	0.00	2.61	0.39
SHORTS 330	2.00	0.00	0.00	1.74	0.26
Sub-total (Day):	5.00	0.00	0.00	4.35	0.65
Sub-total (Nite):	0.00	0.00	0.00	0.00	0.00

TABLE 6-3 (Continued). F0RECAST AVERAGE DAILY OPERATIONS BY ALL AIRCRAFT AT LIHUE AIRPORT DURING 2020

A/C	TOTAL DAILY LANDINGS	--------TRADE--------		---------KONA----------	
		RWY 3 (TR5)	RWY 35	RWY 21 (TR8)	RWY 17
CESSN 414	2.00	1.74	0.00	0.26	
BEECH 1900	2.00	1.74	0.00	0.26	
Sub-total (Day):	4.00	3.48	0.00	0.52	
		(TR10)	(TR16)	(TR15)	
HELICOPTER	93.74	8.16	73.40	12.19	
Sub-total (Day):	93.74	8.16	73.40	12.19	
Sub-total (Nite):	0.00	0.00	0.00	0.00	

A/C	TOTAL DAILY LANDINGS	--------TRADE--------		---------KONA--------	
		RWY 35 (TR9)	RWY 35 (TR9I)	RWY 21 (TR8)	RWY 17
GULFSTREAM IV	0.56	0.24	0.24	0.07	
CESSN 750/FALCON	0.56	0.24	0.24	0.07	
Sub-total (Day):	1.12	0.48	0.48	0.14	

		--------TRADE--------		---------KONA---------	
		RWY 3 (TR5)	LOCAL (TR17)	RWY 21 (TR8)	LOCAL (TR18)
COMTEP	1.62	0.78	0.63	0.12	0.09
COMSEP	14.48	1.93	10.66	0.29	1.59
Sub-total (Day):	16.10	2.71	11.29	0.41	1.69

		--------TRADE--------		---------KONA---------	
		RWY 35 (TR9I)	LOCAL (TR17)	RWY 21 (TR8)	LOCAL (TR18)
C-130	2.74	1.43	0.95	0.21	0.14
P-3C	2.74	1.43	0.95	0.21	0.14
MIL HELO	1.78	0.93	0.62	0.14	0.09
Sub-total (Day):	7.26	3.79	2.52	0.56	0.37

TABLE 6-3 (Continued). F0RECAST AVERAGE DAILY OPERATIONS BY ALL AIRCRAFT AT LIHUE AIRPORT DURING 2020

LIHUE CY 2020 DEPARTURES/DAY:

A/C	TOTAL DAILY DEPART.'S	TRADE RWY 35 (TR3)	TRADE RWY 3 (TR1A)	KONA RWY 17 (TR4)	KONA RWY 21
B-767(300)/A-310/A-300	3.00	0.00	2.61	0.39	
B-757(200)/A-320	3.00	0.00	2.61	0.39	
DC-8(70s)	0.00	0.00	0.00	0.00	
Sub-total (Day):	6.00	0.00	5.22	0.78	
B-767(300)/A-310/A-300	0.00	0.00	0.00	0.00	
B-757(200)/A-320	5.00	3.75	0.00	1.25	
DC-8(70s)	0.00	0.00	0.00	0.00	
Sub-total (Night):	5.00	3.75	0.00	1.25	

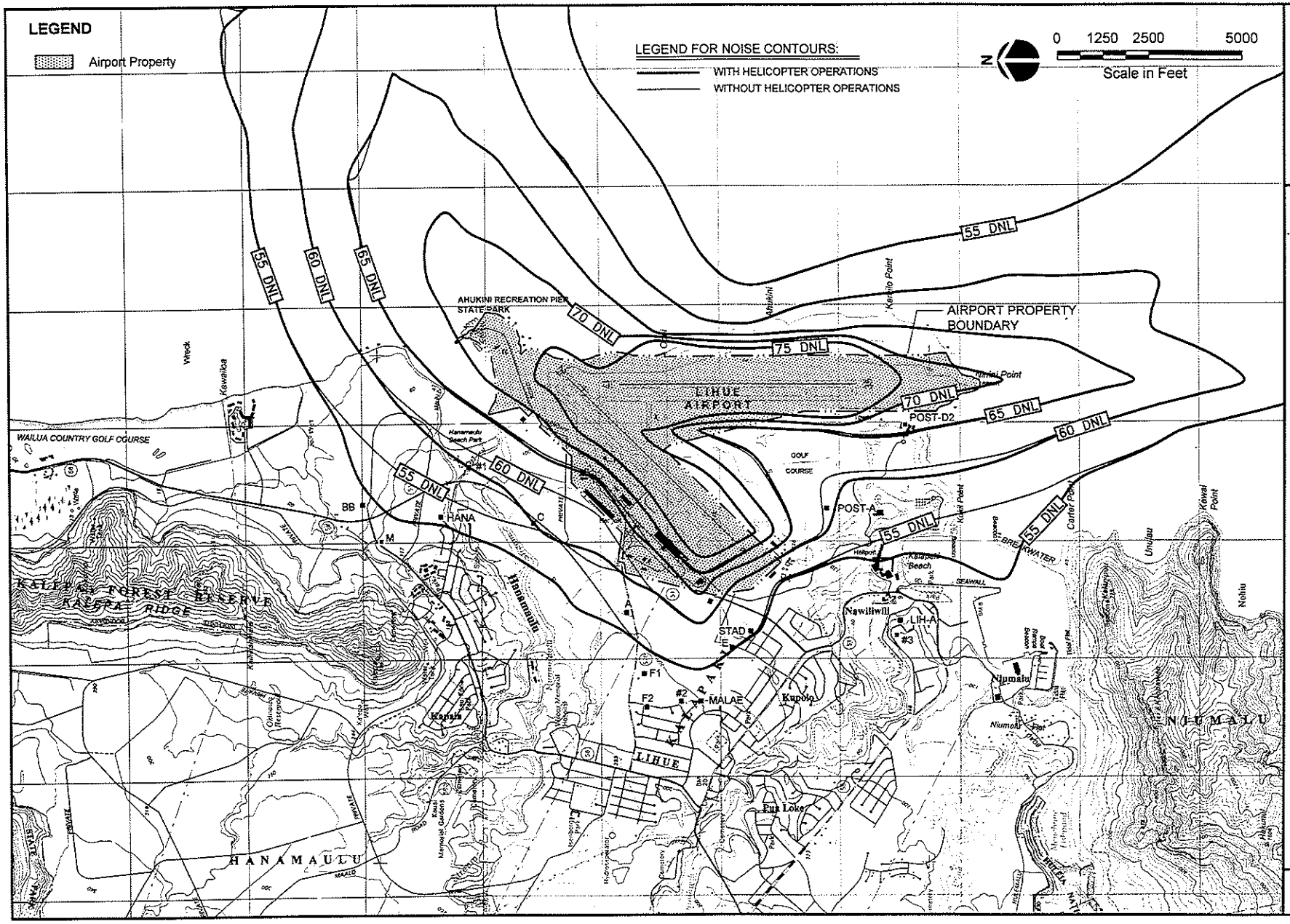
A/C	TOTAL DAILY DEPART'S	TRADE RWY 3 (TR1A)	TRADE RWY 3I (TR1A)	TRADE RWY 3 (TR1B)	KONA RWY 17 (TR4)	KONA RWY 21 (TR2)
B-737(400/700)	14.00	12.18	0.00	0.00	1.82	0.00
B-737(400)	0.42	0.37	0.00	0.00	0.06	0.00
B-717(200)	15.00	13.05	0.00	0.00	1.95	0.00
Bomb CRJ 200	7.00	6.09	0.00	0.00	0.91	0.00
DHC-8	7.00	0.00	3.05	3.05	0.84	0.07
Sub-total (Day):	43.42	31.69	3.05	3.05	5.58	0.07
B-737(400/700)	1.00	0.00	0.75	0.00	0.25	0.00
B-737(400)	3.00	0.00	2.25	0.00	0.75	0.00
B-717(200)	2.00	0.00	1.50	0.00	0.50	0.00
Bomb CRJ 200	1.00	0.00	0.75	0.00	0.25	0.00
DHC-8	0.00	0.00	0.00	0.00	0.00	0.00
Sub-Total (Nite):	7.00	0.00	5.25	0.00	1.75	0.00

A/C	TOTAL DAILY DEPART'S	TRADE RWY 3 (TR1B)	TRADE RWY 3 (TR1C)	KONA RWY 17 (TR4)	KONA RWY 21 (TR2)
CESSN 208	3.00	1.31	1.31	0.04	0.35
SHORTS 330	2.00	0.87	0.87	0.03	0.23
Sub-total (Day):	5.00	2.18	2.18	0.07	0.59
Sub-total (Nite):	0.00	0.00	0.00	0.00	0.00

TABLE 6-3 (Continued). F0RECAST AVERAGE DAILY OPERATIONS BY ALL AIRCRAFT AT LIHUE AIRPORT DURING 2020

A/C	TOTAL DAILY DEPART'S	---------TRADE-------- RWY 3 (TR1B)	RWY 3 (TR1C)	----------KONA--------- RWY 17 (TR4)	RWY 21 (TR2)
CESSN 414	2.00	0.87	0.87	0.03	0.23
BEECH 1900	2.00	0.87	0.87	0.03	0.23
Sub-total (Day):	4.00	1.74	1.74	0.06	0.46
		(TR12)	(TR13)	(TR14)	(TR14A)
HELICOPTER	93.74	80.74	0.82	9.14	3.05
Sub-total (Day):	90.93	77.93	0.82	9.14	3.05
Sub-total (Nite):	2.81	2.81	0.00	0.00	0.00

A/C	TOTAL DAILY DEPART'S	--------TRADE-------- RWY 3 (TR1A)	RWY 35	---------KONA--------- RWY 21 (TR2)	RWY 17 (TR4)
GULFSTREAM IV	0.56	0.49		0.00	0.07
CESSN 750/FALCON	0.56	0.49		0.00	0.07
Sub-total (Day):	1.12	0.98		0.00	0.14
		--------TRADE-------- RWY 3 (TR1C)	LOCAL (TR17)	---------KONA--------- RWY 21 (TR2)	LOCAL (TR18)
COMTEP	1.62	0.78	0.63	0.12	0.09
COMSEP	14.48	1.93	10.66	0.29	1.59
Sub-total (Day):	16.10	2.71	11.29	0.41	1.69
		--------TRADE-------- RWY 35 (TR3)	LOCAL (TR17)	----------KONA-------- RWY 17 (TR4)	LOCAL (TR18)
C-130	2.74	1.43	0.95	0.21	0.14
P-3C	2.74	1.43	0.95	0.21	0.14
MIL HELO	1.78	0.93	0.62	0.14	0.09
Sub-total (Day):	7.26	3.79	2.52	0.56	0.37



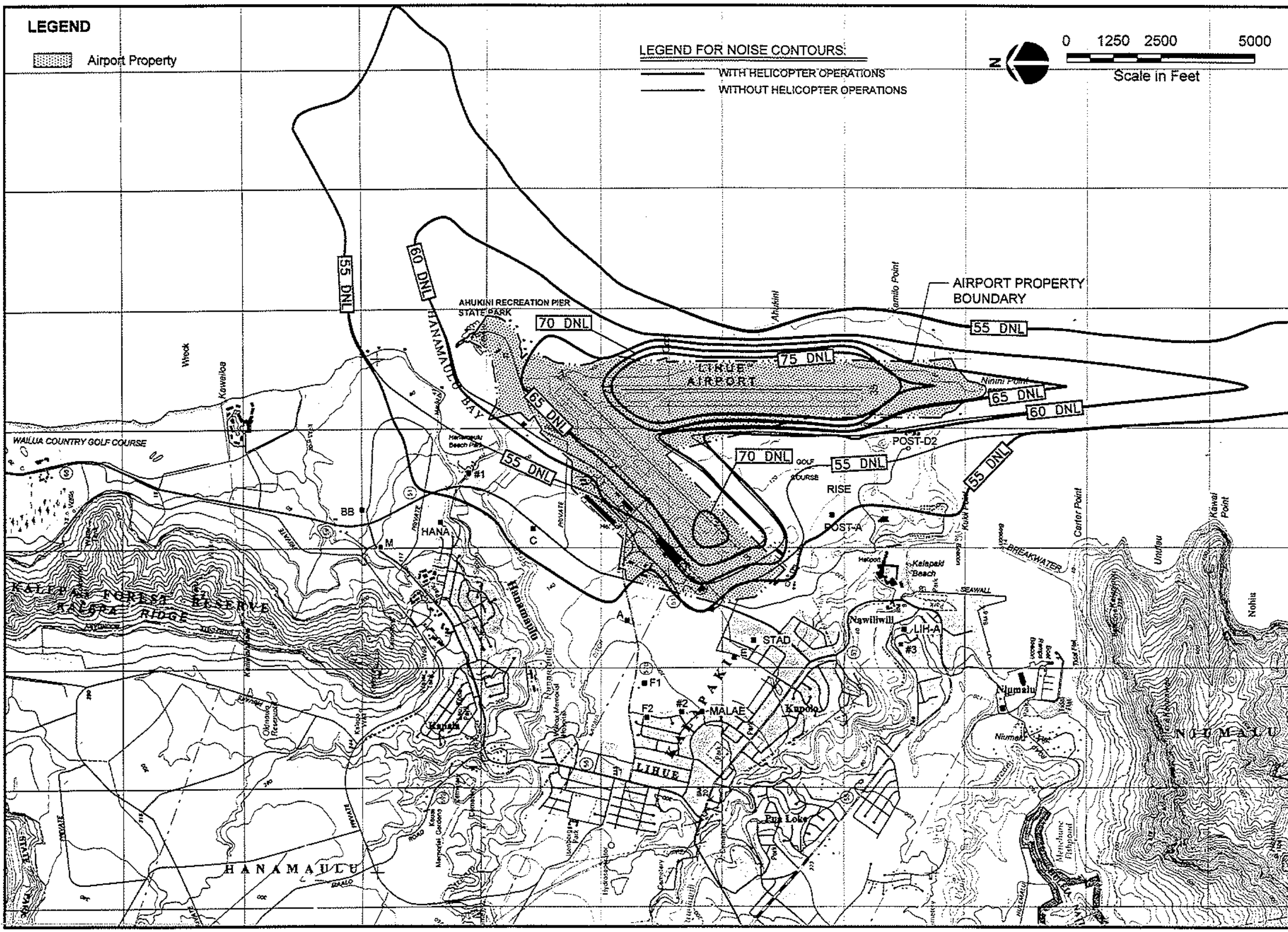
Airports Division
DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII

LIHUE AIRPORT

COMPARISON OF 2011 AIRCRAFT NOISE CONTOURS WITH AND WITHOUT HELICOPTER OPERATIONS

Prepared by:
WILSON OKAMOTO CORPORATION
ARIES CONSULTANTS LTD.
Y. EBISU & ASSOCIATES

FIGURE 6-1



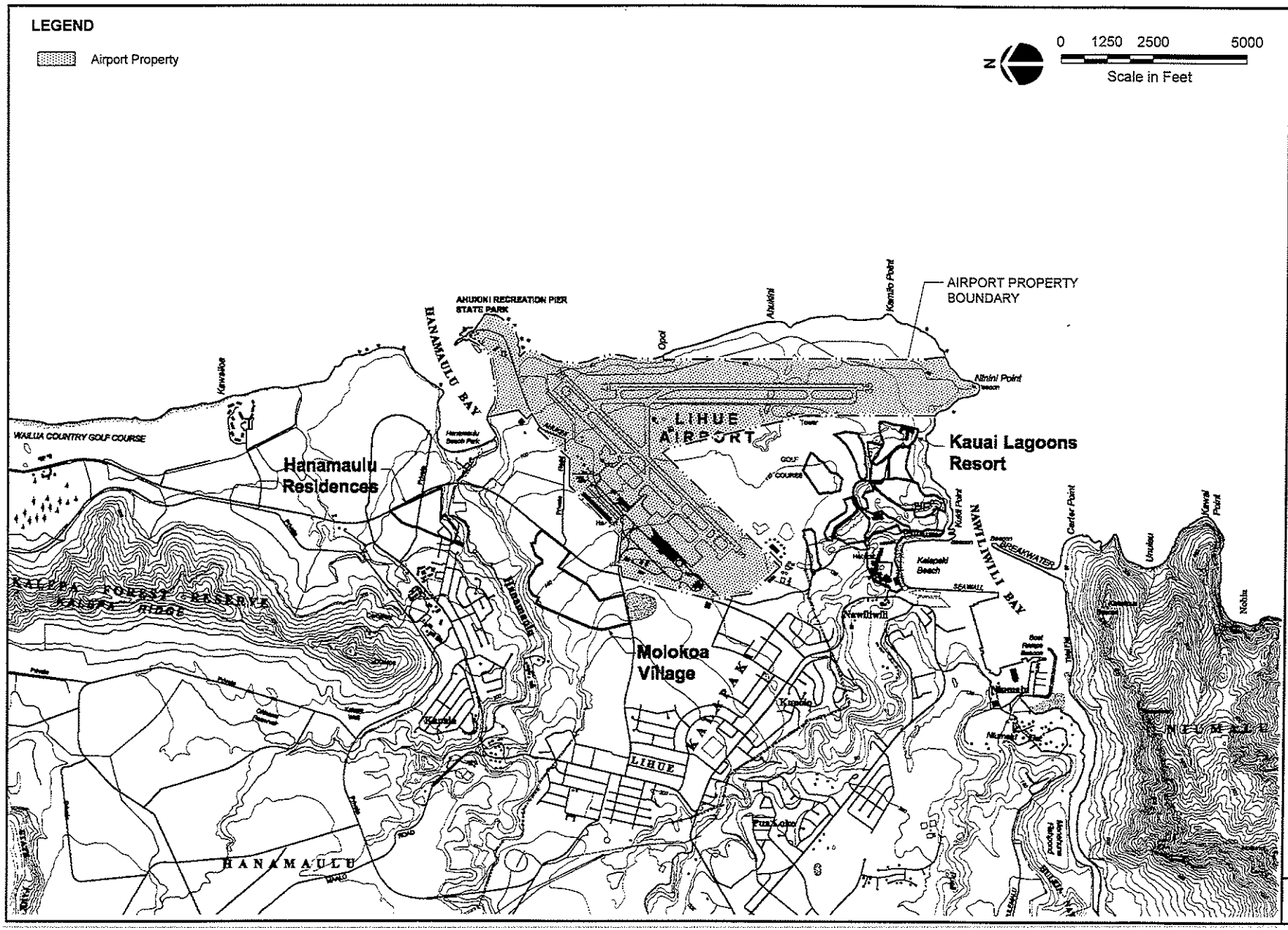
Airports Division
DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII

LIHUE AIRPORT

COMPARISON OF 2020 AIRCRAFT NOISE CONTOURS WITH AND WITHOUT HELICOPTER OPERATIONS

Prepared by:
WILSON OKAMOTO CORPORATION
ARIES CONSULTANTS LTD.
Y. EBISU & ASSOCIATES

FIGURE 6-2



Airports Division
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STATE OF HAWAII

LIHUE AIRPORT

PROPOSED DEVELOPMENTS IN AIRPORT ENVIRONS

FIGURE 6-3

TABLE 6-4
COMPARISON OF AIRCRAFT NOISE LEVELS ASSOCIATED WITH VARIOUS ALTERNATIVES, LIHUE AIRPORT

	DNL AT NOISE MEASUREMENT LOCATIONS														
	#1	#2	#3	A	BB	C	E	F1	F2	POST-D2	M	HANA	STAD	LIH-A	MALAE
2005 BASE YEAR	59.2	51.6	51.0	55.4	54.0	59.4	56.1	52.5	50.5	65.0	53.2	55.0	55.8	50.3	51.8
2005 W/O HELO OPS.	57.6	51.5	50.9	55.1	50.8	54.8	56.0	52.4	50.4	64.9	49.5	52.7	55.7	49.1	51.8
(Change from Base Year)	-1.6	-0.1	-0.1	-0.3	-3.2	-4.6	-0.1	-0.1	-0.1	-0.1	-3.7	-2.3	-0.1	-1.2	0.0
NO ACTION AND ACTION ALTERNATIVES (CY 2011)															
2011 WITH HELO OPS.	59.8	52.2	51.5	56.3	54.7	60.0	56.3	53.2	51.2	66.0	53.9	55.7	55.3	51.0	52.3
(Change from Base Year)	0.6	0.6	0.5	0.9	0.7	0.6	0.2	0.7	0.7	1.0	0.7	0.7	-0.5	0.7	0.5
2011 W/O HELO OPS.	58.3	52.1	50.7	56.1	51.6	55.5	56.2	53.1	51.1	65.9	50.3	53.4	55.3	49.7	52.3
(Change from Base Year)	-0.9	0.5	-0.3	0.7	-2.4	-3.9	0.1	0.6	0.6	0.9	-2.9	-1.6	-0.5	-0.6	0.5
NO ACTION AND ACTION ALTERNATIVES (CY 2020)															
2020 WITH HELO OPS.	56.8	44.4	49.8	49.4	53.1	59.2	48.6	45.5	43.5	59.1	52.5	53.3	48.5	48.7	44.5
(Change from Base Year)	-2.4	-7.2	-1.2	-6.0	-0.9	-0.2	-7.5	-7.0	-7.0	-5.9	-0.7	-1.7	-7.3	-1.6	-7.3
2020 W/O HELO OPS.	51.4	43.9	48.2	47.8	43.8	48.5	48.3	45.0	42.9	58.2	42.4	46.0	48.1	45.7	44.1
(Change from Base Year)	-7.8	-7.7	-2.8	-7.6	-10.2	-10.9	-7.8	-7.5	-7.6	-6.8	-10.8	-9.0	-7.7	-4.6	-7.7

CHAPTER 7. DISCUSSION OF PROJECT RELATED NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES

Traffic Noise. Risks of future traffic noise impacts resulting from the proposed Lihue Airport Improvements are considered to be low due to the relatively small increases in traffic noise associated with the Action Alternative. The largest increases in traffic noise attributable to the Lihue Airport Improvements are anticipated to occur along Kapule Highway, and the forecast increases are less than 0.5 DNL from CY 2004 to CY 2020. Traffic noise level increases associated with the Action Alternative are not expected to exceed the DOTH "greater than 15 dB increase" criteria. Along all roadways in the airport environs, risks of adverse traffic noise impacts are expected to be minimal due to the relatively small increases in traffic volumes anticipated. Along the section of Ahukini Road east of Kapule Highway, which primarily services Lihue Airport, future traffic noise level increases of approximately 5 DNL are expected to be the highest among the roadways in the project environs with or without implementation of the Lihue Airport Improvements. However, the land uses along this roadway do not contain any noise sensitive uses. For these reasons, adverse traffic noise impacts are not expected to result from the Lihue Airport Improvement's Action Alternative.

Potential noise impacts along the public roadways which service Lihue Airport are possible irrespective of the selected development alternative for Lihue Airport, and in respect to both existing and planned noise sensitive receptors along these roadways (Kapule Highway, Ahukini Road west of Kapule Highway, Rice Street, and Kuhio Highway). Existing and future residences which are located along these roadways may be impacted by traffic noise if their setback distances to the 66 Leq(h) contours are less than those indicated in Table 5-2. Because traffic noise along public roadways are generated by non-project as well as project traffic, mitigation of off-site traffic noise impacts are generally performed by individual property owners fronting the roadways' Right-of-Way or by public agencies during roadway improvement projects. These mitigation measures generally take the form of increased setbacks, sound attenuating walls, total closure and air conditioning, or the use of sound attenuating windows.

Aircraft Noise. Based on the forecasted aircraft noise contours which were developed for the proposed Lihue Airport Improvements, it was concluded that significant aircraft noise impacts need not occur in the Lihue Airport. The primary reason for this is that the mix of quieter Stage 3 aircraft is expected to increase to 100 percent of the total interisland air carrier fleet by CY 2020. Therefore, even with increasing aircraft operations at Lihue Airport, the resulting noise contours at the airport are not expected to increase by the FAA criteria of 1.5 DNL under the Do Nothing or Action Alternatives. Because the Lihue Airport Improvements should not result in increases of airport noise by greater than 1.5 DNL at noise sensitive receptor locations within the 60 or 65 DNL contours, adverse noise impacts (as defined in Reference 14) should not occur.

Prior to the replacement of the B-737(200) aircraft with the quieter Stage 3 aircraft, the 60 DNL noise contour will enclose existing noise sensitive buildings within

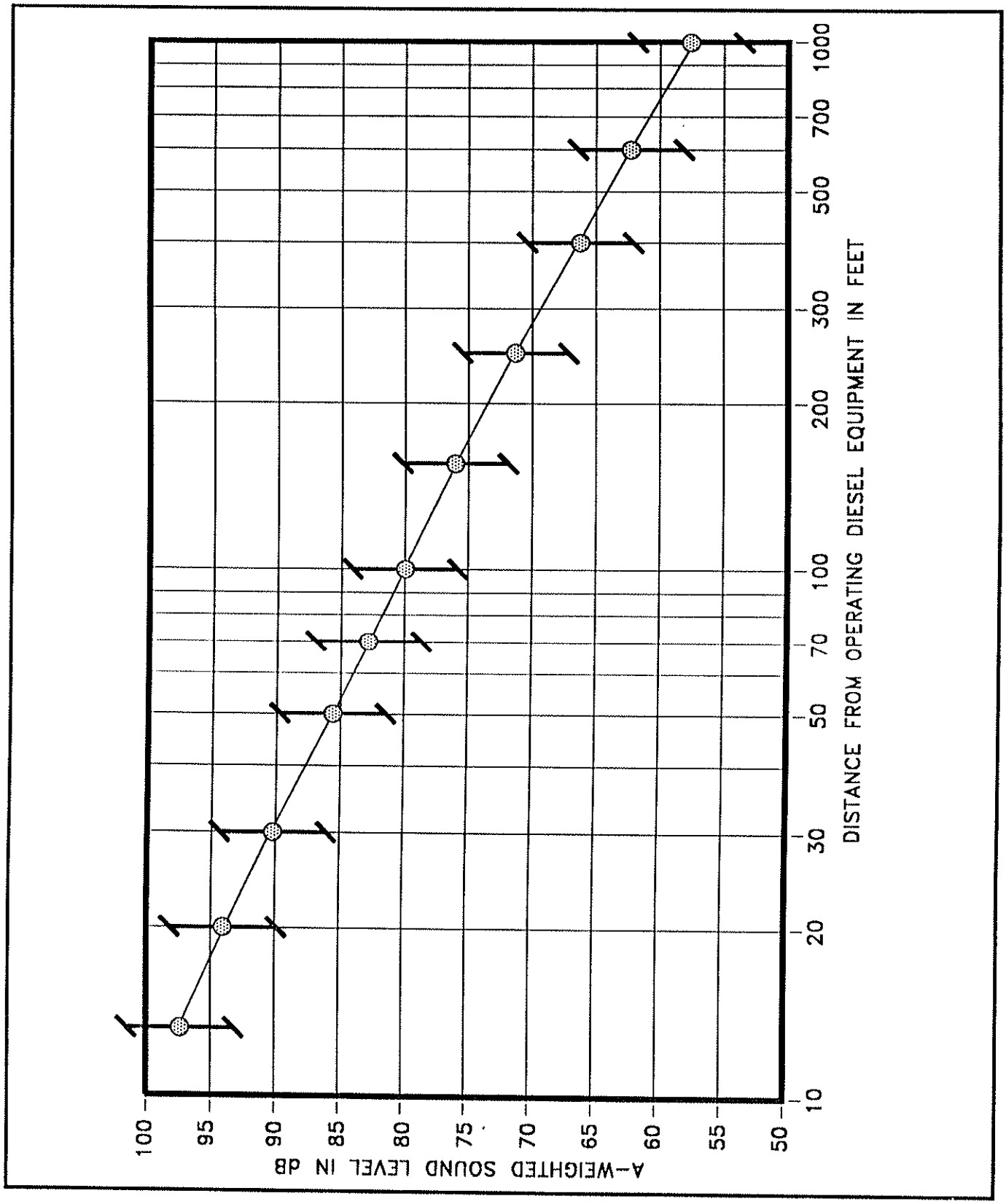
the Public Precinct area, and possibly enclose future residential and resort developments in the Kauai Lagoons Resort area. Therefore, the use of sound attenuation construction at the affected buildings will be required through 2011 and until the actual date of replacement of the noisier B-737(200) aircraft with the quieter Stage 3 aircraft. The inclusion of aircraft noise disclosures in real estate transactions within the 55 and 60 DNL contours will also be required through 2011 until the airport's FAR Part 150 noise contours are updated to reflect the lower noise levels associated with the new aircraft.

CHAPTER 8. OTHER NOISE IMPACT CONSIDERATIONS

Noise from Other On-Site Airport Facilities. Noise from other on-site facilities at Lihue Airport are primarily associated with mechanical equipment such as air conditioning and refrigeration condensers and chillers, blowers, emergency generator equipment, and ground transportation vehicles. Because the existing and planned airport facilities are located at relatively large (500+ FT) distances from noise sensitive areas, adverse noise impacts from these on-site facilities are not anticipated. Additionally, if airport equipment or facilities need to be located near noise sensitive properties, sound attenuation treatment may be applied to the airport equipment or facilities to minimize the possible adverse noise impacts from these units.

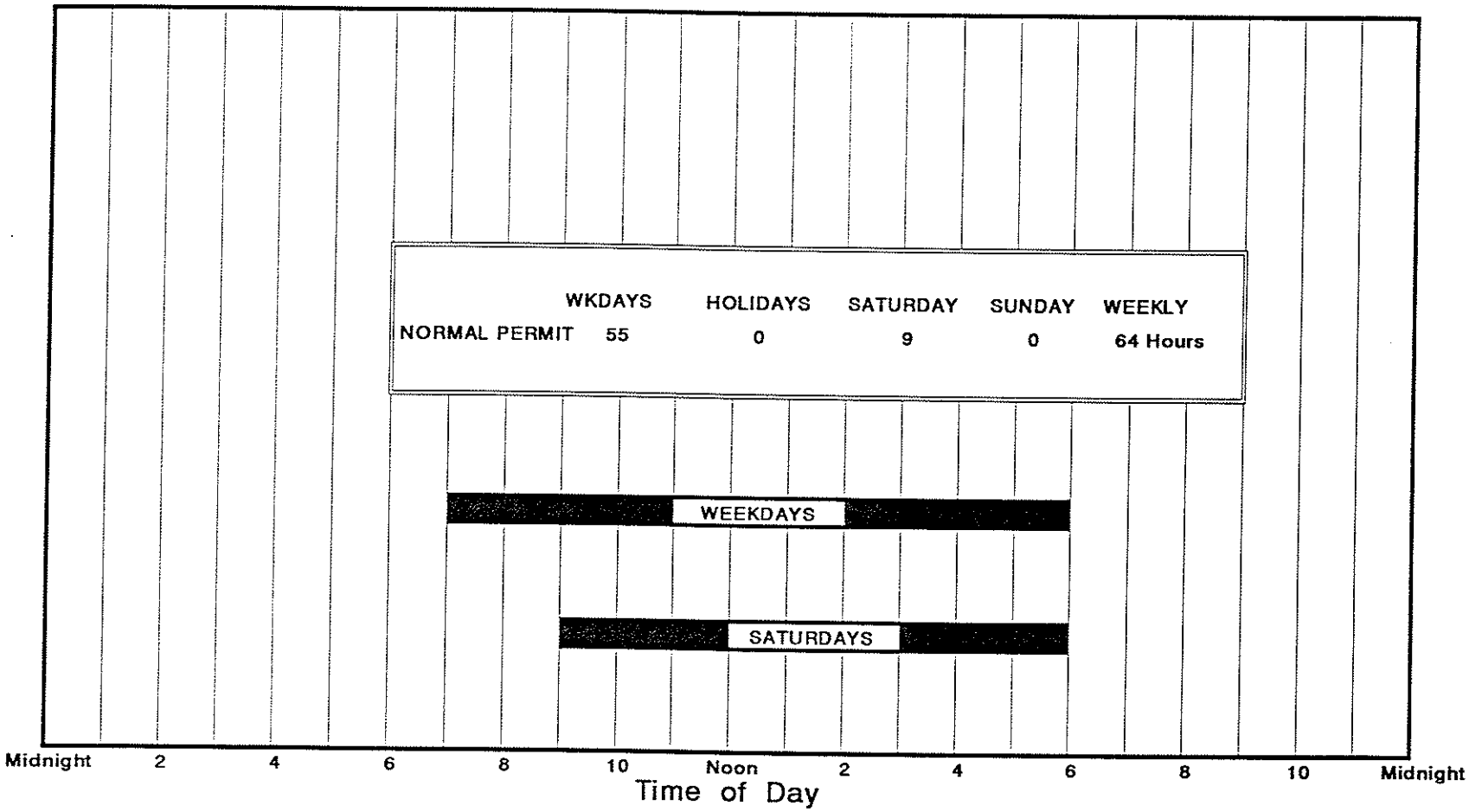
Construction Noise. Audible construction noise will probably be unavoidable during the entire airport construction period. The total time period for construction is unknown, but it is anticipated that the actual work will be moving from one location on the airport site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of noise from construction activity (excluding pile driving activity) are shown in Figure 8-1. The noise sensitive properties which are predicted to experience the highest noise levels during construction activities on the airport site are the existing residences at Kukii Point, Nawiliwili, Hanamaulu, and Hanamaulu Bay. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the various construction sites.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 FT distance), and due to the exterior nature of the work (grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job sites. The incorporation of State Department of Health (DOH) construction noise limits and curfew times, which are applicable on the island of Kauai (Reference 6), is another noise mitigation measure which can be applied to this project. Table 8-1 depicts the allowed hours of construction which exceed the noise DOH limits of Reference 6. Noisy construction activities are not allowed on Sundays or holidays under the DOH permit procedures.



ANTICIPATED RANGE OF CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 8-1



AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

TABLE 8–1

APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control;" Federal Interagency Committee on Urban Noise; June 1980.

(2) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; July 12, I979.

(3) "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety;" Environmental Protection Agency (EPA 550/9-74-004); March 1974.

(4) "Mandatory Seller Disclosures in Real Estate Transactions;" Chapter 508D, Hawaii Revised Statutes; July 1, 1996.

(5) "Noise Analysis and Abatement Policy;" Hawaii State Department of Transportation, Highways Division, Materials Testing and Research Branch; June 1997.

(6) "Title 11, Administrative Rules, Chapter 46, Community Noise Control;" Hawaii State Department of Health; September 23, 1996.

(7) "Acoustic Study for the Lihue-Hanamaulu Master Plan; Lihue, Kauai, Hawaii;" Y. Ebisu & Associates; September 1994.

(8) "FAR Part 150 Noise Compatibility Program; Volume 1: Noise Exposure Map Report; Lihue Airport; Lihue, Hawaii;" Hawaii State Department of Transportation, Airports Division; September 1989.

(9) "FHWA Traffic Noise Model User's Guide;" FHWA-PD-96-009, Federal Highway Administration; Washington, D.C.; January 1998 and Version 2.5 Upgrade (April 14, 2004).

(10) "Traffic Impact Report; Lihue Airport Improvements;" Wilson Okamoto Corporation; July 2006.

(11) September 15-17, 2003, 24-Hour Traffic Counts; Station 22-C, Kapule Highway at Ahukini Road; Hawaii State Department of Transportation.

(12) September 16-17, 2003, 24-Hour Traffic Counts; Station 22-D, Kuhio Highway at Kapule Highway; Hawaii State Department of Transportation.

(13) September 17-18, 2003, 24-Hour Traffic Counts; Station 22-A, Kuhio Highway at Ahukini Road and Oxford Street; Hawaii State Department of Transportation.

APPENDIX A. REFERENCES (CONTINUED)

(14) "FAA Order No. 1050.1E - Environmental Impacts: Policies and Procedures;" Federal Aviation Administration; June 8, 2004 (Change 4).

(15) "Integrated Noise Model (INM) Version 6.1 User's Guide;" FAA-AEE-99-03; March 4, 2003.

(16) CY 2005 and 2011 Aircraft Operations Forecasts for Lihue Airport from Aries Consultants Ltd. dated March 31, 2006. CY 2020 Aircraft Operations Forecasts for Lihue Airport from Aries Consultants Ltd. dated October 30, 2006.

(17) "FAR Part 150 Noise Compatibility Program; Volume 2: Noise Compatibility Program Report; Lihue Airport; Lihue, Hawaii;" Hawaii State Department of Transportation, Airports Division; December 1989.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "LepN" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

TERM	SYMBOL
1. A-Weighted Sound Level	L_A
2. A-Weighted Sound Power Level	L_{WA}
3. Maximum A-Weighted Sound Level	L_{max}
4. Peak A-Weighted Sound Level	L_{Apk}
5. Level Exceeded x% of the Time	L_x
6. Equivalent Sound Level	L_{eq}
7. Equivalent Sound Level over Time (T) (1)	$L_{eq(T)}$
8. Day Sound Level	L_d
9. Night Sound Level	L_n
10. Day-Night Sound Level	L_{dn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$
12. Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78,

APPENDIX B (CONTNUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

TERM	A-WEIGHTING	ALTERNATIVE[1] A-WEIGHTING	OTHER[2] WEIGHTING	UNWEIGHTED
1. Sound (Pressure)[3] Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% of the Time	L_x	L_{Ax}	L_{Bx}	L_{px}
6. Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7. Equivalent Sound Level[4] Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8. Day Sound Level	L_d	L_{Ad}	L_{Bd}	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average Value Over (Non-Time Domain) Set of Observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level Exceeded x% of the Total Set of (Non-Time Domain) Observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x Value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

APPENDIX C

SUMMARY OF BASE YEAR AND FUTURE YEAR TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2005 *****		CY 2010 (DO NOTHING)		CY 2010 (ACTION)		CY 2020 (DO NOTHING)		CY 2020 (ACTION)	
	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH
Rice Street East of Kapule (EB)	619	655	755	989	757	991	912	1,341	916	1,345
Rice Street East of Kapule (WB)	657	618	874	866	876	867	1,099	1,122	1,105	1,124
Two-Way	1,276	1,273	1,629	1,855	1,633	1,858	2,011	2,463	2,021	2,469
Rice Street West of Kapule (EB)	383	517	429	662	430	663	600	863	603	865
Rice Street West of Kapule (WB)	445	462	518	580	519	584	630	805	635	813
Two-Way	828	979	947	1,242	949	1,247	1,230	1,668	1,238	1,678
Kapule Hwy. South of Ahukini (NB)	484	803	684	1,137	718	1,195	976	1,472	1,025	1,547
Kapule Hwy. South of Ahukini (SB)	762	540	1,000	884	982	856	1,200	1,290	1,183	1,261
Two-Way	1,246	1,343	1,684	2,021	1,700	2,051	2,176	2,762	2,208	2,808
Kapule Hwy. North of Ahukini (NB)	520	1,072	916	1,524	929	1,539	1,177	1,901	1,208	1,931
Kapule Hwy. North of Ahukini (SB)	1,211	595	1,541	1,194	1,556	1,206	1,791	1,583	1,835	1,607
Two-Way	1,731	1,667	2,457	2,718	2,485	2,745	2,968	3,484	3,043	3,538
Ahukini Road East of Kapule (EB)	341	295	385	321	419	350	434	365	530	423
Ahukini Road East of Kapule (WB)	208	359	223	416	195	362	250	494	250	452
Two-Way	549	654	608	737	614	712	684	859	780	875
Ahukini Road West of Kapule (EB)	374	560	674	794	689	807	836	1,156	876	1,184
Ahukini Road West of Kapule (WB)	654	410	821	812	828	825	1,042	1,149	1,065	1,175
Two-Way	1,028	970	1,495	1,606	1,517	1,632	1,878	2,305	1,941	2,359
Ahukini Road East of Kuhio (EB)	335	412	708	829	723	843	951	1,155	997	1,183
Ahukini Road East of Kuhio (WB)	301	412	564	940	571	953	710	1,355	733	1,381
Two-Way	636	824	1,272	1,769	1,294	1,796	1,661	2,510	1,730	2,564

APPENDIX C (CONTINUED)

SUMMARY OF BASE YEAR AND FUTURE YEAR TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2005 *****		CY 2010 (DO NOTHING)		CY 2010 (ACTION)		CY 2020 (DO NOTHING)		CY 2020 (ACTION)	
	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH
Kuhio Hwy. North of Ahukini (NB)	618	1,083	669	1,216	669	1,217	747	1,440	748	1,442
Kuhio Hwy. North of Ahukini (SB)	1,107	1,022	1,197	1,140	1,198	1,141	1,331	1,330	1,334	1,332
Two-Way	1,725	2,105	1,866	2,356	1,867	2,358	2,078	2,770	2,082	2,774
Kuhio Hwy. South of Ahukini (NB)	734	1,180	1,104	1,629	1,118	1,642	1,372	2,073	1,415	2,099
Kuhio Hwy. South of Ahukini (SB)	1,189	1,119	1,488	1,664	1,495	1,676	1,715	2,163	1,737	2,187
Two-Way	1,923	2,299	2,592	3,293	2,613	3,318	3,087	4,236	3,152	4,286

APPENDIX D

Archaeological Inventory Survey

LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR - LAND

DEAN NAKANO
ACTING DEPUTY DIRECTOR - WATER

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CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

December 29, 2006

Dr. Hal Hammatt
Cultural Surveys Hawaii
P.O. Box 1114
Kailua, Hawai'i 96734

LOG NO: 2006.4304
DOC NO: 0612NM15
Archaeology

Dear Dr. Hammatt:

SUBJECT: National Historic Preservation Act, Section 106 Review - Historic Preservation Review –Archaeological Inventory Survey For the Proposed Lihue Airpost Improvements, Hanamaulu and Kalapaki Ahupuaa, Puna District, Island of Kauai, (Bell, OHare, McDermott and Hammatt, CSH, 2006)
Hanamaulu, Puna, Kaua'i
TMK: (4) 3-5-001: por 005, 008, 102, 160 and 3-7-002: por. 001

Thank you for submitting the aforementioned report which we received on December 20th, 2006. The project covers 175 acres. One historic property 30-08-3958 - a piggery was found. It was evaluated as significant under criteria D. It has been thoroughly documented. No futher archaeological work is need for this project.

This report is approved. If you have any questions, please call Nancy McMahon, the Kauai Lead Archaeologist, at 742-7033.

Aloha,

for Peter Young
State Historic Preservation Officer

NM:gvf

Cc: Ian Costa, County of Kauai

Archaeological Inventory Survey of the Proposed Līhu'e Airport Improvements, Hanamā'ulu and Kalapakī Ahupua'a, Līhu'e District (Puna Moku), Island of Kaua'i

TMK [4] 3-5-001: Por. 005, 008, 102, 160, and 3-7-002: Por 001)

Prepared for
Wilson Okamoto & Associates, Inc.

Prepared by
Matthew Bell, BA,
Constance R. O'Hare, BA,
Matt McDermott, MA,
and
Shawn Barnes, BS

Cultural Surveys Hawai'i, Inc. (CSH)
Kailua, Hawai'i
(CSH Job Code: HANAM 1)

September 2006

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Management Summary

Reference	Archaeological Inventory Survey of the Proposed Līhu'e Airport Improvements, Hanamā'ulu and Kalapakī Ahupua'a, Līhu'e District (Puna Moku), Island of Kaua'i (Bell et al. 2006)
Date	September 2006
Project Numbers	Cultural Surveys Hawai'i, Inc. (CSH) Job Code: HANAM 1
Investigation Permit Number	Investigation fieldwork was performed under Hawai'i State Historic Preservation Division (SHPD) permit No. 0605, issued per Hawai'i Administrative Rules (HAR) Chapter 13-282.
Project Location	The project area is located in and around the Līhu'e Airport, Hanamā'ulu and Kalapakī Ahupua'a, Līhu'e District (Puna Moku), on the southeast shore of Kaua'i [TMK (4) 3-5-001: Por. 005, 008, 102, 160, and 3-7-002: Por. 001]. This area is depicted on the 1996 Līhu'e and Kapa'a USGS 7.5-minute topographic quadrangles.
Land Jurisdiction	State of Hawai'i (Department of Transportation—Airports Division [HDOT-A]) and Private (Kaua'i Lagoons and Visionary LLC)
Agencies	Federal Aviation Administration (FAA), SHPD, HDOT-A
Project Funding	FAA and HDOT-A
Project Description	HDOT-A is proposing the following facility improvements at Līhu'e Airport to accommodate forecast aviation demand through the year 2010, based on a review of the 1989 Līhu'e Airport Master Plan and to address current FAA requirements: 1) reconfigure existing heliport; 2) air cargo facility expansion; 3) fuel storage facility expansion; 4) realignment and extension of emergency access/perimeter roads and perimeter fencing; 5) public and employee parking expansion; 6) land acquisition of approximately 125 acres for heliport reconfiguration, to prevent future development incompatible with airport operations, and for future airport-related facilities; 7) runway safety improvements; 8) new terminal exit road to Kapule Highway; and 9) terminal building modifications for new security and passenger processing requirements. The improvement project will include existing building and structure demolition, grading and grubbing, new building and structure construction, landscaping, and utility installation.
Project Acreage	Approximately 175 acres
Area of Potential Effect (APE) and Survey Acreage	The proposed improvements will take place at nine areas in and around the airport. Based on available information, the proposed airport facilities improvements will not impose additional adverse visual, auditory or other environmental impact to any known cultural resources[1], including standing architecture, located in the project area's vicinity. Accordingly, the project's APE extends no further than the project area's approximately 175-acre footprint. The survey area for the current investigation included the entire approximately 175-acre APE. Because prior historic and modern land disturbance, first from commercial sugar cane cultivation and second from airport construction, were so extensive within portions of the project area, not all portions of the project area were subjected to 100 % pedestrian inspection. The areas not subjected to 100 % survey were visually inspected for cultural resource and to confirm prior extensive land disturbance.

Historic Preservation Regulatory Context	Due to FAA oversight and funding for land acquisition, this project is a federal undertaking requiring compliance with Section 106 of the National Historic Preservation Act (NHPA), the National Environmental Policy Act (NEPA), and the Department of Transportation Act (DTA). As an HDOT project within state and private land, the project is subject to Hawai'i State environmental and historic preservation review legislation [Hawai'i Revised Statutes (HRS) Chapter 343 and HRS 6E-8 / HAR Chapter 13-275, respectively].
Document Purpose	At the request of the Wilson Okamoto & Associates, Inc., HDOT's consultant for the project, CSH completed this archaeological inventory survey investigation. It was prepared in consideration of the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation and was conducted to identify, document, and make National Register of Historic Places (National Register) and Hawai'i Register of Historic Places (Hawai'i Register) eligibility recommendations for the project area's cultural resources. The investigation also fulfills Hawai'i State archaeological inventory survey requirements (per HAR Chapter 13-276). The investigation includes an undertaking-specific effect recommendation and treatment/mitigation recommendations for the cultural resources recommended National/Hawai'i Register eligible. This document is intended to support the project's state and federal historic preservation review and project-related historic preservation consultation among stake-holding federal and state agencies, Native Hawaiian organizations, and/or community groups.
Fieldwork Effort	Matt McDermott, MA (principal investigator), and Hallett H. Hammatt, Ph.D. completed the investigation's fieldwork on August 14th, 2006, requiring 2 person-days.
Background Research Results	Background literature review included historic and archaeological documents to provide a regional context for the project area. Background research indicates that most of the project area was formerly part of Līhu'e Plantation's sugar cane fields. Later portions of the project area were disturved by Līhu'e Airport construction. Based on decades of cane cultivation, including some recently active fields, and airport related ground disturbance, few, if any traditional Native Hawaiian cultural resources were anticipated. Expected cultural resources included plantation-era historic buildings and structures and agricultural infrastructure remnants. These were particularly expected in the vicinity of Ahukini Landing. Ahukini Landing was used over the period 1920-1950, and for a short period of time ca. 1920-1930 was the main port for the eastern portion of Kaua'i.
Identified Cultural Resources and National/Hawaii Register Eligiblity[2] Recommendations	A single cultural resource/historic property[3] was identified within the project area. It was assigned State Inventory of Historic Properties (SIHP) # 50-30-08-3958. Consisting of plantation-era concrete enclosures and foundation remnants that likely functioned as a piggery, it is recommended eligible to the National and Hawai'i Registers under criterion D, for its information content.

Effect Recommendation	The single cultural resource recommended National/Hawai'i Register-eligible within the project area is located along the seacoast, on the extreme periphery of the project area. Although technically within the project's APE, it is unlikely that project-related construction will affect SIHP # 50-30-08-3958 because of its peripheral location. Furthermore, the information for which SIHP # 50-30-08-3958 is recommended National and Hawai'i Register-eligible has been recorded through the maps, photographs, and written descriptions of the current investigation. Accordingly, the project-specific effect recommendations of "No adverse effect" (federal historic preservation legislation) and "No historic properties affected" (Hawai'i historic preservation legislation) are warranted.
Mitigation Recommendation	No further cultural resource management work is recommended for the project; however, in the unlikely event that previously unidentified cultural resources are encountered by project construction, the project proponents should immediately stop work in the vicinity and contact the SHPD Kaua'i Office [Ms Nancy McMahon, Tel. (808) 742-7033] and/or O'ahu Office [Tel. (808) 692-8015].

[1]In historic preservation parlance, cultural resources are the physical remains and/or geographic locations that reflect the activity, heritage, and/or beliefs of ethnic groups, local communities, states, and/or nations. Generally, they are at least 50 years old, although there are exceptions, and include: buildings and structures; groupings of buildings or structures (historic districts); certain objects; archaeological artifacts, features, sites, and/or deposits; groupings of archaeological sites (archaeological districts); and, in some instances, natural landscape features and/or geographic locations of cultural significance.

[2]To be considered eligible for listing on the National and/or Hawai'i Register a cultural resource must possess integrity of location, design, setting, materials, workmanship, feeling, and association, and meet one or more of the following broad cultural/historic significance criteria: "A" reflects major trends or events in the history of the state or nation; "B" is associated with the lives of persons significant in our past; "C" is an excellent example of a site type/work of a master; "D" has yielded or may be likely to yield information important in prehistory or history; and, "E" (Hawaii Register only) has traditional cultural significance to an ethnic group, includes religious structures and/or burials.

[3]Historic properties, as defined under federal historic preservation legislation, are cultural resources that are at least 50 years old (with exceptions) and have been determined eligible for inclusion in the National Register of Historic Places based on their integrity and historic/cultural significance in terms of established significance criteria. Determinations of National Register- eligibility are generally made by a federal agency official in consultation with SHPD. Under federal legislation, a project's (undertaking's) potential effect on historic properties must be evaluated and potentially mitigated. Under Hawai'i State historic preservation legislation, historic properties are defined as any cultural resources that are 50 years old, regardless of their historic/cultural significance under state law, and a project's effect and potential mitigation measures are evaluated based on the project's potential impact to "significant" historic properties (those historic properties determined eligible, based on their integrity and historic/cultural significance in terms of established significance criteria, for inclusion in the Hawai'i Register of Historic Places). Determinations of eligibility to the Hawai'i Register result when a state agency official's historic property "significance assessment" is approved by SHPD, or when SHPD itself makes an eligibility determination for a historic property.

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Section 1 Introduction

1.1 Project Background and Description

The Hawai'i State Department of Transportation—Airports Division (HDOT-A) is proposing various improvements and land acquisitions to the state-owned Līhu'e Airport on the island of Kaua'i. The project is largely HDOT-A funded, with some Federal Aviation Administration (FAA) funding for proposed land acquisition. The proposed improvement project will take place at nine improvement areas within and immediately adjacent to the existing airport property. The airport improvements project area is located within Hanamā'ulu and Kalapakī Ahupua'a, Līhu'e District (Puna *Moku*—traditional Hawaiian district), within TMK (4) 3-5-001: Por. 005, 008, 102, 160, and 3-7-002: Por 001] This area is depicted on the 1996 Līhu'e and Kapa'a USGS 7.5-minute topographic quadrangles (Figure 1), a TMK map (Figure 2), a construction plan (Figure 3, and an aerial photograph (Figure 4). Land jurisdiction for the nine improvement areas is both State of Hawai'i (HDOT-A) and private (Kaua'i Lagoons and Visionary LLC). The nine improvement areas are labeled on Figure 4 and summarized in Table 1.

As part of the airport improvement project, the following facility improvements at Līhu'e Airport are proposed to accommodate forecast aviation demand through the year 2010, based on a review of the 1989 Līhu'e Airport Master Plan and to address current FAA requirements: 1) reconfigure the existing heliport; 2) air cargo facility expansion; 3) fuel storage facility expansion; 4) realignment and extension of emergency access/perimeter roads and perimeter fencing; 5) public and employee parking expansion; 6) land acquisition of approximately 125 acres for heliport reconfiguration, to prevent future development incompatible with airport operations, and for future airport-related facilities; 7) runway safety improvements; 8) new terminal exit road to Kapule Highway; and 9) terminal building modifications for new security and passenger processing requirements (refer to Figure 3). The project will include existing building and structure modification and/or demolition, grading and grubbing, new building and structure construction, landscaping, and utility installation.

1.2 Historic Preservation Regulatory Framework and Document Purpose

Due to FAA oversight and funding for land acquisition, this project is a federal undertaking requiring compliance with Section 106 of the National Historic Preservation Act (NHPA), the National Environmental Policy Act (NEPA), and the Department of Transportation Act (DTA). As an HDOT-A project within state and private land, the project is subject to Hawai'i State environmental and historic preservation review legislation [Hawai'i Revised Statutes (HRS) Chapter 343 and HRS 6E-8 / Hawai'i Administrative Rules (HAR) Chapter 13-275, respectively].

At the request of the Wilson Okamoto & Associates, Inc., HDOT's consultant for the project, Cultural Surveys Hawai'i, Inc. (CSH) completed this archaeological inventory survey investigation. It was prepared in consideration of the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation and was conducted to identify, document,

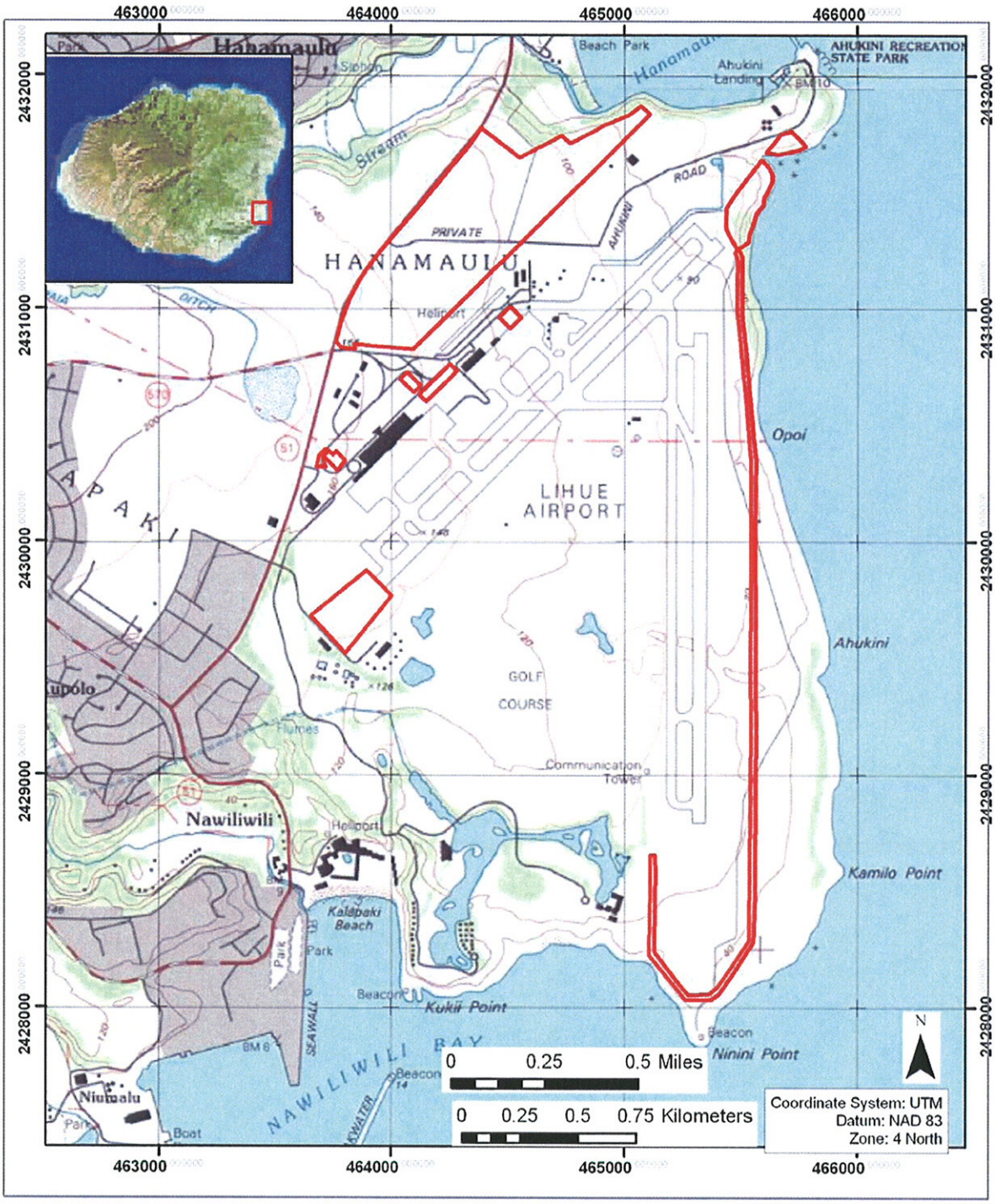

Figure 1. Portions of the 1996 Līhu'e and Kapa`a USGS 7.5-minute topographic quadrangles showing the nine improvement areas that make up the approximately 175-acre project area.

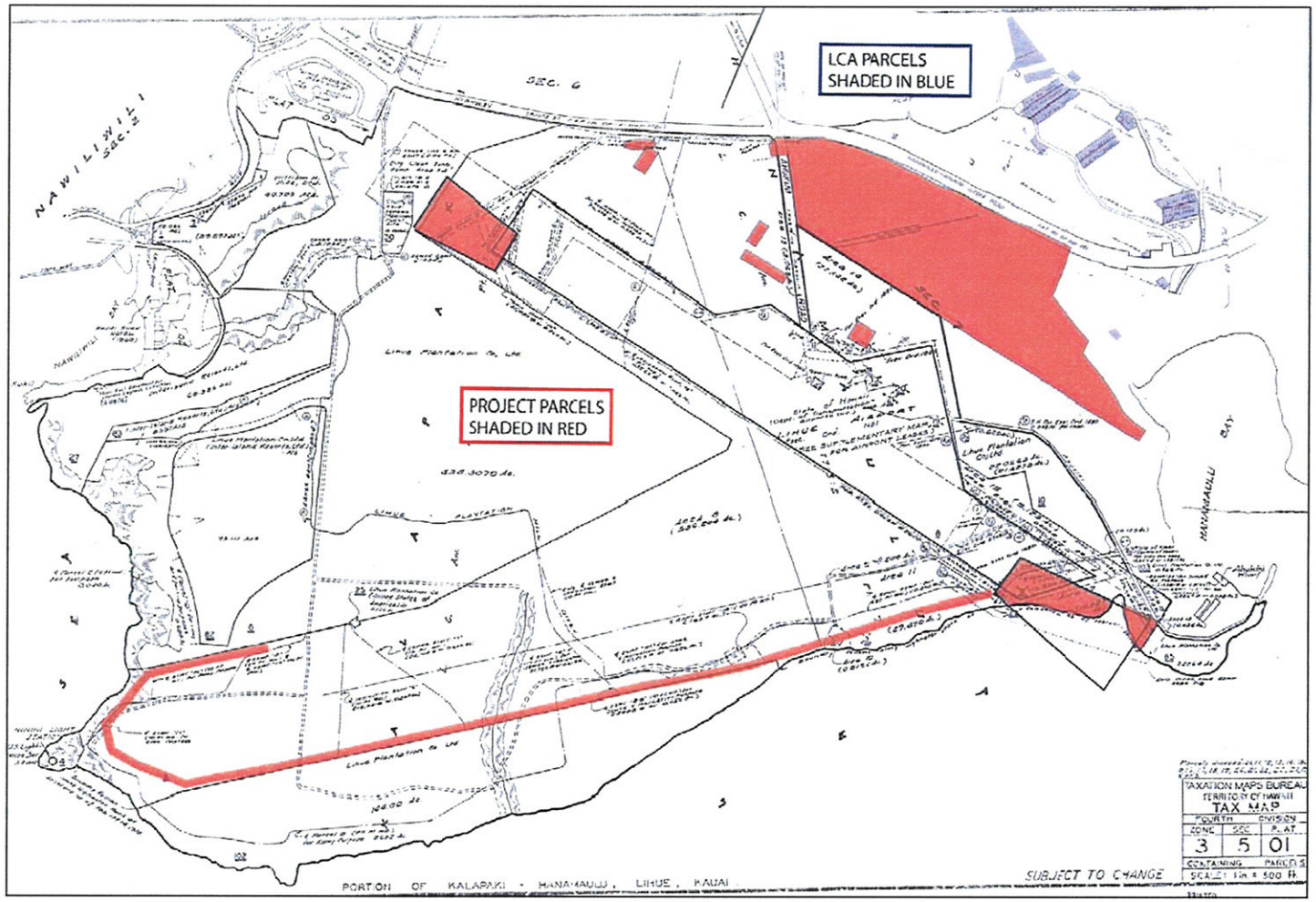

Figure 2. Combined map of TMK [4] 3-5-01 and 3-7-02, showing the project's improvement areas (shaded in red); the map also shows the location of some Land Commission Award (LCA) parcels (shaded in blue) along Hanamā'ulu Stream north of the project area.

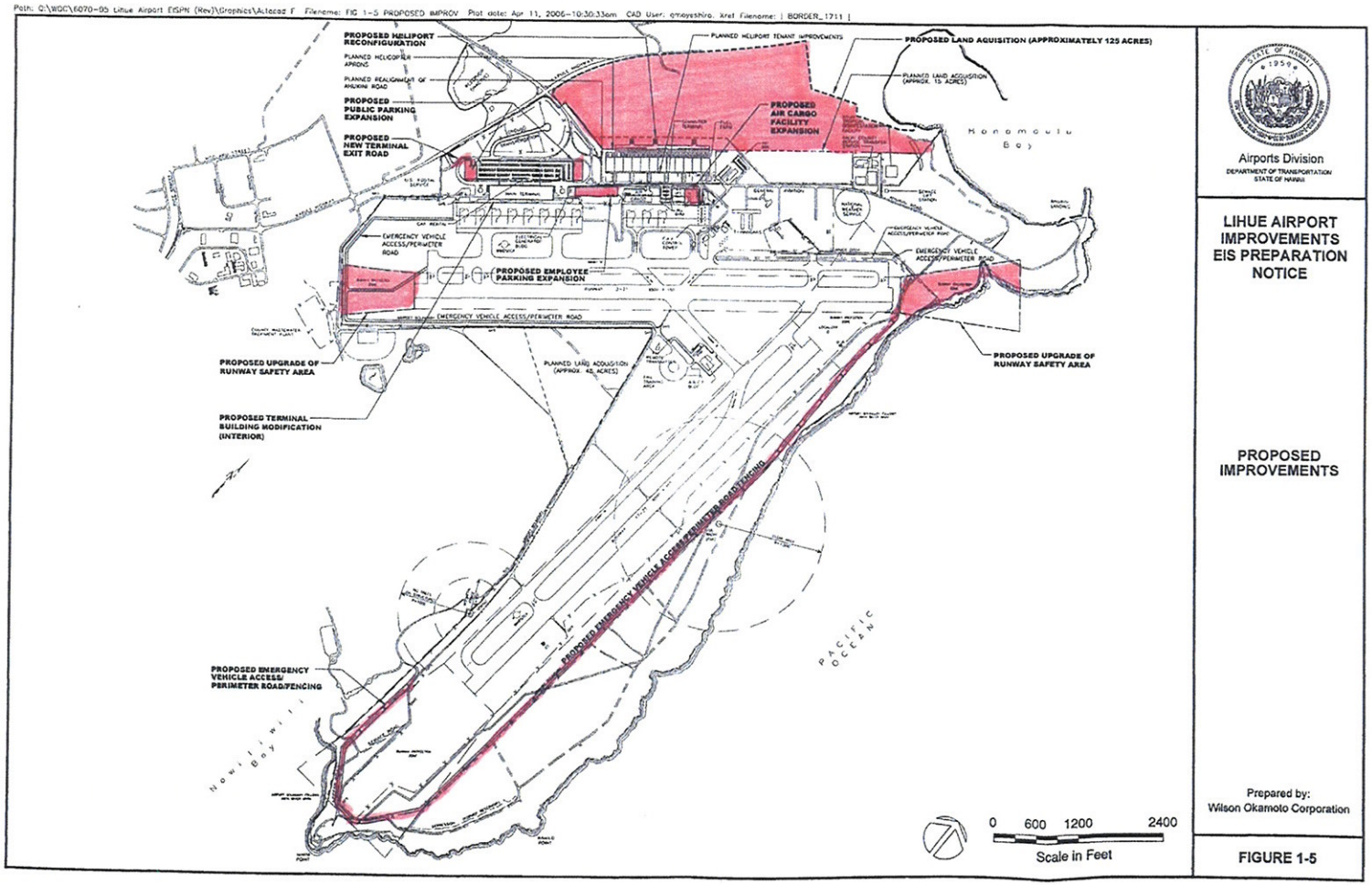

Figure 3. Lihue Airport Proposed Improvements construction plan

Figure 4. Recent aerial photograph of the project area showing the nine improvement areas (labeled 1-9) and the project's area of potential effect (UTM NAD 83 Zone 4 North)

Table 1. Summary of the Nine Improvement Areas within the Līhu'e Airport

Improvement Area	Land Jurisdiction	TMK	Acreage	Survey Coverage
1. Proposed New Terminal Exit Road	Government, State	(4)-3-5-001:008	0.43	100 % Pedestrian Inspection
2. Proposed Public Parking Expansion Southwest	Government, State	(4)-3-5-001:008	0.97	100 % Pedestrian Inspection
3. Proposed Public Parking Expansion Northeast	Government, State	(4)-3-5-001:008	0.83	100 % Pedestrian Inspection
4. Proposed Employee Parking Expansion	Government, State	(4)-3-5-001:008	1.92	100 % Pedestrian Inspection
5. Proposed Air Cargo Facility Expansion	Government, State	(4)-3-5-001:008	1.07	100 % Pedestrian Inspection
6. Proposed Heliport Reconfiguration	Private, Visionary LLC	(4)-3-7-002:001	122.83	Partial Pedestrian Inspection—area heavily disturbed by past commercial sugar cane cultivation
7a. Proposed Upgrade of Runway Safety Area North--Southwest	Government, State	(4)-3-5-001:160	9.48	100 % Pedestrian Inspection
7b. Proposed Upgrade of Runway Safety Area North--Northeast	Government, State	(4)-3-5-001:160	2.32	100 % Pedestrian Inspection
8. Proposed Upgrade of Runway Safety Area South	Government, State	(4)-3-5-001:008	14.34	Visually Inspected—area heavily disturbed by past commercial sugar can cultivation and airport runway installation
9. Proposed Emergency Vehicle Access/Perimeter Road/Fencing	Government, State Government, State Private, Kauai Lagoons	(4)-3-5-001:008 (4)-3-5-001:005 (4)-3-5-001:102	21.16	100 % Pedestrian Inspection

and make National Register of Historic Places (National Register) and Hawai'i Register of Historic Places (Hawai'i Register) eligibility recommendations for the project area's cultural resources. The investigation also fulfills Hawai'i State archaeological inventory survey requirements (per HAR Chapter 13-276). The investigation includes an undertaking-specific effect recommendation and treatment/mitigation recommendations for the cultural resources recommended National/Hawai'i Register eligible. It is also intended to support the project's state and federal historic preservation review and project-related historic preservation consultation among stake-holding federal and state agencies, Native Hawaiian organizations, and/or community groups.

This archaeological inventory survey investigation is designed to comply with both federal and Hawai'i state historic preservation legislation. Generally, under both Hawai'i state and federal historic preservation legislation, archaeological inventory surveys are designed to identify, document, and make significance recommendations for "historic properties." As discussed in the paragraphs below, there are important distinctions between the federal and Hawai'i state definitions of "historic properties." To alleviate any confusion these different definitions might cause, CSH has opted in this document to use the more generic term "cultural resources," as defined below, in its discussion of the cultural remains within the current project area.

In historic preservation parlance, cultural resources are the physical remains and/or geographic locations that reflect the activity, heritage, and/or beliefs of ethnic groups, local communities, states, and/or nations. Generally, they are at least 50 years old, although there are exceptions, and include: buildings and structures; groupings of buildings or structures (historic districts); certain objects; archaeological artifacts, features, sites, and/or deposits; groupings of archaeological sites (archaeological districts); and, in some instances, natural landscape features and/or geographic locations of cultural significance.

Historic properties, as defined under federal historic preservation legislation, are cultural resources that are at least 50 years old (with exceptions) and have been determined eligible for inclusion in the National Register based on established significance criteria. Determinations of eligibility are generally made by a federal agency official in consultation with the State Historic Preservation Division (SHPD). Under federal legislation, a project's (undertaking's) potential effect on historic properties must be evaluated and potentially mitigated.

Under Hawai'i State historic preservation legislation, historic properties are defined as any cultural resources that are 50 years old, regardless of their historic/cultural significance under state law, and a project's effect and potential mitigation measures are evaluated based on the project's potential impact to "significant" historic properties (those historic properties determined eligible, based on established significance criteria, for inclusion in the Hawai'i Register). Determinations of eligibility to the Hawai'i Register result when a state agency official's historic property "significance assessment" is approved by SHPD, or when SHPD itself makes an eligibility determination for a historic property.

1.3 Area of Potential Effect

The project area consists of nine improvement areas, totaling approximately 175 acres, within and immediately adjacent to Līhu'e Airport (refer to Figure 4). Based on available information, the proposed airport facilities improvements will not impose additional adverse visual, auditory or other environmental impact to any known cultural resources, including standing architecture, located in the project area's vicinity. Accordingly, the project's Area of Potential Effect (APE) extends no further than the project area's approximately 175-acre footprint. The survey area for the current investigation included the entire approximately 175-acre APE, however, there were limitations to which portions of the project area received 100 % pedestrian inspection.

Because prior historic and modern land disturbance, first from commercial sugar cane cultivation and second from airport construction, were so extensive within portions of the project area, not all portions of the project area were subjected to 100 % pedestrian inspection. The areas not subjected to 100 % survey were visually inspected for cultural resource and to confirm prior extensive land disturbance. Table 1 (above) summarizes the field effort for each of the project area's nine improvement areas.

1.4 Scope of Work

The archaeological inventory survey and its accompanying report document the cultural resources within the approximately 175-acre project area. The following scope of work was followed:

1) Research on historic and archaeological background, including a search of historic maps, written records, and Land Commission Award documents. This research focused on the specific project area with general background on the *ahupua'a* and district and emphasizes settlement patterns.

2) A ground survey of the project area. Surface cultural resources were identified and recorded with and evaluation of age, function, interrelationships, and significance. Documentation included photographs, scale drawings, and written descriptions.

3) Preparation of this survey report, which includes the following:

- A project description;
- A topographic map of the survey area showing all recorded cultural resources;
- Descriptions of all cultural resources, including selected photographs, scale drawings, and discussions of age, function, and significance, per the requirements of HAR Title 13, Subtitle 13, Chapter 276 "Rules Governing Standards for Archaeological Inventory Surveys and Reports." Cultural resources were assigned State Inventory of Historic Properties (SIHP) numbers;
- Historical and archaeological background sections summarizing prehistoric and historic land use of the project area and its vicinity;

- A summary of cultural resources and significance based upon the National and Hawai'i Register criteria;
- A project specific effect recommendation related to the project's potential effects to cultural resources recommended National/Hawai'i Register-eligible;
- Treatment recommendations to mitigate the project's adverse effect on any cultural resources recommended eligible to the National/Hawai'i Register identified in the project area.

1.5 Methods

1.5.1 Background Research

Historical research included a review of previous archaeological studies on file at the SHPD O'ahu Office in Kapolei; studies of documents at Hamilton Library of the University of Hawai'i, the Hawai'i State Archives, the Hawaii Sugar Planters Association, the Archives of the Bishop Museum, and the library at Cultural Surveys Hawai'i, Inc.; and study of maps at the Survey Office of the Department of Land and Natural Resources. Nineteenth-century Land Commission Award claim records were accessed via the Internet from the Māhele database prepared by Waihona 'Aina Corporation and available over the Internet.

1.5.2 Fieldwork

Matt McDermott, MA (principal investigator), and Hallett H. Hammatt, Ph.D. completed the investigation's fieldwork on August 14th, 2006, requiring 2 person-days. Investigation fieldwork was performed under SHPD permit No. 0605, issued per Hawai'i Administrative Rules (HAR) Chapter 13-282.

To facilitate navigation between and within the nine separate improvement areas that make up the project area, the boundaries of each improvement area were uploaded as shape files into a hand-held Garmin GPS unit (horizontal accuracy between 3 and 6 meters). During pedestrian inspection, the "track-log" feature of the GPS unit enabled precise control of the survey coverage of each improvement area.

As discussed briefly above, not all portions of the project area were subjected to 100 % pedestrian inspection. This was due to the extreme prior land alteration of some portions of the project area from past commercial sugar cane cultivation and/or airport development. Documentation of this past land alteration within these portions of the project area was compiled as part of the investigation's background research. This documentation included historic maps of cane production and past aerial photographs. Table 1 and Figure 4 indicate the portions of the project area where 100 percent pedestrian inspection was carried out.

In the areas where 100 % pedestrian inspection was not warranted, based on background research, a lesser level of surface survey was carried out. It focused on confirming the disturbed state of the land surface that was indicated by documentary evidence. This comprised an inspection of the portion of the project area, both on foot and from vehicle, to confirm the past land alteration and unlikelihood of remaining cultural resources. Photographs were taken to

document current conditions of these portions of the project area, particularly their disturbed state.

Where indicated based on background research, systematic 100 % pedestrian inspection was carried out within the project area. Systematic pedestrian transects were used to identify cultural resources. The interval between archaeologists was 10-15 meters or less. Ground visibility varied greatly with the different vegetation types. General written descriptions and photographs recorded the current condition for each of the improvement areas subjected to 100 % survey. All surface cultural resources were identified and documented.

Cultural resource location information was recorded on project area maps and with a Trimble Pathfinder Pro XR GPS unit (submeter horizontal accuracy). Surface cultural resource documentation also included tape and compass plan view maps, digital photographs, and written descriptions. Surface cultural resources boundaries were defined in terms of the geographic extent of the feature or features that comprise the cultural resource. In the current investigation, all surface cultural resources were comprised of standing architectural features and/or remnants of structures. The boundary of each of these cultural resources was defined as the geographic extent of the component feature(s) and/or structure(s).

Subsurface testing was not warranted based on the surface survey results. Throughout the vast majority of the project area, prior land disturbance was extensive. The relatively small portions of the project area that were not subjected to extensive prior ground disturbance were located along the coast, in areas of very shallow soils and/or exposed bedrock.

1.5.3 Cultural Consultation

Regarding archaeological inventory survey investigations and their need for cultural consultation to identify cultural resources/historic properties, the Hawai'i State rules for archaeological inventory surveys state:

> The report shall contain information on the consultation process with individuals knowledgeable about the project area's history, <u>if</u> discussions with the SHPD, background research or public input indicate a need to consult with knowledgeable individuals . . . [HAR Chapter 13-276-5(g)--emphasis added]

Based on background research and the fieldwork results, this type of cultural consultation did not appear warranted for the current investigation. Accordingly, no cultural consultation effort was undertaken.

1.5.4 Cultural Resource Evaluation for National/Hawai'i Register Eligibility

Cultural resource significance is evaluated and expressed as eligibility for listing on the National and/or Hawai'i Register of Historic Places (National and Hawai'i Registers). To be considered eligible for listing on the National and/or Hawai'i Register, a cultural resource must possess integrity of location, design, setting, materials, workmanship, feeling, and association, and meet one or more of the following broad cultural/historic significance criteria: "A" reflects major trends or events in the history of the state or nation; "B" is associated with the lives of persons significant in our past; "C" is an excellent example of a site type/work of a master; "D"

has yielded or may be likely to yield information important to prehistory or history; and, "E" (Hawai'i Register only) has traditional cultural significance to an ethnic group; includes religious structures and/or burials. For this report, cultural resource integrity and significance were considered based on the guidance provided in National Register Bulletin # 15, "How to Apply the National Register Criteria for Evaluation."

1.6 Environmental Setting

1.6.1 Natural Environment

The project area extends from the coastline to approximately 1.7 kilometers (1 mile) inland. Rising from near sea level to 160 ft AMSL (above mean sea level), the project area lies within the Līhu'e depression or basin. The area's topography is generally level, with a few shallow, intermittent, unnamed drainages closer to the coast. These drainages currently conduct runoff from the Līhu'e airport runway system to the sea.

Of the area's volcanic history, MacDonald et al. (1983) noted:

> Lava flows of the Koloa Series cover about half the surface of the eastern part of the island. They form the entire floor of the Līhu'e basin, except for two small *kipuka* of Waimea Canyon rocks (Aaohoaka hill and Pu'u Pilo), that protrude through them west of the gap through which the Wailua River crosses the Kālepa-Nounou Ridge . . . The greatest exposed thickness of Koloa lavas is 650 meters, in the east wall of Hanalei Valley; but they may be even thicker in the Līhu'e Basin and along the southern edge of the island, where their base is not exposed. [MacDonald et al. 1983:460-461]

Where the highway crosses Hanamā'ulu Gulch, 1.5 kilometers north of Līhu'e, the upper 7.5 m of lava rests on an ancient soil zone 2 m thick, which grades downward into much-decomposed Koloa lava at least 10 m thick. Even in a favorable climate, such deep weathering must have required a very long time (MacDonald et al. 1983: 463).

Located on the southeast coast of Kaua'i, the project area is exposed to the prevailing northeast trade winds generally from 10-20 miles per hour, and experiences 40 to 50 inches of rainfall annually. Rainfall increases to 75 to 100 inches in more inland (western) localities. The annual average temperature ranges from 75-80° F at the airport.

The soils in the area are Līhu'e silty clay (LhB and LhC) and Līhu'e gravelly silty clay (LIB) (Foote et al. 1972:Sheets 30 & 31). Līhu'e soils have a surface layer of dusky-red to dark reddish-brown, firm to friable silty clay. The subsoil is dark-red to dark reddish-brown, firm silty clay. The substratum is soft, weathered basic igneous rock. Sugar cane is the main crop (Foote et al. 1972:12).

Vegetation within the project area is variable. Appendix A at the back of this report has 25 representative photographs of the vegetation and conditions at each of the nine improvement areas. Figure A in Appendix A shows the location and orientation of each photograph. In improvement areas 1 to 5 (refer to Figure 4 and Figure A and Photos 1-10 in Appendix A), vegetation consists of landscaped lawns and introduced exotic species. These are set amid

parking areas and roadways of the Lihue Airport grounds. Improvement area 6 (Photos 11-14 in Appendix A) consists almost exlusively of tall grasses, which typically "take over" in former commercial sugar cane lands. Improvement area 7a and 7b are covered in dense coastal vegetation, including both native and introduced species, including *Naupaka*, *`Ilima*, *Koa Haole*, Christmas Berry, Night Blooming Sirius, Ironwood, and tall grass (Photos 15-17 in Appendix A). Improvement Area 8 has only low grasses (Photos 18 and 19 in the Appendix A). Improvement Area 9 has a variety of coastal vegetation, including*`Ilima*, *Koa Haole*, Christmas Berry, Ironwood, and tall grass. The majority of Improvement Area 9 is through former commercial sugarcane lands that have a dense covering of tall grasses (Photos 20-25 in Appendix A).

1.6.2 Built Environment

Background research, discussed below, clearly indicates that nearly the entire project area was, prior to the construction of Lihue Airport, under commercial sugarcane cultivation. This agricultural use of the project area resulted in the grading and repeated plowing of the project area. With the construction of Lihue Airport, portions of the project area were further modified with parking areas, roadways, runways, buildings and structures, and landscaping. Improvement areas 1 through 5 and 8 are within the Lihue Airport grounds and have been heavily modified by modern land use (refer to the photographs in Appendix A). Improvement Area 7a and 7b along the coast have been less affected by modern lans use, but still have clear indications of modifications, such as unimproved roads (refer to Figure 4) and illegal dumping of refuse materials.

Section 2 Hanamā'ulu and Kalapakī Ahupua'a: Cultural and Historical Documentation

The *ahupua'a* of Hanamā'ulu and Kalapakī are very old land divisions that were permanently inhabited and intensively used in Pre-Contact Hawaii. The coastal zones of Kalapakī and Hanamā'ulu were the locus for permanent habitation, *heiau*, and numerous trails. There were fishponds at Kalapakī, and intensive agriculture within the valley floodplain of Nāwiliwili River. In Hanamā'ulu the houses, gardens, and pastures were spaced throughout the floodplain of the Hanamā'ulu River. The dryland areas (*kula*) of both *ahupua'a* contained native forest and were cultivated with crops of *wauke*, sweet potatoes, gourds. Legends and historic documentation elaborate on many of these features of the landscape. A more detailed discussion of the history of these *ahupua'a* can be found in Creed et al. 1999.

2.1.1 Legendary References

The names Hanamā'ulu and Kalapakī are referenced in numerous legends and oral traditions, some of them very old, that hint at life as it was. In a number of myths both *ahupua'a* are mentioned in with the naming of the winds. In a chant in the legend of Hi'aka, the sister of the Hawaiian volcano goddess Pele, the names of the districts and associated winds (*makani*) of Kaua'i are chanted. A portion of this chant lists the winds (from south to north) of Nāwiliwili, Kalapakī, Ahukini, Līhu'e, Kapaia, and Hanamā'ulu, which are all *ahupua'a* or *'ili* names.

> *He Heone ka makani o Nawiliwili,*
> *He Waimua ka makani o Kalapaki,*
> *He Ehukai ka makani o Ahukini,*
> *He Pahola ke kiu ho o kii makani lele kula o Lihue,*
> *He Kuliahiu ka makani o Kapaia,*
> *He Hooluakainehe ka makani o Hanamaulu.*
> *[Poepoe 1908,* Ku'oko'a, *April 24, 1908]*

Many references to Hanamā'ulu are made in the "Legend of Kawelo" Kawelo-lei-makua, called Kawelo, was born at Hanamā'ulu, and after having become the paramount chief of Kaua'i, he returned to Hanamā'ulu, where he lived with his parents and his wife, Kanewahineikiaoha (Fornander 1918, Vol. V, Part I:62, 70; Rice 1974:66, 85). The hero of this legend lived in the last half of the seventeenth and early decades of the eighteenth century (Hommon 1976:135).

During the 1920s, William Hyde Rice (1974), a life-long resident of Kaua'i, recorded and collected Hawaiian lore of the island in the book *Hawaiian Legends*. In that volume, Hanamā'ulu is named three times. Two other place names in the vicinity of the project area--Ninini (to the south of the project area) and Ahukini (to the east and north)--are mentioned once each. In the story of "The Goddess Pele":

> Two brothers of Pele, who had come from foreign lands, saw Lohiau's body lying as a stone where the lava flow had overtaken him. Pity welled up in their heard and they brought Lohiau to life again. One of these brothers made his own body

> into a canoe and carried the unfortunate Lohiau to Kauai, where he was put ashore at Ahukini [Rice 1974: 14].
>
> Coming to Hanamā'ulu, Lohiau found all the houses but one closed. In that one were two old men, one of whom recognized him and asked him to enter. The men were making *tapa,* which they expected to carry soon to Kapa'a, where games were being held in honor of Kaleiapaoa and his bride, Hi'iaka [Rice 1974:14].

The suggestion of inhospitality at Hanamā'ulu recorded by Rice ("Lohiau found all the houses but one closed") is reminiscent of the Hawaiian proverb *No Hanamā'ulu ka ipu puehu,* or "the quickly emptied container belongs to Hanamā'ulu" (Pukui 1983:252), that implies the food containers of Hanamā'ulu were often bare – a plausible reason for the local residents to be stingy.

As used above, the name Ahukini, meaning "altar of many blessings," probably refers to the *heiau*, which formerly stood in Kalapakī near Ahukini Point (south of Ahukini Landing) on a bluff overlooking the sea – not far from Improvement Area 9. The *heiau* was likely named for Ahukini-a-la'a, one of the three sons of La'a-mai-kahiki, an ancestor of the Kauai' chiefly lines. Ahukini lived about ca. 1250 A.D. (Wichman 1998:61), and became the *ali'i nui* (supreme chief) of the Puna district (Wichman 2003:39).

Not only a name for a *heiau,* Ahukini is also a land division name in Hanamā'ulu, according to a collection of "Kaua'i Place Names."

> *Ahukini, oia ka inoa nui o ka' aina a hiki Hanama'ulu.*
>
> Ahukini is the overall name of the land next to Hanama'ulu.
> [Kelsey n.d., Kelsey Collection]

Another *heiau* mentioned in legend is Kalauokamanu, which means the "tip of the endpiece of the canoe." It was located in Hanamā'ulu near the mill. Human sacrifice was conducted at this *heiau*, and travelers would pass by the temple quickly, holding their noses to avoid the great stench coming from the dead bodies (Wichman 1998:62). According to a study by the Lahainaluna students:

> Kalauokamani [*sic*] was another heiau. It was named for a real woman and this is a little story pertaining to it:
>
> Two men came from Kauai, Uukanipo and Kaipoleimanu. While they lived at Kahikimaiaea, they heard of the beauty of Kalauokamani and went in search of her until they arrived in the upland of Wailua. Kalauokamani was dead but her spirit saw the men, followed after them and asked, "Where are you going?' they answered, "To see Kalauokamani to be our wife." The spirit said, "There is no woman, for she is dead." The spirit again warned them, "Do not go up this way but go down below. There is the woman for you, Moeapakii. Do not go up this way lest you smell the stench of the body of the woman [you seek] for she lies unburied.

> The men insisted on going up on the upper side of Wailua and they did smell the stench of the woman and both died. They stand at Kaohokaualu to this day. Both had turned to stone [Lahainaluna Students 1885, HEN I:218].

As a whole, these legends, as well as others, contain a number of recurrent threads. Canoe landings are mentioned frequently and would have been easy in the protected bay environments of Hanamā'ulu and Kalapakī, and so were probably very common. Whether arriving by canoe or land, travelers did not find much sustenance here on their way through, either due to lack of resources, the tight fisted nature of the residents, or both. A number of references to *kapa* manufacturing provide evidence that the area may have been known for its production of fine *kapa* or tapa, the traditional material used for clothing, mats, and sails prior to contact with western cultures. Finally, it is likely that Hanamā'ulu was the residence of some *ali'i*-status individuals, as suggested in the legend of Kawelo and the presence of a number of *heiau*, including the large Kalauokamanu.

2.1.2 Early Missionary Accounts and Survey Expeditions

The first written accounts of the lifestyle on Kaua'i are from travelers, missionaries, and surveying expeditions. Missionary accounts of first half of the nineteenth century provide the majority of the early written records for this portion of Kaua'i, and in some ways they confirm and expand upon what can be gathered from oral tradition.

Historic documentation records the changing of the name of the district in which the *ahupua'a* of Hanamā'ulu and Kalapakī are located. In earlier days, the two *ahupua'a* were considered to be in the *moku* (district) of Puna, but are today in the judicial district of Līhu'e (meaning "cold chill", or "goose-flesh").

> The name, Lihue, applied in a larger sense, included the districts of what are now Kawaihau and Lihue, reaching from Anahola to the Gap, being made so by law in about the year 1861, according to early court records, but some years later divided into the present two districts. The large district was also known as the Puna district, and is found on early maps as such. It was August thirteenth, 1880, that the district was divided into two, by act of Legislature with King Kalākaua's signature. . . . Lihue, in a local sense, and from which the name of the district was derived meant only that little portion of land upon which the present village, as consisting of bank, post office and store, now stands [Rice 1914:46].

Ethel Damon, in *Koamalu* repeats the scenic description of Līhu'e given by Reverend Hiram Brigham in his book, *A Residence of Twenty-One Years in the Sandwich Islands*, published in 1847:

> In 1824, when walking around the island from Waimea to counsel the people after the wreck of *The Cleopatra's Barge*, Rev. Hiram Bingham crossed from Hanapepe, as has been seen, over the old upland trail back of Kilohana, and wrote of it as 'a country of good land, mostly open, unoccupied and covered with grass, sprinkled with trees, and watered with lively streams that descend from the forest-

> covered mountains and wind their way along ravines to the sea, - a much finer country than the western part of the island' [Damon 1931: 401].

William DeWitt Alexander, son of Waioli missionary William P. Alexander, traveling from Kōloa to the north shore of Kaua'i in 1849 records some descriptive notes of Hanamā'ulu :

> A few miles further on we crossed the picturesque valley of Hanamaulu. This valley is prettily bordered by groves of Kukui, koa, & hala trees, and is well cultivated with taro. A fine stream flows through the midst of it, which makes a remarkable bend at this place like a horse shoe. We then traveled along the seashore at the foot of a range of hills through groves of hau, & among hills of sand. It was now after dark, but the moon shone brightly, and there was no difficulty in finding our way. About eight o-clock we arrived at the banks of the Wailua river [Alexander 1933, reprinted in Kauai Historical Society 1991:121].

One of the last vestiges of the pre-cash crop landscape is depicted in the diary entry for the Rice family's arrival on Kaua'i in 1854. During the second half of the nineteenth century, western settlers and entrepreneurs set their sights on southeast Kaua'i. Ethel Damon, in *Koamalu*, her history of the Rice family of Kaua'i, describes the Līhu'e landscape at the time of the family's arrival at Nāwiliwili Bay:

> From the deck of their river craft in 1854 Mrs. Rice and the children could plainly see above the rocky shore and ruins of Kuhiau, the old heiau, or temple, and nearby on the bluff the flaming blossoms of a great wili-wili tree among koa trees which ten grew almost down to the water's edge [Damon 1931:17-18].

These early accounts speak of hills of native forest and taro cultivation. They do not mention intensive inland agriculture as oral tradition suggests, but some are from cursory visits and land claim documents during the Great Māhele do document such land use.

2.1.3 The Māhele Claims

Legal documentation created by the Great Māhele (1848-1853) provides invaluable and numerous accounts of land use in the mid 1800s. Unprecedented details about land use and land transfer between both royalty and commoners reveal intensive agricultural use suggested in legend and document changes in the agricultural landscape. For a comprehensive listing of Land Claims for Hanamā'ulu refer to Appendix B and for Kalapakī refer to Appendix C.

Māhele land claims by commoners are most suggestive of traditional activities in the area. The locations of *kuleana*, or commoner land claims of the in Hanamā'ulu and Kalapakī Ahupua'a are from the shore back into and along the floodplains of the valley land (See Figure 5). In both *ahupua'a*, the cultivation of *kalo* (taro), the major staple, was along these river flood plains. There were small *kula* listed for both *ahupua'a* where presumably sweet potatoes and other produce were grown. According to the records, none of the *kuleana* claims directly overlap the project area, but unrecorded and earlier activities within the project area are likely.

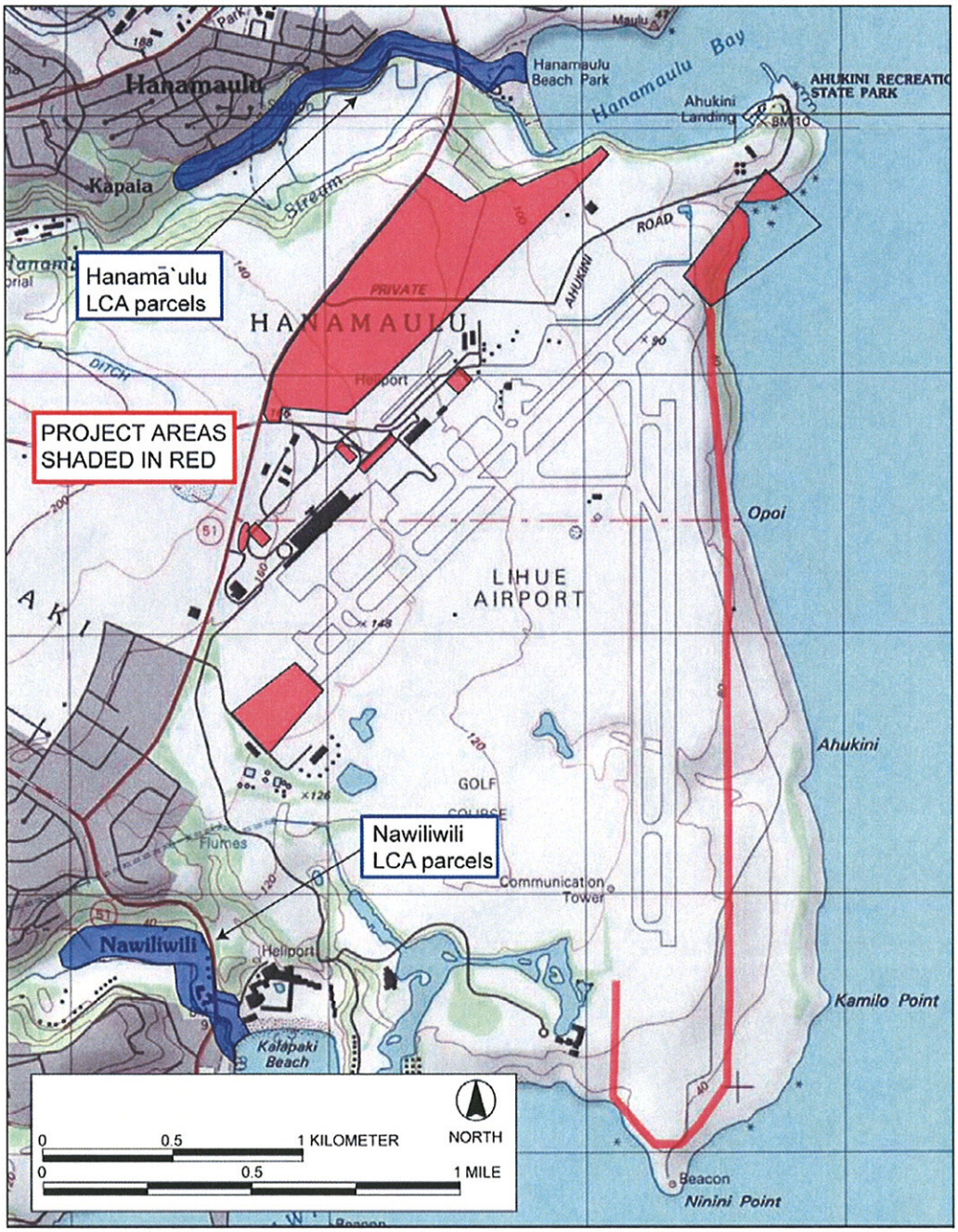

Figure 5. USGS 1996 Lihue Quad, showing project area and location of LCA parcels in Nawiliwili and Hanamā'ulu.

The settlement pattern at Hanamā'ulu features lo'i, kula, and houses along both sides of the Hanamā'ulu River, that extend from the shore up to the village of Kapaia. The kula and lo'i are often together in one 'āpana and the house is in a separate 'āpana, slightly removed from the floodplain. There are four claims in the back bay area of Hanamā'ulu and two claims for house lots (LCA nos. 3650 and 3653) near the beach, south of Kapule Highway. Much of the land claimed in Hanamā'ulu is in land that has been under sugar cane cultivation for much of this century and occasionally artifacts, like adze and volcanic glass can still be found in soil of the cane fields. Many of these claims are less than half a kilometer from Improvement Area 6.

The Kalapakī claimants descriptions of the land differentiate it from Hanamā'ulu. Traditional taro *lo'i* cultivation was along the river with houses at the shore in a village. The Kalapakī *lo'i* claims were on the north side of Nāwiliwili River (the *wauke* land in Claim 3907 on the south side of the river being the sole exception) and along the smaller brooks of Kalapakī and Koena'awa, where there were springs. Two streams, Koena'awa nui and Koena'awa iki, are also identified in the claims, but neither is named on current maps. According to a local informant (Figure 6), these two streams can be seen in this early (undated) photograph on file at the Kaua'i Museum, with the larger stream Koena'awa to the left.

The claims on the south side of the Nāwiliwili River are in the *ahupua'a* of Nāwiliwili. Most Kalapakī claimants lived, however, at the shore in the *kulana kauhale,* or village of Kalapakī, located on Nawiliwili Bay. Several of the claimants describe their village house lots in relation to the fishponds of Koena'awa (Koena'awainui & Koena'awaiki). There is also a description of the *muliwai*, or estuary, of Koena'awanui. The claims in Kalapakī are generally more than a kilometer from the closest portions of the project area.

Claim 3640 mentions a footpath for the *'ili* of Limawela near the shore at the boundary between Hanamā'ulu and Kalapakī. These documents therefore indicate a north/south path along the shoreline, and other paths going inland from the shore, which is a traditional transit pattern for Kaua'i *ahupua'a*. However, since the Līhu'e basin covers a large part of southeastern Kaua'i, it was also easily traversed inland.

The large awards, often entire *ahupua'a,* that were given to royalty were particularly volatile and subject to land use change spreading throughout the islands, especially the development of the sugar industry. These widespread, largely *kula* lands are likely to overlap the project area.

Paulo Kanoa, Governor of Kaua'i at the time of the Māhele, claimed both the *ahupua'a* of Hanamā'ulu and Kalapakī but was awarded neither. Instead, Victoria Kamāmalu was awarded both *ahupua'a* under LCA (Land Commission Award) No. 7713:2. A portion of this award (7713:2 part 7) includes land within the present project area. Following the death of Victoria Kamāmalu in 1866, Princess Ruth Ke'elikōlani inherited her lands. In 1870, Ke'elikōlani sold large portions of her Kalapakī and Līhu'e lands to William Hyde Rice of Līhu'e Plantation. In addition, in 1870, Paul Isenberg purchased the *ahupua'a* of Hanamā'ulu from J.O. Dominis, which includes the land of the present airport area. William Hyde Rice made subsequent land purchases from Princess Ruth in 1879:

> William Hyde Rice, who already had his own home on the hill east of the mill, bought a large makai section of the ahupuaa of Kalapaki from Princess Ruth in 1879 and there conducted the Lihue Ranch. In later years he sold most of this land to the plantation [Damon 1931:747].

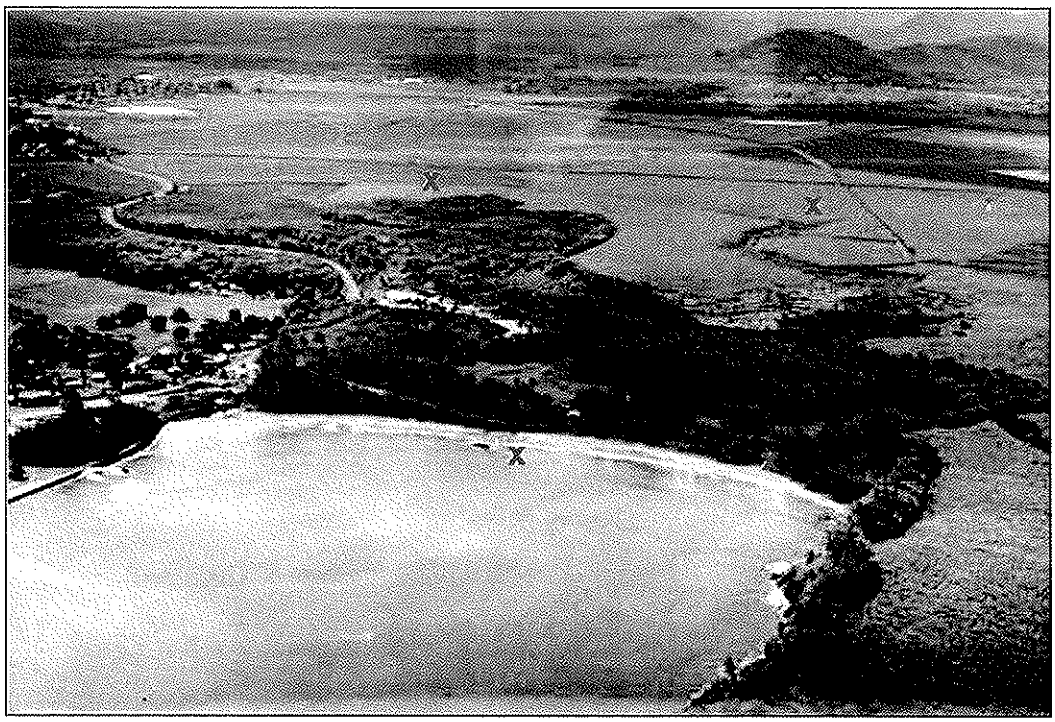

Figure 6. Kalapakī Bay, showing location of two streams and their outlets (marked with red Xs) to Kalapakī Bay; Koena'awa on left (undated photograph in Kaua'i Museum files; available at http:www.hawaii.edu./environment.ainakumuwai.htm)

The large tracts of inland areas (*kula*), not in the river valleys or at the shore, are not described in the claims but were probably in use. This *kula* land at the time of the Māhele belonged to Victoria Kamāmalu. Land use is not elaborated in her claims for Hanamā'ulu or Kalapakī. Traditional *kula* resources for all claimants would have been medicines, herbs, construction materials such as *pili* grass and trees for building houses, canoes, and perhaps lithic materials for tools. Sweet potatoes and other dryland crops, such as *wauke*, probably were cultivated in patches throughout the area at one time or another.

2.2 Transition to Cash Crops and Exportable Products

Early accounts there is mention of rich lands in Hanamā'ulu and Kalapakī, but little mention of industry, suggesting that land may only have been cultivated for local

subsistence. Oral traditions reporting that these lands were not necessarily ones of abundance are consistent with these later observations. When the first non-Hawaiian sailing vessels began arriving in Hawai'i (post 1794), pigs, sweet potatoes, and salt, among other items, were traded re-supply these ships. It is likely that at this time agricultural production in Hanamā'ulu and Kalapakī began to grow beyond traditional subsistence patterns.

Cutting and shipping sandalwood to the Orient was probably the fist real "industry" seen from a western perspective. An indirect reference to the sandalwood trade in the Līhu'e area via Ethel Damon records that Chief Forester C.S. Judd had told an early settler, Richard Isenberg, that Mount Kālepa had formerly been covered with sandalwood (Damon 1931:913).

The sandalwood trade was shortly replaced by the whaling industry, which was based in Kōloa to the west and peaked in Hawai'i between 1840 and 1860. Though there is no specific evidence of crops raised in the Līhu'e area for trade in Kōloa, the roadstead would have provided residents of Līhu'e with a market for their produce (see Wilkes below).

In the *Narrative of the United States Exploring Expedition* (1845), Lt. Commander G.E.G. Wilkes describes the "Lihui" District:

> The principal village is Nawiliwili, ten miles east of Koloa. This district contains about forty square miles, being twenty miles long by two broad. The soil is rich: it produces sugar-cane, taro, sweet-potatoes, beans, &c. The only market is that of Koloa. The cane suffers somewhat from the high winds on the plains [Wilkes 1845:67-68].

By 1842 missionaries had moved into the area and had established five schools. Some of these missionaries attempted to introduce cotton as the first intensive cash crop, but were unsuccessful (Damon 1931).

Sugar, however, caught on. The sugar cane plantation at Līhu'e was first established in 1849 by Henry A. Pierce; Judge Wm. Little Lee, the chairman of the Land Commission; and Charles Reed Bishop who formed Henry A Peirce and Company (Damon 1931). The first 3,000 acres were purchased in Nawiliwili and an additional 300 acres were purchased in Ahukini in 1866. The Līhu'e Plantation became the most-modern plantation at that time in all Hawai'i. It features a steam-powered mill built in 1853, the first use of steam power on a Hawaiian sugar plantation, and the ten-mile-long Hanamā'ulu Ditch built in 1856 by plantation manager William H. Rice, the first large-scale irrigation project for any of the sugar plantations (Moffatt and Fitzpatrick 1995:103).

The success of the Līhu'e Plantation allowed it to continue to expand. When the owner of Hanama'ulu Ahupua'a, Victoria Kamāmalu, died in 1870, all 9,177 acres in the *ahupua'a* were purchased by Paul Isenberg, the manager of Līhu'e Plantation from 1862-1878 (Damon 1931:742-747). By 1872, the plantation owned 17,000 acres in Hanamā'ulu. A total of 30,000 leased acres in Wailua were added in 1878. Līhu'e Plantation built a second mill in 1877, north and west of the present airport, recorded in

an 1885 map of Hanamā'ulu Bay by Lt. George G. Jackson (Figure 7). This mill operated until 1920, when it was converted into housing for laborers.

The extent of the sugar cane fields near the turn of the century can be seen in an 1878 Hawaiian Government Survey map (Figure 8). In this map, there are not yet sugar cane fields depicted in the current study parcels. However, well before 1910, the project area came under heavy alteration accompanying the cultivation of sugar cane. The 1910 USGS map shows the cane fields and railroads have expanded toward the ocean into the area of the present airport (Figure 9). The expansion of Līhu'e Plantation's sugar cane cultivation would accelerate throughout the entire airport area in the early decades of the twentieth century.

Sugar cane cultivation transformed nearly the entirety of the traditional landscape of Hanamā'ulu into plantation landscape. By 1931, Līhu'e Plantation had 6,712 acres in cane. Condé and Best's map of Līhu'e Plantation in 1941 (Figure 10) also shows cane fields covering the entire area of the present Līhu'e Airport. This map also shows heavy historic use throughout the area: Ahukini Landing at the bottom center, Ninini Lighthouse on lower left, a dumping place between them; roads and railroad tracks, a reservoir in Field 20 just west of present entrance to the airport, other reservoirs, camps, parks, an athletic field and a school are also nearby to the west and southwest. An undated aerial photograph showing early Līhu'e Airport also clearly illustrates the extent to which the land around the airport was put to use for sugar cane (Figure 11).

The explosion of the sugar industry in Hawai'i fundamentally transformed the *ahupua'a* of Hanamā'ulu and Kalapakī. The land on which the airport now stands, including the land of the proposed Airport Improvement Areas, was used before historic times by traditional Hawaiians. However, during the later sugar plantation era, the area came under very heavy use and all present day airport land and most of the land in the improvement areas was plowed. Nearly all prehistoric structures were almost certainly destroyed and if archaeological remains are to be encountered they will likely be historic in nature.

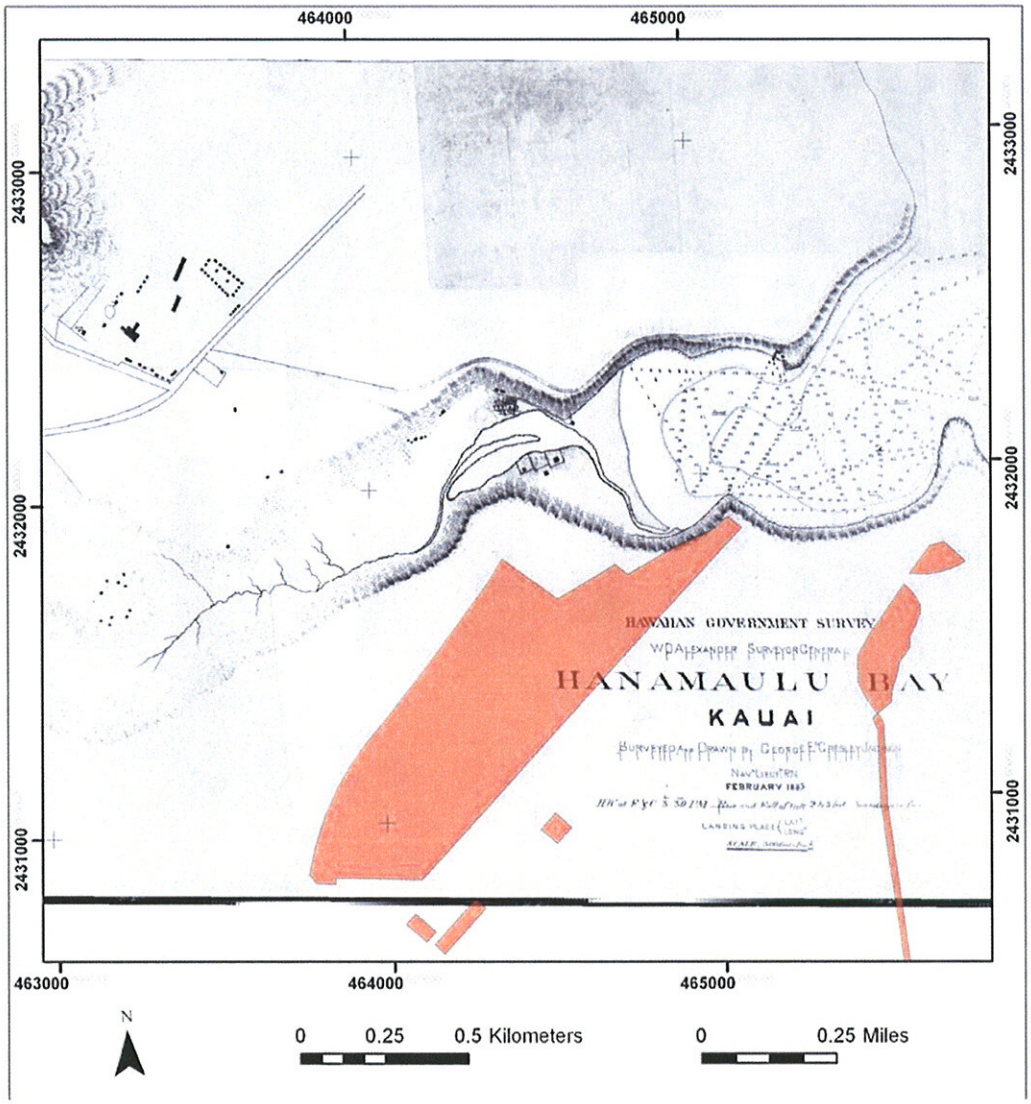

Figure 7. Portion of 1885 Hawaiian Government Survey map (Lt. George Jackson, Surveyor) of Hanamā'ulu Bay. Project area closest to extents of map is shown in red and Hanamā'ulu Plantation sugar mill buildings are in the upper left corner.

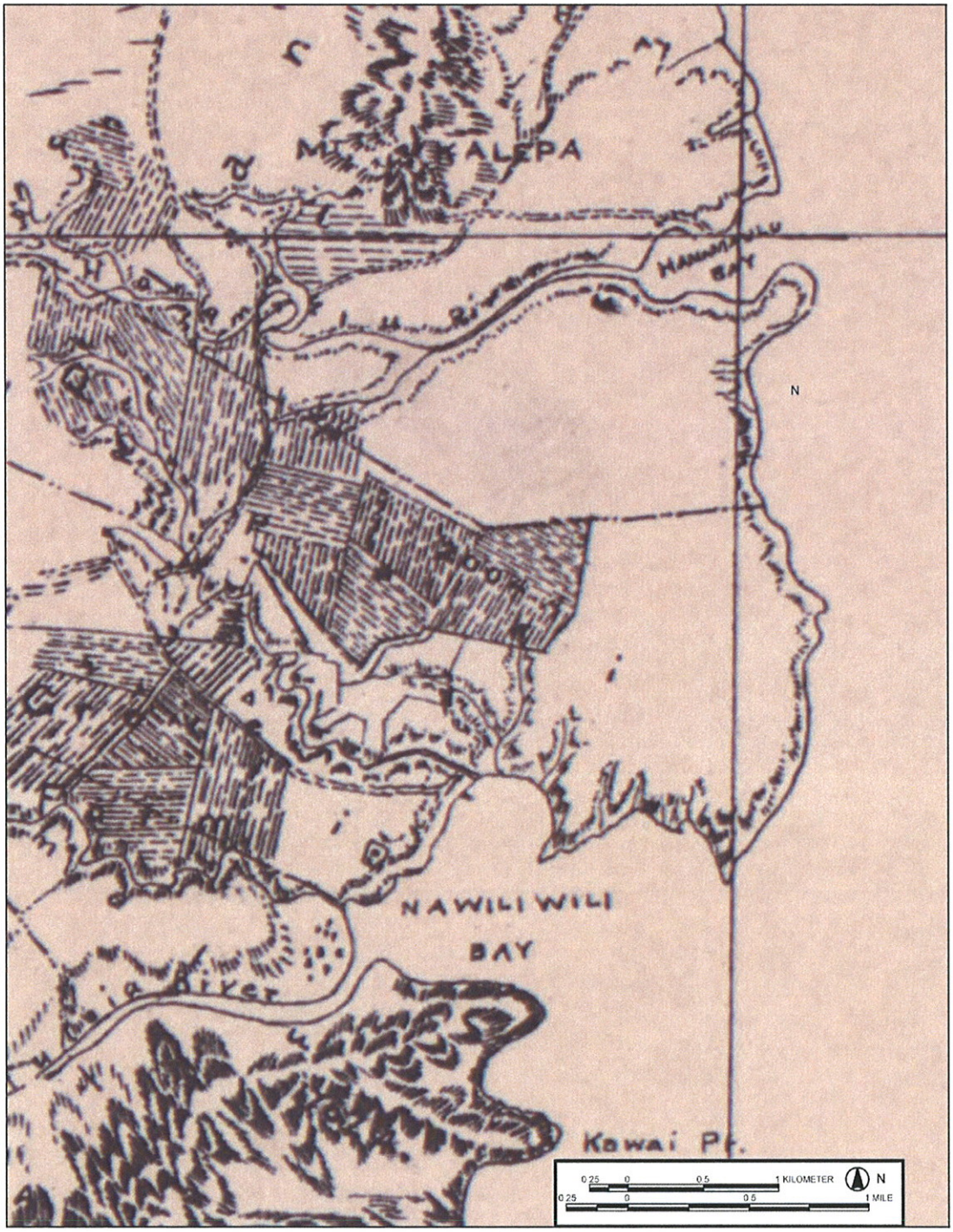

Figure 8. 1878 Hawaiian Government Survey map of Kaua'i clearly showing the area between Hanamā'ulu and Nāwiliwili Bays, where the airport is currently located, not yet under cultivation for sugar cane.

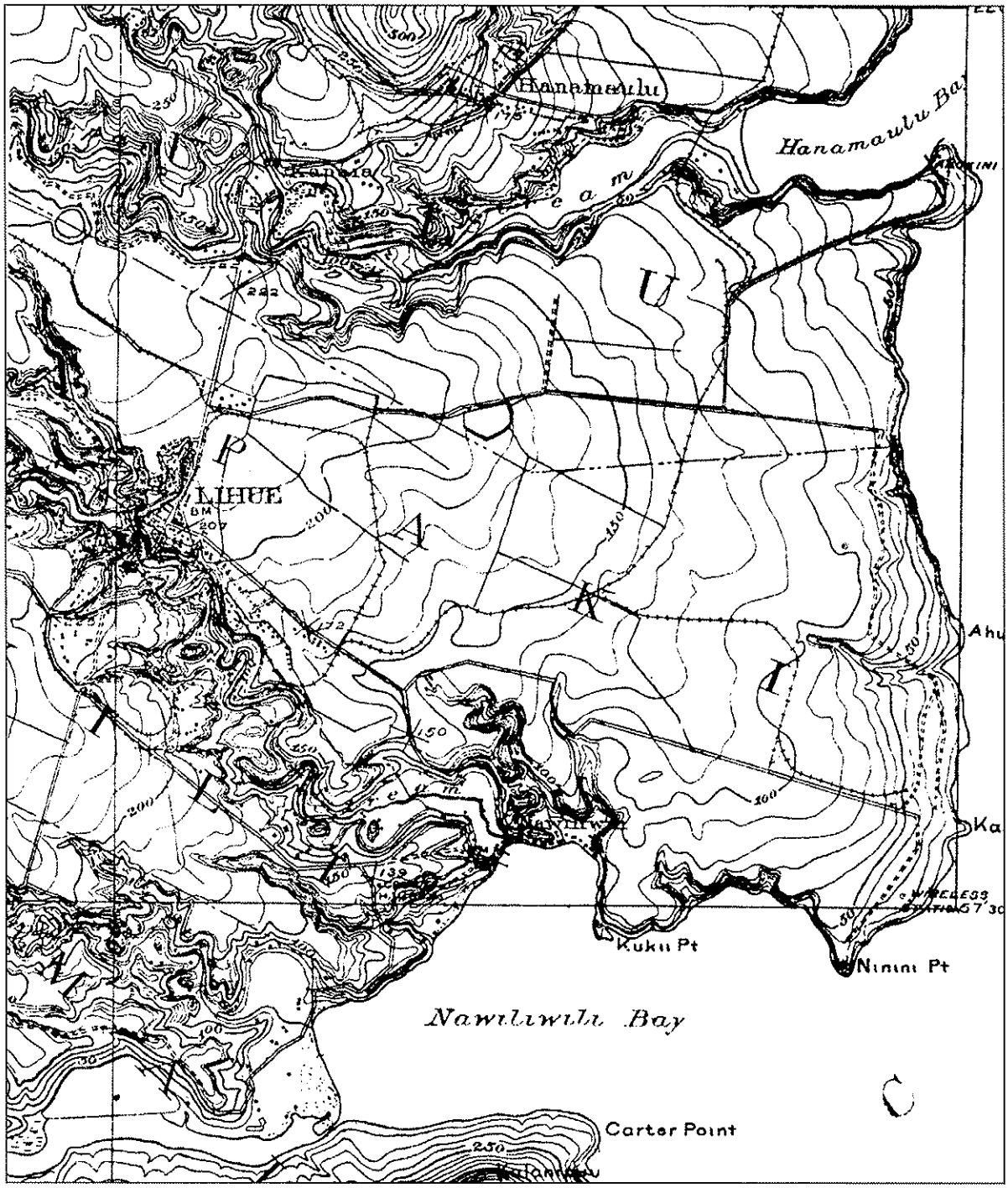

Figure 9. 1910 US Geological Survey map, Līhu'e Quad (Displayed Scale 1:31680)

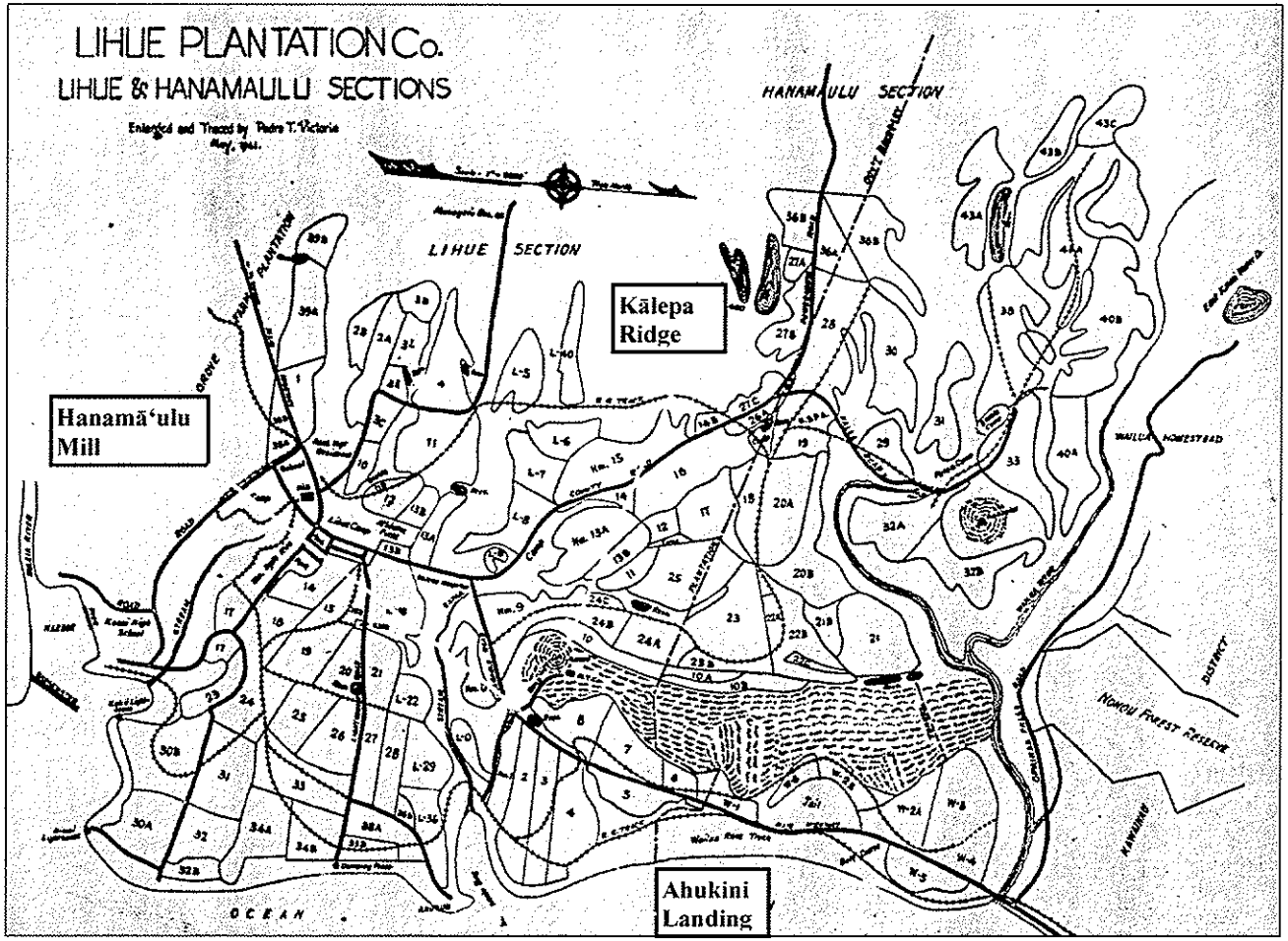

Figure 10. 1941 Līhu'e Plantation Co. map showing intensive sugar cane cultivation nearly to the shoreline. Hanamā'ulu Bay is in the lower left and Kālepa Ridge in the lower right (figure from Condé and Best 1973:168). NOTE: Map is as originally drawn, with north to the reader's right.

Figure 11. Undated aerial photo of Hanamā'ulu and early Līhu'e Airport surrounded by cane fields.

Section 3 Previous Archaeological Research and Settlement Patterns

3.1 Archaeological Studies and Sites in Hanamā'ulu and Kalapakī

Two tables outline the archaeological research and historic properties. These tables are followed by discussion of the research and historic properties. Table 2 provides a list of archaeological research conducted within Hanamā'ulu and Kalapakī *ahupua'a*, Table 3 is a list of known historic properties within the two subject *ahupua'a* and includes columns for site numbers, site type, *ahupua'a* location, and reference.

Archaeological surveys that have covered portions of the presently proposed expansion project area include: 1) Hammatt (1990); 2) Walker et al. (1991), 3) Franklin & Walker (1994), and Creed et al. 1999. No sites of any kind were documented within the present project area(s) from these previous surveys.

Previous archaeological background research shows there are some 33 known historic properties surrounding the airport area in the two *ahupua'a* of Hanamā'ulu and Kalapakī (Figure 12 following Table 2). A total of 26 of the sites are on the State Inventory of Historical Places (SIHP) and the other 7 are cemeteries not listed on the SIHP. None of these 33 properties are within the present project area, or property proposed for expansion.

Table 2. Previous archaeological studies within Hanamā'ulu and Kalapakī *ahupua'a*

Source	Location	Nature of Study	Findings
Thrum 1907	Island-wide	Almanac of Kaua'i	Listing of five *heiau* in the area
Bennett 1931	Island-wide	Archaeology of Kaua'i	Site 103. Dune burials. In the sand dunes that run along the shore halfway between Hanamā'ulu and Wailua River
Handy 1940	Island-wide	Reconnaissance of agricultural lands	Several sites identified
Hammatt 1988	Kalapakī	Archaeological Reconnaissance	Reports wall alignments, a terrace, and a midden scatter.
McMahon 1990	Līhu'e	Archaeological Fieldcheck	Three previousl identified historic residential sites (50-30-9390, -9401, -9402)
Rosendahl 1990	Kālepa Ridge	Archaeological Field Inspection	Identifies Site 50-30-11-1827 Burial platform (2+ individuals)
Walker & Rosendahl 1990	East of Kūhio Hwy, NW of Hanamā'ulu Bay	Archaeological Inventory Survey	No significant findings
Folk & Hammatt 1991	Niumalu	Archaeological Survey and Subsurface Testing	Reports 2 previously recorded fishponds and one newly discovered *'auwai*

Source	Location	Nature of Study	Findings
Walker, Kalima and Goodfellow 1991	A study of 8 parcels most near Hanamā'ulu Bay	Archaeological Inventory Survey	Identifies 10 sites; 3 pre-contact, 7 historic. A subsurface cultural layer was located adjacent to the project area (SS# 50-30-08-1838)
Walker & Rosendahl 1991a	Hanamā'ulu	Archaeological Inventory Survey	Reports only isolated coral fragments
Walker & Rosendahl 1991b	Nawiliwili	Archaeological Inventory Survey	Reports 34 intact historic burials and several historic headstones at Nawiliwili Cemetary (50-30-11-6008)
Hammatt and Creed 1992	Nawiliwili	Archaeological Inventory Survey	Reports 3 *'auwai* (50-30-11-491; 492; 493) and a single rock (50-30-11-494) thought to mark a burial.
Franklin & Walker 1994	7 parcels in Hanamā'ulu	Archaeological Inventory Survey	Mostly a summary of Walker & Rosendahl 1990 and Walker et al. 1991(same project area)
KRD – Kaua'i Renovation & Development 1994 (Kaipo Akana)	Kālepa Ridge	Monitoring Report	Revetment for Burial Site -746; additional bone fragments recovered
Hammatt et al. 1994	Hanamā'ulu	Archaeological Document Review	Reports on various archaeological features of the area, emphasizing the Wailua Heiau Complex (50-30-08-502)
Hammatt & Folk 1995	Kalapakī	Archaeological and Osteological Study	Reports 69 historic burials at Nawiliwili Cemetary (50-30-11-6008)
Creed et al. 1999	Hanamā'ulu and Kalapakī	Archaeological Assessment	Reports the finding of historic remnants of Ahukini Landing (50-30-08-9000)
Hammatt et al. 2002	Kūhiō Highway	Archaeological Study	Reports on various archaeological features of the area, emphasizing the Wailua Heiau Complex (50-30-08-502)
Hammatt & Shideler 2003	Kūhiō Highway	Archaeological Assessment	Reports on various archaeological features of the area, emphasizing the Wailua Heiau Complex (50-30-08-502)

Table 3. Previously Recorded Sites in Hanamā'ulu and Kalapakī

SIHP Site No.	Site Type	*Ahupua'a* Location and Reference
50-30-11-099	Kuhiau Heiau (A large paved *heiau*, whose enclosure covered an area of about four acres; long since destroyed)	Nāwiliwili from Thrum IN Bennett 1931:124
50-30-11-100	Ninini Heiau (near site of Nawiliwili light house, double paved wall remnant)	Kalapakī Bennett 1931:124
50-30-11-101	Ahukini Heiau (A *heiau* of medium size; foundations only now remain)	Hanamā'ulu; from Thrum IN Bennett 1931:125
50-30-11-102	Kalauokamanu Heiau (A large walled *heiau* that stood above the present mill; destroyed about 1855- of *pō'okanaka* [human sacrifice *heiau*] class.)	Hanamā'ulu; from Thrum IN Bennett 1931:125
50-30-11-421	Midden Scatter of marine shells	Hanamā'ulu on shoreline; Hammatt 1990
50-30-11-422	Remnant/probable cattle wall	Hanamā'ulu on shoreline; Hammatt 1990
50-30-11-423	Remnant/probable cattle wall	Hanamā'ulu on shoreline; Hammatt 1990
50-30-11-424	Oval Terrace Alignment	Hanamā'ulu on shoreline; Hammatt 1990
50-30-11-503	Halehaka Japanese Cemetery	Kikuchi & Remoaldo 1992: and pers. comm. N. McMahon 1999
50-30-08-621	Kapaia Chinese Cemetery	Hanamā'ulu; NE of airport Kikuchi & Remoaldo 1992: and pers. comm. N. McMahon 1999
50-30-08-746	Kālepa Road Burial	Hanamā'ulu; on Kālepa Hill; Rosendahl 1990
50-30-11-818	Plantation Wall	West of Kapaia in Hanamā'ulu; (Kikuchi 1992)
50-30-11-1826	Halemanu Graves	Hanamā'ulu; on Kālepa Hill; Pers. comm. N. McMahon 1999
50-80-08-1827	Kālepa Burial Platform	Hanamā'ulu, on Kālepa Ridge; (pers. comm. N. McMahon 1999)
50-80-08-1838	Pre-contact habitation deposit	Hanamā'ulu coast, north of bay
50-80-08-1839	Pre-contact agricultural wall and terrace	Hanamā'ulu coast, north of bay

SIHP Site No.	Site Type	*Ahupua'a* Location and Reference
50-30-11-1840	Historic Retaining Wall	Hanamā'ulu, Walker, Kajima & Goodfellow 1991
50-30-11-1840	Historic Retaining Wall	Hanamā'ulu, Walker, Kajima & Goodfellow 1991
50-30-11-1841	Historic Road	Hanamā'ulu, Walker, Kajima & Goodfellow 1991
50-30-11-1842	Boundary/Agricultural Wall	South side of Hanamā'ulu Valley; Franklin & Walker 1994
50-30-11-1843	Historic Concrete Foundation, Road and Concrete Wall	Hanamā'ulu, Walker, Kajima & Goodfellow 1991
50-30-11-1844	Historic Cemetery	Hanamā'ulu, Walker, Kajima & Goodfellow 1991
50-30-11-1845	Historic Railroad Bridge	Hanamā'ulu, Walker, Kajima & Goodfellow 1991
50-30-11-1846	Two concrete bridges	Hanamā'ulu coast; Walker, Kajima & Goodfellow 1991
50-30-11-1847	Hanamā'ulu Valley	Walker, Kajima, & Goodfellow 1991
50-30-11-1999	Paukini Rock (in the ocean)	Kalapakī or Nawiliwili Bay; N. McMahon (personal comm. 1999)
50-30-11-6009	Nāwiliwili Cemetery	Kalapakī near high school Hammatt & Folk, ed. 1997
50-30-08-9000	Ahukini Landing	Hanamā'ulu Bay; N. McMahon (personal comm. 1999)
50-30-08-9402	Historic Building Remnant at Site of Radio Station KIVM	Off Radio Road near Ahukini Hwy (McMahon 1990; Franklin & Walker 1994)
08-B008	Kaua'i Memorial Gardens	Kikuchi & Remoaldo 1992
08-B009	Hanamā'ulu Immaculate Conception Church Cemetery II, Roman Catholic	Kikuchi & Remoaldo 1992
08-B011	Immaculate Conception Church Cemetery, Kapaia	Kikuchi & Remoaldo 1992
08-B019	Family cemetery, not located, possibly connected to LCA 3653:2	Kikuchi & Remoaldo 1992
11-B001	Līhu'e Lutheran Church Cemetery	Kikuchi & Remoaldo 1992
11-B002	Japanese Cemetery, purported to have been moved	Kikuchi & Remoaldo 1992
11-B003	Līhu'e Lutheran Church Cemetery /Līhu'e Public Cemetery	Kikuchi & Remoaldo 1992

Figure 12. Portion of Hanamā'ulu and Kalapakī Quads showing known archaeological sites

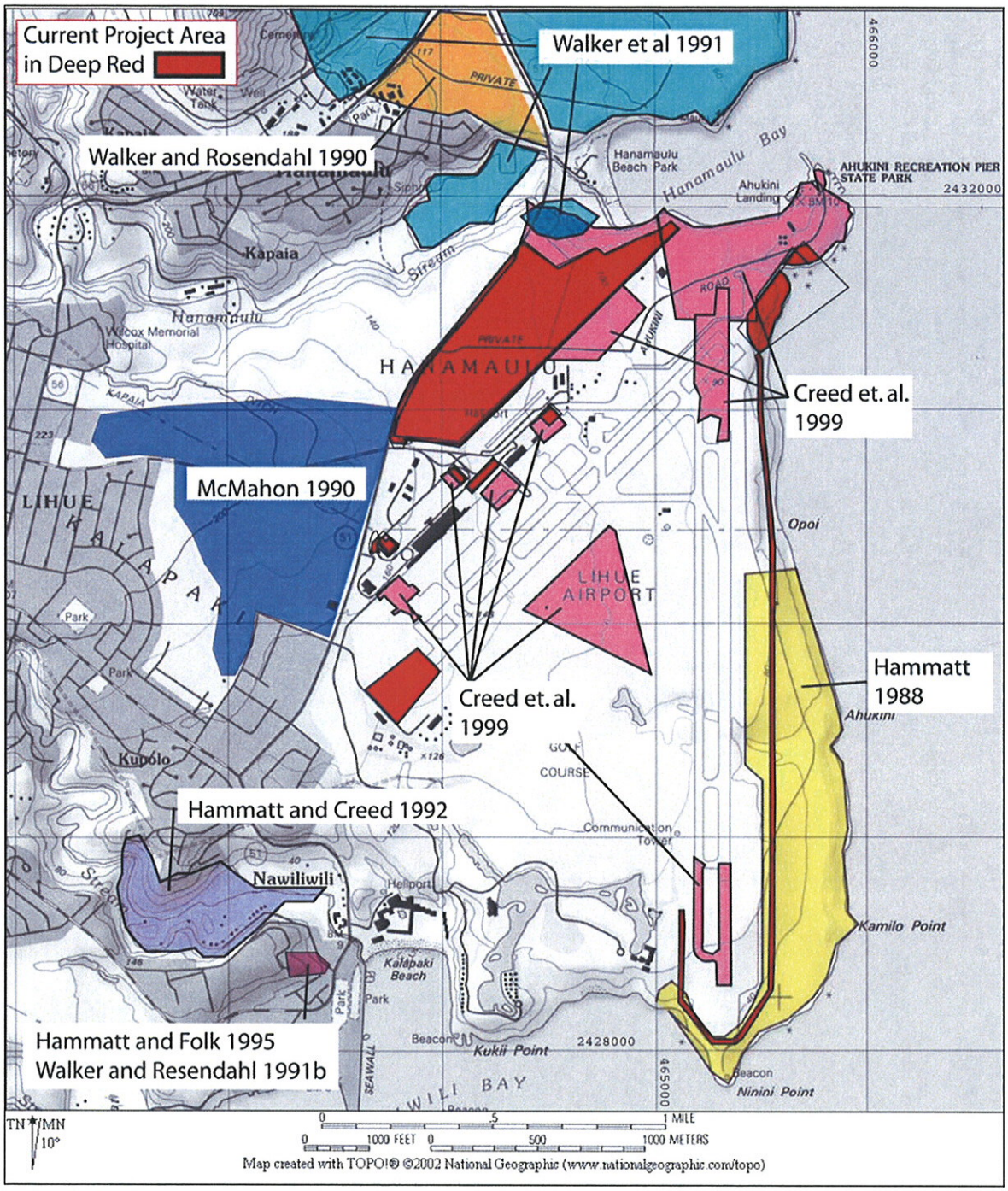

Figure 13. Map of the Līhu'e area showing areas of previous archaeological work.

3.1.1 Early Archaeological Surveys and Documentation of *Heiau*

Thomas Thrum, the publisher of the *Hawaiian Almanac*, gathered lists of *heiau* on all islands. From the *ahupua'a* of Hanamā'ulu and Kalapakī (with neighboring Nāwiliwili's Kuhiau Heiau close by), he compiled a list of five, as found in Bennett:

1. Ninini, Kalapakī, near site of Nāwiliwili light house. All destroyed (Site 100) (Thrum 1907)
2. Ahukini, Kalapakī. A *heiau* of medium size; foundations only now remain (Site 101) (Thrum 1907)
3. Pohakoelele, Kalapakī. A medium sized *heiau*; all destroyed (no site number) (Thrum 1907)
4. Kalauokamanu, Hanamā'ulu. A large walled *heiau* that stood above the present mill; destroyed about 1855- of *pō'okanaka* class (Site 102) (Thrum 1907)
5. Kuhiau, Nāwiliwili, near site of court house - a large paved *heiau*, whose enclosure covered an area of about four acres: long since destroyed (Site 099). The rock Paukini, now separate from but formerly connected with the shore, was where the *kahuna* [priest] lived (Thrum 1907).

The first comprehensive archaeological survey on the Island of Kaua'i was undertaken by Wendell Bennett and published in 1939. Bennett used Thrum's list for reference and added the sites he found. For Hanamā'ulu he lists two *heiau* and for Kalapakī one, but both destroyed, and he also notes sand dune burials (Site 103) towards the Wailua River.

Bennett repeats the descriptions given by Thrum for Sites 100-102 and adds

> Site 103. Dune burials. In the sand dunes that run along the shore halfway between Hanamā'ulu and Wailua River are many burials [Bennett 1931:125].
>
> Paukini Rock, a heiau or priest's house now under water in Nawiliwili harbor (Bennett 1931:48) (recently given State Site #50-50-11-1999)

Sites 100-102 had been either entirely or mostly destroyed by the time Bennett did his survey in 1930. Several sand dune burials or grave sites have also been noted in Hanamā'ulu, one by Bennett (Site 103), another near Kālepa Ridge (50-30-08-746) (Rosendahl 1990) and the Kālepa Burial Platform (Site 50-50-08-1827) discovered by Mr. Kaipo Akana during a field survey of damage after Hurricane 'Iniki by the Kaua'i Island Burial Council in 1992.

In an archaeological reconnaissance survey for the Kaua'i Lagoons Resort, a wall, possibly related to Ninini Heiau was noted. "A high well-constructed wall running 400' north of Ninini Lighthouse [is a] possible prehistoric wall and [it is] possibly related to the former Ninini Heiau

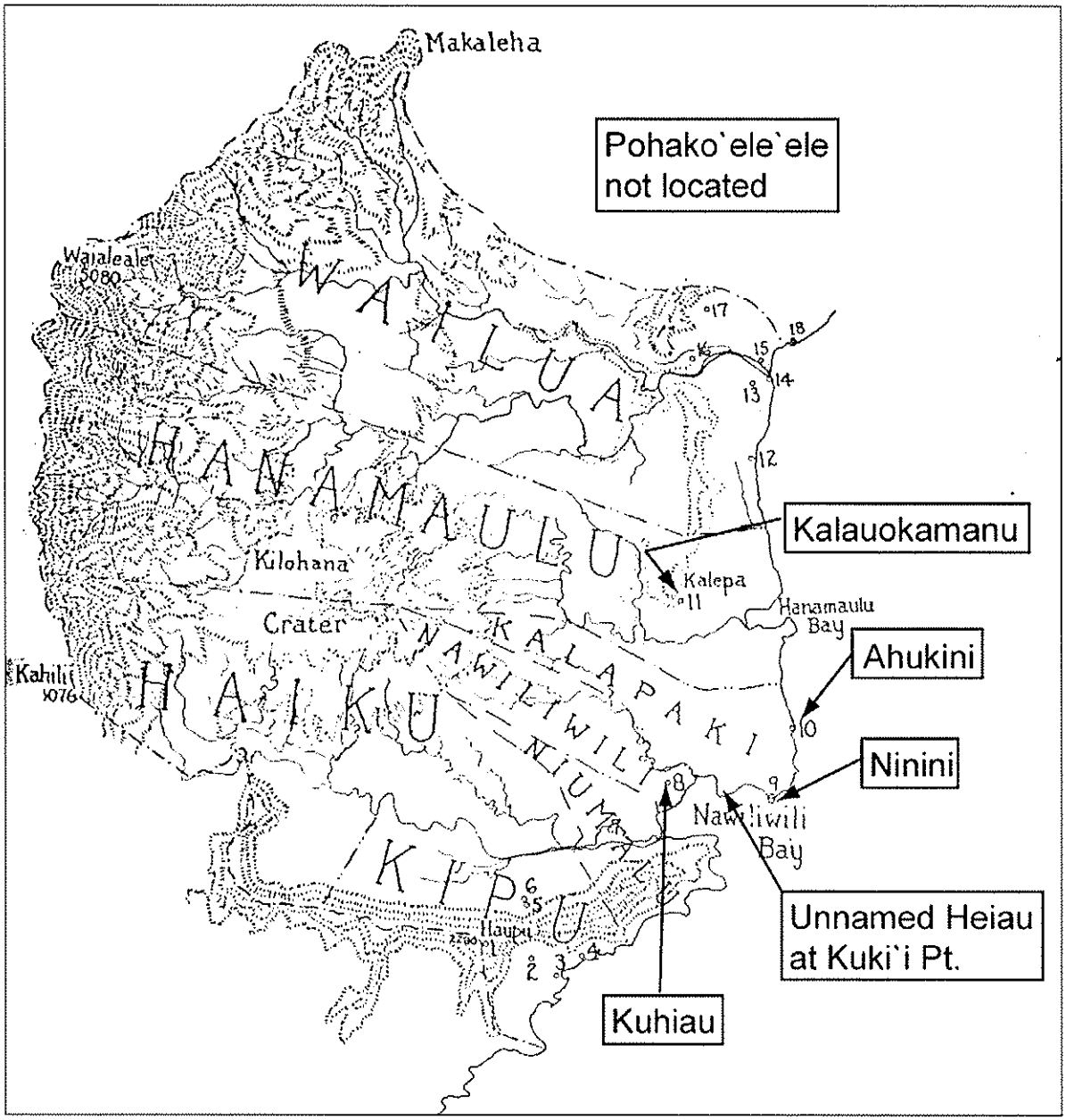

Figure 14. Heiau of Hanamā'ulu, Kalapakī, and Nāwiliwili Ahupua'a (figure modified from Damon 1931:391)

(Site 100) (Hammatt 1990:11). A dune midden scatter (Site -421), two probable cattle walls (Sites -422 & -423), and an oval terrace alignment (Site -424) were also recorded.

Bennet places Ahuhini [*sic*] heiau "in Kalapaki, near Ahukini Point on the bluff overlooking the sea. This is now entirely destroyed" (Bennett 1931:125).

Bennett (1931:152) lists Pohakoele'ele Heiau in Kalapaki under "Kauai sites not located. Damon probably would have mentioned its location if she had known it. There do not seem to be other references to Pohakoele'ele Heiau in Kalapaki, and it is unknown if Damon used Thrum for her source, or if she knew the information from persons on Kaua'i. Although Bennett could not verify its existence, and its location is speculative, it is included as a non-located site of pre-Contact Kalapakī, passed down in local memory. There was a *heiau* in the neighboring (north) *ahupua'a* of Wailua called Pōhaku'ele'ele, said to have been located just *mauka* of the junction of 'Ōpaeka'a Stream and the Wailua River (Dickey 1917:29; Yent 1997:9). It is possible that these two *heiau* are the same, and Thrum was confused on the location. It is also possible that this was the name of an unnamed *heiau* on Kuki'i Point. Neither Thrum nor Bennett mention a *heiau* noted by Lt. George G. Jackson, Navy surveyor for the Hawaii Government Survey Office in 1881 (Figure 15) at Kūki'i Point. The Kaua'i Community College newsletter, *Archaeology on Kaua'i* (1973:4) notes that the "remains of ancient heiau" noted by Jackson are "where the cottages of the Kauai Surf now stand."

Ethel Damon (1931), in her book about Kaua'i history, *Koamalu*, mentions Kuhiau Heiau in Nāwiliwili, placing it near the location of the Court House (see Figure 15 for Court House location). She mentions Pohako-ele'ele and Paukini Rock, the location of the first unknown, and the second shown in Figure 12 above (SIHP -1999):

> An additional area of four acres was during this same year, 1851, sold to the government for harbor and road near Nawilwili Bay. The first sighting point in this deed was the north corner of Kuhiau heiau [Damon 1931:415].
>
> From the deck of their rivercraft in 1854 Mrs. Rice and the children could plainly see above the rocky shore the ruins of Kuhiau, the old heiau, or temple, and nearby on the bluff the flaming blossoms of a great wili-wili tree among koa trees which then grew almost down to the water's edge [Damon 1931:17].
>
> On the bluff overlooking the bay of Nawiliwili, where the public High School now stands, was once the large paved heiau called Kuhiau, extending over about four acres of ground. It was in its day the largest and most far-famed temple on the island. Below it, in the bay, is still the rock called Paukini, which was said to be its companion or sister heiau, and was probably also the home of the kahuna, or priest, of Kuhiau. In ancient times this rock was connected with the shore near the site of the former boat landing. All the dredging and filling in for the modern wharves have not yet touched this old rock of Paukini, the sole remnant of the famous heiaus of Nawiliwili Bay. For almost no traces, even of the great Kuhaiu temple, are now [in 1931] to be found; and of the three small heiaus in the

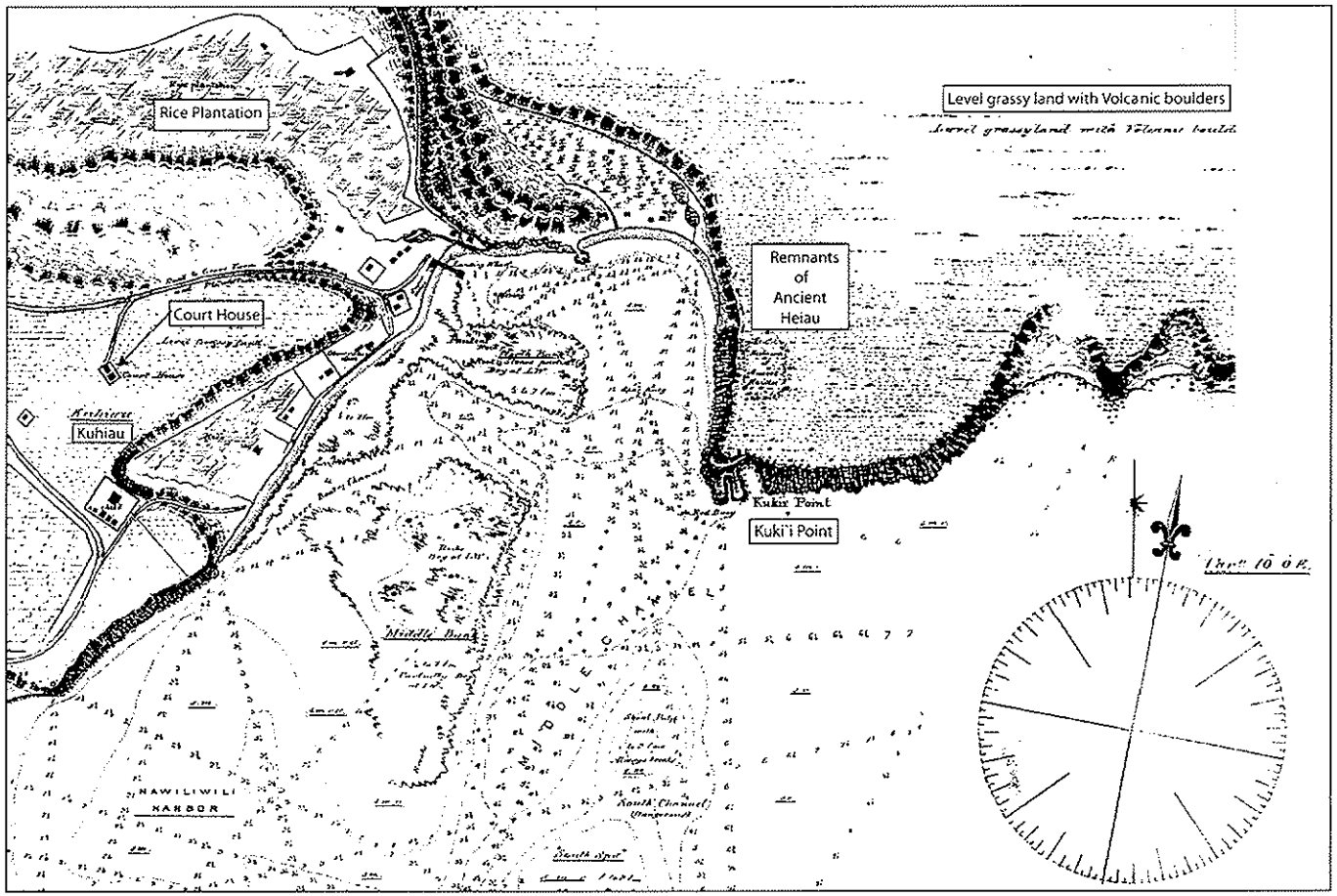

Figure 15. Portion of 1881 map of Nāwiliwili Harbor by Lt. George G. Jackson's, showing remnants of *heiau* at Kūki'i Point, rice plantations at the river mouth and "Level grassy land with volcanic boulders" in the present-day airport area; also note location of area called "Kuhiau" and the Court House; Kuhiau Heiau was once located "near the court house."

> neighboring ahupuaa of Kalapaki, those of Ninini, Ahukini and Pohako-eleele, little more than the names survive [Damon 1931:397-398].

In a collection of Kaua'i Place names, the *heiau* of Kuhiau is also mentioned:

> *Nawiliwili, oia ke awa kumoku. Aia ilaila ka heiau of Kuhiau. Kalapaki, aia oia makao o Nawiliwili.*
>
> Nawiliwili is the harbor. The temple of Kuhiau is there. Kalapaki is on the shoreline of Nawiliwili.
> [Kelsey n.d., Kelsey Collection]

Thomas Thrum placed the location of Kuhiau Heiau near the "Court House," which is labeled on a 1881 Jackson map (refer to Figure 15) in an area called "Kuhiau." Jackson does not label any structure as the *heiau*, so it is possible it had been destroyed sometime between 1854, when Mrs. Rice and her children saw it from the harbor, and 1881, when Jackson made his map. According to Dr. William Kikuchi, the *heiau* was destroyed when people took the rocks to use for other purposes (Memo dated July 11, 1989 from Ed Slavish to John Finney and Bernard Bays). Its general location was near the ironwood tree next to the Kaua'i High School flagpole (Kalima and Smith 1991:B-5). Ms. Nancy McMahon indicated that the Paukini Rock location in Kalapakī Bat was shown to her by Ms. Cheryl Lovell (pers. comm. 1999), and it has been added to the SHIP list (Site 50-50-11-1999).

Thrum gives the location of the *heiau* of Kaluaokamanu Heiau as "above the mill." A 1934 *Garden Island Press* newspaper account and then Ethel Damon gives additional information on the location of this *heiau*:

> Another *heiau* located in Hanamā'ulu is Kalauokamanu. This was situated just west of the Lihu'e Plantation Yard and adjacent to a cane haul road. It is said to be of the *pookanaka* class and was destroyed in 1855 [*Garden Island Press* 1934, cited in Corbin 2002:14].
>
> Within the ahupua'a of Hanamaulu was a large walled heiau called Ka-lau-o-ka-manu of the poo-kanaka type, or one in which human sacrifices were offered; but in the almost unconscious days of transition, when popular interest in such thing was still asleep, most of the stones from this enclosure were taken to make firm the foundation of the Hanamaulu sugar mill [Damon 1931:397].

There were also two stones associated with this temple, which guarded the pathway to the *heiau*. Mary Rice, in her "History of Līhu'e" stated that there were "two large rocks formerly in the field opposite Mr. Wolter's residence, of which it is said they were chiefs on their way to this heiau but stricken dead by the stench from the human sacrifices" (Rice 1914b:48). Carl Wolters was the manager of Līhu'e Plantation from 1893 to 1900. Kalauokamanu Heiau was said to have been located "above the mill" at the base of Kālepa Ridge (Wichman 1998:61) (refer to Figure 10 for relationship of mill and Kālepa Ridge). The *heiau*, therefore, may once have been located in the area now occupied by Kālepa Village and Hanamā'ulu Plaza (Lo 2005).

3.1.2 Recent Archaeological Projects

A brief walk-through fieldcheck was conducted by McMahon (1990) of three parcels of land for possible new Judiciary building in Līhu'e. Three previously identified historic residential sites (50-30-9390, -9401, -9402) were recorded. No archaeological artifacts were found.

An archaeological reconnaissance of a coastal area between the Lihue Airport and Ninini point was conducted by Hammatt (1988). He reported five sites. These include 2 wall remnants of the historic era, a midden scatter along the wave cut shoreline, an oval alignment or terrace, and a 400-foot long wall. The area was heavily disturbed and no trace of the two *heiau* mentioned by Bennett (1931) could be found.

An archaeological survey and subsurface testing was conducted at the Kanoa Estate Lands in Niumalu by Folk and Hammatt (1991). During this survey, two fishponds originally recorded by Ching et al. (1973) were identified. In addition, a previously unrecorded 'auwai was found which connected one of the fishponds, known as Kanoa's fishpond, to the Hule'ia stream.

Nine backhoe trenches were excavated in association with the Hanamā'ulu Affordable Housing Project from which only "several small isolated coral fragments" were found. No further archaeological work was recommended in TMK 3-7-03:Por. 20, since, like much of the Līhu'e area, it was former cane lands (Walker and Rosendahl 1991a:8).

The archaeological inventory survey of the 552.3 acres of Molokoa Lands included a portion of the airport. Two sites were located: a boundary/agricultural wall, State site 50-30-11-1842 along south side of Hanamā'ulu Valley near Kapaia and a re-identified Site 9402, an historic building associated with Radio Station KIVM (Franklin and Walker 1994:27), located in the Kalapakī portion of the airport. No sites of any kind were reported for the Ahukini Makai Parcel, which overlaps with Areas 7 and 8 of current study area).

A document review (Hammatt et al. 1994), archaeological study (Hammatt et al. 2002), and archaeological assessment (Hammatt and Shideler 2003) were all carried out to evaluate the potential impacts to archaeological resources of the proposed Kūhiō Highway Improvements. The most critical concern is suggested to be the potential impact to the viewplanes of the Wailua Complex of Heiau (designated Site 50-30-08-502).

Walker, Kajima, and Goodfellow's *Archaeological Inventory Survey Līhu'e / Puhi / Hanamā'ulu Master Plan* (1991) identified or re-identified 10 sites, of which 8 can be seen on the map of archaeological sites. Three sites are pre-Contact historic properties: 1) Site -1838A &B (a habitation cultural deposit); -1839A& B (agricultural wall and terrace of undetermined function); and, Site -1847 (river valley of approximately 53 acres). Site -1839 provided a carbon date of 1170-1400 A.D. (Walker et al. 1991:72).

Six sites were related to plantation-era transportation; four related to roads (-1840 a wall, -1841 a road, -1842 a wall and -1843 a complex of a concrete foundation, a road, and a concrete wall), two to bridges (-1845 a railroad bridge and -1846 two concrete bridges) probably all related to railroads. One site is an historic cemetery (Site -1844 Japanese-Buddhist and Filipino-Catholic cemetery). As one would expect, the three pre-Contact sites are in areas never cultivated for sugar cane. Two of the three sites are along the shoreline and the third is in the river valley.

No structural remains were located in the river valley, but sub-surface remains of traditional agricultural activities may continue to exist.

Hammatt and Creed (1992) conducted an archaeological survey of 61 acres of land in Nawiliwili. Historical evidence suggested this land was intensively used for agriculture in both pre and post contact times. They report the finding of 3 *'auwai* (50-30-11-491; 492; 493) in the area and also the presence of a single rock (50-30-11-494) thought to be a burial marker.

Kikuchi and Remoaldo's *Cemeteries of Kauai* (1992) notes 8 cemeteries in Hanamā'ulu and Kalapakī (See Līhu'e Area Cemeteries: p. 120 Hanamā'ulu Cemeteries p. 76). Descriptions do not exist for two of them (B019, B004). A pre-Contact burial platform on Kālepa Ridge was found by Kaipo Akana in 1992 in an inspection of areas damaged by Hurricane 'Iniki. These sites are not in the project area but lie scattered in all directions throughout Hanamā'ulu and Kalapakī.

Hammatt and Folk (1995) conducted an archaeological and osteological study at Nawiliwili Cemetary (50-30-11-6009). This area was heavily disturbed during development in the 1970s. The immediate demand for more development prompted a mortuary study of the area. 68 burials of historic age were discovered, removed and reinterred nearby. The burials represent a wide variety of ethnicities and ages. Walker and Rosendahl (1991b) surveyed this same general area and discovered 34 intact, historic burials with several associated headstones.

In a 1999 archaeological assessment report, eleven subsets (Figure 16) of the airport area received 100% surface survey coverage (Creed et al. 1999). Some of these areas of study are very similar to those under investigation in this inventory survey. No evidence of prehistoric or early historic sites was encountered within the project boundaries during this 1999 study. However, extensive remains of Ahukini Camp (part of Ahukini Landing SIHP 50-30-08-9000) were documented at Hanamā'ulu Bay. The remains consisted of 15 concrete slabs believed to have been associated with residential structures, concrete drainage systems remnants, piles of historic trash, railroad tracks, loading dock and camp-related infrastructure. Additionally, a large wooden house (the Bertrand House) with attached garage/living area and an associated rock wall lies within the project area, in proximity and just south of the Ahukini Landing.

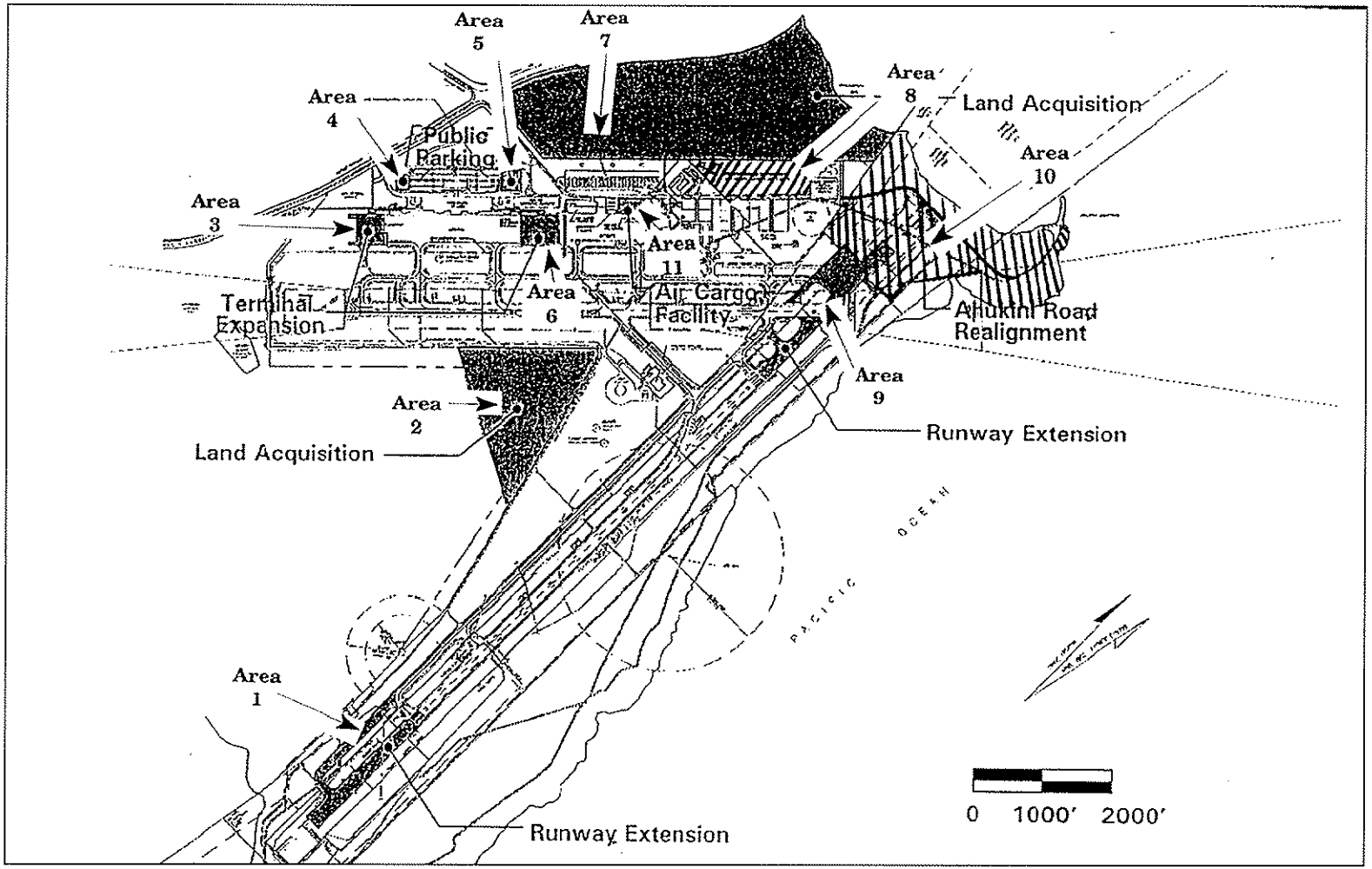

Figure 16. Darkened areas on the Līhu'e Airport Master Plan are areas of archaeological investigation reported in Creed et al. 1999. Adapted from "Lihue Airport Master Plan Improvements" figure prepared by Wilson Okamoto and Associates 1998).

3.2 Settlement Pattern Summary and Predictive Model

Creed et al. (1999) provide a detailed synthesis of the settlement patterns and prehistory of the *ahupua'a of* Hanamā'ulu and Kalapakī. This systhesis includes extensive research on how both *ahupua'a* fit into the settlement patterns of Kaua'i as a whole. Because both Creed et al. 1999 and the current investigation focus on portions of the Līhu'e Airport property, the Creed et al. (1999) synthesis is very applicable to the current study. The synthesis presented here is derived from that presented in Creed et al. 1999, if more limited in scope and abbreviated If further information about the area is desired, it is recommended that the reader use this earlier report for reference.

The archaeological record of early Hawaiian occupation in the Līhu'e District indicates a date range of ca. AD 1100 to 1650 for pre-Contact Hawaiian habitations (Walker et al. 1991). As pointed out by Franklin and Walker (1994), two important *ahupua'a* and large rivers lie on either side of Hanamā'ulu and Kalapakī lands (Franklin and Walker 1994:17). The first, Wailua Ahupua'a, is home of the royal chiefs and lies immediately to the north. The other, Hulē'ia River Valley and the *ahupua'a* of Ha'ikū lie to the south beyond Nāwiliwili and Niumalu. Thus Hanamā'ulu and Kalapakī Ahupua'a would be expected to have less varied pre-Contact resources than their more dominant neighbors, who had greater populations along large river valleys.

Hanamā'ulu and Kalapakī, however, would hardly be devoid of pre-Contact structures as legends assign considerable importance to the region. They portray Hanamā'ulu as the birth and death place of Kawelo, a late seventeenth century paramount chief. They reference paths crossing both Hanamā'ulu and Kalapakī as well as frequent canoe landings, and speak of a number of *heiau* including the large Kalauokamanu, where human sacrifice was conducted. Based on Māhele records, archeological surveys and ethno-historical accounts, the traditional settlement pattern for Hanamā'ulu and Kalapakī varied somewhat but both populations were concentrated in a stream valley and near the shore. The *kula* lands were used for *wauke* and other dryland crops.

Archaeological remains of a terrace and midden along the Kalapakī coast (Hammatt 1998) indicate that other shoreline habitations existed that were not included in the Māhele records. Shorelines are also traditional burial sites, as attested by Bennett (1931), Cox (1977; 1992), Erkelens and Welch (1993), Beardsley (1994), and Hammatt and Folk (1995), particularly along the shoreline on both sides of the Wailua River.

The large amount of *kula* land and the importance of the sugar industry in Hanamā'ulu and Kalapakī dramatically altered land use patterns, perhaps more so than in prestigious traditional *ahupua'a* like Wailua and Ha'ikū. Many people moved away from the river valleys to make a living through cash crop agriculture. As a result Kalapakī and Hanamā'ulu should have a very high number of cultural resources, both relatively and absolutely, that are related to sugar plantations.

The pattern of plantation land use (e.g. plowing, rock removal, etc.) generally obliterates most traces of pre-historic and early historic land use. Thus, the non-cane shoreline is the most likely place to find traces of the pre-Contact sites such as midden and artifact scatters. Structure

remnants are highly unlikely as many pre-Contact structures such as *heiau* were disassembled and their stones incorporated into historic structures. Only Improvement Areas 7 and parts of 9 fall into these unplowed coastal areas.

Traces of the plantation and port community still in existence in the airport lands are much more likely to be encountered. If found, they will probably be almost exclusively on the surface. Major finds are not expected because the vast majority of the plantation infrastructure was located to the northwest and port infrastructure to the north and south of the project area. Most of the airport lands were regularly plowed fields used up until relatively recently. Artifacts that could be found include low density lost or abandoned items, small historic structures, and abandoned machinery. Improvement Areas 6, 7, 8 and 9 are the most likely to contain historic deposits. Other Improvement Areas are located immediately within highly developed airport grounds.

Section 4 Survey Results

4.1 Field Findings

The pedestrian survey located one surface cultural resource in Improvement Area 7a and no others in the rest of the project area. These results are consistent with expectations set forth by background research – that any findings were likely to be historic and that it was unlikely to find dense cultural resources in this area.

The historic property found in Improvement Area 7a is comprised of two small, concrete structural remnants in poor condition that were likely used for animal husbandry. No portable artifacts of any kind were found with the structures. A detailed description, including maps and photographs can be found on the following Cultural Resource Description.

No other surface cultural resources were located within the project area, but a summary of the Improment Areas investigated and their current land use is listed in Table 4. Photographs taken during the survey are ordered by Improvement Area in Appendix A. The majority of the Improvement Areas were found to be heavily disturbed from sugar cane plantation activities and/or highly developed as part of the modern airport. Except where noted below, all the following Improvement Areas are in former cane land (refer especially to Figure 11).

Area 1 is a highly developed landscaping strip next to the terminal approach road. It features a maintained lawn, trees and shrubs and traffic signs.

Area 2 is also a highly developed landscaping island between the terminal approach road and the terminal itself. It also has a maintained lawn, a bed of mixed shrubs and trees, a small asphalt paved parking area and metal building serving as a taxi dispatch stand.

Area 3 is very similar to Area 2, but on the north end of the terminal. It is also completely landscaped and has a paved parking area.

Area 4 is a partially landscaped, graded open lot on airport grounds near the terminal. It is covered in gravel and is used for parking.

Area 5 is in the middle of the airport grounds and is a maintained grass field used for parking large equipment.

Area 6 is a former cane field that is filled with tall, wild grasses.

Area 7a and 7b are undeveloped lands off the north end of the runway that are overgrown with dense shrubs and trees except for some erosional areas near the coast. Documentation and field observation does not suggest these areas were cane fields.

Area 8 is a heavily graded, fenced area opposite of the runway from Area 7.

Area 9 is undeveloped, dense grassland ringing the runway that was partially plowed for sugar cane cultivation, but also borders the coast at its northern and southern most extents where land was probably not utilized for cane cultivation.

Table 4. Summary of Field Observations of Improvement Areas

Improvement Area	**Land Jurisdiction**	**TMK**	**Acreage**	**Current Land Use**	**Photo Numbers** *(See Appendix A)*
1. Proposed New Terminal Exit Road	Government, State	(4)-3-5-001:008	0.43	Developed, landscaped area with grass and trees	1 ,2, 3
2. Proposed Public Parking Expansion Southwest	Government, State	(4)-3-5-001:008	0.97	Developed, densely landscaped area, taxi stand and taxi standby lot	3, 4, 5
3. Proposed Public Parking Expansion Northeast	Government, State	(4)-3-5-001:008	0.83	Developed, densely landscaped area abutting current parking lot	6, 7
4. Proposed Employee Parking Expansion	Government, State	(4)-3-5-001:008	1.92	Partially developed, gravel parking lot and open field	8
5. Proposed Air Cargo Facility Expansion	Government, State	(4)-3-5-001:008	1.07	Undeveloped, open field bordered by small buildings, temporary equipment storage	9, 10
6. Proposed Heliport Reconfiguration	Private, Visionary LLC	(4)-3-7-002:001	122.83	Undeveloped, open field that is not maintained	11, 12, 13, 14
7a. Proposed Upgrade of Runway Safety Area North Southwest	Government, State	(4)-3-5-001:160	9.48	Undeveloped, dense and overgrown shrubs and trees	15, 16, 17
7b. Proposed Upgrade of Runway Safety Area North Northeast	Government, State	(4)-3-5-001:160	2.32	Undeveloped, dense and overgrown shrubs and trees	15, 16, 17
8. Proposed Upgrade of Runway Safety Area South	Government, State	(4)-3-5-001:008	14.34	Undeveloped, but nearly entire area has been graded, encircled by a chain-link fence	18, 19
9. Proposed Emergency Vehicle Access/Perimeter Road/Fencing	Government, State Government, State Private, Kanai Lagoons	(4)-3-5-001:008 (4)-3-5-001:005 (4)-3-5-001:102	21.16	Undeveloped, largely fields of low scrub and grass, area is occasionally crossed by a dirt road	20, 21, 22, 23, 24, 25

4.2 Cultural Resource Description

4.2.1 SIHP 50-30-08-3958

FORMAL TYPE:	Enclosures and related structures
FUNCTION:	Animal Husbandry
# OF FEATURES DOCUMENTED:	2 (Features A and B)
CONDITION	Remnant
AGE:	Historic, Likely Early to Mid 20th Century
DIMENSIONS/AREA:	20 m E/W by 20 m N/S / 400 m^2
LOCATION:	Improvement Area 7a, adjacent to coast
TAX MAP KEY:	[4] 3-5-001: 160
LAND JURISDICTION:	Government, State of Hawai'i
UTM Coordinates	Feature A: 465,568 m East; 2,431,419 m North
(NAD 83 Zone 4 North)	Feature B: 465,586 m East; 2,431, 442 m North

SIHP 50-30-08-3958 was unrecorded prior to the current investigation. SIHP 50-30-08-3958's two component features are located in improvement area 7a along the coast, immediately north of an unnamed intermittent drainage that flows from the Līhu'e Airport runway system into the sea.

Figure 17 shows the historic property's location plotted on a USGS topographic quadrangle. Figure 18 is a recent aerial photograph showing the historic property's location. Figure 19 is a plan view map of SIHP 50-30-08-3958.

Feature A is a remnant, linear, east-west trending, alignment of at least five concrete enclosures. It is perched on the upper, north edge of the east-west trending intermittent drainage, near where the drainage enters the sea. Feature B is a lone cement foundation remnant located approximately 25 m northeast of Feature A, along the upper edge of the low sea cliff that makes up the coastline. Both features appear to be contemporaneous based on construction materials and techniques. Both features are in poor condition – only remnants of the original structures remain.

Vegetation at SIHP 50-30-08-3958 consists of a mix of introduced and Native Hawaiian coastal flora. Christmas Berry and *Koa Haole* shrubs and low Ironwood trees were noted in the immediate vicinity, along with tall grasses.'*Ilima* and *Naupaka* were also observed around the features. The ground surface around the site is eroding saprolite overlying bedrock (Figure 20).

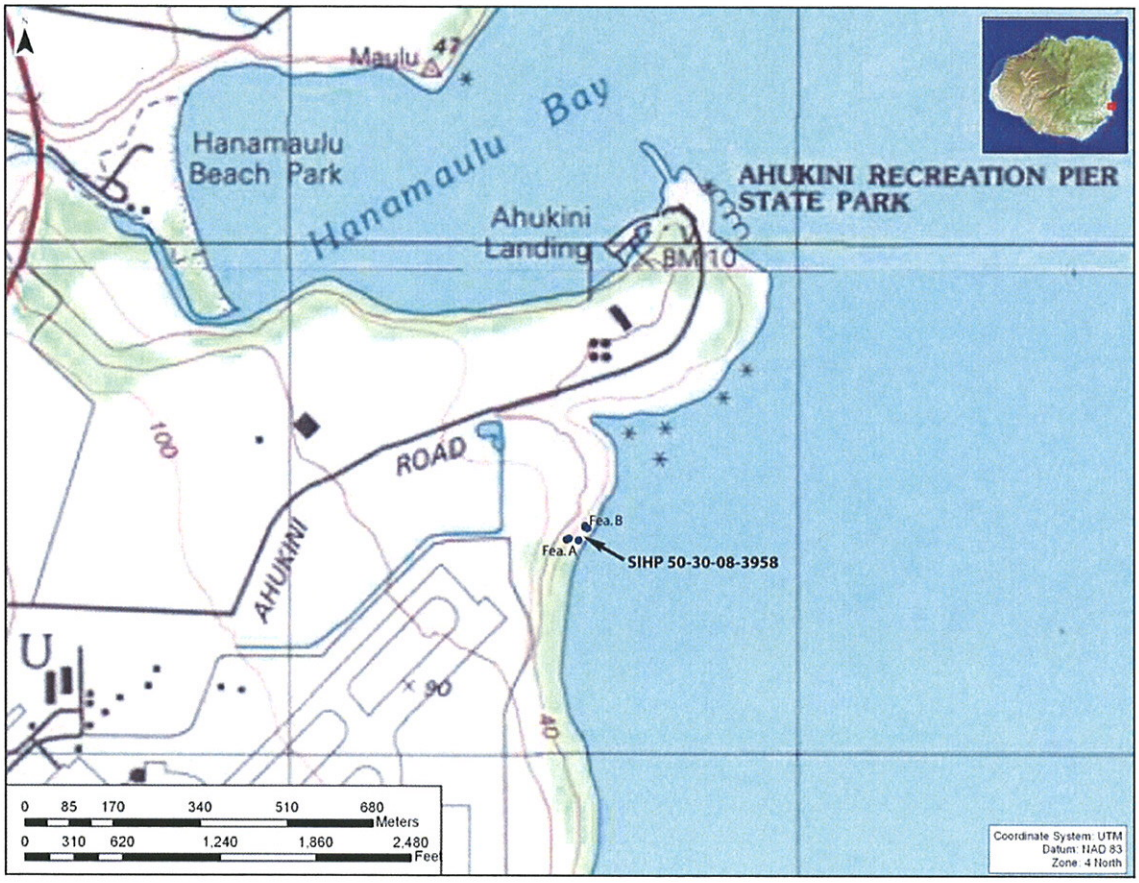

Figure 17. SIHP 50-30-08-3958 shown on portions of the 1996 Līhu'e and Kapa`a USGS 7.5-minute topographic quadrangles.

Figure 18. Aerial photograph showing location of SIHP 50-30-08-3958, Features A and B.

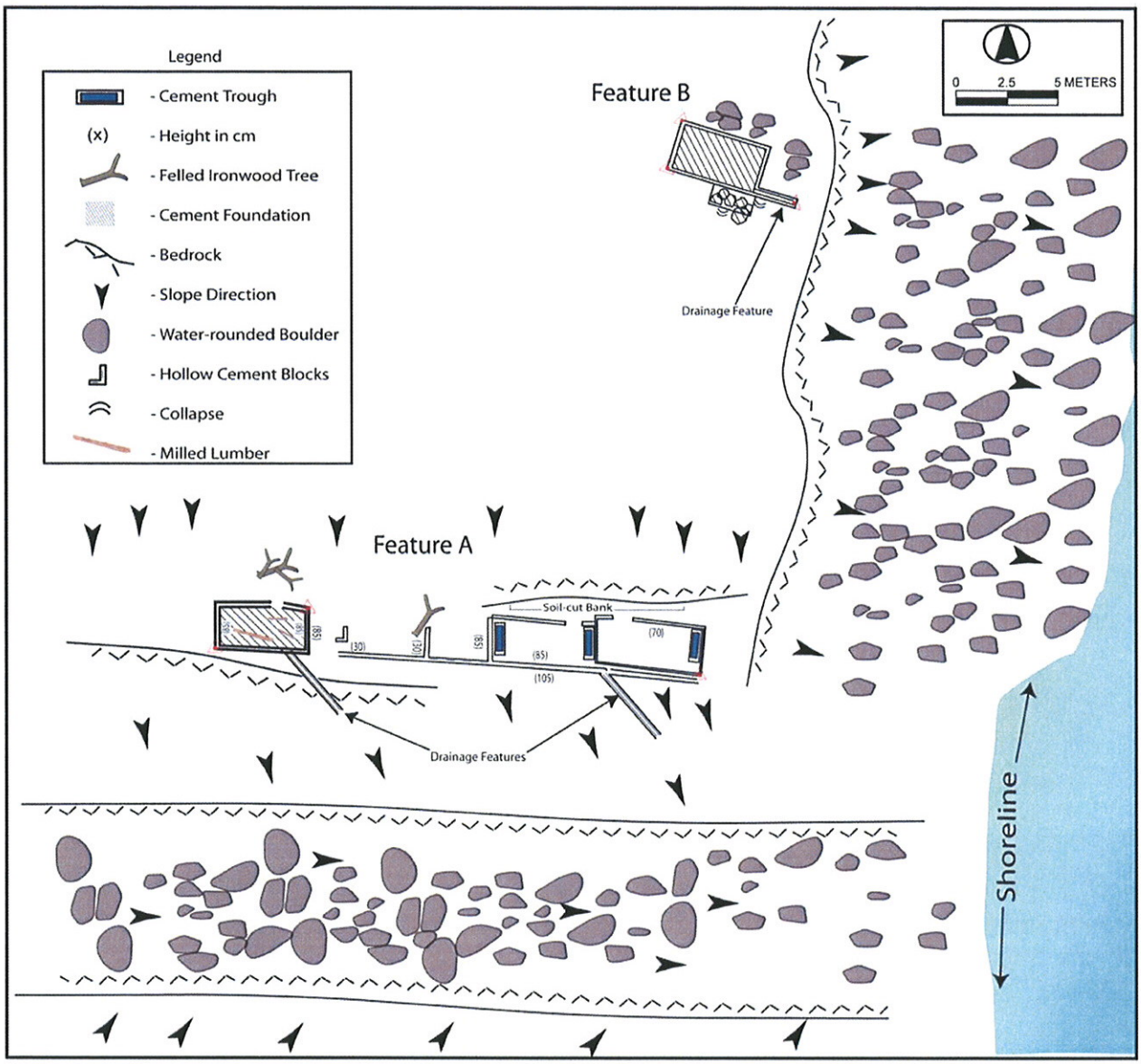

Figure 19. Plan view map of SIHP 50-30-08-3958, Features A and B, showing the historic properties relationship to the unnamed intermittent drainage and the shoreline.

Figure 20. Photo of Feature A, view to the north, showing entire length of the enclosures' south walls, the intermittent drainage ditch is in foreground. At the west (left) end of the feature, remnant concrete alignments, eroded by the drainage, are covered by *Naupaka.*

4.2.1.1 Feature A

Feature A is a series of contiguous rectangular concrete enclosures that typically share adjoining walls. There are five easily recognizable enclosure remnants, with some additional remnant concrete structural alignments extending to the west into thick *Naupaka* and grasses. These concrete remnants in the grass and *Naupaka* at the western end of Feature A are severely eroded and collapsed, having been undercut by expansion of the immediately adjacent drainage (refer to Figure 20).

For the five relatively intact enclosure remnants, most of the enclosing walls are constructed of cemented angular basalt boulders and cobbles. On many wall surfaces the outer layer of cement has crumbled and the basalt stones are exposed amid the concrete mortar that holds them together, as seen in Figure 21. On the walls that are more intact, no basalt stones are visible, only the original concrete surface, revealing distinct seams left by wooden forms that were used to create the wall segments. These seams run horizontally and are on average 0.25m wide (Figure 22). There is no evidence of steel used as reinforcement inside the cement of these structures. The enclosure wall segments are a uniform 15 cm wide and vary in height, but are generally from 0.7 m to 1.05 m high. The wall heights were likely a uniform 1.05 m originally, but have collapsed as the feature has deteriorated. A small portion of one of the enclosure walls is constructed from concrete hollow tiles (refer to Figure 19). This hollow tile wall segment is collapsed and only 0.3 m tall. (refer to Figure 21).

Each enclosure varies in its size and completeness. The center two enclosures, one of which is partially constructed of the hollow tile, are lower to the ground and open on one or two sides, towards the north or east. Those enclosures that are enclosed on all four sides have north facing gaps or doorways in the walls. The size of the enclosures ranges from 5 by 2.5 m to 3 by 2.5 m, the largest being the one closest to the coast. The two enclosures closest to the coast are constructed between the steep slope to the ditch and a cut soil bank upslope, to the north.

Two of the enclosures have short, narrow poured concrete drainage features, or gutters, extending down into the intermittent drainage at roughly 45-degree angles from the enclosures' general east-west alignment (refer to Figure 19). The eastern gutter-like feature is clearly visible in the central portion of Figure 22, to the left of the large boulder, extending down the slope from the southern enclosure wall. The gutter-like features extend from the enclosure walls approximately four meters down slope into the intermittent drainage. These gutter-like features are similar to that observed in Feature B described below, but in considerably worse condition, having been partially eroded by the drainage.

Inside the two enclosures furthest west there are three, rectangular concrete troughs directly attached to the larger enclosure walls (Figure 23, refer to Figure 19). These low troughs measure roughly 0.3 by 1.2 m by 0.3 m high. They are made of the same concrete as the enclosure walls.

No portable artifacts were noted in association with these structures, with the exception of some aged milled lumber noted in the westernmost enclosure.

No construction dates were observed in the Feature A's concrete. Based on construction style materials, and state of preservation, the feature appears to have been constructed in the early to mid 20th century. Based on similarity with other, still in use structures, these enclosures likely

functioned as pigpens. The troughs would have contained feed. The gutter-like features would have channeled waste out of the structures during cleaning.

4.2.1.2 Feature B

Feature B is a rectangular concrete foundation with wall remnants and an associated concrete drainage feature (see photo in Figure 24). It measures approximately 2.5 m by 4.5 m. The wall remnants are thin, approximately 0.15 m thick, and are of similar construction to the majority of Feature A. However, the basalt cobbles in the cement appear to be sparser than those in Feature A. The cement foundation is bounded by the walls and is covered with a thin layer of sediment from the surrounding ground, and the foundation is nearly at grade, flush with the surrounding land surface. There is a small collapse of the wall remnant and the foundation near the southeast corner of the foundation. Just off of this same corner is a drainage feature, similar to those in Feature A, pointing directly towards the ocean. It is made of roughly rectangular cement, perhaps poured directly onto the ground, which was then molded to have a circular channel in which water could flow as seen in Figure 25. The drainage feature in Feature B is shorter than those in Feature A, at about 2 meters in length.

The feature is constructed very near to the edge of bedrock that has been exposed by wave erosion. This bedrock underlies the soils at grade. The terrain surrounding the other three sides of the structure is relatively level.

There were no portable artifacts observed in association with this structure and, other than Feature A, no structures of any kind were found nearby.

Based on appearances, Feature B was also constructed in the early to mid 20th century. Like Feature A, based on available evidence, Feature B likely functioned as an animal pen, likely for pigs.

4.2.1.3 Summary of SIHP 50-30-08-3958

Despite its dilapidated condition, SIHP 50-30-08-3958 maintains integrity of location, materials, and workmanship. Arguably, the cultural resource also has integrity of design and setting. Important information regarding 20th century animal husbandry structures has been obtained through the documentation of the cultural resource's component features. The information available from the features has been recorded in this investigation with photographs, plan view maps, GPS location information, and written descriptions. SIHP 50-30-08-3958 is recommended National and Hawai'i Register-eligible for the information it has yielded (criterion D).

Figure 21. Photo from west end of enclosures' south walls, looking east towards lower concrete hollow tile wall. Some very faint alignments disappear in the heavy brush in the background.

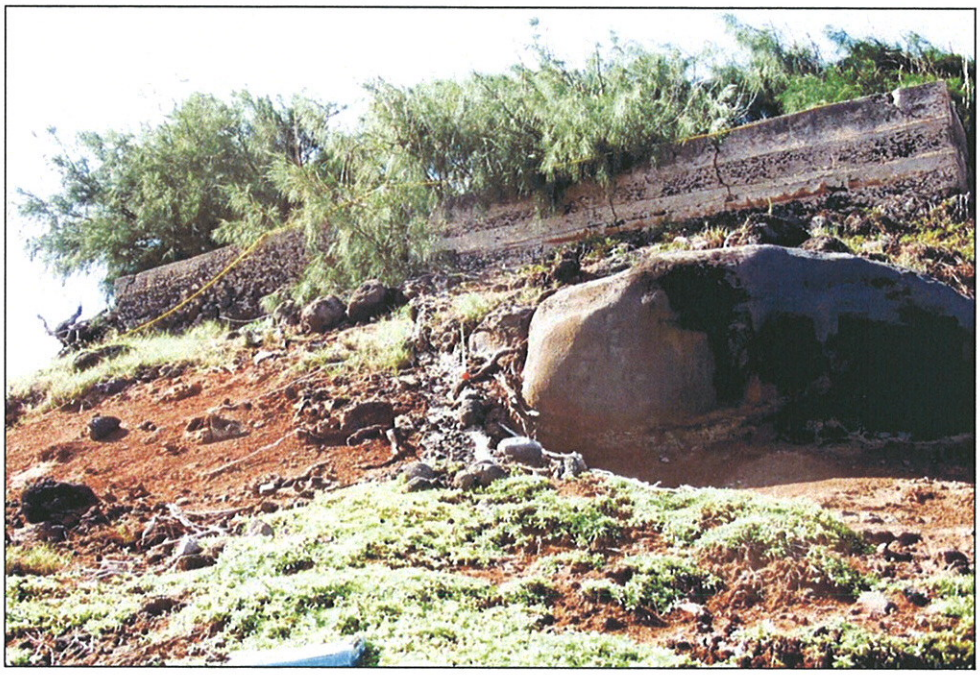

Figure 22. Photo looking at south wall of eastern most enclosures from intermittent drainage ditch. Horizontal lines in the wall indicate placement of wooden forms during construction.

Figure 23. Close up of trough feature in Feature A.

Figure 24. Photo of Feature B. Drainage feature is located just between back right corner (southeast) and the three branched dead tree in the background.

Figure 25. Detail of drainage feature in Feature B.

Section 5 Summary and Interpretation

5.1 Summary of Findings

All Improvement Areas of the project area are devoid of historic properties except for SIHP 50-30-08-3958, concrete animal husbandry structures, in Area 7a. Other Improvement Areas of the project area were observed to show evidence of heavy historic use and/or modern use. Based on historical research, virtually the entire proposed Airport Improvement Area was at one time under commercial sugar cane cultivation (refer especially to Figure 10 and Figure 11). The only exception to this is a narrow coastal strip of land to the east of the runways bordering the ocean.

Because sugar cane cultivation requires heavy, repeated plowing and burning, it is extremely likely that any structures from pre-Contact times and many of those from various stages of the historic sugar plantation were destroyed. Further, the bulk of the plantation infrastructure itself was not located in the project area, nor in the airport lands, but was to the northwest associated with Ahukiki Landing.

SIHP 50-30-08-3958 is a small set of structures located on the strip of unplowed land on the coast, east of the runways. These structures are within half a kilometer of Ahukini Landing, an important early port for the sugar industry and for Hawai'i in general. These small animal husbandry structures are somewhat out of place amid to the massive, mechanized plantation agriculture that virtually surrounded them. They were clearly not industrial in nature and probably represent use of this marginal land for activites closer to subsistence, such as raising a small number of pigs. It seems most likely that it is associated more directly with the settlement at Ahukini Landing than with the sugar plantation. Though there is no direct evidence, it is possible that SIHP 50-30-08-3958 is associated with the Bertrand House, a family dwelling reported by Creed et al. (1999) to be south of Ahukini Landing.

Section 6 Cultural Resource Significance Assesment

Though disturbed and in poor condition condition, SIHP 50-30-08-3958 maintains integrity of location, materials, and workmanship. The property clearly remains in its original location and exibits original materials. The style of construction of the walls, the shared pen walls, and construction materials all evidence a sparingly and locally engineered functional structure.

The cultural resource also has integrity of design and setting. Its design exhibits specific functional considerations seen in the inclusion of troughs of the same material and of drainage channels located on slopes towards the ocean or drainage ditch to carry away waste from the structures themselves. The use of local volcanic stone as the core of the wall to reduce the amount of concrete needed speaks to the resourcefulness of the technique and the builder. The setting of the historic property is significant as it is located very near expansive former sugar cane lands, but is of small scale itself. It may represent a form of subsistence not regularly recorded in direct association with the largely market driven landscape of sugar cane.

Important information regarding 20th century animal husbandry structures has been obtained through the documentation of the cultural resource's component features. The information available from the features has been recorded in this investigation with photographs, plan view maps, GPS location information, and written descriptions. SIHP 50-30-08-3958 is recommended National and Hawai'i Register-eligible for the information it has yielded (criterion D). Table 5 on the following page summarizes the integrity and significance of SIHP 50-30-08-3958.

Table 5. Cultural Resource Summary Table for the Project Area

CSH #	SIHP # (50-30-08-####)	Property Description	Number of Features	Apparent Age	Integrity[1]							Recommended Significance Under Hawai'i and National Register Criteria	Recommended Mitigation
					Location	Design	Setting	Materials	Workmanship	Feeling	Association		
1	-3958	Animal Husbandry Structures	2	Historic	Y	Y	Y	Y	Y	N	N	D	No further work

[1]Assessed based on the guidance and definitions from National Register Bulletin #15, "How to Apply the National Register Criteria for Evaluation."

Section 7 Project Effect and Mitigation Recommendations

7.1 Project Effect

The single cultural resource recommended National/Hawai'i Register-eligible within the project area is located along the seacoast, on the extreme periphery of the project area. Although technically within the project's APE, it is unlikely that project-related construction will affect SIHP # 50-30-08-3958 because of its peripheral location. Furthermore, the information for which SIHP # 50-30-08-3958 is recommended National and Hawai'i Register-eligible has been recorded through the maps, photographs, and written descriptions of the current investigation. The results are presented in this inventory survey report. Accordingly, the project-specific effect recommendations of "No adverse effect" (federal historic preservation legislation) and "No historic properties affected" (Hawai'i historic preservation legislation) are warranted.

7.2 Mitigation Recommendations

No further cultural resource management work is recommended for the project. However, there is a real but unlikely chance that previously unidentified cultural resources could be encountered by project construction. In the even that this occurs, the project proponents should immediately stop work in the vicinity and contact the SHPD Kaua'i Office [Ms Nancy McMahon, Tel. (808) 742-7033] and/or O'ahu Office [Tel. (808) 692-8015].

Section 8 References Cited

Alexander, William Patterson

1933 "A Tour of Kauai in 1849. Private Journal of William DeWitt Alexander." Kaua'i Historical Society Paper #57. Reprinted in, *The Kauai Papers*, pp. 121-135. 1991. Kaua'i Historical Society, Līhu'e, Kaua'i.

Archives of Hawaii

n.d. Land Matters, Document No. 11; List of Konohiki, Prohibited Fish and Prohibited wood.

Baptiste, Lucinda

1993 "Ahukini memories: The glory days." *The Garden Island*, November 24, 1993, 1, 5A.

1993 "Bustling Ahukini fades into fond memories" *The Garden Island*, November 26, 1993, 1-2.

Beardsley, Felicia Rounds

1994 *Dune Burials and Landscape Change: Archaeological Subsurface Testing Inventory Survey, Kauai Community Correctional Center and Wailua Golf Course Sewage Force Main Project, Wailua, Kauai.* Draft Report. International Archaeological Research Institute, Inc., Honolulu.

Bennett, Wendell C.

1931 *The Archaeology of Kaua'i.* Bernice P. Bishop Museum, Bishop Museum Bulletin 80, Honolulu.

Ching, F.K.W.

1981 *A Cultural Resource Reconnaissance for the Wailua River Hydropower Study.* Prepared for U.S. Army Corps of Engineers by Archaeological Research Center Hawai'i (ARHC 140-79), Honolulu.

Cobb, Scott

1902 *Commercial Fisheries of the Hawaiian Islands.* U.S. Fish Commission Report for 1901, Government Printer, Washington D.C.

Condé, Jesse C., and Gerald M. Best

1973 *Sugar Trains, Narrow Gauge Rails of Hawai'i.* Glenwood Publishers, Felton, California.

Cox, David W.

1977 *Report on the Burials Recovered During the Effluent Reclamation Project at Wailua, Puna, Kaua'i Island.* ARCH 14-71. Archaeological Consultants of Hawai'i, Lawa'i, Hawai'i.

Creed, Victoria S., Loren Zulick, Gerald K. Ida, David W. Shideler, and Hallett H. Hammatt

1999 *Archaeological Assessment of the Proposed Līhu'e Airport Expansion Area, Hanamā'ulu and Kalapakī Ahupua'a, Līhu'e District, Island of Kaua'i (TMK 3-5-*

01: 5, 6, 8, 9, 109, 111, and 158 and 3-7-02: Por. 1). Cultural Surveys Hawai'i, Kailua, Hawai'i.

Damon, Ethel M.

1931 *Koamalu.* Privately printed at the Honolulu Star-Bulletin Press, Honolulu, (2 Volumes).

Dickey, Lyle

1917 Stories of Wailua in The Garden Island, published in six consecutive installments beginning 6/29/15, Lihu'e, Kaua'i.

Erkelens, Conrad, and David J. Welch

1993 *Literature Review, Archaeological Assessment and Recommendations for the Kaua'i Community Correctional Center Sewage Force-Main Project Wailua, Kauai.* International Archaeological Research Institute, Inc., Honolulu.

Folk, William H., and Hallett H. Hammatt

1991 Archaeological Survey and Subsurface Testing at Kanoa Estate Lands, Niumalu, Kaua'i. Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

1995 *Archaeological Monitoring of the Fiberoptic Cable Conduit Installation Through the Wailua Golf Course at Wailua, Kauai.* Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

Foote, Donald E., E.L. Hill, S. Nakamura, and F. Stephens

1972 *Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai and Lāna'i.* State of Hawaii, U.S. Dept. of Agriculture, U.S. Government Printing Office, Washington, D.C.

Fornander, Abraham

1918 *Fornander's Collection of Hawaiian Antiquities and Folklore. Vol V, Part,1.* Bishop Museum Press, Honolulu.

Franklin, Leta J., and Alan T. Walker

1994 *Additional Archaeological Inventory Survey, Molokoa Lands Project Area, Lands of Hanama'ulu and Kalapakī, Lihu'e District, Island of Kauai.* Paul H. Rosendahl, Ph.D., Inc, Hilo, Hawai'i.

Hammatt, Hallett H.

1978a *Archaeological Reconnaissance of Ninini Point Area, Kalapaki.* Archaeological Research Center Hawaii, Lāwa'i, Kaua'i.

1978b *Archaeological Reconnaissance of an 18-Acre Parcel in Lihue Town, Kalapaki.* Archaeological Research Center Hawaii. Archaeological Research Center Hawai'i, Lāwa'i, Kaua'i.

1988 *Archaeological Reconnaissance Survey of 150 acres of Coastal Land, Kalapakī, Kauai Island* [Kauai Lagoon's Resort]. Cultural Surveys Hawai'i, Kailua, Hawai'i.

1990 *Archaeological Assessment of Phase III, IV, V Kaua'i Lagoons Resort, Kalapaki, Kaua'i, TMK 4-3-5-001:102.* Cultural Surveys Hawai'i, Kailua, Hawai'i.

1992 *Data Recovery and Preservation Plan for Three Archaeological Sites in Phase V, Kaua'i Lagoons Resort, Kalapaki, Kaua'i, TMK: 4-3-5-001:102.* Cultural Surveys Hawai'i, Kailua, Hawai'i.

Hammatt, Hallett H., and Victoria S. Creed
1992 Archaeological Inventory Survey of 61.6 Acres in Nawiliwili, Kauai. Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

Hammatt, Hallett H., and William H. Folk (eds)
1995 Nāwiliwili Cemetery Burial Treatment: An Archaeological and Osteological Study. Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

Hammatt, Hallett H., and David W. Shideler
2003 *Archaeological Assessment for the Kuhio Highway Improvements, Kapa'a to Hanama'ulu (Kapa'a Relief Route) Project within the Ahupua'a of Kapa'a, Waipouli, North Olohena, South Olohena, Wailua, and Hanama'ulu, Island of Kaua'i (TMK 4-3-7; 4-3-9; 4-4-1; 4-4-3; 4-4-5; 4-4-6.* Cultural Surveys Hawai'i, Kailua, Hawai'i.

Hammatt, Hallett H., Gerald K. Ida, and Rodney Chiogioji
1994 *Archaeological Document Review and Assessment of Three Alternative Widening and Bypass Options for the Kūhiō Highway Within the Ahupua'a of Hanamā'ulu, Wailua, South Olohena, North Olohena, Waipouli & Kapa'a, Līhu'e and Kawaihau Districts, Island of Kaua'i.* Cultural Surveys Hawai'i, Kailua, Hawai'i.

Hammatt, Hallett H., David W. Shideler, and William H. Folk
2002 *Archaeological Study in Support of Proposed Kūhiō highway Improvements (Kapa'a By-Pass). Hanamā'ulu to Kapa'a Ahupua'a, Kaua'i.* Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

Handy, E.S. Craighill
1940 *The Hawaiian Planter, Volume 1.* Bishop Museum Bulletin No. 161, Bernice P. Bishop Museum, Honolulu.

Hommon, Robert J.
1976 *The Formation of Primitive States in Pre-Contact Hawai'i.* Ph.D. Dissertation, University of Arizona, Tucson, Arizona.

Kalima, Lehua, and Helen Wong Smith
1991 Appendix B: Historical Documentary Research, IN, *Archaeological Inventory Survey, Hanamā'ulu Affordable Housing Project Area, Land of Hanamā'ulu, Lihue District, Island of Kauai (TMK: 3-7-03:Por. 20),* by Alan T. Walker, and Paul H. Rosendahl. Paul H. Rosendahl, Ph.D., Inc, Hilo, Hawai'i.

Kaua'i Historical Society
1991 *The Kauai Papers.* Kaua'i Historical Society, Līhu'e, Kaua'i.

Kelsey, Theodore
n.d. "Kauai' Place Names." Unpublished manuscript, Kelsey Collection, Hawai'i State Archives.

Kikuchi, William K.

1992 Use Permit For J.C. Sandblasting, Hanama'ulu, Lihu'e, Kaua'i.ARCHAIOS.

Kikuchi, William K., and Susan Remoaldo
1992 *Cemeteries of Kaua'i, Volume 1.* Kaua'i Community College and University of Hawai'i, Puhi, Kaua'i, Hawai'i

Kosaki, Richard
1954 *Konohiki Fishing Rights, Report No. 1, 1954.* Legislative Reference Bureau, University of Hawaii, Honolulu.

Lahainaluna Students
1885 *Record of a tour of Kauai (heiaus and fishing grounds), Wailua, September 14, 1885.* Translated by Mary Pukui. Lahainaluna Students Contributions, No. 19. Hms. Misc. 43. Hawaiian Ethnological Notes (HEN) I:217-22, Bernice P. Bishop Museum Archives, Honolulu.

Lo, Catherin Pascual
2005 *The Hanama'ulu Experience:The Land.* Hanama'ulu Town Celebration. http://poipuwebdesigns.tripod.com/id5.html, 1-10-2006.

Macdonald, G.A., A.T. Abbott and Frank L. Peterson
1983 *Volcanoes in the Sea.* Second Edition, University of Hawaii Press, Honolulu.

McMahon, Nancy
1990 *Archaeological Fieldcheck of Three Parcels in Lihue Judiciary District: Possible Locations for a New Kaua'i Judiciary Building, Nawiliwili, Kalapakī, and Hanamā'ulu, Kaua'i.* Historic Preservation Program, State of Hawai'i.

Moffat, Riley M. and Gary L. Fitzpatrick
1995 *Surveying the Mahele, Mapping the Hawaiian Land Revolution, (Palapala'aina, Volume 2).* Editions, Ltd., Honolulu.

Nakuina, Moses K.
1992 *The Wind Gourd of La'amoamoa.* Translated by Esther T. Mookini and Sarah Nākoa. Kalamakū Press, Honolulu.

Poepoe, Joseph M.
1908 Ka Moolelo Kaaoohiiaka-I-Ka-Poli-O-Pele. *Ku'oko'a* April, 24, 1908.

Pukui, Mary Kawena
1983 *Olelo No'eau: Hawaiian Proverbs and Poetical Sayings.* Bishop Museum Special Publication No.71. Bernice P. Bishop Museum Press, Honolulu.

Rice, Mary A. Girvin
1914 "History of Lihue." Typescript of a talk presented on December 17, 1914 to the Kauai' Historical Society. Reprinted in *The Kauai Papers*, pp. 46-67. Kauai Historical Society, Līhu'e, Kaua'i.

Rice, William Hyde
1974 *Hawaiian Legends.* Originally published in 1923. Bernice P. Bishop Museum, Honolulu

Rosendahl, Paul H.

1990 *Archaeological Field Inspection and Limited Subsurface Testing Kalepa Radio Station and Kalepa Road Improvement Project Areas, Land of Hanamaulu, Lihue District, Island of Kauai, 4-3-8-002:005.* Paul H. Rosendahl, Ph.D., Inc, Hilo, Hawai'i.

1991 *Burial Treatment Plan, Kalepa Radio Station Project Area, Land of Hanamaulu, Lihue District, Island of Kauai.* Paul H. Rosendahl, Ph.D., Inc, Hilo, Hawai'i.

Stauder, Catherine

1973 Observations of Kuhiau Heiau. *Archaeology on Kaua'i* 2(4):3-6.

Thrum, Thomas G.

1907 Tales from the Temples, Preliminary paper in the study of the Heiaus of Hawaii, with plans of the principal ones of Kauai and Oahu. *The Hawaiian Annual,* Honolulu.

Waihona 'Aina Corp.

1998 The Mahele Database at waihona.com, Kailua, Hawai'i.

Walker, Alan T., and Paul M. Rosendahl

1990 *Archaeological Field Inspection Wilcox Hospital Lot A Project Area, Land of Hanamaulu, Lihue District, Island of Kauai (TMK:3-7-01:Por.l).* Paul H. Rosendahl, Ph.D., Inc, Hilo, Hawai'i.

1991a *Archaeological Inventory Survey, Hanamā'ulu Affordable Housing Project Area, Land of Hanamā'ulu, Lihue District, Island of Kauai (TMK: 3-7-03:Por. 20).* Paul H. Rosendahl, Ph.D., Inc, Hilo, Hawai'i.

1991b Archaeological Inventory Survey, Kalapaki Point Development Project Area. Land of Nawiliwili, Lihue District, Island of Kauai. Paul H. Rosendahl, Ph.D., Inc, Hilo, Hawai'i.

Walker, Alan T., Lehua Kalima, and Susan T. Goodfellow

1990 *Archaeological Inventory Survey Lihue/Puhi/ Hanamaulu Master Plan, Lands of Hanamaulu, Kalapaki, Nawiliwili, and Wailua, Lihue District, Island of Kauai (TMK 4-3-2-; 4-3-3-; 4-3-9-).* Paul H. Rosendahl, Ph.D., Inc, Hilo, Hawai'i.

Wichman, Frederick B.

1998 *Kauai: Ancient Place-Names and Their Stories.* University of Hawaii Press, Honolulu.

2003 *Nā Pua Ali'i O Kaua'i. Ruling Chiefs of Kaua'i.* University of Hawai'i Press, Honolulu.

Wilcox, Carol

1996 *Sugar Water, Hawaii's Plantation Ditches.* University of Hawai'i Press, Honolulu.

Wilkes, Charles

1845 *Narrative of the United States Exploring Expedition, Volume 4.* Lea and Blanchard, Philadelphia, Pennsylvania.

Wilson Okamoto & Associates

1998 *Lihue Airport Master Plan, Environmental Impact Statement, Preparation Notice.* for State of Hawaii, Department of Transportation, Airports Division and U.S. Department of Transportation, Federal Aviation Administration.

Appendix A Project Area Photographs

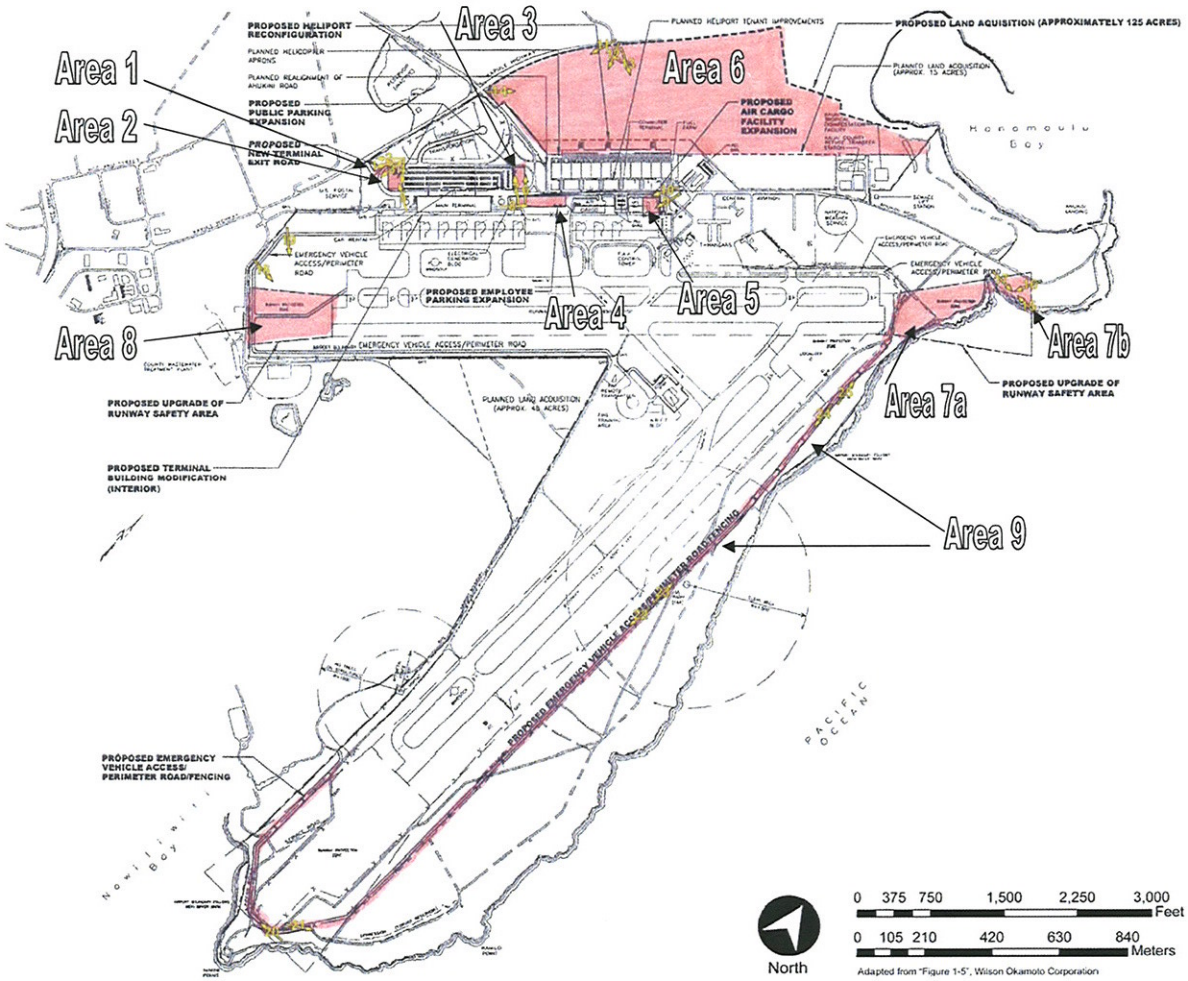

Figure A. This figure shows the location and orientation for the following 25 photographs of the project area's different improvement areas.

Photo 1 — Area 1 — Landscaped Airport Grounds

Photo 2 — Area 1 — Landscaped Airport Grounds

Photo 3 — Area 1 and 2 — Landscaped Airport Grounds

Photo 4 — Area 2 — Landscaped Airport Grounds with Taxi Stand

Photo 5 — Area 2 — Landscaped Airport Grounds with Taxi Stand

Photo 6 — Area 3 — Landscaped Airport Grounds

Photo 7 — Area 3 — Landscaped Airport Grounds

Photo 8 — Area 4 — Landscaped Airport Grounds with Gravel Parking Area

Photo 9 — Area 5 — Landscaped Airport Grounds

Photo 10 — Area 5 — Landscaped Airport Grounds

Photo 11 — Area 6 — Tall Grass, Former Commercial Sugar Cane Lands

Photo 12 — Area 6 — Tall Grass, Former Commercial Sugar Cane Lands

Photo 13 — Area 6 — Tall Grass, Former Commercial Sugar Cane Lands

Photo 14 — Area 6 — Tall Grass, Former Commercial Sugar Cane Lands

Photo 15 — Area 7 — Along the Coast with Dense Vegetation

Photo 16 — Area 7b — Representative Dense Vegetation

Photo 17 — Area 7b — Representative Dense Night Blooming Sirius

Photo 18 — Area 8 — Graded Runway Pad

Photo 19 — Area 8 — Graded Runway Pad

Photo 20 — Area 9 — Existing Dirt Road Around Runway Perimeter

Photo 21 — Area 9 — Existing Dirt Road Around Runway Perimeter

Photo 22 — Area 9 — Alignment of Proposed Runway Perimeter Fence Through Tall Grass

Photo 23 — Area 9 — Tall Grass with Unimproved Roadways

Photo 24 — Area 9 — Low Grass, *'Ilima*, and Occasional Ironwood Shrubs

Photo 25 — Area 9— Grass with Unimproved Roadways

Appendix B Land Claims Table for Hanamā'ulu

Land Claim #	Claimant	'Ili	Land Use*	Landscape Features*	Awarded/ Not Awarded*
3271	Lalahilimoku	Kuha Pu'aka	1) *lo'i* 2) house	*'auwai*, river, *alanui*, *pali*	Aw. 2 *'āpana*; 1 acre, 1 rood, 21 rods
3371	Naehu	Kapaia	10 *lo'i* & small *kula* with house	junction of river & *'auwai*, *pali*	Aw. 1 *'āpana*; 1.25 acres, 19 rods
3329 B	Kala	Opai/ Opoi	3 *lo'i*	river	Not awarded; See 3648 in Ha'ikū
3423	Paka	Pe'aiki	1) 3 *lo'i*, small *kula* 2) house	*pali*, river, *hau* bush (or spring)	Aw. 2 *'āpana*; 1.5 acres, 33 rods
3426	Pelekane	Kapūhala	1) 4 *lo'i* 2) house at shore	*'auwai*, river, fence, fish pond, well, school enclosure	Aw. 2 *'āpana*; 1 acre, 17 rods
3558	Keke	Wai'ao'ao/ Waiauau Hoena	1) 3 *lo'i*, small *kula* 2) house lot	*pali*, *'auwai*, road	Aw. 1 *'āpana*; 3 roods, 1 rod
3600	Keolanui	Pālaha/ Palaka	7 *lo'i* & house lot	*pali*, stream	Aw. 1 *'āpana*; 1.75 acres, 30 rods
3640	Kumuakahaohao	Limawela Kamaka-hanahana	1) 4 *lo'i*, small *kula* 2) house lot	*'auwai*, river, foot trail, orange tree	Awa. 1 *'āpana*; 1 acre, 1 rood, 12 rods
3641	Kuhaimoana	Kapaia	1) 6/7 *lo'i* 2) house lot	*'auwai* surrounded by lands of H.A. Pierce & Co.	Not awarded under this numbers. These land awarded under No. 5089
3644	Kaualupa	Hanamā'ulu	1) 3 *lo'i* 2) house lot	*'auwai*, river, *pali*	Aw. 2 *'āpana*, 1.25 acres, 23 rods
3647	Kapuahi	Mo'ala/ Waieo Pāpua'a	1) 1 *lo'i* 2) 7 *lo'i* cultivated & 23 not cultivated 3) house lot	*'auwai*, *pali*, spring (or *hau*)	Aw. 3 *'āpana*, 4 acres, 32 rods & 38 rods
3649	Kamalo	Noni/ Ononi	5 *lo'i* , small *kula*, house	*'auwai*, river	Aw. 1 *'āpana*, 1.75 acres, 20 rods
3650	Kaluhiwaha	Ka'aukai Pukakolu (*kulanakauhale*)	1) 2 *lo'i* 2) house lot	*'auwai*, *muliwai*, river	Aw. 2 *'āpana*, 3 roods, 35 rods
3653	Kolii	Ma'ulili Kamakai-hanahana (village)	1) 4 *lo'i* & small *kula* (2 house	*pali*, *'auwai*, *alanui*	Aw. 2 *'āpana*, 1 acre, 37 rods
3657	Niho	Limawela	4 *lo'i* & small *kula*	*'auwai*, river	Aw. 1 *'āpana*, 1 acre, a rood, 13 rods
5089	Kuhaimoana	Kapaia	See 3641, this claim was for Aliomanu		Aw. 2 *'āpana* in Kapaia, Hanamā'ulu

Land Claim #	Claimant	'Ili	Land Use*	Landscape Features*	Awarded/ Not Awarded*
5640 B	Kumakahaohao	Limawela	4 *lo'i* & small *kula*	*'auwai*, river	Not awarded; See Award 3640
7713:2, pt 7	Kamāmalu, Victoria	Hanamā'ulu Ahupua'a	*ali'i* award		Aw. 9,177 acres

*Hawaiian terms:

ahupua'a = large land division
a*lanui* = government road
'āpana = lots
'auwai = irrigation ditch
hau = native Hawaiian bush/tree (*Hibiscus tiliaceus*)
'ili = small land division within an *ahupua'a*
kula = land used for dryland agriculture or pasture
kula mala wauke = cultivated field of wauke (paper mulberry; *Broussonetia papyrifera)*
kulanakauhale = village
kauhale = group of houses
lo'i = irrigated taro patches
loko = pond
muliwai = river mouth; pond near river mouth
pāhale = house
pali = cliff

Appendix C Land Claims Table for Kalapakī

Land Claim #	Claimant	'Ili	Land Use*	Landscape Features*	Awarded/ Not Awarded*
238P	Kinipeki, Hoano sister; heir	Kena Kalapakī village	4 *lo'i* house lot	Hanoi *pali*, Nawiliwili river, *loko*, seashore	Aw. 2 *'āpana*, 1 acre, 32 rods; TMK maps list it as 238C
3249	Hao	Pohaluau Kalapakī village	4 *lo'i* house lot	Kalapakī brook, Kona'awa pond, Kalapakī sand, river	Awa. 2 *'āpana*, 3 roods, 11 ords
3280	Wawae/ Wawai, Waiowae	Keahua Kalapakī shore Kalapakī *makai*	3 *lo'i* , *kula* house lot fishponds	*pali*, Kalapakī brook, *muliwai*, fishpond, *pali*, sea shore, *pali*, *loko*, sea, *hau*/or spring	Aw. 2 *'āpana*, 1 acre, 1 rood, 18 rods
3325	Kanipeki				Not awarded. See 238P for award
3408	Papaa	Nuuhai Kuuhai at shore	2 *lo'i* house lot	Kalapakī brook, road, *pali*, sea shore, Kalapakī brook	Aw. 2 *'āpana*, 2.5 acres, 33 4odsw
3425	Paiki Hiku, widow	Kiolepo Kalapakī village	5 *lo'i* & kula house lot & 1 *lo'i*	Wawai's *lo'i*, *pali*, *muliwai* pali, fishpond, sea shore	Aw. 2 *'āpana*. 1 acre, 1 rood, 36 rods
3637	Kauhaila wa	Koena'awa iki Koena'awaiki	2 *lo'i* , kula 10 *lo'i*	Wawae's *lo'i*, sea beach, *pali* Wawae's lo'is, pali, Kalapakī river	Aw. 1 *'āpana*, 2 acres, 1 rood, 14 rods (TMK 3-5)
3642	Kuaolohu	Kaahekea/ Keakekea Kalapakī village	3 *lo'i*, *kula* house lot	Kalapakī brook Hao's lot, Koena'awanui pond, sea shore	Awa. 2 *'āpana*, 3 roods
3643	Kukahiko	Puhauluau Kalapakī village	5 *lo'i* & *kula* house lot	*'auwai*, Nawiliwili river, Kanoa's pond, side hill (Hanoi/Hanai) *pali*, sea shore, Koena'awa stream	Aw. 2 *'āpana*, 3 roods, 24 rods
3645	Kauleaki / Kauleoki Haano, wife; heir	Kalapakī village	house lot	Koena'awanui pond, sea shore	Not awarded
3687	Kauhila wa				See 3637
3907	Nakala	Koena'awanui Pau (*mauka*) Kualalai	4 *lo'i* & house lot 1 *lo'i*, *kula* *mala wauke*	brook, *pali*, sea shore, *ko'ele* Mookapu *kula*	Aw. 3 *'āpana*, 3 acres, 25 rods
7713:2	Victoria Kamāmalu	Kalapakī Ahupua'a			Aw. 2,004 acres

Land Claim #	Claimant	'Ili	Land Use*	Landscape Features*	Awarded/ Not Awarded*
10632	Pahao	Palanohi	12 *lo'i*	*pali* of Palanohi	Not awarded

APPENDIX E

Cultural Impact Assessment

CULTURE IMPACT

ASSESSMENT

Līhu'e Airport Culture Impact Statement (CIA)
Līhu'e, Kaua'i, Hawai'i.

For Wilson Okamoto & Associates, Inc.

by Pualani Kanahele, Kehaulani Kekua, 'Aikane Alapa'i
Ku'ulei Kanahele

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METHODOLOGY

Our methodology will use indigenous Hawaiian cultural and historical perspective for this Cultural Impact Assessment (CIA). A component of this methodology will reiterate the cultural-spiritual use of the CIA area by the indigenous Hawaiians. Special attention will be paid to the land features and named sites that nurture the cultural-spiritual relationships that indigenous Hawaiians possess for CIA area and its environs. Another methodology considered is of people who continue to utilize the CIA area and its immediate surroundings today. A major part of these examinations are indigenous Hawaiian chants, historical incidents, and interviews with local residents.

TASKS

We will complete these tasks: 1) a literature review that includes indigenous Hawaiian chants, stories, historical reports and interviews with people who utilize the CIA area, 2) a site examination 3) completion of the CIA with special attention to the indigenous Hawaiian cultural perspective and that of residents of Kaua'i who continue to utilize the CIA area for subsistence purposes.

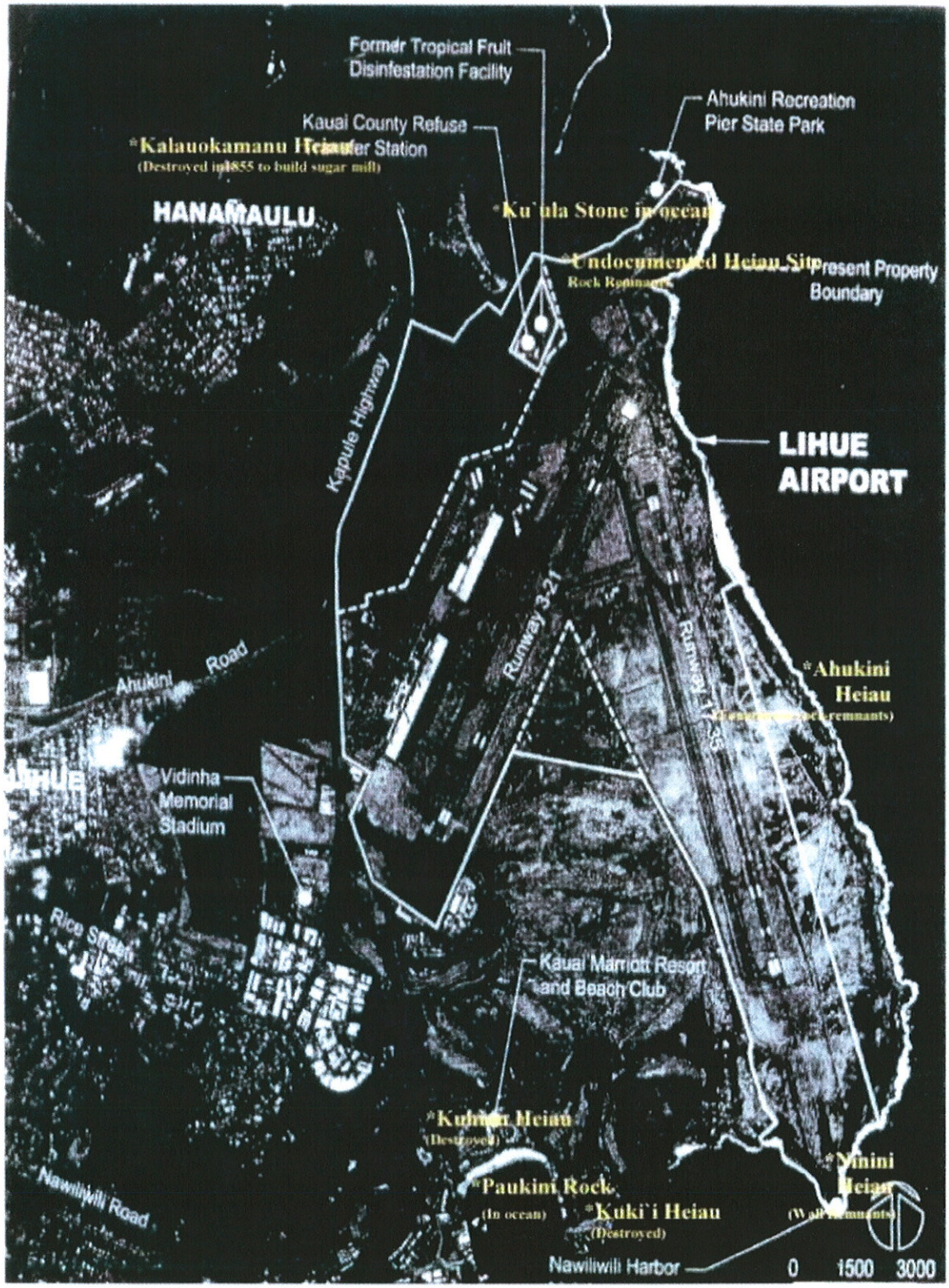
CULTURAL DESCRIPTIONS

The primary site for cultural concern is the plains of Līhu'e, the site easily recognized as the "airport". The secondary site of cultural concern is the land between Haupu mountain to the south, Hanamaulu Bay to the north and Kalepa mountain range to the west. The ahupua'a within these boundaries are Kipukai, Kipuuka, Hule'ia, Niumalu, 'Alekoko, Nawiliwili, Ha'ikū, Kalapaki, and Hanama'ulu. The impact of the expansion upon cultural sites, natural resources and areas continually frequented by the "locals" for subsistence, religious and practical purposes will be addressed in this report.

There are three cultural concerns I would like to focus on: a) cultural sites b) natural phenomenon and c) natural resources and areas frequented by Native Hawaiians and locals alike.

INDIGENOUS LIFE WAYS: Heiau Sites

A heiau was a man-made Native Hawaiian site held in high esteem because it was used to attract or summon the entities of the spiritual realm when needed. The location chosen for such a site had to already have prescribed significances, such as:



Exhibi A : Placement of Heiau near Līhu‘e Airport site.

advantage point for clarity of sight for the immediate purpose of the structure, a location which possesses a sense of awe and wonder and a location which has a foundation fit for the gods or goddesses for whom it was meant to fetch or serve. The photo of Historical Accounts, Exhibit A, displays the sacred heiau sites or man-made structures surrounding the assessment area. There were no heiaus built on the plain of Līhu'e and the immediate location of the airport's present runways. The heiaus in the adjoining areas were destroyed by the plantation in their need to open up more cane lands, develop camp sites, build the mills to process sugar and build infrastructure to service the mills.

The following heiaus, Exhibit A, are found in both the Kalapaki and Hanama'ulu ahupua'a. Both ahupua'a make up the plains of Līhu'e on which the airport is located. 'Opoi, a point on the coast next to Ahukini is the dividing line for both ahupua'a. Although the heiaus are not directly on the assessment sites their close proximity is cause for awareness of their effects and Native Hawaiians' sensitivity to such sites.

Exhibit B : Alignment of very large rocks on location at Kalauokamanu Heiau

Kalauokamanu Heiau, located ma uka of Hanama'ulu valley, was classified as a po'okanaka or luakini temple. Po'okanaka were different from luakini in that it took only

human heads as sacrifice. The similarity between the two was the fact that both used human sacrifice. This kind of heiau required a large staff to maintain which would add to the population of Hanama'ulu and the adjoining areas. It also required that the ruling chief must have the authority to offer human sacrifice before he presided over the ceremonies. This would indicate that the chief would be of highest possible rank. It probably included the ridge or kualono to the west of heiau; this would provide a circular periphery which boundary then, is the horizon. This clarity of sight would fetch many, if not all, spiritual entities. Very powerful! This would attest to the name offered, Kalauokamanu, a place which has the where-withal to attract numerous amounts of birds, metaphorically speaking. Kalauokamanu was a large walled temple which was destroyed in 1855 to make the foundations of the Hanama'ulu sugar mill. On a field inspection we conducted in January 2006, Exhibit B, an alignment of very large boulders was possibly part of the ancient site.

Ahukini Heiau, located on the coast of the Līhu'e plains, see Exhibit A, was named after the chief Ahukini-a-La'a which genealogy places him on Kaua'i approximately 1250 A.D. He was one of the three sons of La'amaikahiki. La'amaikahiki was the son of Mo'ikeha who migrated from Tahiti and settled in Hanama'ulu and lived with two sisters of high chiefly line. Ahukini heiau was a medium sized heiau located north of 'Opoi point. It is difficult to identify the heiau except that its close proximity to the ocean would suggest that it may have been a fishing heiau.

Ninini Heiau, located in the Kalapaki ahupua'a, is probably inclusive of the Nawiliwili light house site. Despite its destruction, remnants of the rock wall are still in place. The menehune who constructed the fish pond at 'Alekoko, just across Nawiliwili Bay, are connected also to Ninini. Local myth talks about Ninini as a favorite bathing place where the sport of lelekawa was enjoyed by the menehune. The menehune are also credited for carrying large slabs of stone from Kipukai to Ninini. In one incident one of the large slabs of stone broke off at Hule'ia before he reached his destination of Ninini and that remains in place till today as a bridge known as, "Kīpapa O ka Menehune" or "pavement of the Menehune". The other half of the stone did make its way to Ninini and is found there today.

Kuhiau Heiau, is located in Kalapaki ahupua'a and on the grounds of Kaua'i High School. Kuhiau is known as the oldest heiau on the island of Kaua'i and its pavement alone covered four acres of land. Despite the size there is not a lot of information on this heiau.

Kūki'i Heiau, was a heiau that once stood on the bluff just above of Kūki'i Point. Kalapaki Bay is identified by Kūki'i as its southern most boundary and the seawall leading into Nawiliwili harbor creating its other boundary. Kūki'i heiau has longed been destroyed and luxury condominiums dot the bluff on which the heiau stood.

Exhibit C : Wall at Ninini Point

Exhibit D : Seasonal Kauna'oa, valuable for lei makers, at Ninini Point

Paukini Rock, is found close to shore in Nawiliwili bay. There was a family relationship with Kuhiau and Paukini. These two sacred sites were officiated over by the same Kahuna or Kahuna class who were also officials of nearby Ninini, Ahukini and Pōhaku'ele'ele heiaus.

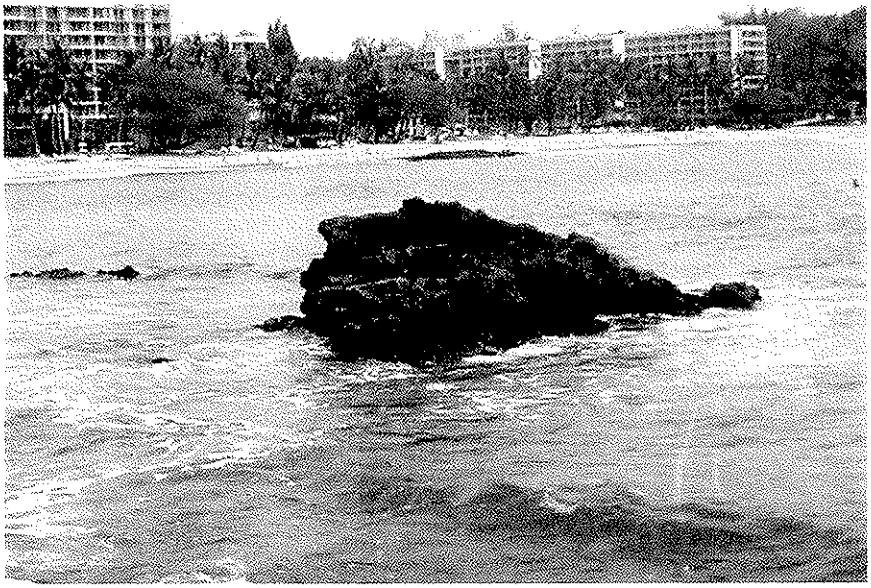


Exhibit E: Paukini Rock in Nawiliwili Bay

Pepeiao, is the name of a very large ko'a, also known as a ku'ula, located about 100 yards from the point inside of Hanama'ulu bay. The rock is completely submerged and Hawaiian fishermen that frequented the bay used its ku'ula abilities. Its charm was to attract fish and was used by the last konohiki of Hanama'ulu bay and Ahukini. The Konohiki was Franklin Manu Kelekoma whose son was interviewed for this report.

Tertiary heiaus associated with the project site are listed below. Very little is known of each of these heiaus nevertheless these names surfaced as part of the research effort.

Halo, a heiau from the remotest of times according to informant was Naiwi in 1885.

Hoku, a heiau located between Haupu and Kalanipu'u on a small hill that lies between the two mountans. Directly on the hill was a heiau at which humans were sacrificed from remotest times, informant was Naiwi in 1885.

Kahala, a heiau owned by the chief Kamahana, Luakahakona was its kahuna, the informant was Koa in 1885.

Kapouwela, a heiau located in Niumalu, informant was Naiwi in 1885.

Kawahine, a heiau formerly located in Nawiliwili, informant was Koa in 1885 Nov.

Keawehale, a heiau constructed by Kaumuali'i for lawai'a in Nawiliwili, informant was Koa in 1885 Nov.

Keolewa, a heiau dedicated to Laka on the summit of Haupu, informant was Naiwi in 1885.

Kualalai, a heiau in Nawiliwili, informant was Naiwi in 1885.

Kuala, a heiau located at Kalapaki, informant was Keo in 1885 Sept. 14th.

Pōhaku'ele'ele, a medium size heiau formerly located by Kalapaki. Kalanikini was its kahuna, informant was Naiwi in 1885.

Exhibit F: Kalanipu'u, the wind of Kahilipu'u. In the Bay of Nawiliwili. Site for Kilo i'a and his flag signals.

INDIGENOUS LIFE WAYS; Natural phenomenon, the Wind

The Hawaiian included the natural world of ocean, fresh water, wind, rocks, earth, sun, moon and stars, as an extension of his family. We will focus on some of these natural phenomena in detail as they were part of the Hawaiians view of his world. For this project we will concern ourselves with the wind of the immediate and surrounding areas of the airport as a clue to the wind currents of nine ahupua'a mentioned above. The immediate ocean is the concern of the Native Hawaiian and the locals who continue to fish in the area and more especially at Ahukini landing.

Kaua'i is an island of treacherous winds, as we have witnessed within the past three decades. This phenomenon was well known to the Hawaiians of old who lived on that island and experienced its violence. The winds were listed in two different accounts on the island of Kaua'i. The first accounting is the epic saga of Pele and Hi'iaka. This story provides the nomenclature of winds in each 'awāwa (valley), 'awa (bay), 'ili and ahupua'a of this island. According to Pele and Hi'iaka there are two hundred and sixty nine (269) winds on the island of Kaua'i. I will list an abbreviated version of the wind chant including only those affecting the project area.

A wind chant of Antiquity

1. He Puapua'ano'o ko Kīpū kai
   Clouds are gathering like dark piglets, is the wind of Kīpū kai
2. He Aopua'a ko Hā'upu
   Dark pig clouds, is the wind of Hā'upu
3. He 'Ōnohimakani ko Keōlewa
   The center or eye of the wind, is the wind of Keōlewa
4. He Puapua'a a makani o Kīpū uka
   Clouds piling up like dark black pigs, is the wind of Kīpū uka
5. He 'Onowai ka makani o Kahōkū
   Thirsty and craving for water, is the wind of Kahōkū
6. He Kāhilipulu ka makani o Kalanipu'u
   Wet and swift, is the wind of Kalanipu'u
7. Noho nā makani a Kāne, lawe ke ō
   The winds of Kāne reside there, they are piercing
8. He Hāpuku me Alaoli nā makani kuehu lepo o Hule'ia
   Gathering indiscriminately on a friendly path, is the dirt tossing wind of Hule'ia
9. He Lawe'akiupu'ali ka makani o 'Alekoko
   Brings constant scaring, is the wind of 'Alekoko
10. Nahā ka mākāhā, lele ka 'upena a nā akua, 'o Kāne a me Kanaloa
    The sluice gates are open, the nets of the gods, Kāne and Kanaloa are thrown
11. He Kahilipili ka makani o Niumalu
    The wind of Niumalu is swift and sticky
12. He Hu'eone ke makani o Nawiliwili
    The wind of Nawiliwili is rippling sand
13. He Waimua ka makani o Kalapaki
    The wind of Kalapaki is the first water
14. He 'Ehukai ka makani o 'Ahukini

The wind of 'Ahukini causes great ocean spray

15. He Pāhola ke kiu ho'oki'i makani lele kula o Līhu'e
Spreading out is the strong fetching wind flying to the plains of Līhu'e

16. He Ho'oluakanehe ka makani o Hanama'ulu
Moving in two directions from the land or from the ocean, is the free flowing wind of Hanama'ulu.

The first, second and forth wind describes the movement of rain clouds to the land. These are high places which attract rain clouds and at which place the clouds will gather and sit. The idea of the pig clouds is that pigs are attracted to rain clouds and in the description of pig clouds it is always a reference to the sacred black pig that finds water. Black pigs are also a kinolau of the god Lono, an epithet to winter storms and rain clouds over land.

Wind number three is a center where wind disperses to all directions. The following five winds are so strong they effect change to the land or water which they touch. The Ho'olua wind of Hanama'ulu are typical of winds in a valley which originate on land blowing out to sea or vice versa, in either case the valleys act as a funnel and the wind becomes strong and swift. Winds names were given because long observation has produced an accurate account of distinct and unique effects of wind currents on the land.

The second wind source for this island was discussed in the last CIA report. The wind source tells of the wind gourd of La'amaomao and the last to inherit the gourd was Kuapaka'a. Kuapaka'a's father was Paka'a from the court of high chief Keaweaumi. Kuapaka'a mother was from the island of Kaua'i and he inherited the wind gourd from his mother. This story begins its history from Tahiti and the descendents to Kuapaka'a were the ones who recorded all the wind names for the islands. However this family's tradition was first established on the island of Kaua'i.

Exhibit G : The ocean off of 'Ahukini Coastline

INDIGENOUS LIFE WAYS; The Ocean

The ocean and access to the ocean is always a big issue with local fishermen. The interviews included twelve people, both men and women. Their concern was access to 'Ahukini landing and their need to fish. They also bemoaned the fact that the changes to the airport space will only accommodate more visitors to the island. This will not benefit the local community in that the highways are already burdened with the amount of cars on the road. There is too much construction on beach front properties which will inhibit access to other fishing sites. Mr. Mike Higa complains that everywhere on the island there are tourists. Whether he is hunting or fishing or gathering plants or greenery, he is disturbed. He learned to hunt and fish since a young child and this is his lifestyle. In his observations more visitors will quickly deplete the resources on their island or buy up the lands.

Of the twelve people interviewed ten of them were fishermen; five of them were born and raised in the 'Ahukini / Hanama'ulu area. They all continue to find their way down to the 'Ahukini landing in Hanama'ulu Bay. Mr. Clifford Lee was from the old 'Ahukini camp and he along with 60 other families was evicted for the expansion of the airport in 1964. He recalls that there was an "up camp" and "down camp". Mr. Lee expressed that that expansion of the airport had a negative cultural impact on them as well as the land because it forced them to change their lifestyle. When they lived at the shoreline the area and resources were cared for and now it is a dump. His greatest fear is that they will no longer be able to pole fish, gather limu and 'opihi in that area because it

will be closed off to the public. His after thought is if there are changes it should be done on the Ninini side of runway 17-35 and not the Hanama'ulu side.

The 'Ahukini down camp is the location of the kalo and running water we found on our last CIA and since the passing of six years, we can no longer find the kalo and running water. That coast line has been thrashed more so then it was in 1999.

Mr. Valentine Ako revealed something very valuable, that is, Kaua'i still retained the Konohiki status in the 1950's. This is a very recent loss of men recognized with Konohiki title. Konohiki is one who was respected and listened to for his knowledge of his ahupua'a and in turn his kuleana was to regulate the resources of the ahupua'a. I believe Kaua'i held on to the Konohiki title longer then any of the other Hawaiian Islands. Because Mr. Ako moved from Holualoa, Kona in 1953 when he was twenty seven, he still remembers the Konohiki vividly. The Konohiki of Wainiha's ahupua'a was a gentleman named Mr. Kimokea. Wainini/Kalihiwai had Mr. Akana, Mr. Henry Kalani Tai Hook was for the ahupua'a of Hanalei, Mr. Franklin Manu Kelekoma was the Konohiki for 'Ahukini and Hanama'ulu and a haole man was the Konohiki for Nawiliwili. This reveals that the fishing practices and protocol for these areas around the island was still in tact because these Konohiki would maintain the fishing cycles of the ocean and would not allow over fishing. This system kept other people from coming in to their area to fish that didn't belong unless they asked permission.

Mr. Ako, like many of the other fisher men such as the Konohiki were well versed in the knowledge of traditional fishing, making of nets, lures, poles and preparing bait. It was their business to know when to feed the ko'a, when to fish for 'opelu, akule, etc.

Like Mr. Lee, Mr. Ako feels that if changes to the airport were to happen it should be on the Ninini side of the runway and not toward the Hanama'ulu or 'Ahukini side of the runway.

Mr. Alexander Kelekoma is the son of Mr. Franklin Manu Kelekoma the Konohiki of Hanama'ulu and 'Ahukini. Mr. Alex Kelekoma like his father before him was born and raised in Hanama'ulu with the fishing tradition as their lifestyle. Mr. Alex Kelekoma can easily point out the spots of the kilo i'a or the places beneficial to locating the exact position of fish schools in the bay, near the mouth or out side of the bay. Mr. Kelekoma pointed out the rock Pepeiao, the ko'a and recollected the way his father located the rock which is under water. He elaborated on the kinds of fish found there such as the moi, mullet, 'akule in schools, lobster, limukohu and 'opihi.

Mr. Kelekoma did not feel the expansion of the airport would impact the cultural practice he is involved with, that is fishing, however he feels that the limitation of access or no access at all would be devastating. He is adamant about continued access for pole fishing, diving, kupuna fishing and young people who find value in fishing.

Cheryl Lovell Obatake reminisced of her young days in Nawiliwili, she talks about her uncle who was kilo i'a. He would place himself on Kalanipu'u with two flags and people would watch for his signal. One flag up indicated the school of fish ('akule) was sighted, two flags up warned the boats to begin to come out to surround the schools. Cheryl said she was the runner to her uncle when he needed something. Later walkie-talkie was used, then the planes came. The bay was the best grounds for 'akule, now hardly any!

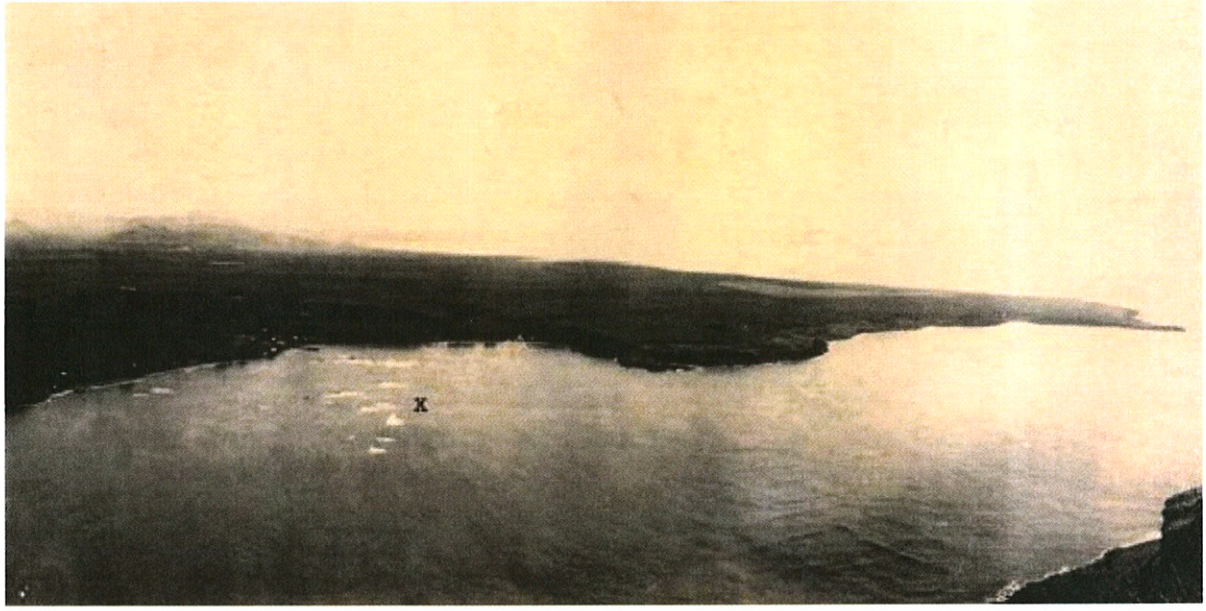


Exhibit H: Nāwiliwili Bay and the Plains of Līhu'e

HISTORY OF LAND USE

THE NAME

The town or area known as Līhu'e did not exist before 1825. This was the ahupua'a of Kalapaki and Hanama'ulu in the district of Puna. In the early 19th century, this area was culturally rich with fresh water streams, rivers, springs, fish (both fresh and salt water), taro, dense forest with luxuriant growth of both the sea shore plants and the upper forest hardwoods. Both Nawiliwili and Hanama'ulu Bays produced an abundance of sea food. Nawiliwili Bay was one of the best surfing spots on the island. Because of the fertility of land, there were large settlements of Hawaiians in Halehaka Valley, Niumalu, Nawiliwili and Hanama'ulu Valleys.

During the time of Kamehameha III, the island of Kaua'i was governed by an ali'i from the island of O'ahu who was a friend of the ruling chief and whose name was Kaikio'ewa. As was the practice of the ruling chief he assigned people he knew from O'ahu to the different islands to govern. Kaikio'ewa was from a place on O'ahu known as Līhu'e near Pearl Harbor. Chief Kaikio'ewa governed Kaua'i from 1825 – 1839 at which time he desired to remember his home and named the place Līhu'e. The name caught on and continues today.

THE MĀHELE OF 1848

In 1845, Lt. Commander G.E.G. Wilkes reached Līhu'e and his described the place as having no industry or cattle. There were two churches, seventy pupils and no apparent decrease in the native population.

At the time of the Great Māhele in 1848, the lands of Hanama'ulu and Kalapaki were claimed by the governor of Kaua'i , Paulo Kanoa. However, the land was awarded by Kamehameha III to his sister, Victoria Kamamalu. She also claimed Hule'ia as a preserve for cattle.

Kamehameha III formally defined the ancient fishing rights and practices of the Hawaiian people in the Constitution and Laws of 1839 which Laws were reconfirmed in 1840. The King distributed the fishing grounds and resources between himself, the chiefs and the people of the land. He also specifically, noted that fisheries on coral reefs fronting various lands were for the Konohiki (landlords) and the people who lived on their given lands under the Konohiki.

Victoria Kamamalu was identified as Konohiki of Kaua'i, ahupua'a from Waimea to Wailua. All of the lands of Ni'ihau Island were also under her authority. Victoria established the kapu (prohibited) on fish and timber within each of the ahupua'a below:

AHUPUA'A	I'A (Fish)	LĀ'AU (Hardwood)
Wailua	'Anae	'Ōhi'ahā
Hanama'ulu	'Anae	Hau
Papua'a	'Opihi	Kukui
Kalapaki	Uhu	Koa
Nawiliwili	He'e	Hau
Kukuiokahea	'Opihi	
Kaholo	'Opihi	
Ha'ikū	'O'opu	'Ōhi'ahā
Niumalu	'Awa	Koa
Makaopuna	'Opihi	
Kipu	He'e	Koa

Following the death of Victoria Kamamalu in 1866, her lands were inherited by Ruth Ke'elikolani. Four years later in 1870, Ke'elikolani sold large portions of her Kalapaki and Līhu'e lands to William Hyde Rice. Ruth inherited lots of land, some of these lands were eventually inherited by Bernice Pauahi Bishop and later Kamehameha Schools became the beneficiary of Bernice Pauahi.

The project area consisting of two separate proposed land acquisitions of 125 acres and 15 acres were included in Victoria's land award. Both are in the Hanama'ulu ahupua'a and are currently owned by Visionary LLC doing business as Līhu'e Land

Company. These two parcels make up the northwest land acquisition of the CIA study as is seen in the map below.

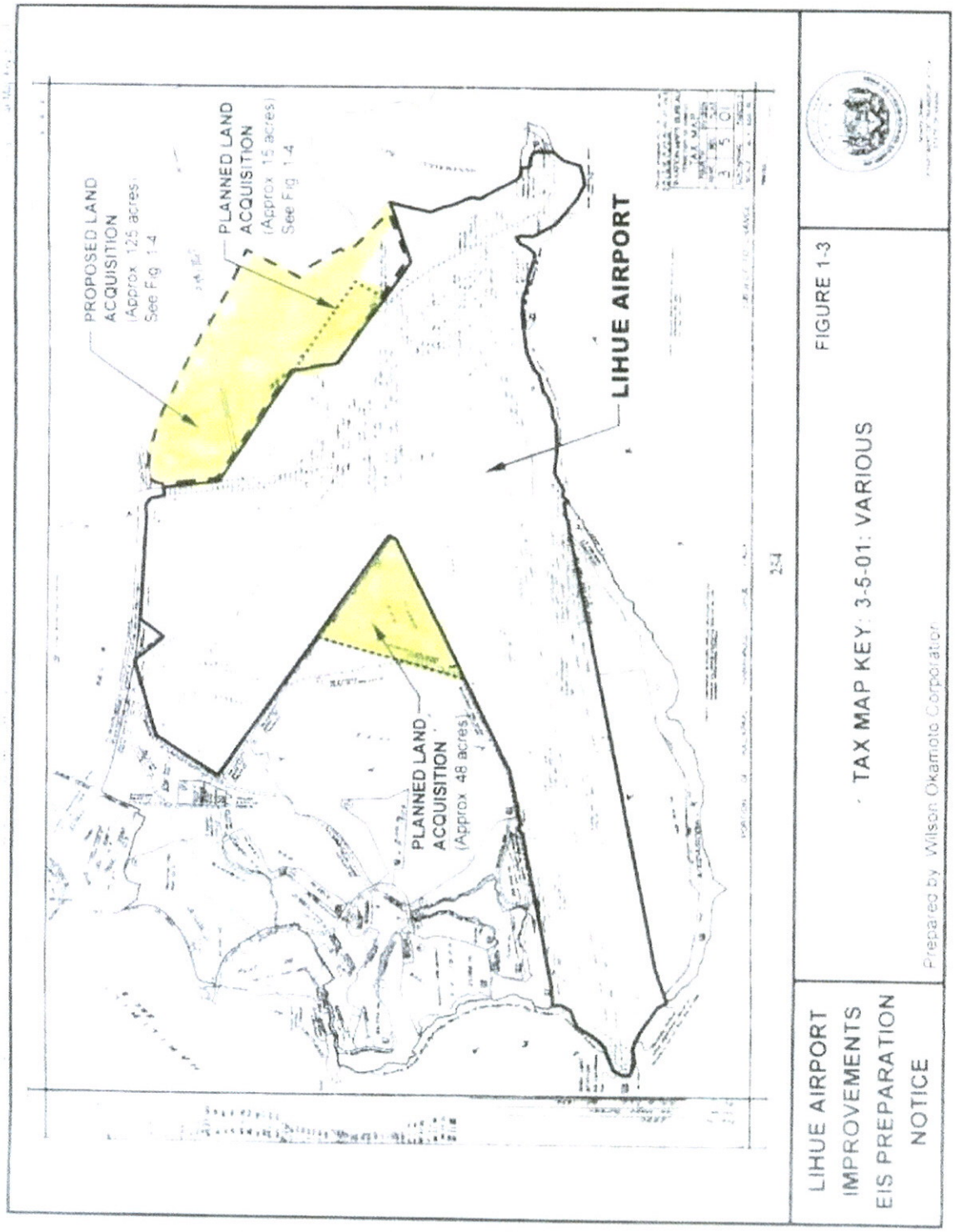


Exhibit I: Map of Parcels to be Acquired

Exhibit J: Līhu'e Plantation Company Mill with old pond.

LĪHU'E PLANTATION COMPANY

The Līhu'e Plantation originated in 1849 between Charles Reed Bishop, Judge William L. Lee and Henry A. Pierce of Boston. J.H.B. Marshall was the first plantation manager of record in 1853 to 1854. The site of the mill was selected in the valley of the Nawiliwili stream, the same site the mill stands today. Water power was used to drive the mill rollers which were brought from China.

The Līhu'e Plantation was the best financed, most modern, and most costly of the new agricultural enterprises during the mid 1800's. In 1853, Līhu'e Plantation was the first in Hawai'i to use steam power. While the laborers in the fields were exclusively Hawaiians, Chinese workers operated the mill. In 1856 and 1857 William Harrison Rice engineered and built the sugar industry's first irrigation ditch, the ten mile Hanama'ulu Irrigation Ditch that brought water from Kilohana Crater.

In 1859, a new partnership was formed and the name was changed to the Līhu'e Plantation Company (LPC) The original 3,000 acres increased by 300 more acres at 'Ahukini in 1866. In 1872, 17,000 acres at Hanama'ulu were added, which included an excellent water source. It was during the management tenure of Paul Isenberg that the company was incorporated in 1872.

Other sugar ventures, later becominf a part of LPC, were started in the area. Judge McBryde began planting cane at 'Ele'ele around 1875 and Captain James Makee Sugar Company at Kapa'a in 1877.

A mill was built at Hanama'ulu in 1877 for grinding cane grown on the north side of Hanama'ulu gulch. Mr. George Wilcox had brought the mill from Scotland, intending to erect it at Grove Farm. He decided, however, to continue to have his cane ground at Līhu'e, and eventually sold the mill to LPC.

LPC continued to expand, leasing 30,000 acres in Wailua in 1878.

In 1891, a railway system was constructed at LPC to replace the ox carts used to transport cane from the many acres of fields to the mills.

Shortly after the turn of the century 1,600 workers were employed by LPC. Japanese, Portuguese, Hawaiian, Korean, and Puerto Rican laborers made up the work force. Plantation housing was provided in 1910 along with a plantation hospital. Several churches, schools, a ranch and dairy also served the plantation communities.

In 1922, American Factors, Ltd. acquired control of LPC with the purchase of 3,026 shares of stock. Prior to that in 1920 major improvements were made and the Līhu'e mill was electrified with power supplied by hydro-electric generators. The same year Hanama'ulu mill closed and some of the equipment was used to improve the Līhu'e mill which was grinding cane from Grove Farm and Kipu Plantations as well as its own. A lease of Wailua lands prompted work on a project to bring water from the south branch of the Hanalei River for irrigation and hydro-electric power; this was in the year 1923. The year 1930 was a record breaking year for the harvest of cane which yielded 36,506 tons of sugar.

In 1933, LPC became the sole owner of Makee Sugar Company and the two plantations merged. World War II intruded upon LPC, slowing down production for a few years. However in September 1944 LPC was back in full swing with approximately 5,000 employees. With the help of returning veterans they celebrated an all time record harvest of 59,417 tons of sugar in 1947.

The history of LPC has been a record of increasing improvements and innovative ways of growing, producing and manufacturing sugar. New cane varieties and creative irrigation techniques were developed and efficient milling and shipping operations have contributed to higher sugar yields and greater productivity in keeping LPC successful in a highly competitive industry.

On November 17, 2000 AMFAC/JMB closed the Līhu'e Plantation Company after 151 years of producing sugar on Kaua'i.

ENVIRONMENTAL WASTELAND

Despite the innovation of LPC to produce sugar efficiently, they proved to be deficient as environmentalists and they were not Native Hawaiians who tend to maintain natural resources especially water. The Plantation's success was the cause of environmental stress on the natural world of Nawiliwili, Līhu'e, Kalapaki, Hanama'ulu and Hule'ia. This disregard for the environment put pressure on the Native Hawaiian who depended on the natural environment for sustenance. This land use was economically advantageous but it was the deficiency factor in the lifestyle of the Native Hawaiian. The land was always productive for the people because of the abundance of fresh water,

ocean and land resources, many of these resources kept alive because of the natural waterways.

The Native Hawaiian had a very efficient fresh water law known as Kanawai which kept the tenants aware of this valuable asset and how it should be used and the fact that water was a gift very much like land. Because of this, a water protocol was practiced and observed throughout the islands especially when living near a waterway. These were the steps observed:

a) care was taken not to pollute the water

b) baths were taken on the lower part of the stream

c) people went up further for washing utensils

d) the po'owai or water head for 'auwai was above the lo'i

e) above of the po'owai was drinking water

f) a po'owai could not take more then 50% of the water source

During the plantation years the Native Hawaiian lost some of their lo'i for rice paddy. The plantation demanded a lot of water and fuel for the fire. Water power was used to drive the crushers. Cutting the Līhu'e forest provided fuel for the fire and shipping fire wood to O'ahu was also something that was done to aid in the depletion of the forest. LPC denuded the forest of Līhu'e, Hule'ia, and Kalapaki to feed the sugar mills. The water was also diverted from streams to feed the mill. Volumes of water from the rivers decreased because of diversion to ditches. LPC built 51 miles of ditches and 18 intakes from streams. This system swallowed an average of 100 – 140 million gallons of water a day. From the years 1850 – 1973 the Plantations were allowed to divert water.

Once the waters were diverted from the water head it was not always possible to restore the water. Many ditches built were so remote that their impacts were not realized. The land dried up where natural stream flow once existed. During the rainy season the water was not able to flow in stream beds and ran everywhere causing great floods. Another problem of this was the fact that the trees were no longer there. There was nothing to hold the water. The lack of stream water flowing and the wind and rains storms seriously impacted the environment of the wet lands, dry land and the ocean.

Finally realizing that the denuded forest and diversion of water were the cause of heavy mud deposits in the rivers, unbridled water flow through the land, dirty water for fish, river bank plants to dry up, filtering process for river water was blocked and lastly a drastic depletion of subsistence resources of the area, LPC initiated a large reforestation program. They, however, used non-native trees, an insufficient substitute for what was already there. Building of the breakwater and harbor was another blow to the flow of fresh water which now was becoming stagnant and collecting sediment and mangrove were beginning to grow. (Restoration of fresh water flow is a program now (2006) in place.)

Hawaiians lost water laws and management for raising taro and fish. They lost their lo'i which were converted into rice paddies or deprived of water source. They lost their traditional culture, the population was wiped out by disease and their land was in the hands of foreign businessmen.

PROJECT AREAS

Project area map Figure 1-3, Tax Map Key: 3-5-01: Various, Exhibit I was the map which provided the exact areas of concern. The CIA team scouted the 15 acre parcel, the 125 acre parcel and the 48 acre parcel. All parcels were covered with very thick grass which was difficult to penetrate. These were areas we examined on our last report and at that time the grass was not as thick in fact there was still some cane growing in the 125 acre parcel.

Because it was difficult to penetrate, we examined the perimeter. However it was necessary for us to look closer at the cultural site locations and the Plantation history. According to heiau locations there was not a site close to all parcels, therefore we are certain that heiaus or other cultural sacred sites were not located in the project areas. There was no indication in the literature or interviews of a village site there. Village sites were near water ways and heiau sites were elevated near cliffs or on high bluffs over looking a broad area with a long view as is noted in Exhibit A.

Although the project area is minimal, an extended study was very necessary, based on this effort, we are confident that there are no cultural sites within these areas.

Initially we believed that the sites to be acquired would be used to accommodate runway expansion. We have since learned that this will not be the case, expansion is no longer the reason for acquisition.

CONCLUSIONS

The disturbance and or intrusion which will occur while developing these sites will not impact upon any cultural site. In saying this we realize that negative impacts occur despite caution taken to minimize the negativity. We adhere to the words of the people interviewed and their fear of erosion of the cultural use, in this case fishing. The erosion of cultural use was experienced during the time of the plantation and their negative impact on the environment and the very slow mitigation process to revivify the land and once again perfect the flow of water.

A. The proposed expansion of the 125 acres and 15 acres close to the 'Ahukini landing. Most of the interviewees were concerned with the possibility of closed access to 'Ahukini Landing and the coast line for diving, pole fishing and net throwing. There was not any Indigenous Hawaiian heiau site for worshipping or any other site in that area that not already destroyed by the plantation.

Alternatives or Mitigation: There are no heiau left in these areas. There is however an area on the cliff of Hanama'ulu where there seems to be remnants of a heiau but there was no literature to confirm this. There is a visible alignment which interested Hawaiians should have access to in order to study it. The fisher people were adamant concerning their continued fishing practices therefore serious consideration must be made for these practitioners who are still attached to the natural world and the fishing rights they deserve. A gate was placed near the 'Ahukini landing which regulates the times people

spend in that area. They felt this was an improvement, however, the continuation of this system of regulation and not any further denial of access would be appreciated by the locals who have suffered the influx of foreigners for many years and for some, many generations.

The 48 acre parcel is located on the road going to Ninini Point. Ninini Point has visible fragments of a heiau despite the lighthouse's location there. Part of the wall continues to exist and special rocks are enclosed. The seasonal kaunaoa continue to grow in the area and is greatly valued as material for beautiful leis and was used medicinally.

A. In developing the 48 acres, the access to Ninini Point is most desirable to gather kauna'oa and other plants. Fisher men still access the Ninini side of the runway to the 'Ahukini coast line. The site of the heiau is available to contemplate and study.

Alternatives or Mitigation: The fragmented heiau at Ninini Point continues to be a connection to the past, therefore the need to maintain access is necessary. Hawaiians who are interested in heiau would like to know that the Ninini Point heiau is available for study and possibly keeping it from further destruction. Continued study will eventually produce a document of the whole site and its use. Access to fishing area along the coast line will ensure the care and protection of the coast line by fishermen instead of people who abuse the land and dump garbage there. Kauna'oa is seasonal and is becoming scarce because of development on beach areas. Because Ninini is not utilized as often as popular sandy beaches, kauna'oa will reestablish itself.

RECOMMENDATIONS

1. The State and County government must enhance and maintain 'Ahukini Landing and maintain access to said Landing site and and the coastline of 'Ahukini.

2. The State and County government must provide a safe fishing site at 'Ahukini Landing.

3. The State and County government must regulate commercial fishing in the bays of Kaua'i including Hanama'ulu

4. The State and County government must aid in the work to restore clean waterways in the Nawiliwili, 'Alekoko and Hule'ia areas.

5. The State and County government and their agencies ought to consider the study of the Ninini site heiau. An interpretation of the site and its uses should be made and used for public knowledge.

6. The State and County government must have regulations for dumping refuse along the coast line of 'Ahukini.

SOURCES

Damon, Ethel M. 1931. *Koamalu*, private collection of the Kaua'i Historical Society Līhu'e, Hawai'i

Joeting, Edward 1984. *Kaua'i A Separate Kingdom,* University of Hawai'i Press, Honolulu, Hawai'i

Handy, E.S. Craighill 1940. *Native Planters in old Hawai'i – Their Life, Lore and Environment,* Bishop P. Bishop Museum Bulletin 233, Honolulu, Hawai'i

Juvic, Sona P. and James O. 1998. *Atlas of Hawai'i,* University of Hawai'i Press, Honolulu, Hawai'i

Kaua'i Historical Society. 1991. *The Kaua'i Papers,* Kaua'i Historical Society Publication, Līhu'e, Hawai'i

Kaua'i Historical Society 1995. *A Guided Tour Into Historic Kaua'i,* presented by E. Kalani Flores for the Kaua'i Historical Society, Published in The Garden Island Newspaper, Līhu'e, Hawai'i

Kikuchi, William A. 1992. Archaeology of Kaua'i, Kaua'i Community College, Līhu'e, Hawai'i 1992

Krauss, Bob with Alexander, W.P. 1965. *Grove Farm Plantation – The Biography of Hawaiian Sugar Plantation,* Pacific Books, Palo Alto, California

Maly, Kepa *Ka Lawai'a,* Kumu Pono Associates

Moffit, Riley M. and Gary L. Fitzpatrick, 1995. *Survey the Māhele, Mapping the Hawaiian Land Revolution* (Palapala'āina, Volume 2), Editions, Ltd., Honolulu, Hawai'i

Nakuina, Moses K. 1990. *The Wind Gourd of La'amaomao,* Kalamaku Press, Honolulu, Hawai'i

Pukui, Mary kawena, 1983. *'Ōlelo No'eau: Hawaiian Proverbs and Poetical Sayings,* Bishop Museum Special Publication No. 71, Bishop Museum Press, Honolulu, Hawai'i

Pukui, Mary K., Samuel H. Elbert, and Esther T. Mo'ōkini. 1974. *Place Names of Hawai'i.* University Press of Hawai'i, Honolulu, Hawai'i

Rice, William Hyde, 1923. *Hawaiian Legends,* Bernice P. Bishop Museum, Honolulu, Hawai'i

Wichman, Frederick B., 1988. *Kaua'i: Ancient Place-Names and Their Stories,* University of Hawai'i Press, Honolulu, Hawai'i

Wilcox, Carol 1996. *Sugar Water, Hawai'i's Plantation Ditches,* UH Press, Honolulu, Hawai'i

Edith Kanaka'ole Foundation Chant Index.

Fornander, 1918, *Fornander Collection of Hawai'i Antiquities and Folk-lore: Volume V,* Bishop Museum Press, Honolulu, Hawai'i

"Nā Hiohiona O Līhu'e." *Ka Nupepa Kuokoa,* 12 February 1876

Nakuina, M.K., 2006. *Wind Gourd of La'amaomao,* University of Hawai'i Press, Honolulu, Hawai'i

Poepoe, J. M. "Ka Mo'olelo o Hi'iakaikapoliopele." *Kuokoa Home Rule*, 1908

INTERVIEW SYNOPSIS

1. Dustin Mahi Native Hawaiian Fisherman

Dustin Mahi is a native Hawaiian born and raised in Kapa'a and Anahola. He is an active fisherman and practices gathering from the sea using methods of net fishing, pole fishing, spear fishing and diving. His grandfather, Clifford Lee, was born and raised in the 'Ahukini camp formerly located adjacent to the Līhu'e Airport area above of the 'Ahukini landing. Their family still access and fish at the 'Ahukini landing as well as up and down the 'Ahukini coast. When asked about his thoughts about the expansion of the Līhu'e Airport facilities, he felt that much of the island resources are already being negatively impacted. He continued that expanding the runway and airport facilities are not for the betterment of the local residents. He stressed that as more and more tourists and outside come to Kaua'i that the culture and lifestyle of the people is threatened with change and negative impact. "I'm totally against any expansion that will bring more people here."

2. Christopher Gampon Fisherman

Chris Gampon was born and raised in Koloa on the south end of Kaua'i. He is a resident of Kalaheo. He goes trolling and deep sea fishing with his father, but rarely out of Nawiliwili. They mostly frequent the south side of the island. He did share however, that when they did fish out of Nawiliwili and outside of the 'Ahukini Coastline that they would catch an abundance of weke.

3. Ginger Saiki Lā'au Lapa'au Practitioner

Ginger Saiki was born and raised in Wailua, Kaua'i and is a practitioner of Lā'au Lapa'au or Hawaiian Herbal healing. Of all of the places on Kaua'i, she has never gathered herbs or plants for healing from the project site or its surrounding areas. She shared that although many of the plants used in healing grow up and down the 'Ahukini coastline, as well as throughout the areas surrounding the project site, the excessive amounts of pollution generated from aircraft, vehicle and human traffic causes the healing properties of the plants to lose potency. Evidence of Lā'au populations throughout the area is indicates that adequate resources were available to native Hawaiians and practitioners from the Hanama'ulu, Kalapaki, and Nawiliwili areas. She shared that it saddened her that the residents of those areas (surrounding the project site) would have to search out other areas elsewhere for herbs and plants to continue their medicinal and Hawaiian healing practices. The current airport traffic as well as all things that have come as a result of more visitors, transients, etc. has already negatively impacted the resources for lā'au lapa'au. Her regular use of Lā'au in her practice has motivated the growing of various native plants and herbs on her property in Wailua. However, she still gathers from the wild as well. Even more so today, she travels to far and remote places such as Waikoko and Wai'ale'ale to ensure that the medicinal and healing qualities of the lā'au are pure and excellent.

4. Miki Kawaiikaika Higa Native Hawaiian Practitioner

Kawaiikaika Higa is a native Hawaiian born and raised in Anahola. Although not from 'Ahukini or Hanama'ulu, he frequents the 'Ahukini Landing area and coastline occasionally. He is adamantly against any expansion or improvements at the Līhu'e Airport that will allow for larger aircrafts and more visitors to the island. "Everywhere we go, from one end of the island to the other there are tourists. It seems like there are no more places for the local people to go to enjoy the beaches or let alone, hunt, fish or gather without being disturbed," he says. Kawaiikaika is the 3rd offspring of a family of eight children. I learned to hunt and fish from when I was a little boy," he explained. "Hunting and fishing is part of my lifestyle. Our survival was dependant on it and we need to continue to be able to practice these ways well into the future. More visitors will quickly deplete our resources. There will be no more balance.

5. Valentine Kalaniho'okaha Ako Native Hawaiian Practitioner / Kupuna

We met with Uncle Val on July 5, 2006 at his home in Wailua, Kaua'i. Uncle Val was born on July 10, 1926 at Holualoa, Kona, Hawai'i. His father is James Kimo Ako and his mother is Keahialoa Kanoholani. On his mother's side are Kanoholanikaiamakini (grandfather from Kohala, Hawai'i) and Kolekanui Keawekamalinui (grandmother from Waimea, Kaua'i). Uncle Val moved to Kaua'i with his family in 1953. This area (Wailua houselots) was originally opened up as farm/agricultural lots just before the War (World War II). Shimamoto, a County Engineer, was the previous owner of the Ako's property and surrounding parcels before it was subdivided into house lots. Other old-time families noted in the are are Aki, Park (Johnny and Phillip and their father, Johnny SR.), Apana, Ki'ilau (Charles, Sr.) Nagao, Saki (Harry and George) and Tanglin (Johnny).

When asked about fishing practices and resources relating to the Līhu'e Airport Project area, Uncle Val shared that the title and kuleana of Konohiki on Kaua'i was still active in the 1950's. He recalls that Kimokea was the konohiki of Wainiha, Akana was the Konohiki of Wainini/Kalihikai and Kalihiwai and Henry Kalani Taihook was the Konohiki of Hanalei. In the project area, the old man, Kelekoma was the Konohiki for 'Ahukini and a man by the name of Conant was the Konohiki for Nawiliwili. Kelekomo was a very knowledgeable man and had extensive knowledge and respect for the ocean resources as well as for the people.

Uncle Val is unsure as to how Malcolm Conant earned the title and station of Konohiki. He was a haole man who worked as a tax assessor. Uncle Val was working on an aku boat in the 1950's. He shared an experience he had while catching nehu in the Hule'ia River one night. The nehu are anchovies and were used for bait and to chum the water for aku fishing. They would turn on a light that shined into the water to attract all of the nehu. Huge schools, estimating about 4 tons of aholehole would also be attracted to the light. One night while gathering nehu for bait, they were shot at with a 30/30 rifle by Conant. The captain of their boat call Honolulu to speak with a Mr. Bill Kanakanui who wa a former Navy Commander. The Tuna Boat Association had appointed him as president (Kanakanui) and he was asked to field their complaint of the shooting incident

at Nawiliwili. Their concerns eventually went to the legislature and the station of Konohiki was soon abolished, thus removing Conant from Nawiliwili.

The County of Kaua'i used a portion of the 'Ahukini coastline as a dump sit for many years. As a result of all of the pollution, rubbish and debris, the fish population diminished greatly. Besides, no one wanted to consume the fish from the area and so it was not a very popular fishing site for all of the years that the dump was there. After they closed the dump in the 80's, the fish have slowly returned to the 'Ahukini coastline. 'Ahukini was known for its mullet and Kona crab grounds.

Growing up, Uncle Val spent lots of time with his kupuna. he is very knowledgeable of traditional fishing methods and the making of nets, lures, plies. preparation of special baits, etc. He talked about preparing and affixing kepau to coral or ala stones for sinkers on their nets. He also explained the use of kalo and ulu which was smashed into a paste form to be used as chum for the 'opelu at the ko'a. They generally did this daily, once in the morning and once in the evening from January through September. By September, you'd get a big school "trained". The fishermen on the wa'a would slap the paddle on the side of the canoe, which signaled the 'opelu to come to the ko'a to feed.

While Uncle Val has thorough knowledge of the ko'a in Kona from far north in Kailua to Kaulupulehu, he was unsure of trdtional ko'a and their associated landmarks in the Līhu'e project area, Hanama'ulu, 'Ahukini, Nawiliwili, and Kalapaki. When asked about Kū'ula in any of the related project area, he remarked that if anything, Hule'ia maybe.

When asked about the expansion of the Līhu'e Airport runway, Uncle Vaal sai that expansion toward the Lighthouse, Ninini, is okay, but only if it is absolutely necessary. He was steadfast that expansion toward Hanama'ulu and 'Ahukini Landing was not good at all and that it would negatively impact the fishing practices and resources that are still important to local fishermen and practitioners.

6. Clifford Lee Native Hawaiian Practitioner

Mr. Lee was born and raised in the old village community of 'Ahukini, which was located on the lands where the Līhu'e Airport is now located. Approximately 60 families made u p the 'Ahukini Community, which occupied two separate areas that they referred to as "camps." The "down camp" was located south of the narrow bay on the 'Ahukini shoreline where we found the kalo and spring water source. However, majority of the people lived in the "up camp" which was located in the vicinity of the old Bertram House (now destroyed and the open field is used as a parking/staging area for rental car companies), the defunct Masterworks Auto Body Yard and the adjacent lands planted in cane that is part of the project area. Although he recalls a heiau area located on the shoreline bluff of 'Ahukini, behind of the airport, he did not know its name or function of the site. It has been many years since remnants of the site have long been destroyed. Mr. Lee commented on the fact that expanding the runway or airport facilities seem to be

inevitable. "We were evicted and forced to move from our homes in 1964 and were among the last families, shared Mr. lee. He also noted how the State condemned the land to allow for the airport expansion. They were told with planes flying overhead of the area, the imposed danger of the planes dripping or dropping fuel would create possible health hazards to the families living there. He shared that back in 1964; the airport extension caused negative cultural impact because sit changed their lifestyle and uprooted them from their home. He also commented, that prior to the airport, only the families who lived in the 'Ahukini village fished and gathered resources from the coastal shoreline. Once they were evicted and the airport was developed, it became an area frequented by people from all over the island. Because no one lived in the area anymore, the resources and land areas were not maintained and tended to as it had been for years prior. Which much reservation, he shared that the runway and/or airport improvements could be a positive step to accommodate larger planes to access Kaua'i, as it would bring more customers and visitors to Kaua'i. Mr. Lee and his entire family continue to frequent the Hanama'ulu and 'Ahukini coastal shoreline for throw net fishing, spear fishing, diving, net fishing, pole fishing, as well as for gathering limu and 'opihi. His greatest fear is that they will be imposed with access that is inconvenient should the access routes change as a result of the airport facilty expansion. If there is any type of extension to the runway, he felt that it should be done on the Ninini pont side of the airport and not toward Hanama'ulu.

7. Mr. Alexander Kelekoma Native Hawaiian Practitioner

Mr. Kelekoma was born and raised in the ahupua'a of Hanama'ulu, located north of the project area. He is the sone of the late Franklin Manu Kelekoma, the last person who was given the konohiki fishing right to Hanama'ulu. Fishing practices have always been part of their family lifestyle since they were children. Before going to work in the morning, his father would venture out to various kilo i'a (fish spotting) sites around Hanama'ulu Bay to spot fish. Although he did not recall the exact names to the kilo i'a sites, he mentioned specific pine trees located on the bluff above the bay as well as the Līhu'e Point and the Hanama'ulu Point from which he remembers his father spotting fish. When asked about ko'a (marked fishing grounds) and traditional landmark names, Mr. Kelekoma mentioned a large, black rock located inside of Hanama'ulu bay, about 100 yards from the point. The name of the rock is Pepeiao. Although he could not recollect any specific story that would explain the name, he mentioned that his father had once marked the rock's location with two large sticks as well as aligned it with landmarks on land. 'Akule, mullet and lobster were plentiful at Pepeiao. Once he recalled the nets were so full of fish he had to cut off the last 10 feet off of the net because the weight of the fish in the net would have certainly caused their boat to sink. Other cultural resources sites that he spoke about included the locations of more 9 fresh water springs sources within the Hanama'ulu Bay area as well as toward the old Nukoli'i Dairy site, where the Kaua'i Hilton Resort is now located. "The spring located at the mouth of Hanama'ulu River marked by coconut trees, has always been known to us as the Waimea Flow," shared Mr. Kelekoma. The water originates in Waimea and is channeled underground of Mount Ha'upu then to the Hanama'ulu river itself. Many of the spring sources come from the Waimea Flow. In addition, he spoke of many moi fishing holes, the abundance

of 'akule and mullet, lobster, limu kohu and 'opihi. When asked about the kind of impact the expansion of the airport would impose, Mr. Kelekoma commented that it would not interfere with cultural resources of the coastline or the ocean. However, he shared that the most devastating impact would be caused by restricting or limiting access to the resources along the coastline and in the ocean as a result of the airport expansion. He strongly felt that continued convenient access was extremely important. 'Ahukini Landing is a fishing area for diving and pole fishing. Pole fishing is enjoyed mostly by kupuna, although others of younger generation frequent the area too.

8. John Pia Native Hawaiian Practitioner

Mr. Pia was born and raised in the ahupua'a of Hanama'ulu. His maternal side of the family descends from the project area loction. His family always utilized the natural and cultural resources of the Hanama'ulu area as well as that of the 'Ahukini coastal shoreline for subsistent purposes. Mr. Pia commented that the various fresh water springs located near the Hanama'ulu stream where they continue to plant taro for family use only. He'e, 'opihi, limu, reef and deep sea fish provide food for their table. When interviewed about the expansion of the airport, Pia strongly felt that no expansion was needed. He commented that the current traffic situation on the island is already a major problem that needs to be addressed prior to bringing in more planes, visitors and people to the island. He was discontented with the issue about lack of access to the area where he and his family have fished and gathered many, many generations. Mostly as a result to the closure of roads and right-of-ways imposed by land owners. "Now that some of those lands are for sale we will probably lose more access," he said. "Access is the most important concern to me. We must be able to continue our custormary practices."

9. Cheryl Lovell-Obatake Native Hawaiian Practitioner

Ms. Lovell-Obatake's perspective was that the Hawai'i Supremem Court in PAS held government agencies responsible to protect Native Hawaiian Tradtional and Custoomary Practices following the opinion of the Supreme Court of the State of Hawai'i in Public Access Shoreline Hawai'i vs. Hawai'i County Planning Commission.

10. Nani Rogers Native Hawaiian Practitioner

The following is a direct quote received via email from Aunty Nani Rogers in response to the expansion of the Līhu'e Airport.

Aloha mai e Kehaulani, happy to oblige:

The State has already approved a Super-ferry to our island, which I am strongly opposed to; there are already thousands of people that step all over our 'āina coming off the huge ocean liners that dock at Nawiliwili too, that will surely cause harm to our 'āina,

resources, cultural values and our po'e. What are their motives? It is money, greed and power? We know that the want and greed for money is the "root of all evil." We see wealth as not money; our waiwai (wealth) comes from the 'āina, our ola comes from our 'āina, our kapu laws come from Ke Akua which is higher that any man-made laws. It is our kuleana to obey Ke Akaua's laws and honor our ancestors.

Hawai'i already has many environmental problems: Too much tourism and resort development (we need a moratorium), depletion of our resources: fresh water, coral and reef damages, over fishing, air pollution, and many others. Military damages: dumping of bombs off our shores, depleted uranium, desecration of Mauna Kea, Pohakuloa, Waikane, Makua, Kaho'olawe, Manā, Ka'ula with cultural damages of desecration of burials, development around cultural sites and disrespect of our cultural values.

These are just the tip of the iceberg. Enough is enough! Stop the destruction; turn the focus to restoration, preservation and protection of our 'āina, resources and the roots of our culture. Think Kanaka maoli...think ahupua'a. Aloha, Aunty Nani.

Andy Fisherman, Interviewed at 'Ahukini Landing

Was born and raised on Kaua'i, originally from 'Ahukini and Hanama'ulu. Moveed to Kapa'a in his later years, and then to Wailua Homesteads where he currently resides. He grew up fishing for subsistence purposes. And contuse to do so mostly onn the weekends. YAhukiini has liong been a favorite spot for fishing, although the fish supplies have depleted tremendously. When asked about fising on the coastline, he commentd that access is limited due to the new development on the Kaua'i Lagoons Resort closer to Ninini Point. He does some fishing there, but prefers 'Ahukini Landing. Andy is not in favor of the expansion of the airport runway, for with it comes more and more vsitors and traffice to the island. Access is a major concern, as more and more coastal spaces are purchased by wealthy foreigners. He feels strongly that any form of expansion (such as the runway, increased flisghts, numbers of tourists) is not good for the island or the local people. It (runway expansion) will only incdrrease commercialism all the way around. 'Ahukini is one of the few laces left that can be easily accessed for non-commercial fishermen like Andy. He share that the fish population has been diminished by over-fishing by commercial fishermen in Hanama'ulu Bay. 'Akule and other desired fish species come into the bay to spawn. Yet, they are raked out by commercial fishermen who lay nets and take young, juvenile fish far before they are ready to reproduce for future populations of fish. Another problem comes with commercial boat charter, diving tours and tourists who ignore the fact that they disturb and encroach into fishing areas such as 'Ahukini landing. There is an attitude by commercial operators and tourist that locals should be grateful for tourism because it fuels the economy. Tourism and the increased growth of traffic has negatively impacted this non-commercial fisherman and practitioner of fishing and gathering for subsistence – a custom that he was born and raised with throughout his lifetime. He shared that in his growing up years, and into a portion of his adulthood, 'akule would be so plentiful that they would just hook them on their fishing pole lines regularly. People would come by and they would always unselfishly offer strangers and passersby to help themselves to the fish, and to take home

to feed their families. Andy said, "We're lucky if we catch enough today to go with 3 scoops of rice."

Joseph Destrilco Native Hawaiian Fisherman

The interviewee is a kupuna lawai'a, an elderly fisherman who was born and raised in Hanama'ulu. He continues to reside in the neighboring town of Hanama'ulu. 'Ahunikin Landing is a favorite place for him to come to fish for subsistence purposes. He fishes mostly by methods of pole casting. He periodically lays crab nets as well. Just before speaking with Mr. Destrilco, he caught a medium sized palani fish. He too lamented about the decrease in fish populations in Hanama'ulu Bay. The State (via DLNR) has done nothing to regulate the taking of fish from Hanama'ulu and other bays on Kaua'i for commercial purposes. He shared that Kaua'i is the only island the DLNR allows for commercial fishing and activities inside the bay. He is adamant that it is the main reason for the decrease in fish. "More and more tourist comes down here," he said as another packed bus of tourists unloaded into the parking lot. "The buses bring them down here to kill time before they take them to, or pick them up from the airport." Tourists venture out on the 'Ahukini Landing Pier which is in great disrepair. He shared that the State has done nothing to fix the pier walkway and that whatever improvements are there, have been done by fishermen and other locals like himself who want to continue to access and use the 'Ahukini Landing. He pointed out a section of the wooden pier that was burned down by people who go to the 'Ahukini landing area after dark to party and indulge in drugs and alcohol. Mr. Destrilco would like the State to repair and maintain the landing area for local people and subsistence fishermen first, instead of expanding the airport runway which will bring more people and traffic to Kaua'i. He also suggested that a gate be erected to control misuse of the area perhaps with access hours from early morning to early evening.

APPENDIX F

Hazardous Materials Survey

Appendices from the Hazardous Materials Survey report are available upon request from the Department of Transportation-Airports Division
Contact: Steve Takashima
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HAZARDOUS MATERIALS SURVEY
LIHUE AIRPORT MASTER PLAN IMPROVEMENTS
LIHUE, KAUAI, HAWAII

September 2006

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MFA Job # 05096-072

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APPENDICES

Appendix A Environmental Resources, Inc. Report & Letters of Sanborn Fire Insurance Map Coverage
Appendix B Summary of Information from Previous Environmental Reports
Appendix C Summary of DOH Databases and Files Review for Lihue Airport USTs

LIST OF ACRONYMS

ACFE	air cargo facility expansion
ACM	asbestos-containing material
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
bgs	below ground surface
BMP	best management practice
BTEX	benzene, toluene, ethylbenzene, xylenes
CEC	Clayton Environmental Consultants
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response Compensation and Liability Information System
CFC	Cotton and Frazier Consultants, Inc.
CFR	Code of Federal Regulations
CORRACTS	TSD facilities subject to Corrective Action under RCRA
CWA	Clean Water Act
DOH	State of Hawaii, Department of Health
DOT	State of Hawaii, Department of Transportation
DOTA	State of Hawaii, Department of Transportation, Airports Division
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EPE	employee parking expansion
ERNS	Emergency Response Notification System
ERP	Environmental Remediation Project
FAA	Federal Aviation Administration
HEER	DOH Office of Hazard Evaluation and Emergency Response
HR	heliport reconfiguration
HW	hazardous waste
LBP	lead-based paint
LPC	Lihue Plantation Co., Ltd.
LUST	leaking underground storage tank
MFA	Masa Fujioka & Associates
NASA	National Aeronautics and Space Administration
NE3-21	northeast runway 3-21

NFA	No Further Action
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NWLA	northwest land aquisition
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PPE	public parking expansion
ppm	parts per million
PRG	preliminary remediation goal
PS	proposed emergency vehicle access roads, perimeter roads, fencing upgrades
RCRA	Resource Conservation and Recovery Act
SHWB	Solid and Hazardous Waste Branch
SW3-21	southwest runway 3-21
TCLP	toxicity characteristic leaching procedure
TE	terminal exit
TIAL	Tier I Action Level
TPH	total petroleum hydrocarbons
TSD	treatment, storage and/or disposal (category of RCRA facility)
UIC	Underground Injection Control
UPS	United Parcel Service
USDA	United States Department of Agriculture
USGS	United States Geological Survey (US Department of the Interior)
UST	underground storage tank
VRP	Voluntary Response Program
WOC	Wilson Okamoto Corporation

HAZARDOUS MATERIALS SURVEY
LIHUE AIRPORT MASTER PLAN IMPROVEMENTS
LIHUE, KAUAI, HAWAII

EXECUTIVE SUMMARY

Masa Fujioka & Associates (MFA) has conducted this Hazardous Materials Survey (Survey) for the proposed Lihue Airport Master Plan Improvements. The purpose of the Survey is to evaluate the presence or likely presence of materials considered hazardous to human health and the environment that may impact the proposed improvement areas.

The Survey included investigation of historical and current use of the proposed improvement areas, interviews with State of Hawaii, Department of Transportation (DOT) personnel, and a site reconnaissance of the proposed improvement areas. The Survey addressed the following potential environmental conditions: asbestos, biohazard/medical waste, hazardous material/waste, heavy metals, landfills, lead paint, offsite sources of contamination, operationally contaminated areas, pesticides, polychlorinated biphenyls, radioactive materials, radon, storage tanks (aboveground and underground), storm water, and wastewater.

We assessed the following eight primary improvement areas: (1) 125-acre land acquisition area ("NWLA") northwest of the airport; (2) proposed heliport reconfiguration ("HR") area; (3) proposed southwest and northeast public parking expansion ("PPE") areas; (4) proposed employee parking expansion ("EPE") area; (5) proposed air cargo facility expansion ("ACFE") area; (6) proposed new terminal exit ("TE") road; (7) proposed upgrades of southwest & northwest Runway 3-21 ("SW3-21" & "NE3-21") safety areas; and (8) proposed emergency vehicle access roads, perimeter roads, and fencing upgrades ("PSs").

We found no historical records or visual indications of conditions that would indicate the presence or former presence of hazardous materials or subsurface contamination in the proposed Master Plan improvement areas, with these exceptions:

- The north end of NE3-21 is situated within the former Ahukini Landing area, and historical Sanborn maps indicate that chemical (fertilizer and pesticide) warehouses, a locomotive maintenance shed, and a wrecking yard were situated within or immediately adjacent to the north end of NE3-21. Several environmental investigations at Ahukini Landing documented the existence of hazardous materials and subsurface contamination in the area. Although subsurface investigation and cleanup has occurred, it is possible that additional, previously undocumented, subsurface contamination and hazardous materials may be encountered if excavation is conducted at the site

- Long-term applications of agricultural chemicals to the cane fields indicates a potential for residual chemicals in soil and groundwater. Although reportedly only herbicides (not pesticides) were applied to study area cane fields, review of a previous report indicates that use of various chemicals (including pesticides) cannot be ruled out.

Proper application of chemicals for agricultural purposes is presently excluded from regulation under RCRA and CERCLA (Superfund). Although the potential presence of these chemicals is unlikely to be of concern with respect to the planned use of the land for airport facilities, the Department of Health (DOH) Office of Hazard Evaluation and Emergency Response (HEER) promulgated a guidance document in August 2006 intended for use during the redevelopment of former agricultural areas. The HEER guidance describes methods for assessment of risk, based on soil testing and intended use. Sampling and testing in accordance with the HEER guidance is recommended.

- A former (unregulated) County dump may have been located on or adjoining the northern perimeter road improvement area and could contain buried hazardous materials.

- A currently used underground storage tank (UST) abutting the EPE area is exempt from UST Solid and Hazardous Waste Branch (SHWB) regulation, and release monitoring requirements are deferred. Therefore, past, present, and future undetected/unreported releases and contaminant migration to the EPE area may be of concern. Furthermore, excavation work must be planned so as to avoid accidental encounters with the tank or piping.

- UST records indicate that several facilities with USTs within the airport complex were demolished in the 1990s; however, documentation of closure by tank removal is missing. Furthermore, abandoned wells (containing fuel product) have been encountered during previous airport construction work. Plans should be in place to appropriately respond to encounters with contaminated soil and groundwater during construction within the improvement areas, specifically those within the airport complex.

HAZARDOUS MATERIALS SURVEY
LIHUE AIRPORT MASTER PLAN IMPROVEMENTS
LIHUE, KAUAI, HAWAII

1.0 INTRODUCTION AND PURPOSE

1.1 INTRODUCTION

Masa Fujioka & Associates (MFA) has conducted this Hazardous Materials Survey (Survey) for the proposed Lihue Airport Master Plan Improvements. The airport improvements are proposed through the year 2020 to accommodate forecast aviation demand projections and other anticipated facility requirements. The location of Lihue Airport is indicated in Figure 1 (Map of Area).

1.2 PURPOSE OF THE HAZARDOUS MATERIALS SURVEY

The purpose of the Survey is to evaluate the presence or likely presence of materials considered hazardous to human health and the environment that may impact the proposed improvement areas. An Environmental Impact Statement (EIS) for this project is currently being prepared by Wilson Okamoto Corporation (WOC). This Survey was conducted to provide information concerning hazardous materials for the EIS.

1.3 DESCRIPTION AND BOUNDARIES OF PROPERTY

For ease of reference, we have designated eight proposed improvement study areas, hereafter referred to by the acronyms indicated in Table 1.

According to tax map depictions (Figure 2) and County of Kauai records (County, 2006), the study areas within airport boundaries are owned by the Hawaii State Department of Transportation (DOT) Airports Division or by Visionary LLC, with some parcels leased to Lihue Plantation Company, Ltd. (LPC), as indicated in Table 1.

Specific locations of the study areas are shown on Figure 3 (Proposed Improvement Areas). Major roads bounding portions of the study areas include Kapule Highway and Ahukini Road. A terminal/current parking access road bounds public parking expansion areas.

Table 1. Proposed Lihue Airport Improvements: Survey Study Sites

Proposed Improvement Area	Description	TMK Parcel (Portions)	Owner (Lessee)
NWLA Northwest Land Acquisition	125 acres of former sugarcane fields are proposed as airport acquisition land. The acreage is NW of the Heliport and bounded to the south and west by Ahukini Road and Kapule Highway (respectively).	3-7-02: 1 ~125 ac	Visionary LLC c/o Lihue Land Co.
		3-7-02: 15 < 1 ac	County of Kauai
HR Heliport Reconfiguration	The HR area is on the NW side of the heliport, boundingthe NWLA. HR consists of a concrete drainage canal, portions of former sugarcane field, and helicopter pads with small storage sheds and an AST.	3-5-01: 8 ~2.8 ac	State of Hawaii Department of Transportation (DOT), Airports Division
(SW-NE) PPEs Public Parking Expansions	The two PPE areas are additions to each end of the existing parking lot immediately northwest of the terminal. They are bounded by Mokulele Loop.	3-5-01: 8 ~1.5 ac	State DOT, Airports Div.
EPE Employee Parking Expansion	Located at the NE end of the terminal, the proposed EPE area is partially grassy or graveled. It fronts Ahukini Road along the northwest side.	3-5-01: 8 ~ 1.75 ac	State DOT, Airports Div.
ACFE Air Cargo Facility Expansion	The proposed ACFE area is about 1,800 feet NE of the main terminal, adjoining the NE side of the present UPS facility. Site is mostly grassy, and is occupied by a small building. Fronts Ahukini Road along the NW boundary.	3-5-01: 8 ~ 1 ac	State DOT, Airports Div.
TE Road Terminal Exit Road	The proposed TE Road area is immediately SW of Ampco (the existing public parking lot), intersecting Kapule Highway.	3-5-01: 8 ~ 7,800 sf	State DOT, Airports Div.
SW3-21 NE3-21 Runway Safety Areas	An upgrade to safety areas is proposed at either end of Runway 3-21. Both areas are presently undeveloped, except for streets, sewer pipeline, and a canal occupying portions. The areas are overgrown with trees, brush, fallow sugarcane, and grasses. SW3-21 adjoins the County wastewater treatment plant. NE3-21 extends offshore and includes an area formerly occupied by Ahukini Landing and an auto wrecking yard.	3-5-01: 8 ~ 14 acres	State DOT, Airports Div.
		3-5-01: 9 ~ 0.75 ac	State DOT, Airports Div. (Lihue Plantation Co., Ltd)
		3-5-01: 159 ~2,600 sf	State of Hawaii (Former Masterworks)
		3-5-01: 160 ~ 13 acres	State DOT, Airports Div.
PSs Perimeter Segments	Perimeter roads and fencing are proposed for the south end and east side of Runway 17-35. The perimeter segments are partially occupied by dirt roads and a small shed, and are bordered by chain link fence. Kauai Lagoons Golf Course adjoins the southwestern PSs.	3-5-01: 8	State DOT, Airports Div.
		3-5-01: 5	State DOT, Airports Div.
		3-5-01: 109	State DOT, Airports Div. (Lihue Plantation Co. Ltd)

1.4 SCOPE OF SURVEY

The Survey consisted of (1) review of literature and government agency records to document incidents or operations that may have impacted the environmental condition of the improvement areas; (2) interviews with airport personnel and other persons that have knowledge of current or past facility operations that may have impacted the environmental condition of the improvement areas; and (3) an environmental survey / site reconnaissance of the proposed improvement areas and a brief visual assessment of immediately adjoining properties.

The Survey addressed the following potential environmental conditions: asbestos, hazardous material/waste, heavy metals, landfills, lead paint, medical/biohazard waste, operationally contaminated areas, pesticides, polychlorinated biphenyls (PCBs), potable water, radioactive materials, radon, storage tanks (aboveground and underground), storm water, and wastewater.

This Survey report documents our findings and provides conclusions regarding the presence of hazardous materials that could impact the proposed improvement areas. The report also provides our recommendations for addressing environmental concerns.

1.5 LIMITATIONS

The conclusions presented in this report are professional opinions based solely upon visual observations of the site and vicinity, our interpretation of available historical and regulatory information and documents reviewed, and information given to us by DOT-Airports representatives. The conclusions are intended exclusively for the purpose outlined herein and apply only to the site location and project indicated. This report is intended for the sole use of Wilson Okamoto Corporation and their client, State of Hawaii Department of Transportation. The scope of services performed in execution of this investigation may not be appropriate to satisfy the needs of other users, and any use or re-use of this document or the findings, conclusions, or recommendations presented herein is at the sole risk of said user.

Opinions and recommendations presented herein apply to site conditions existing at the time of our investigation and those reasonably foreseeable; they cannot necessarily apply to site changes of which this office is not aware and has not had the opportunity to evaluate. Due to limited access and the presence of vegetation in some of the study area, the ground surface over the entire study area was not visually inspected. Hazardous materials could be present in these areas, as described in the report text.

2.0 SUMMARY OF FINDINGS

2.1 HISTORIC USE INFORMATION

2.1.1 Overview

Information regarding past uses of the proposed improvement areas and immediately adjoining land was obtained from interviews and our review of topographic maps (USGS 1910; USGS, 1960b; USGS, 1963a; USGS, 1963b; USGS, 1983a; USGS, 1983b, USGS 1996), historic fire insurance maps (Sanborn, 1927; updated to 1943), aerial photographs (USGS, 1950; USGS, 1959; USGS, 1960a; USDA, 1965; USGS, 1978; NASA, 1992a; NASA, 1992b), and plans and reports received from DOT.

In general, the site vicinity has been used for agricultural and transportation purposes since the late1800s. The first sugarcane in the area was cultivated in 1850 about two miles west of the present-day airport. The Lihue sugar mill, about a mile west of the airport, began operating by 1851(Lo, 2005). A 1878 relief map indicates that sugarcane fields extended seaward to a portion of airport land that includes the PPE and SW3-21 areas (Kittredge-Wall, 1878).

The 1910 topographic map indicates that the airport vicinity was under agricultural (sugarcane) cultivation. Railway tracks ran through the sugarcane fields and terminated at Ahukini Landing (Sanborn, 1927). In 1948, land was acquired near Ahukini Terminal for the purpose of constructing Lihue Airport. The airport's first runway and main terminal were operational by 1949 (DOT, 2006). By 1950, Nawiliwili Harbor shipping facilities were fully operational, and the Ahukini Landing shipping and cane-processing complex were abandoned (LPC, 1987). Land surrounding the airport remained in agricultural use until at least 1978, as indicated by the 1963 topographic map (USGS, 1963) and aerial photographs (USGS, 1950; USGS, 1959; USGS, 1960; USDA, 1965, USGS, 1978). Developments on adjoining land (a saw mill, wastewater treatment plant, refuse transfer station, tropical fruit deinfestation facility, and a wrecking yard) occurred over the period from 1978 through 1996.

2.1.2 Site-specific Improvement Area Histories

125-Acre Northern Land Acquisition (NWLA) Area

The 125-acre NWLA property is located northwest of the existing airport facility (Figure 3). Historic topographic maps, dating from 1910 through 1996, show no structures on the property. Aerial photographs, dating from 1950 through 1992, indicate that the area has been under sugarcane cultivation. Sugarcane cultivation was observed during a 1998 site visit (MFA, 1999), and the land is currently occupied by fallow cane fields.

Property adjoining the NWLA area was under sugarcane cultivation until expansion of the airport in the 1980s. By 1983, the airport property abutted the southern and eastern edges of the NWLA area (USGS, 1983). Other land adjoining the north and west part of the NWLA area remained in agricultural use, according to 1992 aerial photographs (NASA, 1992) and confirmed by our site reconnaissance. The 1992 aerial photo shows the present-day Kauai County Refuse Transfer Station site situated south of the property at its east end.

Heliport Reconfiguration (HR) Area

The HR area is situated along the northwest side of the current heliport facility, and along the south border of the proposed NWLA (Figure 3). Historic topographic maps do not show structures in the HR area, and indicate that the area has been under sugarcane cultivation.

Property adjoining the north boundary of the HR area was still in sugarcane cultivation to the late 1990s, as was property along the south border until expansion of the airport in the 1980s (WOA, 1998). By 1983 the airport property abutted the south edge of the HR area.

Southwest and Northeast Public Parking Expansion (PPE) Areas

The two proposed PPE areas are situated at either end of the current terminal parking area (Figure 3). The 1910 topographic map shows no buildings on or adjoining to these two improvement areass. Areas around the terminal remained in agricultural use (sugarcane) until at least 1978, as indicated by the 1963 Lihue topographic map and aerial photographs. No structures are indicated in improvement areas on the 1983 topographic map, although they are within the airport property boundary. The present-day terminal opened in 1987 (WOA, 1998); the 1992 aerial photographs show that the two PPE areas remained vacant land within the developed airport complex. Our site reconnaissance confirmed that these areas are landscaped areas within the airport complex.

Adjoining properties had similar development histories as part of the airport complex. Rental car companies (on Hoolimalima Place) are located across the access road from the southwest PPE area. A paved taxi stand currently occupies a cutout portion of the southwest PPE area.

Employee Parking Expansion (EPE) Area

The proposed EPE area is situated immediately east of the current terminal parking area (Figure 3). The 1910 topographic map shows no buildings on or adjoining this area. Areas around the terminal remained in agricultural use (sugarcane) until at least 1978, as indicated by aerial photographs (USGS 1950, 1959, 1960a , and 1978). No structures are indicated in the improvement area on the 1983 topographic map, although it is within the airport property boundary. The present-day terminal opened in 1987 (WOA, 1998); the 1992 aerial photographs show that the EPE area remained vacant land within the developed airport complex. Our site reconnaissance confirmed that this area is currently utilized for employee parking.

Air Cargo Facility Expansion (ACFE) Area

The proposed ACFE area is situated immediately east of the current cargo area (Figure 3). The 1910 topographic map shows Ahukini Road and railway tracks near the ACFE, but no buildings are mapped on it or on adjoining land. Areas around the terminal remained in agricultural use (sugarcane) until at least 1978, as indicated by the topographic maps and aerial photographs (USGS, 1963 and 1978). The ACFE area is mapped within airport boundaries by 1983, but no structures are indicated on it or other improvement areas (USGS, 1983). The existing cargo building was completed by 1991 (WOA, 1998); the 1992

aerial photographs show that the ACFE area remained vacant land within the developed airport complex. A small office-type building (locked and unoccupied) was observed in this area during our site visit.

New Terminal Exit (TE) Road

This relatively small, proposed roadway area is located across Mokulele Loop from the southern public parking expansion area discussed above (Figure 3). The area is covered with grass, and is abutted by Mokulele Loop (southeast) and Kapule Highway (northwest). Rental car companies (on Hoolimalima Place) are located to the northeast, and an access road for the USPS building is located to the west.

The 1910 topographic map shows no buildings on or adjoining this area. Areas around the terminal remained in agricultural use (sugarcane) until at least 1978, as indicated by the 1963 Lihue topographic map and aerial photographs (USGS, 1963 and 1978). A cane haul road occupied the future Kapule Highway alignment at the location of the TE road in 1963 (USGS, 1963). No structures are mapped in this area by 1983 (USGS, 1983). The current (east-adjoining) car rental complex and a south-adjoining access road for the USPS building were built by 1992 (NASA, 1992).

Upgrades of Southwest & Northeast Runway 3-21 (SW3-21 & NE3-21) Safety Areas

The proposed runway safety areas are located at either end of Runway 3-21, the site of the first runway developed at the airport by 1949 (DOT, 2006). As with other study areas near the airport described in previous sections, the SW3-21 area and most of the western end of the NE3-21 area were occupied by sugarcane fields from the late 1800s until the development of the airport. Historical details for each proposed improvement area follow.

The SW3-21 safety area is located at the southwest end of Runway 3-21 (Figure 3). It is currently vacant land bounded by Ninini Point Road to the southeast and by emergency access and perimeter road to the southeast and east. The County's waste water treatment plant (WWTP) adjoins the southwest end of SW3-21.

A golf course, warehouse, and WWTP were fully constructed on southwest adjoining land by at least 1992 (NASA, 1992). Evidence of an early construction phase at the WWTP and the golf course is visible in a 1978 aerial photograph (USGS, 1978). The warehouse, immediately northwest of the WWTP, currently appears to be abandoned.

This NE3-21 safety area extends northeast from Runway 3-21, stretching to and beyond the nearby shoreline (Figure 3). The area is mostly vacant land that is currently overgrown with vegetation (including kiawe, haole koa, grasses, and fallow sugarcane). Evidence of fugitive dumping (mostly household trash) was observed during our site visit.

Like other areas near the airport, the western portion of the NE3-21 area was under agricultural use until development of the airport. The eastern portion partially occupies

Ahukini Landing, developed by LPC in the early 1920s (GII, 2006). The plantation complex included sugar cane/pineapple processing and storage facilities, worker housing, a railroad terminal, and an ocean shipping terminal (Sanborn, 1927). A tank farm was constructed and operated by Standard Oil in 1924 (GII, 2006). By 1927, Sanborn maps indicated warehouses, a tank farm, railway sheds and associated facilities, and Ahukini Camp

dwellings. Sanborn maps indicate that the north tip of NE3-21 and adjoining land was occupied by: a fertilizer warehouse by 1927 through at least 1975; a small warehouse labeled "poison shed" in 1936, "warehouse" in 1945, and "vacant" in 1975; several camp dwellings; Ahukini Road; and a portion of railroad tracks. A roundhouse/locomotive maintenance shed adjoined or abutted the NE3-21 area by 1927 through at least 1945. Camp dwellings extended to the shoreline within the central portion of the NE3-21 area by at least 1963 (USGS, 1963). Operations at Ahukini Landing ceased by 1950 and Ahukini Railway was abandoned by 1959; however, Ahukini Camp dwellings were mapped until at least 1974 (NOAA, 1974).

1978 aerial photographs indicate that the former shipping terminal area was recently razed. An autowrecking yard and solid waste disposal facility occupied the Landing's former tank farm and sugar warehouse areas from at least 1975 (EDR, 2006b) to January 1996. According to legislative records, Masterworks accepted junk vehicles, white goods, and scrap metal from island-wide sources (State of Hawaii, 2001b). In 1998, a private contractor reportedly removed 98 percent of the scrap metal, junk vehicles, and around 600 batteries from the former wrecking yard (MFA, 1999). Between 2002 and 2004, only the footprint of the wrecking yard remained (DG, 2002-2004).

Proposed Perimeter Segment (PS) Improvement Areas

Emergency vehicle access roads, perimeter roads, and fencing upgrades improvement areas run along the northeast, east, south, and southwest perimeter of the site, just inside an existing chain-link fence. The development of the areas mirrors that previously reported for the airport, i.e., agricultural use until the airport development in the late 1940s. By 1984, Runway 17-35 (which is bounded by the PSs) was constructed and operational.

A golf course was under development west of the southwest PSs by 1978 (USGS, 1978). Shoreline borders the remainder of the PS areas. According to the airport's Environmental Coordinator, Mr. Jose Balignasay, a former county landfill (not reported in available regulatory or other historical sources) is located immediately east of a PS area, near the shoreline (Figure 3). The "Ahukini Dumping Ground" (as indicated in a 1978 shoreline survey map), operated on about 1.5 acres from at least 1948 through closure in 1975. The land was subsequently acquired by the State in order to construct the runway extension.

2.2 PHYSICAL SETTING

2.2.1 Topography and Drainage

Topographic map coverage of the airport facility is provided by the US Geological Survey (USGS) Lihue and Kapaa Quadrangles at a scale of 1:24,000 (USGS, 1996; USGS, 1996). The elevation of the airport facility ranges from zero at the east shoreline to approximately 160 feet above mean sea level near the west boundary of the facility. The airport facility is located at approximately 21°58'28" north latitude and 159°20'26" west longitude.

The subject areas are outside the 500-year flood plain (DG, 2002-2004), with the exception of the coastal areas of the NE3-21 safety area, which are subject to inundation by a 100-year flood (coastal flood zone with velocity (wave action) hazard).

Natural drainage at the site is west to east, based on topography, and has been modified by the extensive use of agricultural irrigation ditches in the area. The airport facility also has an extensive storm drainage system using open concrete-lined ditches.

2.2.2 Geologic and Hydrogeologic Setting

MFA reviewed published geologic and hydrogeologic reports and maps to obtain information regarding subsurface conditions in the general area of the site.

Geology

The airport facility is located along the eastern coast of Kauai at the southeastern edge of the Lihue Basin, possibly a late-stage flank caldera developed on the southeast side of Kauai's original shield volcano. Bedrock in the vicinity of the airport facility consists of basement Waimea Canyon basalt, cut extensively by nearly vertical dikes (Izuka and Gingerich, 1998). The bedrock underlies alkalic basalts associated with sedimentary rocks (poorly sorted conglomerates and soil) of the late-stage Koloa Volcanic Series. The eroded Koloa Series is overlain by alluvium, especially along stream valleys. Calcareous sands occur on coastal beaches (MacDonald, et al., 1983).

Soils

Soils in the north coast of the study area consist of two similar silty clays, the dominant Koloa Series (KvB, KvD) and smaller exposures of Lihue Series (LhC). These soils are well drained, with rapid permeability and slow runoff. Water capacity is approximately 1.5 inches per foot of soil (Foote et al., 1972). Rough broken land (rRR) at gulches and other steep (40%-70%) slopes is mapped along the western coastline of southern Ninini Point and along drainage gullies. The eastern coastline of Ninini Point is mostly rock outcrops (rRO) of Koloa Series alkalic basalt (Foote et al., 1972). Soils in the inland portion of the site consist mostly of Lihue Series silty clay (LhB) and gravelly silty clay (LlB) (Foote, et al., 1972).

Soils of the NWLA area consist of Lihue Series silty clay (LhB). This series consists of well drained soils on uplands of the island of Kauai. These soils developed in material weathered from basalt. They are gently sloping (0-8%) (Foote, et al., 1972).

Drainage channel areas consist of Hanalei Silty Clay (HnA), a poorly drained, moderately permeable soil with very slow runoff and moisture capacity of 2.1 inches per foot of soil (Foote, et al., 1972).

Hydrogeology

The site area is located within the boundaries of the Hanamaulu Aquifer System of the Lihue Aquifer Sector. The site area is characterized by two high level aquifers, one overlying the other. Both aquifers are characterized as ecologically important, freshwater, and irreplaceable aquifers. The upper aquifer, present in Koloa Volcanic basalt, is classified as an unconfined, horizontally extensive aquifer with a high vulnerability to contamination. The lower aquifer, located in the basement rock, is classified as a confined, dike-type aquifer with moderate vulnerability to contamination (Mink and Lau, 1992).

The site is located below the Underground Injection Control (UIC) line (SDWB, 2006). According to State records, an unused Lihue Sewage Treatment Plant (STP) well is located on or adjoining the southwest end of SW3-21 safety area. It was installed in 1974 at a depth of 319 feet below ground surface at 121 feet elevation above mean sea level, and last used in 1977. Six Westin Kauai wells were installed in 1987. Five are used for irrigation and one is listed for "other" (no further details) purpose (EDR, 2006a). The nearest Westin Kauai well (used for irrigation) is approximately 200 feet northeast of SW3-21.

Hydrology

No surface water bodies are located within the site area. However, based on our field observations and on a report by M&E Pacific, Inc. (1998), storm and canefield runoff in the airport area is channeled into a network of reinforced concrete pipes and culverts, lined and unlined ditches and channels, drain inlets, and box drains. The collected runoff flows into an existing gully, northeast of Runway 3-21 and, ultimately, into the ocean. Within the parking areas, a network of reinforced concrete pipes and culverts, catch basins, and drain inlets collect surface runoff. Within the runway areas, subdrains, field inlets, swales, and reinforced concrete pipes and culverts collect runoff.

2.3 PREVIOUS ENVIRONMENTAL REPORTS

We reviewed several environmental reports for information regarding the environmental history of the subject and adjoining areas. Report summaries are contained in Appendix B. Many of these investigations focused on the former Masterworks Salvage Yard facility (Figure 3), located in the Ahukini Landing area (partially occupied by NE3-21). The reports document soil contamination by operations at the Masterworks facility in the Ahukini Landing area and previous heavy industrial land use.

A 1997 Environmental Assessment (EA) for the Lihue Airport Ahukini Road Realignment and General Aviation Subdivision (DOT, 1997) states that eight USTs, two cesspools and nine sumps and dry wells are located in the area of the former lease lots, located approximately 500 feet east of the proposed ACFE area. The USTs and cesspools were subsequently closed, as described in Appendix B.

In their Stormwater Pollution Prevention Plan for Lihue Airport (M&E, 1998), M&E discusses the airport sewage and waste systems; oil-water separators, USTs and AST utilized by airport tenants; and historical spills and leaks of potential pollutants. None of the environmental issues discussed appear to affect the proposed airport improvement areas.

Kimura International conducted an environmental audit of the existing Lihue Airport facilities in August 1998 (Kimura, 1998). During their audit, they looked for existing aboveground and underground storage tanks, transformers, injection wells, cesspools, septic tanks, drain fields, detention ponds, storm drain inlets, spill kits, drum storage areas, parts washing areas, tanker trucks, waste storage areas, fire pits, paint booths, contaminated soil areas, vehicle wash areas, hazardous waste (HW) generators, fuel dispensers, hazardous materials storage areas, and oil water separators. They annotated these features on a map, entitled "Lihue Airport Environmental Map." None of the noted features are located within the proposed airport improvement areas. The Kimura map notes the presence of existing

aboveground and underground storage tanks, transformers, a detention pond, spill kits, drum storage areas, parts washing areas, tanker trucks, waste storage areas, fire pits, fuel dispensers, hazardous materials storage areas, and oil water separators. We have no indications of problems related to any of these features that would be likely to affect the proposed improvement areas.

We reviewed a map and list of ASTs and USTs within the Lihue Airport facility provided by DOT (DOT, 1999a; DOT, 1999b). None of the documented USTs or ASTs is located on the proposed improvement areas.

We reviewed a July 2001 Environmental Remediation Project (ERP) Summary Report for the Lihue Airport Apron Site Preparation and Road Realignment Phase I (R. M. Towill Corp. (RMTC), 2001). The ERP report documents the closure of two septic system cesspools, two underground injection wells (dry wells), one drum storage site, and two vehicle hydraulic lift systems which were in use at the former Robert's Hawaii and the Trans-Hawaiian facilities on Ahukini Road, on land leased by the State of Hawaii Department of Transportation – Airports Division property. Contaminated soil and sludge was excavated and shipped to the Nanakuli Landfill (Oahu) for permanent disposal.

2.4 REVIEW OF REGULATORY RECORDS

2.4.1 Overview of Regulatory Record Review

MFA used a regulatory database search service, Environmental Data Resources, Inc. (EDR), to review standard Federal and State government databases of known or potential sources of hazardous materials or waste. The site assessment reports provided to MFA by EDR are attached in Appendix A. The following record sources were searched for incidents or facilities within search distances from the subject property specified in Table 2. The search distances are based on guidelines from the American Society for Testing and Materials (ASTM) for use in Phase I Environmental Site Assessments (ASTM, 2000).

Table 2. Search Distances for Standard Environmental Record Sources

Standard Environmental Record Sources	Search Distance (miles)
Federal NPL site list	1.0
Federal RCRA CORRACTS facilities list	1.0
Federal RCRA non-CORRACTS TSD facilities list	0.5
Federal CERCLIS list	0.5
State-equivalent CERCLIS list (SHWS)	0.5
State LUST (leaking underground storage tank) list	0.5
State landfill and/or solid waste disposal site lists	0.5
Federal CERCLIS NFRAP site list	property and adjoining properties
Federal RCRA generators list (RCRIS)	property and adjoining properties
State registered UST list	subject and adjoining properties
Federal ERNS list	property only

MFA requested further information from the DOH for facilities located on subject areas or adjoining property. On February 13, 2006, MFA conducted a file review at DOH for the purpose of gathering details about some of the facilities discussed in the following regulatory records sections. Results of the review are summarized in the relevant sections.

2.4.2 U. S. EPA National Priorities List (NPL)

The NPL, also known as the Superfund list, is a subset of the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) and lists properties with the highest priority for cleanup under the EPA Hazard Ranking System (40 CFR Part 300). The list is compiled by the EPA pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 42 USC §9605 (a)(8)(B). EDR found no NPL sites within one mile of the subject property (EDR, 2006a and 2006b).

2.4.3 U. S. EPA RCRA CORRACTS Facilities List

The Resources Conservation and Recovery Act (RCRA) list is compiled by the EPA. The database contains those regulated facilities that have notified EPA as hazardous waste generators; transporters; or treatment, storage, or disposal facilities under RCRA, as summarized on the Resource Conservation and Recovery Information System (RCRIS). CORRACTS identifies hazardous waste handlers with RCRA corrective action activity (EDR, 2006). No RCRIS CORRACTS facilities were found within one mile of the subject property (EDR, 2006a and 2006b).

2.4.4 U. S. EPA RCRA Non-CORRACTS TSD Facilities List

RCRIS non-CORRACTS Treatment, Storage, and Disposal (TSD) facilities are those facilities at which treatment, storage, and/or disposal of hazardous wastes takes place, as defined and regulated by RCRA. EDR listed no RCRA TSD facilities within one-half mile of the subject property (EDR, 2006a and 2006b).

2.4.5 U.S. EPA CERCLIS List

The CERCLIS list is compiled by the EPA. It contains sites that the EPA has investigated or is currently investigating for potential hazardous substance contamination for possible inclusion on the NPL (ASTM, 2000). The CERCLIS No Further Remedial Action Planned (NFRAP) list includes sites for which, after initial investigation, no contamination was found, or contamination was not serious enough to require Federal Superfund action or NPL consideration (EDR, 2006). CERCLIS sites were not found within the half-mile search radius, nor were CERC-NFRAP sites found on the subject or adjoining properties (EDR, 2006a and 2006b).

2.4.6 Hawaii State Hazardous Waste Sites

The State Site List contains all Solid and Hazardous Waste Sites (SWHSs) that have been determined by the HEER Office to need further assessment and possible removal or remedial action, based upon the criteria in the Hawaii State Contingency Plan (Chapter 11-

451, Hawaii Administrative Rules). The majority of cleanup sites are identified through the spill/release "notification system" required by the State Contingency Plan. All spills and releases, both CERCLA and non-CERCLA eligible. (i.e. petroleum product contaminated), are reported to the DOH. The remainder of SHWSs are identified from deferrals by other programs and the HEER Office's site discovery process. The current database contains SHWSs logged in Fiscal Year (FY) 1998 through FY 2005. MFA found a number of SHWSs within one-half mile of the subject site (EDR, 2006a and DOH, 2006a).

Of the SHWSs within one-half mile of the airport proposed improvement areas, MFA found two listings of potential concern: the former Masterworks facility in the Ahukini Landing area (immediately north of the north corner of the NE3-21 area), and the "Lihue Airport AvGas AST." Masterworks was ranked as "medium priority" in 1999, and by 2004, had Engineering Evaluation and Cost Analysis activity. As of 2005, the SHWS was undergoing screening activity and a referral to the SHWB (DOH, 2006a). Background information about the Masterworks facility is described in Appendix B and Section 4.1.12 (Releases).

The AvGas SHWS (specific location unknown) is indicated in database details to involve an unregulated underground storage tank (UST). The case was assigned in 1988, and by 1994, a letter of no further action (NFA) was issued by DOH for achievement of cleanup goals (DOH, 2006a).

2.4.7 State of Hawaii Landfill / Solid Waste Disposal Sites

The Hawaii Solid Waste Facilities List contains information pertaining to all permitted landfills located within the State of Hawaii. EDR reported no landfill facilities within one-half mile of the subject property (EDR, 2006a and 2006b).

2.4.8 State of Hawaii DOH Leaking UST List

The Hawaii State DOH Solid and Hazardous Waste Branch (SHWB) Underground Storage Tank (UST) Section compiles a record of Leaking Underground Storage Tank (LUST) inventoried incidents (DOH, 2006b). The recommended search distance is one-half mile from subject property boundaries. Search results are listed in EDR's radius report (Appendix A). MFA reviewed the EDR report results, DOH databases, DOH SHWB facility files, and previous reports (Appendix B), determining that those UST sites and spill locations with "cleaned up" status that are located 300 feet or more from study area boundaries are unlikely to have affected the study areas. MFA reports here only those LUST facilities inside the 300 feet range. The details for these LUST and UST listings are summarized in Table C-1 (Appendix C).

The Lihue Airport Renovation facility is listed "permanently out of use." The renovations in the 1990s involved numerous tank removals from a former car rental agency complex that was located directly east of the ACFE area (Figure 3). Although no releases were reported at former facilities located within 300 feet of the ACFE, a 1991 release is reported for the general Renovation facility (DOH, 2006a and EDR, 2006a and b). This release is likely related to fuel contamination that was investigated in 1991, during Clayton Environmental Consultants' (CECs') tank closure investigation (CEC, 1991). CEC was slated to oversee removal of 18 USTs in the complex, including four that were within 150 to 200

feet of the ACFE area on the Gray Line Hawaii and Travelers USA lots. CEC conducted soil sampling to determine extent of fuel contamination within the area of the four tanks. They mapped results in their report, and the boring nearest the ACFE (125 to 150 feet eastward) was indicated to have contaminant levels below the laboratory reporting limit. After all subsurface sample results were compared to the current DOH Tier 1 Action Levels, DOH issued a No Further Action (NFA) determination for the site, in July 1997. Since the contamination appeared to be minor, based on information in the Clayton report, and since DOH issued a NFA determination, it is unlikely that petroleum contamination from this site has affected the ACFE area.

Budget Rent A Car is located at the Hoolimalima Place cul-de-sac, immediately across Ahukini Road from the NWLA area (but at least 125 feet between respective property lines), and 300 feet west of the nearest (northeast) PPE area (Figures 3 and 3A). Of four USTs installed at the facility in 1988, two (one lube- and one used-oil) were removed in 1997, at which time a release was reported. The tanks and piping appeared to be in good condition, such that discrete episodes of over-filling spills and minor piping leaks were suspected causes of fuel contamination in excavated materials. The most contaminated samples (all less than or equal to DOH Tier I Action Levels [TIALs], except for two that were slightly above TIALs) were in stockpile material that was removed offsite for thermal treatment (Walker, 1997). Site cleanup was completed at this location in 1997 (DOH, 2006). It is unlikely that the release(s) has affected the improvement areas.

The Avis Hoolimalima release occurred on property adjoining both the TE road and southwest PPE areas; however, MFA's 2005 tank closure report indicates that subsurface fuel contamination was minimal (well below DOH Tier 1 Action Levels), and that tank and piping system components were in good condition. The case was resolved with "no further action" in August 2005. Given these circumstances, the release is unlikely to have affected the adjoining properties.

The airport baseyard, located immediately east of the HR and NWLA areas, reported two releases in 1998, during removal of two fuel USTs near garage dispensers and one waste oil UST at the shop area, more than 300 and at 150 feet from the NWLA boundary, respectively. A 1998 tank closure report by the Fuel Oil Polishing Company of Hawaii (FOPCO) indicates that both the diesel release at the dispenser tank and the waste oil release reportedly had minimal levels (over fifty times less than DOH action levels) of total petroleum hydrocarbons as diesel and as oil, respectively. DOH assigned no further action (NFA) status to the diesel release on January 8, 2001; however, a letter from DOH to the State DOT Airports Division, dated April 5, 2004, indicates that the laboratory work for the waste oil sample was not included in the FOPCO report, and that the case was still open. Given the reportedly low level contamination and the distance from the NWLA, the waste oil release is unlikely to have affected the proposed improvement area.

2.4.9 U. S. EPA RCRA Generators List

Facilities that generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) are recorded on the EPA's RCRAInfo database, a comprehensive information system of information supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid

Waste Amendments (HSWA) of 1984 (EDR, 2006a). The EPA classifies various groups of HW handlers according to handling requirements, e.g., allowable quantities processed and duration of onsite storage. The ASTM-recommended search area for RCRA generators (any person or facility whose processes and actions create hazardous waste) is the subject property and adjoining properties. Two generators were found on adjoining properties: The State of Hawaii Lihue Airport is listed as a small quantity generator (SQG) with no reported violations (MFA, 1999). "TSA AT HI" (Lihue Airport), listed as a SQG at the general airport address, has no violations reported (EDR, 2006a and 2006b). Given the regulated storage of hazardous waste with no current violations, the study improvement areas are unlikely to have been affected by proximity to the generators.

2.4.10 State of Hawaii DOH UST Section Database Listing

The UST database is compiled by the State DOH SHWB UST Section. The ASTM-recommended search area for USTs is the subject property and adjoining properties. Database details (DOH, 2006b) for tanks buried on subject or adjoining properties are listed in Table C-1 (Appendix C), and those with release reports are discussed in Section 2.4.7. MFA reviewed DOH facility files of the "no release" USTs, summarized as follows:

As discussed in Section 2.4.7, the Lihue Airport Renovation UST facility is actually a complex of former rental car facility tanks. The facilities and many of the associated roads are essentially erased from the current site plan following major demolition and reconstruction during past airport improvements. Following major tank removal operations, it was discovered that a number of USTs had not been catalogued for respective facility locations, and apparently a number of "currently in use" tanks at the now-absent facilities are USTs that were not accounted for. The Travelers and Rent-A-Wreck adjoining lots are two such unaccounted-for removal facilities (about 150 feet east of the ACFE area); however, given the information presented in Section 2.4.7, and the significant distance of the fuel system component (more than 150 feet eastward), it is unlikely that the unaccounted for tanks have affected the ACFE area or would affect proposed construction activity at the ACFE.

The Lihue Airport Generator building, located against the southwest boundary of the EPE area boundary and across the street from the northeast PPE, has a currently-in-use fiberglass diesel tank for which no releases have been reported. DOH noted that release monitoring is deferred, since the sole use of the tank is for emergency power. In 2004, the operator was asked to clear standing water in the sump in order to prevent corrosion of piping and other system components. No other significant information was contained in the file. Although no releases are reported, given the deferred monitoring and proximity, potential contaminant migration to the EPE area cannot be ruled out.

2.4.11 U.S. EPA ERNS List

This list is compiled by the EPA and contains reported CERCLA hazardous substance releases or spills in quantities greater than the reportable quantity, as maintained at the National Response Center. No ERNS facilities were reported on subject properties (EDR, 2006a and 2006b).

2.4.12 Additional State Regulatory Databases

DOH HEER maintains databases which include sites that HEER has earmarked for additional investigation, including the Releases database (DOH, 2000). Site and event entries are also published on an annual basis in HEER fiscal year reports to the State Legislature, including coverage for the years 2001 through 2003 (HEER, 2004). MFA searched the databases and reports for facilities listed near the subject property. The State's Voluntary Response Program (VRP) sites and Brownfield sites databases were also searched by EDR. The results are reported below.

Releases Database

The Releases database lists hazardous substance release incidents reported to the DOH HEER office since 1988. Release incidents include a range of events, from found syringes and drug lab cleanups to fuel leaks. MFA reviewed current spill listings (DOH HEER, 2006; and EDR, 2006a) for incidents that occurred on or immediately adjacent to the proposed improvement areas, excluding those cases for gaseous releases, "powders," "suspicious odors," syringes, noxious gases from unknown chemicals, etc. that are highly unlikely to have affected the study areas' environmental conditions. We found seven incidents at four locations of interest:

- An intense white goods fire occurred in July 2004 at the Transfer Station abutting a portion of the NWLA area's south side released noxious black smoke to air. The fire was estinguished quickly, the case was assigned no further action status, and it is unlikely that potential residue would migrate to and/or affect the NWLA area .
- Two August 2000 incidents listed for Lihue Airport involve fuel contamination found in two dry wells within the former car rental complex (Figure 3). These incidents were referred to DOH's Underground Injection Control Branch. As discussed in Appendix B (RMTC, 2001), the dry well contamination was remediated, and the well locations are at the former Roberts and Trans-Hawaiian lease lots, over 500 feet from the nearest improvement area (ACFE). The spills are unlikely to have affected the proposed improvement areas.
- One incident at the Lihue Wastewater Treatment Plant, located immediately southwest of the SW3-21 area, involved the release of treated effluent from the plant. However, the listing indicates that the release occurred to the adjoining golf course and is therefore unlikely to have affected the nearby SW3-21 area.
- Three incidents occurred at the former Masterworks facility in the Ahukini Landing area, immediately north of the north corner of the NE3-21 area. The database information states that, in 1995, the Masterworks facility was crushing cars with the batteries inside, and that oil also flowed onto the ground during this process (DOH, 2006a). The database lists this as a chronic release onto soil and water and the case is listed as Active. In 1996 a second incident was reported at the Masterworks site when the Solid and Hazardous Waste Branch (SHWB) conducted a site inspection and discovered stained soil in the warehouse workshop and stacked cars (DOH, 2006a). According to Mr. Edgar Salire, of the DOH SHWB, the Masterworks facility was shut down in 1995, although it was not properly closed. The third incident reported was for two cesspools (one with sludge in

the bottom) encountered during grading at the site. No updates have been made to the cases since they were reported. The specific locations of the incidents are over 125 feet north of the NE3-21 area.

Hawaii Brownfields Assessment Program

The Hawaii DOH and State Department of Business, Economic Development & Tourism (DBEDT), in conjunction with other State agencies, maintain a list of potential Brownfield sites in Hawaii (DBEDT, 2005). A Brownfield is a site with actual or perceived contamination, which also has an active potential for redevelopment or reuse. The EPA's Brownfields Economic Redevelopment Initiative provides Federal funding to State agencies for conducting site assessments, cleanup models, and job training in order to facilitate Brownfield cleanup and redevelopment. EDR found no Brownfield sites within one-half mile of the subject property (EDR, 2006a and 2006b).

Voluntary Response Program (VRP) Sites

"Hawaii's Voluntary Response Program (VRP) was established by statute in 1997 (Chapter 128D, Part II, HRS). The VRP encourages voluntary cleanup of contaminated properties. The DOH has the authority to grant prospective purchasers or developers an exemption from future liability if cleanup is performed to DOH specifications under the program. Current or past property owners can participate in this program, but exemptions from liability can only be given to future purchasers. Completion of the voluntary cleanup action is accompanied by a Letter of Completion, issued by the Department of Health and recorded on the property deed" (HEER, 2004). EDR listed no VRP sites within one-half mile of the subject property (EDR, 2006a and 2006b).

2.4.13 Supplementary Federal Regulatory Databases

A number of other regulatory databases, not specified by ASTM guidance, are included in EDR's report, in the Facility Index System (FINDS) listings. FINDS contains information about facilities subject to environmental regulations or of environmental interest. FINDS provides links to other database that contain more detail about facility regulatory issues (EDR, 2006b). EDR reported a number of FINDS sites within or near the airport; however, many are linked to the Hawaii Environmental Compliance System (ECS), an information system coordinated in 2004 by the HEER Office SHWB as modeled by EPA's One-Stop goals, to eliminate perceived deficiencies in current paper and electronic systems. It assigns identification to facilities regulated by both DOH offices and helps centralize tracking information (DOH, 2006a). HECs facilities listed for issues previously discussed were excluded from consideration. Other FINDS facilities were not on or immediately adjoining improvement sites, or are linked to databases that do not include spill records or corrective action information, in which case they were excluded from consideration.

Facilities of interest found during our review are: the Lihue Wastewater Treatment Plant (WWTP), adjoining the SW3-21 area; Lihue Airport General Aviation Apron, at the former car rental complex; an airport bulk fuel storage /Grace Pacific Corporation construction facility on Ahukini Road (specific location not determined); and the State of Hawaii/Lihue Airport facility (ECHO, 2006 and EDR, 2006a and b).

The WWTP, Apron, and bulk fuel facilities are recorded on the Permit Compliance System (PCS) for National Pollution Discharge and Elimination System (NPDES) registration and inspection records, for which no alleged significant violations are reported for the facility in the past three years (ECHO, 2006).

The Airport facility has a history of Clean Water Act (CWA) violations. A judicial case and formal administrative actions for violations were taken against the airport and several tenants in 2001 and 2005, respectively. In 2001, the airport's storm sewer permit for Hawaii General Industrial Activities was under scrutiny. Storm water discharge was found to have "a variety of pollutants," and the EPA had requested that the Department of Justice file a complaint seeking civil penalty and injunctive relief (appropriate best management practices program and compliance with permit terms). A $600,000 penalty was imposed under a January 2006 settlement date (ECHO, 2006).

A July 2005 Administrative Penalty action pursuant to Section 311(j) of the CWA was placed against the Hawaii DOT, including the Lihue Airport facility, for violations of provisions covering Spill Prevention, Containment, And Countermeasures requirements. Under the terms of the Consent Agreement and Final Order, the state DOT was to pay a penalty of $157,500. The case information was last updated in June 2006 (ECHO, 2006).

2.5 SITE RECONNAISSANCE FINDINGS

On February 28, 2006, MFA performed site reconnaissance at the subject property. Adjoining properties were also briefly assessed during our reconnaissance. The weather was overcast, with rain falling during most of the visit. Mr. Kyle Cockerham, DOT Airports Division Environmental Health Specialist, was scheduled to escort us around the location sites, but was unavailable due to illness. He later gave MFA a site map which he had marked to indicate some UST and former facility locations. Our tour was unaccompanied by airport personnel in some portions of the facility, or accompanied (in security areas) as necessary. We visited all eight subject property areas (Table 1 and Figure 3), although portions of some were not fully investigated due to access issues. Densely vegetated areas were not accessed except where paths provided ingress.

125-Acre Northwest Land Acquisition (NWLA) Area

This large property is comprised of sugarcane fields. One private access road leads into the middle of the site from Kapule Highway, which borders the site to the west. Ahukini Road Borders the site to the south and east, and the heliport area also borders the site to the east. Hanamaulu Beach Park lies beyond the site to the north. Several buildings are located offsite near the northeast border of the site: a Kauai County Refuse Transfer Station, a former recycling facility, and the Hawaiian Tropical Deinfestation facility. The southern and eastern borders of the site contain a concrete drainage canal (Picture 1).

The Kauai County Refuse Transfer Station site is situated south of the east end of the improvement area. The Transfer Station is an aboveground municipal waste collection facility where users place solid waste into roll-on containers, which are used to ship the waste off the premises for disposal elsewhere.

Heliport Reconfiguration (HR) Area

Access to this area was not obtained, but it was visible from the fence line at the surrounding roads and parking lot. This area is adjoining and to the west of heliports, which are used by at least five (apparently primarily tourist-based) companies. Nine "islands" near the chopper pads were observed, each one containing a trash receptacle, a small storage shed, and an AST reportedly containing Jet Fuel A (Picture 2). The site itself appears to encompass a concrete drainage canal (Picture 1) and a small portion of the adjoining cane fields (i.e., bordering the NWLA Area; Figure 2).

East and West Public Parking Expansion (PPE) Areas

Both of these areas are landscaped, i.e., covered by grass and ornamental vegetation. Both areas adjoin the existing (Ampco) public parking lot on one side, and the airport access road (Mokulele Loop) on the remaining sides. Rental car companies (on Hoolimalima Place) are located across the access road from the west area. A paved taxi stand currently occupies a cutout portion of the west area.

Employee Parking Expansion (EPE) Area

This area, which is partially covered by grass and partially gravel, is bordered by Ahukini Road to the northwest, the airport runway to the south and east, a relatively small portion of land to the south with a bus parking lot beyond, and air cargo shipping and receiving buildings and an associated parking lot to the north. This area is currently used for employee parking. What appeared to be a pad-mounted electrical junction box (not clearly labeled) is located toward the northeast edge of the site (Picture 3).

An electrical generator building is located on the southwest-adjoining property. Mr. Kyle Cockerham, Hawaii DOT Airports Division Environmental Health Specialist, informed MFA that a 2,000-gallon diesel UST is currently operated at the generator building. The UST is discussed further in Section 2.4.10.

Air Cargo Facility Expansion (ACFE) Area

This area is primarily covered by grass, and also has a small office-type building (locked and unoccupied at the time of our visit). Several manholes on and near the site indicate the presence of utility lines below. Unused PVC piping (possibly for sewer or water lines) is stockpiled in the eastern portion of the site. The adjoining areas to the south and east are elevated approximately 3 feet above this site with concrete walls, but no runoff was observed onto the site during our visit (on which day it was raining). The site is bound by Ahukini Road to the northwest and an unmarked access road to the north, which leads to the Federal Aviation Administration (FAA) control tower area. Island Helicopter's office is located on the adjoining land to the south. Chevron occupies the site across the street to the west, and several truck-mounted fuel tanks were parked in the runway area to the east on the day of our visit.

New Terminal Exit (TE) Road Area

This relatively small proposed roadway area is located across Mokulele Loop from south PPE area discussed above. The area is covered with grass, and is abutted by Mokulele

Loop (southeast) and Kapule Highway (northwest). Rental car companies (on Hoolimalima Place) are located to the northeast, and an access road for the USPS building is located to the west.

Proposed Runway Safety Area Upgrades NE3-21

This area is adjoining to, and north of the existing runway 3-21. The area is overgrown with vegetation (including kiawe, haole koa, grasses, and fallow sugarcane), and stretches to the nearby shoreline at its north/northeast end. Many piles of abandoned debris, most of which appeared to be household trash, were observed in this area (Picture 4); however, the undergrowth was too thick to access and fully investigate the area. Ninini Point Street cuts through the southern edge of the site, and Ahukini Road borders the site to the west. Ahukini Landing is beyond NE3-21 to the north.

Proposed Runway Safety Area Upgrades SW3-21

The proposed safety area at the southwest end of Runway 3-21 (Figure 3) is grassy, and includes a swale. Ninini Point Street borders the site to the south and east. A trench runs between the site and Ninini Point Street. The trench contains an above-ground pipeline (Picture 5), which appears to lead to the sewage treatment plant that adjoins the south end of the subject property, across Ninini Street (Figure 3). A golf course is located beyond, to the southwest. An abandoned building, sheds, and piles of construction debris were observed on west-adjoining land, reportedly a former lumberyard, also across Ninini Street. Southwest-adjoining land contained a vacant, open-air warehouse. It is unknown if the warehouse was associated with the former lumber yard.

Emergency Vehicle Access/Perimeter Road/Fencing

This site runs along the northeast, east, south, and southwest borders of the site, just inside an existing chain-link fence. A dirt/gravel road is currently present in this area, and the remainder of the site is covered with grass (Picture 6). Ninini Point Street borders the site, running outside of and parallel to the fenceline. A small shed, reportedly housing a "mowser" (radar station with electrical equipment), is located in the southwestern portion of the site. A golf course is adjoining to the southwest, and shoreline borders the remainder of the site. According to the airport's Environmental Health Specialist, a dump used to be located east of this area, near the shoreline (Figure 3).

3.0 SUMMARY OF HAZARDOUS MATERIALS

3.1 ASBESTOS

Because few structures are located within the airport improvement areas, the occurrence of asbestos is likely to be minimal. Small sheds were noted in the HR, ACFE and PS areas. Prior to the renovation or demolition of these structures, sampling of suspect building materials should be collected to determine the presence or absence of asbestos-containing material (ACM).

ACM, such as discarded material hidden in vegetated areas, may also be located in areas not easily viewed during our reconnaissance. For example, If encountered during construction, suspect materials must be handled appropriately.

3.2 BIOHAZARDOUS/MEDICAL WASTE

We found no indication of biohazardous or medical waste on the proposed improvement areas or in areas that might impact the proposed improvement areas

3.3 HAZARDOUS MATERIALS/WASTES

We did not observe or find records of hazardous materials or hazardous wastes in the proposed improvement areas. While some hazardous materials (i.e., fuels, transformers) were documented at adjoining or nearby areas, there is no indication of release(s) that would affect the proposed improvement areas. Fugitive dumping was noted in the NE3-21 area, and hazardous materials could be present.

3.4 HEAVY METALS

We found no indications of heavy metals contamination within the proposed improvement areas or in areas that might impact the proposed improvement areas.

3.5 LANDFILLS

Our investigation found no regulatory or historical evidence of landfills within the proposed improvement areas; however, Mr. Balignasay reported that a former County dump was located along the ocean shoreline, extending up/westward toward or on the north PS area (Figure 3). This landfill operated on about 1.5 acres from at least 1948 through closure in 1975. It was subsequently acquired by the State in order to construct a runway extension, which was completed without having disturbed the former landfill. Mr. Balignasay stated that the landfill remains inactive, but erosion has exposed debris, consisting mostly of lumber, green waste, glass, metal, plastic tubing, and mechanical equipment parts. Mr. Balignasay stated that the existing perimeter road is inland of the former dump area. A path currently crosses the former dump.

3.6 LEAD-BASED PAINT

LBP may be present on painted surfaces in buildings/sheds in the HR, ACFE and PS areas. Prior to demolition of these structures, the painted surfaces should be tested for lead. Appropriate health and safety precautions should be taken during demolition work, and

demolition waste should be tested according to toxicity characteristic leachate procedure (TCLP).

3.7 OPERATIONALLY CONTAMINATED AREAS

We did not observe present-day operations on any of the proposed improvement areas that are resulting or are likely to result in contamination. However, past operations in the Ahukini Landing area may have caused subsurface contamination at the northeast corner of the NW3-21 area.

Planned future use of proposed improvement areas is unlikely to result in increased risk of operational contamination for most areas. Many of the areas involve extension or procurement of vacant land areas. A Stormwater Pollution Prevention Plan for the Airport Facility addresses the prevention of operational contamination (M&E, 1998); however, as discussed in Section 2.4.13

3.8 PESTICIDES

Our review of past land use indicates that much of the airport area was under long term sugarcane cultivation. According to a 1993 report by Cotton Frazier Consultants, Inc. (CFC, 1993), AMFAC stated that no known pesticide spills had occurred in study area cane fields, and that pesticide was not applied to the fields in the study area, that they had registered all herbicides used (five were noted as hazardous substances) with the EPA, and that they had handled the chemicals properly. CFC analyzed soil samples to detect the presence of pesticides and herbicides in the study areas with long term sugarcane cultivation. The laboratory results indicated that contaminants were not detected at levels above lab reporting limits.

However, the CFC report also contained AMFAC's table of the most frequently used pesticides and herbicides chemicals during the period between 1983 and 1992. CFC tested sump sediment for herbicide contamination, but did not include listings in the table's Top Four. Therefore, the presence of such residual chemicals in study area subsurface can not be ruled out. Furthermore, herbicides and growth regulating chemicals could be present in the soil and groundwater due to their long-term application to sugarcane.

Although the potential presence of these chemicals is unlikely to be of concern with respect to the planned use of the land for airport facilities, the DOH HEER promulgated a guidance document in August 2006 intended for use during the redevelopment of former agricultural areas. The HEER guidance describes methods for assessment of risk, based on soil testing and intended use. Sampling and testing in accordance with the HEER guidance is recommended.

3.9 POLYCHLORINATED BIPHENYLS (PCBS)

MFA found no indications of PCBs within the proposed improvement areas. We noted transformers on adjoining areas but assessed them to be unlikely to affect the proposed improvement areas. Regulatory records indicated no incidents related to PCB contamination. Subsurface investigations conducted at the former Masterworks site (adjoining the NW3-21 area) did not find PCB concentrations of concern associated with the petroleum contamination there.

3.10 RADIOACTIVE MATERIAL

We found no indication of radioactive material within the proposed improvement areas or in areas that might impact the proposed improvement areas.

3.11 RADON

Radon is not a concern for the proposed improvement areas. The geologic formations of the Hawaiian Islands do not provide elevated radon concentrations. Due to low radon concentrations statewide, measured in two studies conducted by DOH in cooperation with the EPA, the Radiation Section of DOH concluded that radon is not a hazard in the State (DOH, 1998b).

3.12 STORAGE TANKS

We found no indication of existing above-ground storage tanks (ASTs) or underground storage tanks (USTs) on the proposed improvement areas. We found no record of former USTs on the proposed improvement areas. However, one adjoining facility has a currently operating emergency generator UST (southwest of the EPE area, discussed in Section 2.4.10), and several adjoining facilities have ASTs. The heliport area (near the EPE and ACFE areas), has nine ASTs, labeled Jet Fuel A. No evidence of releases (i.e., staining) was noted. Truck-mounted fuel tanks were observed parked to the east of the ACFE area, on the airport apron. No evidence of releases was noted. Two large ASTs and truck-mounted fuel tanks were seen at the Chevron site, which is located west of the ACFE area (Picture 7). No evidence of releases was noted.

Two fuel dispensers were seen at the wastewater treatment plant located west of the SW3-21 area (Picture 8). Presumably, one or more USTs are or were located in the vicinity. We found no registered UST records for the facility. An area of possibly stained soil was cordoned off nearby.

The Hoolimalima Place automobile rental facilities (located west of the PPE areas, north of the TE Road, and south of the NWLA area) area contain fuel dispensers and fuel USTs. As discussed in Section 2.4.8, fuel releases at the facilities nearest the improvement areas currently have "cleaned up" status and are unlikely to have affected the improvement areas.

We found records of leaking underground storage tanks in other areas of the airport, mostly in the former car rental subdivision (Figure 3) that has since been redeveloped; the leaking tanks were removed and the associated cleanup has been completed. The facilities in the former rental complex that were nearest an improvement area were Grayline and Travelers/McKenzie Tours/Garden Isl, at 150 feet from the ACFE area. There are numerous other existing and former ASTs and USTs at the Lihue Airport facility, but there is no record of a release from these tanks that would have impacted the proposed improvement areas.

Mr. Cockerham stated that fuel pipelines are not present on airport property. According to government records, Tesoro unloads aviation fuel at Nawiliwili Harbor, stores it in Nawiliwili terminal ASTs, and then trucks it to the airport (State of Hawaii, 2001b).

MFA can not rule out unidentified or ~~and~~ unreported past or future releases from existing ASTs and USTs that could potentially affect the proposed improvement areas;

however, it appears that appropriate precautions and measures are in place to handle spills and releases. In addition, the Airport has a history of cleaning up contamination resulting from UST releases when they are discovered, and have obtained "No Further Action" determinations from DOH.

3.13 STORM WATER

Maps by Kimura (1998b) show an oil/water separator at the airport's maintenance baseyard, two (2) oil/water separators at the fire station/training area, and seven (7) oil/water separators at car rental facilities on Hoolimalima Place. M&E's report (1998) states that there are currently eleven (11) oil/water separators providing treatment to storm water from the aircraft parking aprons and vehicle washing areas at car rental and other facilities

The M&E report states that, to eliminate pollutants discharge into storm drains, it is the airport's policy that facilities that have potential petroleum products discharge into storm drains should install their own oil/water separator(s). This use of oil/water separators is part of the Storm Water Pollution Prevention Plan prepared by M&E, and helps to mitigate contamination that could be carried to coastal waters through the storm drainage system. No storm water contamination issues were identified that could affect the proposed improvement areas.

The 1997 EA (DOT, 1997) reports that the State Department of Health has issued Lihue Airport a Notice of General Permit Coverage, File No. HI R80A416, under the National Pollutant Discharge Elimination System (NPDES) program, to discharge storm water runoff associated with industrial activity from its facility to the Kauai Channel.

As discussed in Section 2.4.13, during past construction activities, the airport has violations recorded for past noncompliance with Clean Water Act (CWA) requirements.

3.14 WASTE WATER

According to M&E (1998), sewage at Lihue Airport is collected by two separate collection networks, one serving the terminal area and ground transportation subdivision, and the other serving the former terminal and maintenance baseyard areas. They report that aircraft waste is trucked to the aircraft waste facility located southwest of the pump station, where it is ground and conveyed through an 8-inch vitrified clay pipe to the pump station by gravity. From the pump station, the aircraft waste is transported together with the airport terminal wastewater to the Lihue Wastewater Treatment Plant.

We found records of cesspools on the airport property, but we found no indication of cesspools in the proposed improvement areas, A number of cesspools in former lease areas were removed during airport renovation. Jeff Dorn of DOT Airports Kauai Division provided us with a plan showing removed cesspools in former lease areas, and a figure in the Final EA for the Ahukini Road Realignment and General Aviation Subdivision (DOT, 1997) also shows cesspools and drywells in the former lease areas. These cesspools were located approximately 500 to 900 feet northeast of the proposed ACFE area, and were closed during the airport renovation. Mr. Gene Matsushige of DOT Airport Division reported that he believed that USPS still uses a cesspool.

4.0 CONCLUSIONS

This Survey addressed the following potential environmental conditions with respect to proposed Master Plan improvements at the Lihue Airport: asbestos, biohazard/medical waste, hazardous material/waste, heavy metals, landfills, lead paint, offsite sources of contamination, operationally contaminated areas, pesticides, polychlorinated biphenyls, radioactive materials, radon, storage tanks (aboveground and underground), storm water, and wastewater.

Historical sources indicate a long history of sugarcane cultivation in the airport vicinity until 1949, when the airfield was constructed. Throughout a number of airport expansions, many areas adjoining to the airfield remained in sugarcane cultivation until the sugar mill closed in 2000. The proposed 125-acre NWLA area is currently fallow cane land. The NE3-21 area is partially located on land formerly used to process and ship sugarcane, and for plantation worker housing. The other six proposed improvement areas are on undeveloped or vacant airport property.

We found no historical or regulatory records or visual indications of conditions that would indicate the presence or former presence of hazardous materials or subsurface contamination in the proposed Master Plan improvement areas, with the exception of the following:

1. Long-term applications of agricultural chemicals to sugar cane fields indicates a potential for residual chemicals in soil and groundwater. Although the potential presence of these chemicals is unlikely to be of concern with respect to the planned use of the land for airport facilities, the Department of Health (DOH) Office of Hazard Evaluation and Emergency Response (HEER) promulgated a guidance document in August 2006 intended for use during the redevelopment of former agricultural areas. The HEER guidance describes methods for assessment of risk, based on soil testing and intended use. Sampling and testing in accordance with the HEER guidance is recommended.
2. Past operations (fertilizer and pesticide storage, locomotive maintenance warehouses, and a junkyard) in the Ahukini Landing area may have caused subsurface contamination at the northeast corner of the NW3-21 area. The former plantation and junkyard operations along and within the north portion of NE3-21 are typically associated with use of hazardous materials, subjecting the local subsurface to potential contamination. Several environmental investigations at Ahukini Landing documented the existence of hazardous materials and subsurface contamination in the area. Although subsurface investigation and cleanup has occurred, it is possible that additional, previously undocumented, subsurface contamination and hazardous materials may be encountered if excavation is conducted at the site.
3. A currently used UST abuts the southwest end of the ACFE area. Since the tank is exempt from UST regulation by SHWB, release monitoring requirements are deferred. Therefore, undetected/unreported releases may be of potential concern. Furthermore (depending on precise UST system location relative to the ACFE future work site),

excavation work at the AFCE will need to consider the UST system in order to avoid accidental encounters with the tank or piping.

4. Records for former wells, cesspools, and USTs are not comprehensive, as indicated by unexpected encounters during past construction, and by conflicting regulatory information. Emergency response plans must be in place should encounters occur during future construction work.
5. The airport has a history of compliance issues pursuant to Clean Water Act requirements. Best management practices and Spill Prevention, Containment, and Countermeasures requirements must be addressed prior to future construction activities at proposed improvement areas.
6. A former (unregulated) County dump may have been located on or adjoining the northern perimeter road improvement area and could contain buried hazardous materials.

5.0 REFERENCES

ASTM, 2000. *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process (ASTM Designation E 1527-00). American Society for Testing and Materials (ASTM)*, Washington, July 2000.

CFC, 1993. *Expanded Phase I Environmental Site Assessment, Amfac/JMB Property, Ahukini Street, Lihue, Hawaii.* Cotton Frazier Consultants, Inc., Honolulu, December 23, 1993.

County, 2006. *Kauai County Directory: Real Property Assessment: Property Search.* County of Kauai, http://www.kauai.gov/default.aspx?tabid=458, last updated June 23, 2006.

DBEDT, 2005. *Hawaii Brownfields Assessment Program.* Hawaii State Department of Business, Economic Development & Tourism, http://www.hawaii.gov/dbedt/gis/brownfields/index.html, last updated August 12, 2005; accessed February 2006.

DG, 2002-2004. *Flood Insurance Rate Maps, Panels 1500020326E, 1500020327E, 1500020329E: Gray-Scale Satellite Images (Mosaicked Two-Foot Resolution, 1:12,000 Scale).* Kauai County Dept of Public Works, Engineering Division, http://www.kauai.gov/portals/0/pw_eng/design-permitting/flood_zone_maps/, maps printed September 16, 2005; base aerial photography by Digital Globe, Inc., July 2002 to January 2004.

DG, 2004. *Color Satellite Image #251465.* Digital Globe, Inc., September 15, 2004.

DOH, 1983. *Underground Injection Control Maps, Lihue Quadrangle, Island of Kauai,* 7.5 Minute Series, State of Hawaii Department of Health Underground Injection Control Program, Honolulu, 1983.

DOH, 1999. *Island of Kauai UIC Areas.* State of Hawaii Department of Health, Safe Drinking Water Branch, http://hawaii.gov/health/environmental/water/sdwb/uic/pdf/kauuic.pdf, September 1999, accessed May 2005.

DOH, 2006a. HEER Public Records: Releases and Sites of Interest (07-2006), Voluntary Response Program State Response Program Completed Activities for FY 2004 and Ongoing Activities for FY 2005 (02-2005). Hawaii Department of Health, Office of Hazard Evaluation and Emergency Response, http://www.hawaii.gov/health/environmental/hazard/index.html, last updated August 2005.

DOH, 2006b. *LUST Releases and UST Database (Fall 2006).* Hawaii Department of Health, Solid and Hazardous Waste Branch , http://www.hawaii.gov/health/environmental/waste/ust/index.html, updated February 2006, accessed May 2006.

DOT, 1997. *Final Environmental Assessment and Finding of No Significant Impact, Lihue Airport Ahukini Road Realignment and General Aviation Subdivision, Island of Kauai, Tax Map Keys: 4-3-5-01:10 and 4-3-7-02: portion of 01.* State of Hawaii Department of Transportation, Airports Division (proposing agency), Honolulu, March 1997.

DOT, 1999a. *Status of Aboveground and Underground Storage Tanks on DOT-Air Property, Lihue Airport (Table).* State of Hawaii Department of Transportation, Airports Division, Honolulu, March 3, 1999.

DOT, 1999b. *Environmental Assets Report Plan, Lihue Airport (Map).* State of Hawaii Department of Transportation, Airports Division, Honolulu, February 1999.

DOT, 2006. *On-Line Press Kits, Lihue Airport: Kauai Airport History.* Hawaii State Department of Transportation, Public Affairs. http://www.hawaii.gov/dot/publicaffairs/presskits/lih/history.htm, modified July 2006.

ECHO, 2006. *Enforcement and Compliance History Online (ECHO), Search Zip Code 96766.* U. S. Environmental Protection Agency, http://www.epa.gov/echo/, accessed September 2006.

EDR, 2006a. *The EDR Radius Map Report Inquiry # 1601641.1s: Ahukini (North Lihue Airport), Ahukini Road, Lihue, HI 96766.* Environmental Data Resources, Inc., January 27, 2006.

EDR, 2006b. *The EDR Radius Map Report Inquiry # 1601641.3s: Lihue Airport, 3907 Mokulele Loop, Lihue, HI 96766.* Environmental Data Resources, Inc., January 27, 2006.

Foote, D.E., E. L. Hill, S. Nakamura, F. Stephens, 1972. *Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii.* U.S. Dept. of Agriculture Soil Conservation Science , U.S. Government Printing Office, 1972.

GII, 2006. The Garden Isle Index (of Past News Items). Kauai Community College, http://w3.kauaicc.hawaii.edu/GIIndex/indexcards.html, accessed March 2006.

Izuka, S.K., and Gingerich, S.B., 1998. *Ground Water in the Southern Lihue Basin, Kauai, Hawaii.* U.S. Geological Survey, Water-Resources Investigations Report 98-4031.

Kimura, 1998a. *Final Work Plan, Excavation of Petroleum Contaminated Soil at the Former Masterworks Site, Lihue Airport, Lihue, Kauai, Hawaii.* Kimura International, Inc., Honolulu, Hawaii, Project No AS1070-01, Delivery Order 3, November 3, 1998.

Kimura, 1998b. *Lihue Airport Environmental Map.* Kimura International, Inc., Honolulu, Hawaii, November 3, 1998.

Kittredge-Wall, 1878. *Kauai Government Survey (Scale 1:125,000),* compiled by C.S. Kittredge, Traced by W.A. Wall, 1878.

Lo, 2005. *Hanama`ulu Town Celebration,* Catherine Pascual Lo, Poipu Web Designs, http://poipuwebdesigns.tripod.com/index.html, February/June 2005, accessed August 2005.

M&E, 1998. *Stormwater Pollution Prevention Plan, Lihue Airport.* M&E Pacific, Inc., Honolulu, Hawaii, October 1998.

Macdonald, 1983. *Volcanoes in the Sea: The Geology of Hawaii.* G. A. Macdonald, A. T. Abbott. Honolulu: University of Hawaii Press, 1983.

Mink and Lau, 1992. *Aquifer Identification and Classification for the Island of Kaua`i Groundwater Protection Strategy for Hawaii.* J. F. Mink and S. Lau, Water Resources Research Center, University of Hawaii, Technical Report 186, September 1992.NASA, 1992. Aerial Photograph [92-160P-Q]. National Aeronautic and Space Administration, September 20, 1992.

MFA, 1999. *Hazardous Materials Survey (Draft), Lihue Airport Master Plan Improvements, Lihue, Kauai, Hawaii.* Masa Fujioka & Associates, March 1999.

NASA, 1992. *Aerial Photograph [92-166-AB].* National Aeronautic and Space Administration, September 29, 1992.

NOAA, 1974. *Hanamaulu Bay, Island of Kauai, 8th Edition of Chart 19384 (Scale of 1:2,500).* National Oceanic & Atmospheric Administration, US Department of Commerce, May 18, 1974.

RMTC, 2001. *Environmental Remediation Project Summary Report, Lihue Airport Apron Site Preparation and Road Realignment Phase I.* R.M. Towill Corporation, Honolulu, July 2001.

Sanborn, 1927, 1945, 1975, 1980, and 1990. *Sanborn Fire Insurance Maps, in Sanborn Map Report # 1601641.2s: Ahukini (North Lihue Airport), Ahukini Road, Lihue, HI 96766.* Environmental Data Resources, Inc., January 27, 2006.

SDWB, 2006. Underground Injection Control Program. Hawaii State Department of Health, Safe Drinking Water Branch, http://www.hawaii.gov/health/environmental/water/sdwb/uic/uicprogrm.html, last updated January 2006, accessed March 2006.

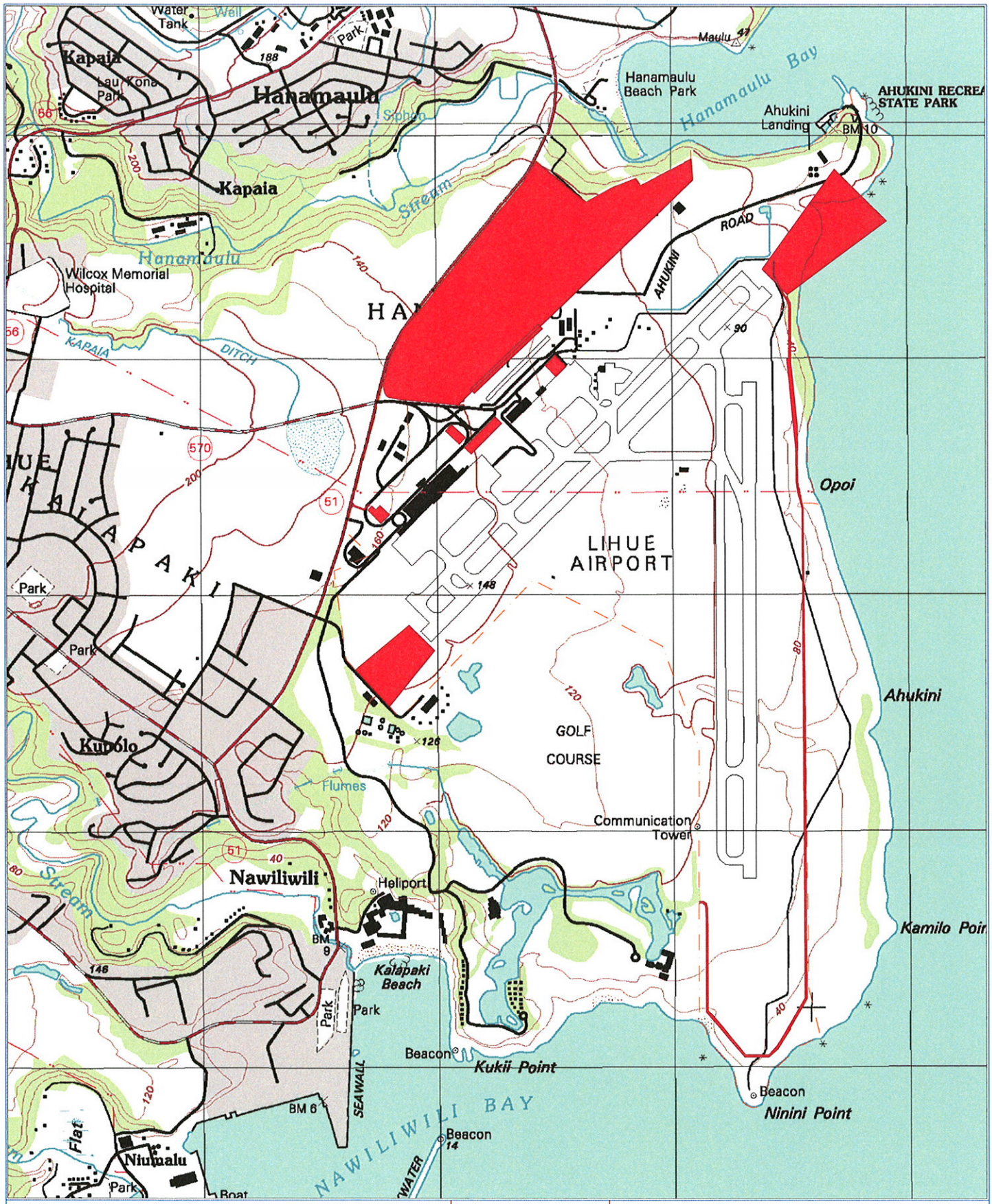
USGS, 1910, 1963, 1982, 1996. *Lihue Quadrangle, Island of Kauai,* 1:24,000 Topographic Maps, United States Department of the Interior Geological Survey, 1910, 1963, 1982, 1996.

USGS, 1950, 1951, 1959, 1960, and 1978. *Aerial Photographs: 1950 GSMF K-2-3 and 12-22-1950 GSMF (no ID); 1-19-1951 GSMF K-3-39;1959GS VXJ 4-2 and 3-3-1959 GS VXJ 4-22; 10-15-1960 GS VXJ 1-13; and 1-11-1978 GS VEEF 11-2 (1:48,000 base for 1978 USGS Lihue Photoquadrangle).* United States Geological Survey, Department of the Interior.

USGS, 1999. *Ground Water Atlas of the United States: Alaska, Hawaii, Puerto Rico and the U. S. Virgin Islands, Open File Report No. HA 730-N: Hawaii,* by Delwyn S. Oki, Stephen B. Gingerich, and R. L. Whitehead. US Geological Survey, http://capp.water.usgs.gov/gwa/ch_n/index.html, 1999, accessed August 2004.

Walker, 1997. *Budget Rent-A-Car Ready/Return Center,Lihue Airport, 3285 Hoolimalima Foad, Facility TMK 3-5-01:132, ID 9-701885, Release #970077.* Walker Consultants, Ltd, July 1997.

WOA, 1998. *Lihue Airport Master Plan Environmental Impact Statement Preparation Notice.* Wilson Okamoto & Associates, Inc., October 1998.



LEGEND

Potential Airport Boundary (Approximate)

Airport Study Sites of Interest

N

0 2000 4000

Scale In Feet

Scale and Feature Locations Are Approximate

Source: USGS Topographic Maps, Lihue & Kapaa Quadrangles (1996).

Project:	05096-072
Approved by:	JCM
Drawn by:	BAS
Date:	Jan. 2006
Scale:	1 in = 2000'

Figure 1 -- Map of Area
LIHUE AIRPORT IMPROVEMENTS
TMK (4) 3-7-02, Por. Parcels 1 and 15
TMK (4) 3-5-01, Various Parcels
Lihue, Kauai, Hawaii

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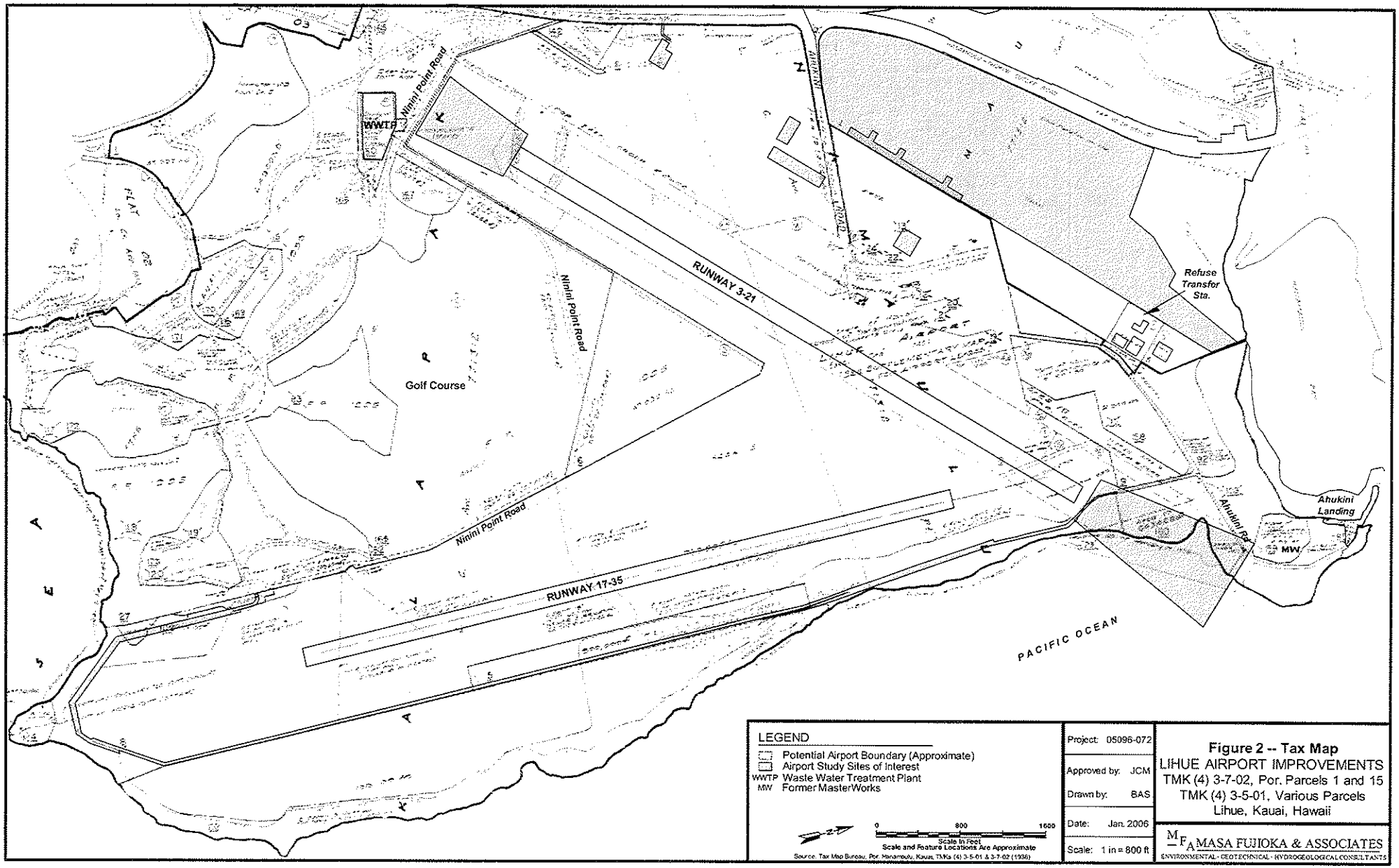

Figure 2 -- Tax Map
LIHUE AIRPORT IMPROVEMENTS
TMK (4) 3-7-02, Por. Parcels 1 and 15
TMK (4) 3-5-01, Various Parcels
Lihue, Kauai, Hawaii

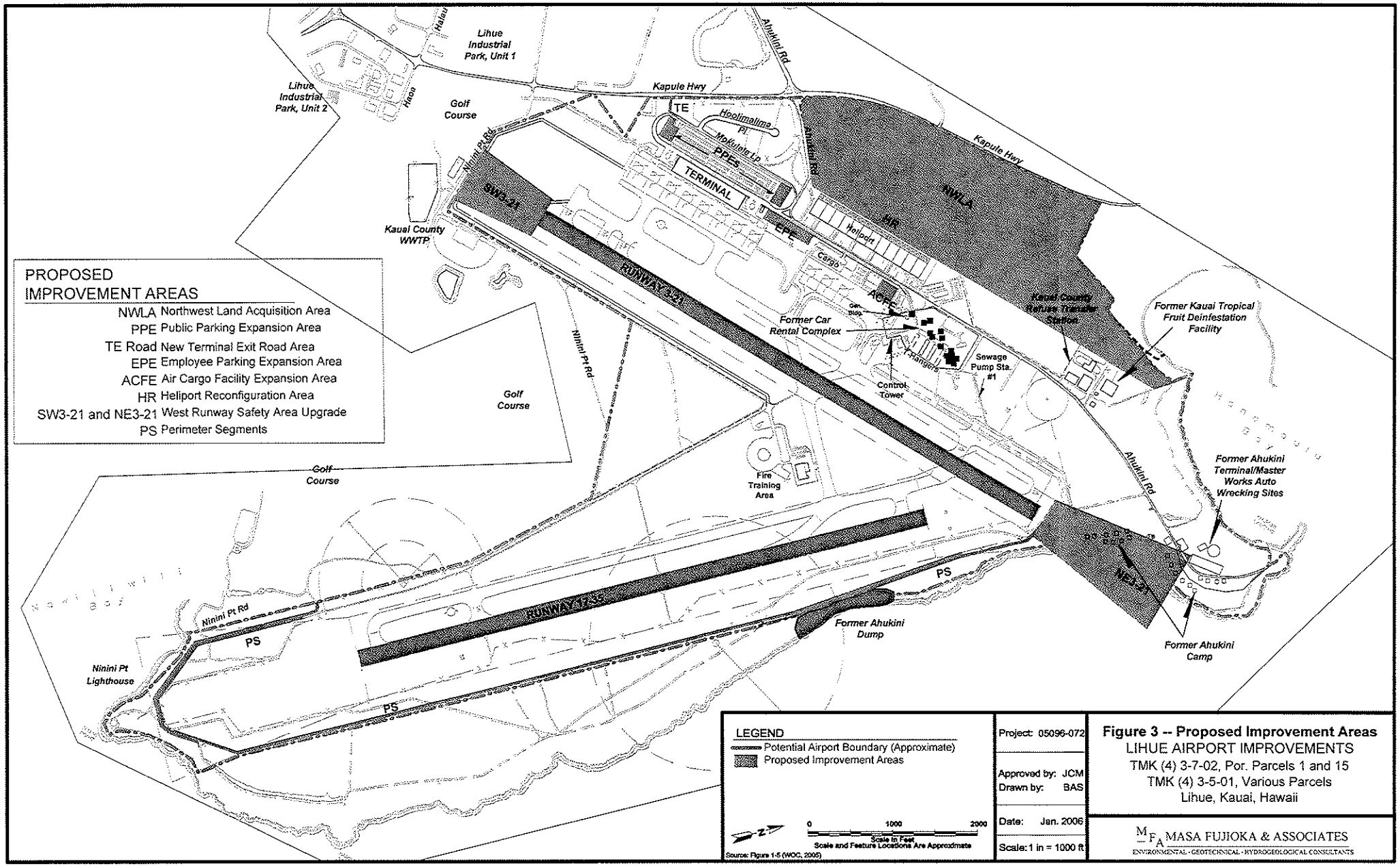

Figure 3 -- Proposed Improvement Areas
LIHUE AIRPORT IMPROVEMENTS
TMK (4) 3-7-02, Por. Parcels 1 and 15
TMK (4) 3-5-01, Various Parcels
Lihue, Kauai, Hawaii

1. Concrete drainage canal at the HR area.

2. AST with Jet Fuel A at the HR area.

3. Pad-mounted electrical box at northeast end of EPE area.

4. Abandoned debris in NE3-21 area.

PLATE 1

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5. Above-ground pipeline in trench in SW3-21 area.

6. Perimeter areas.

7. A variety of mobile and pad-mounted fuel tanks were observed at the Chevron facility, located west of ACFE area and southeast of HR area.

8. Old-model, weathered fuel dispensers located west of SW3-21 Safety Area. Soil in foreground appears to be stained. Photographed at the time of a heavy rain season.

PLATE 2

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APPENDIX G

Traffic Impact Report

TRAFFIC IMPACT REPORT

FOR THE

LIHUE AIRPORT MASTER PLAN

IMPROVEMENTS

Prepared for:

State of Hawaii
Department of Transportation, Airports Division
400 Rodgers Boulevard, Suite 700
Honolulu, Hawaii 96819

Prepared by:

Wilson Okamoto & Associates, Inc.
1907 South Beretania Street
Honolulu, Hawaii 96826

July 2006

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I. INTRODUCTION

A. Purpose of Study

The purpose of this study is to identify and assess the traffic impacts resulting from the implementation of the proposed Master Plan Improvements at the Lihue Airport on the island of Kauai. These improvements include the reconfiguration of the existing heliport, expansion of air cargo and fuel storage facilities, expansion of parking areas, terminal building modifications, and a new terminal access road connection.

B. Scope of Study

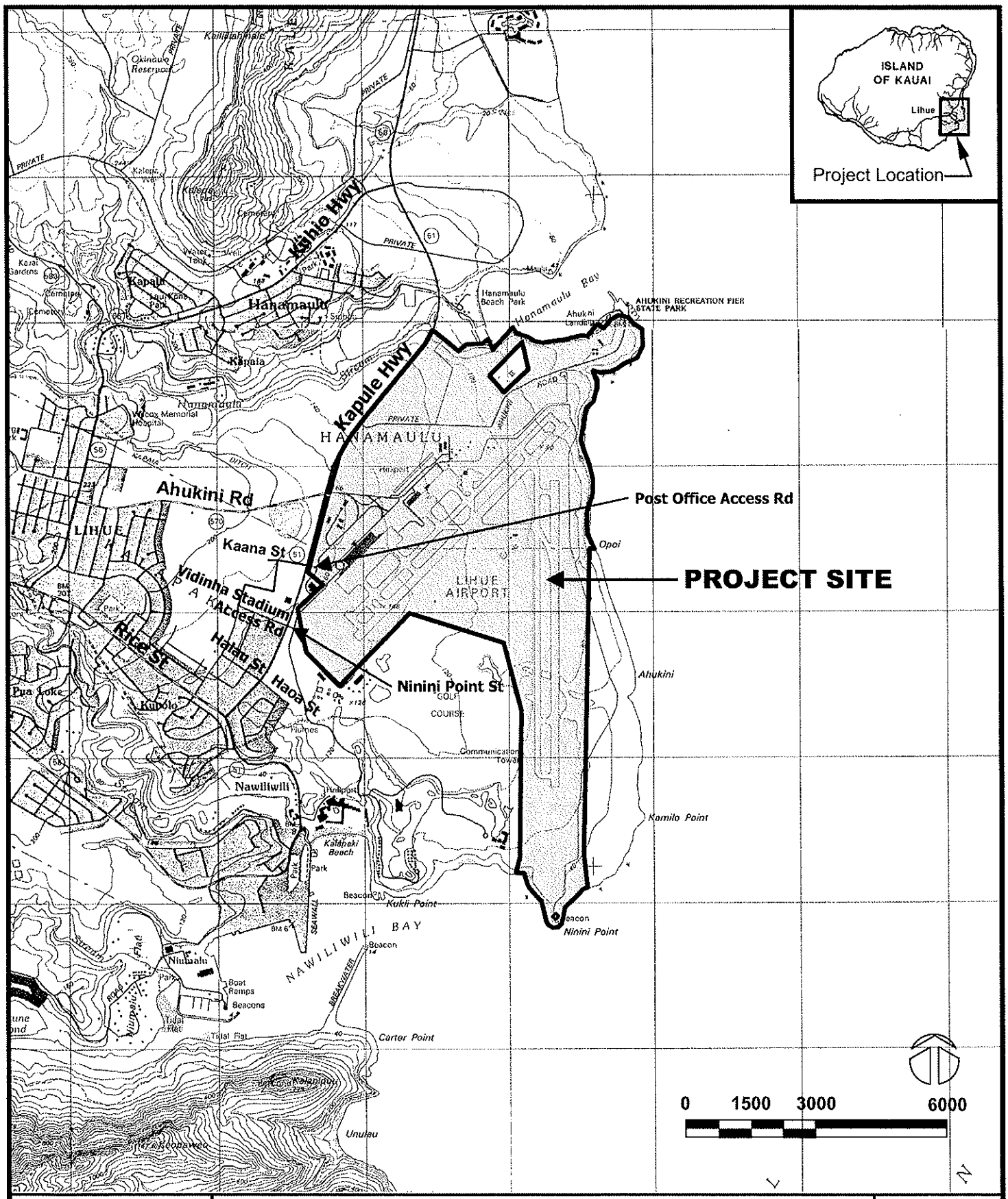
This report presents the findings and conclusions of the traffic study, the scope of which includes:

1. Description of the proposed master plan improvements.
2. Evaluation of existing roadway and traffic operations in the vicinity.
3. Analysis of future roadway and traffic conditions without the proposed improvements.
4. Analysis and development of trip generation characteristics for the proposed improvements.
5. Superimposing site-generated traffic over future traffic conditions.
6. The identification and analysis of traffic impacts resulting from the proposed improvements.
7. Development of recommended mitigation measures, if appropriate, to address the traffic impacts resulting from the proposed improvements.

II. PROJECT DESCRIPTION

A. Location

The Lihue Airport is located east of Kapule Highway in Lihue on the southeastern coast of the island of Kauai (see Figure 1). The project site is further identified as Tax Map Keys 3-5-01: 5, 8, 9, 109, 111, and 158, and 3-7-02: por. 01. Primary access to Lihue Airport is currently provided via Ahukini Road near the northwest corner of the project site.



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LOCATION MAP AND VICINITY MAP

FIGURE 1

B. Project Characteristics

The proposed Lihue Airport Master Plan entails facility improvements at the airport that will take place over the next 10 to 20 years. The following improvements are anticipated to be completed by the Year 2010:

- Expansion of the air cargo facilities
- Expansion of fuel storage facilities
- Realignment and extension of emergency vehicle access/perimeter roads and perimeter fencing, including upgrade of fencing in accordance with current FAA requirements
- Expansion of public parking area and a new employee parking area
- Acquisition of approximately 125 acres of adjacent land north of Ahukini Road to Kapule Highway to provide DOT-A control over its use in order to prevent future development incompatible with airport operations, and to reserve it for undetermined future airport-related facilities
- Runway safety area improvements for Runway 3-21
- New terminal exit road to Kapule Highway near the U.S. Postal Service building
- Terminal building modifications for new security and passenger processing requirements

The improvements to the heliport are not expected to be completed by the Year 2010, but sometime thereafter. As such, for the purpose of this report, the following improvements are anticipated to be completed by the Year 2020:

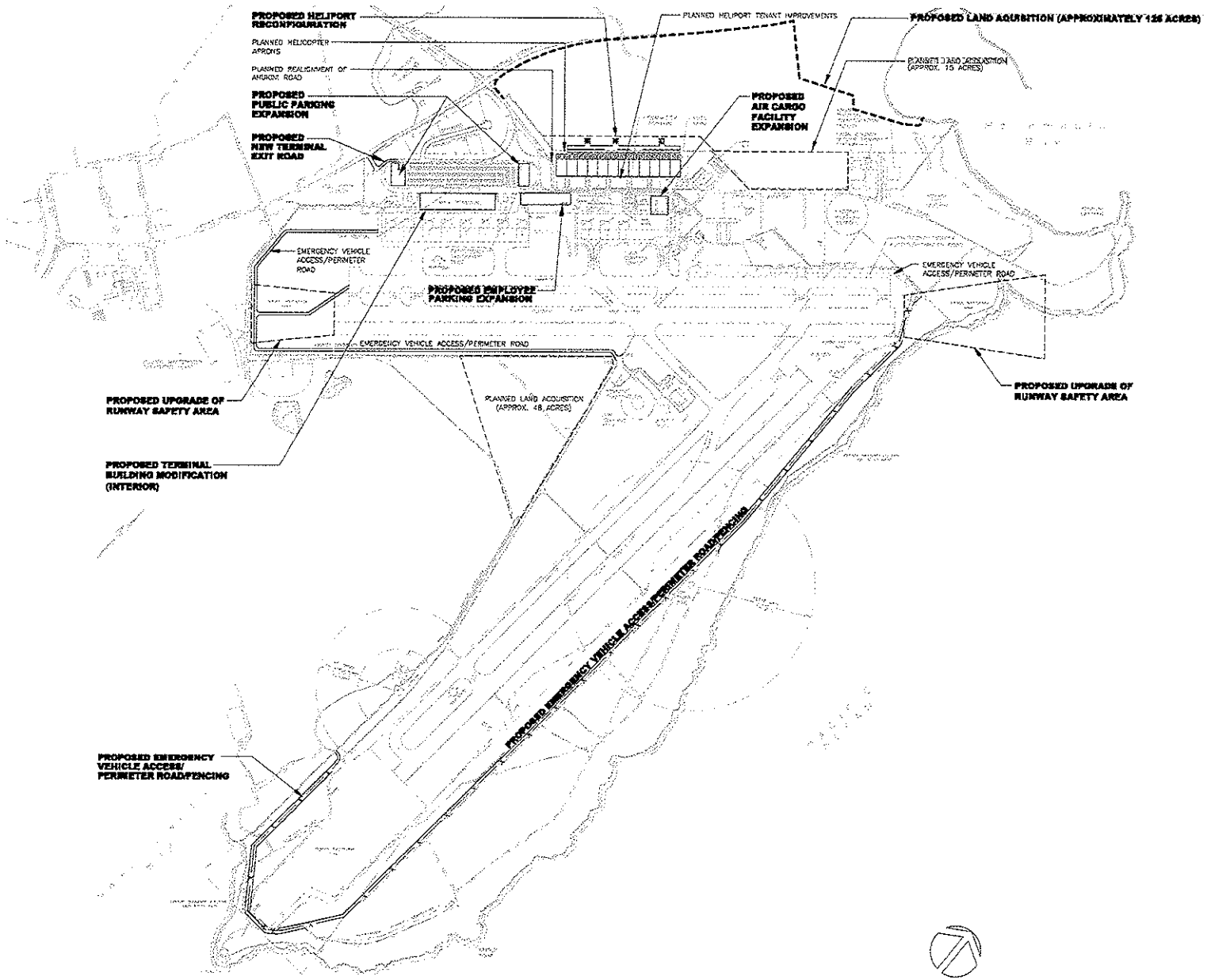
- Reconfiguration of the existing heliport to improve visibility of helicopter operations between the passenger loading/unloading aprons and the touchdown and liftoff areas from the Air Traffic Control Tower

Figure 2 shows the project site plan.

III. EXISTING CONDITIONS

A. General

The Lihue Airport is located east of Kapule Highway in Lihue along the coastline between Hanamaulu Bay and Nawiliwili Bay. Kapule Highway is a predominantly two-way, two-lane State of Hawaii roadway that serves as a major



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PROPOSED SITE PLAN

FIGURE 2

north-south arterial roadway through Lihue between its northern terminus at Kuhio Highway and southern terminus at Rice Street. Kuhio Highway is a predominately two-way, two-lane State of Hawaii roadway that generally runs parallel to Kapule Highway in the vicinity of the airport and also serves as a major north-south collector roadway through Lihue.

B. Area Roadway System

Southwest of the Lihue Airport, Kapule Highway intersects Rice Street. At this unsignalized intersection, the southbound approach of the highway has exclusive left-turn and right-turn lanes. Rice Street originates at Kuhio Highway as a predominantly two-way, four-lane County of Kauai roadway and transitions to a predominantly two-lane roadway west of Kapule Highway until its terminus near the Nawiliwili Harbor. At the intersection with Kapule Highway, the eastbound approach of Rice Street has an exclusive left-turn lane and one through lane while the westbound approach has one lane that serves through and right-turn traffic movements.

Northeast of the intersection with Rice Street, approximately 0.25 miles, Kapule Highway intersects Halau Street and Haoa Street. At this signalized intersection, both approaches of Kapule Highway have exclusive turning lanes and one through lane. Halau Street and Haoa Street are both predominantly two-lane, two-way County of Kauai roadways that provide access to adjacent commercial/industrial areas. At the intersection with Kapule Highway, the eastbound approach of Halau Street and the westbound approach of Haoa Street have two lanes that serve left-turn, through, and right-turn traffic movements.

Further northeast, approximately 0.25 miles, Kapule Highway intersects the Vidinha Stadium Access Road and Ninini Point Street. At this unsignalized intersection, both approaches of Kapule Highway have one lane that serves all traffic movements. The Vidinha Stadium Access Road and Ninini Point Street are predominantly two-lane, two-way roadways with Ninini Point Street currently serving as a service/maintenance road for the adjacent Kauai Lagoons property. At the intersection with Kapule Highway, the eastbound approach of the Vidinha Stadium

Access Road and the westbound approach of Ninini Point Street have one lane that serves all traffic movements.

Approximately 0.25 miles northeast of the intersection with the Vidinha Stadium Access Road and Ninini Point Street, Kapule Highway intersects Kaana Street and the Post Office Access Road. At this signalized intersection, both approaches of Kapule Highway have exclusive turning lanes and one through lane. The Ninini Point Street and the Post Office Access Road are predominantly two-lane, two-way roadways with Kaana Street currently serving as the main access road to the Kauai Judiciary Complex. At the intersection with Kapule Highway, the eastbound approach of Kaana Street and the westbound approach of the Post Office Access Road have two lanes that serve all traffic movements.

Further northeast, at the northwest corner of the project site, Kapule Highway intersects Ahukini Road. At this signalized intersection, both approaches of Kapule Highway have exclusive turning lanes and one through lane. Ahukini Road is a predominantly two-way, two-lane State of Hawaii roadway that serves a connector road between Kapule Highway and Kuhio Highway, as well as the main access road for the airport. At the intersection with Kapule Highway, both approaches of Ahukini Road have an exclusive left-turn lane, one through lane, and a channelized right-turn lane.

At the north end of the study area, approximately 1.5 miles northeast of the intersection with Ahukini Road, Kapule Highway intersects Kuhio Highway. At this signalized intersection, the northbound approach of Kapule Highway has an exclusive left-turn lane and one through lane. This approach is coned during the afternoon peak hours of traffic to allow northbound through vehicles to proceed unimpeded through the intersection since left-turning vehicles from Kuhio Highway are forced to utilize the inner departure lane along northbound Kuhio Highway. At this intersection, the eastbound approach of Kuhio Highway has exclusive turning lanes while the southbound approach of Kuhio Highway has one through lane and an exclusive right-turn lane.

Approximately 1.0 mile west of the intersection with Kapule Highway, Ahukini Road intersects Kuhio Highway. At this signalized intersection, the westbound approach of Ahukini Road has exclusive turning lanes while both approaches of Kuhio Highway have two lanes that serve through and turning movements.

C. Traffic Volumes and Conditions

1. General

a. Field Investigation

Field investigations were conducted during 2005 on June 21-22, September 1, and November 8-9, and consisted of manual turning movement count surveys between the morning peak hours of 6:00 AM and 9:00 AM, and the afternoon peak hours of 3:30 PM and 6:30 PM at the following intersections:

- Kapule Highway and Rice Street
- Kapule Highway, Halau Street, and Haoa Street
- Kapule Highway, the Vidinha Stadium Access Road, Ninini Point Street
- Kapule Highway, Kaana Street, and the Post Office Access Road
- Kapule Highway and Ahukini Road
- Kapule Highway and Kuhio Highway
- Kuhio Highway and Ahukini Road

In addition, 24-hour mechanical traffic count surveys were conducted along Kapule Highway, Kuhio Highway, and Ahukini Road to verify the peak traffic periods in the project vicinity.

b. Capacity Analysis Methodology

The highway capacity analysis performed in this study is based upon procedures presented in the "Highway Capacity Manual", Transportation Research Board, 2000, and the "Highway Capacity Software", developed by the Federal Highway Administration. The analysis is based on the concept of Level of Service (LOS).

LOS is a quantitative and qualitative assessment of traffic operations. Levels of Service are defined by LOS "A" through "F". LOS "A" represents ideal or free-flow traffic operating conditions and LOS "F" represents unacceptable or potentially congested traffic operating conditions. LOS "B", "C", "D", and "E" represent the intermediate traffic operational characteristics between the two extremes of LOS "A" and LOS "F". The LOS definitions are included in Appendix B.

"Volume-to-Capacity" (v/c) ratio is another measure indicating the relative traffic demand to the roadway carrying capacity. A v/c ratio of one (1.00) indicates that the roadway is operating at or near capacity. A v/c ratio of greater than 1.00 generally indicates that the traffic demand exceeds the road's carrying capacity.

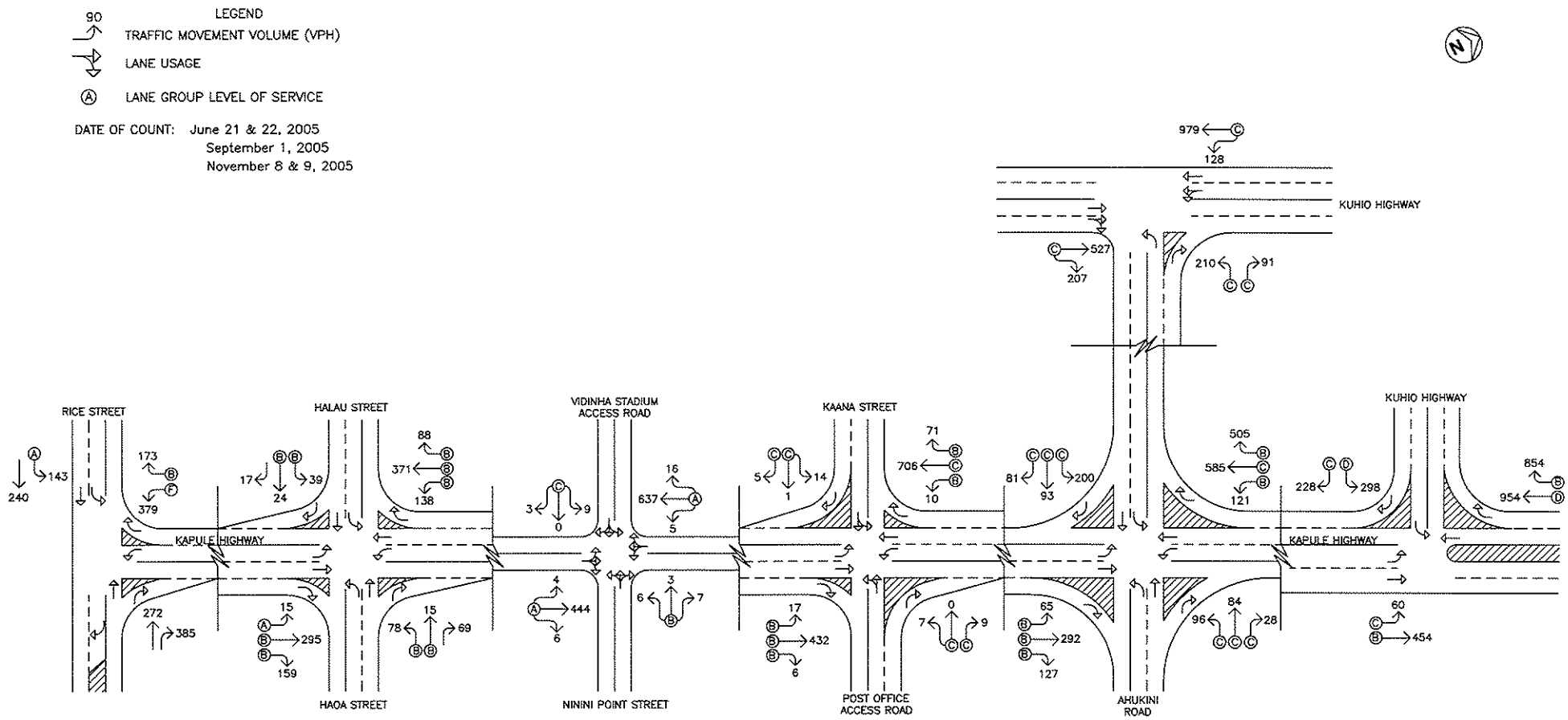
2. Existing Peak Hour Traffic

a. General

Figures 3 and 4 show the existing AM and PM peak hour traffic volumes and traffic operating conditions in the project vicinity. The morning peak hour of traffic generally occurs between 7:15 AM and 8:15 AM in the vicinity of the project. In the afternoon, the peak hour of traffic generally occurs between the hours of 3:30 PM and 4:30 PM in the project vicinity. Although the peak hours of traffic generally occur around the same time periods at each of the study intersections, the absolute commuter peak hour time periods for each intersection may differ slightly as shown in Table 1.

Table 1: Peak Hours of Traffic

Intersection	AM Peak	PM Peak
Kapule Hwy/Rice St	7:30 AM-8:30 AM	4:00 PM-5:00 PM
Kapule Hwy/Halau St/ Haoa St	7:00 AM-8:00 AM	3:00 PM-4:00 PM



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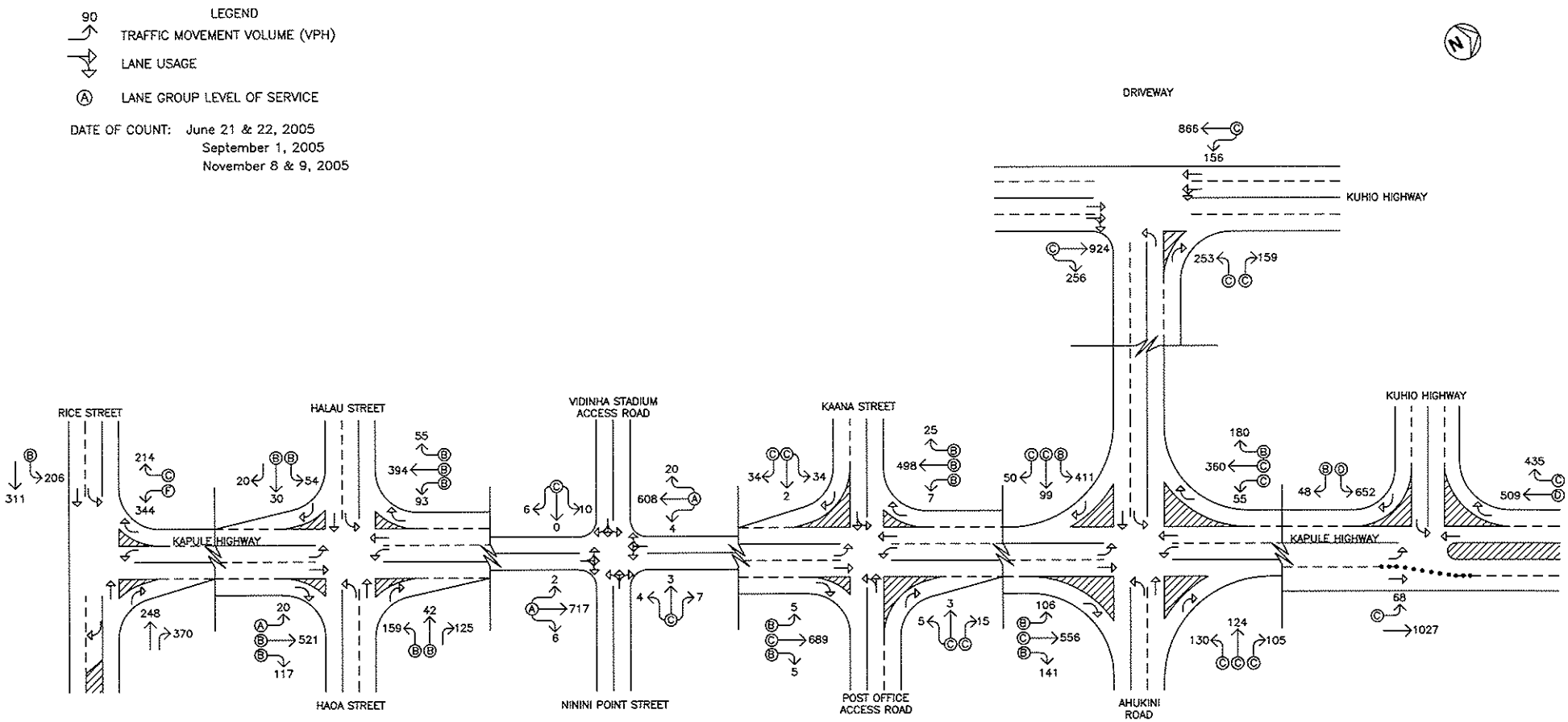
EXISTING AM PEAK HOUR OF TRAFFIC

FIGURE 3



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EXISTING PM PEAK HOUR OF TRAFFIC

FIGURE 4

Table 1: Peak Hours of Traffic (Cont'd)

Intersection	AM Peak	PM Peak
Kapule Hwy/Vidinha Stadium Access Rd/ Ninini Point St	7:15 AM-8:15 AM	3:15 PM-4:15 PM
Kapule Hwy/Kaana St/ Post Office Access Rd	7:30 AM-8:30 AM	3:30 PM-4:30 PM
Kapule Hwy/Ahukini Rd	7:15 AM-8:15 AM	3:45 PM-4:45 PM
Kapule Hwy/Kuhio Hwy	7:15 AM-8:15 AM	4:15 PM-5:15 PM
Kuhio Hwy/Ahukini Rd	7:15 AM-8:15 AM	3:45 PM-4:45 PM

The analysis is based on the above absolute commuter peak hour time periods for each intersection to identify the traffic impacts resulting from the proposed project. LOS calculations are included in Appendix C.

b. Kapule Highway and Rice Street

At the intersection with Rice Street, Kapule Highway carries 552 vehicles southbound during the AM peak period. During the PM peak period, traffic volumes are approximately the same with 558 vehicles traveling southbound. The southbound left-turn traffic movement on the Kapule Highway approach operates poorly at LOS "F" during both peak periods while the southbound right-turn traffic movement operates at LOS "B" and LOS "C" during the AM and PM peak periods, respectively.

Rice Street carries 383 vehicles eastbound and 657 vehicles westbound during the AM peak period at this intersection. During the PM peak period, the overall traffic volume is slightly higher with 517 vehicles traveling eastbound and 618 vehicles traveling westbound. The critical movement on the Rice Street approaches to the intersection is the eastbound left-turn traffic movement which operates at LOS "B" and LOS "A" during the AM and PM peak periods, respectively.

Traffic queues would periodically form at the intersection with the most significant queuing occurring on the southbound approach of Kapule Highway during both peak periods. Average queue lengths of 10 to 12 vehicles were observed in the left-turn lane during both peak periods. Occasionally, these queues extended through the upstream intersection with Halau Street and Haoa Street.

c. Kapule Highway, Halau Street, and Haoa Street

At the intersection of Kapule Highway with Halau Street and Haoa Street, Kapule Highway carries 469 vehicles northbound and 597 vehicles southbound during the AM peak period. During the PM peak period, the overall traffic volume is higher with 658 vehicles traveling northbound and 542 vehicles traveling southbound. The critical movements on the Kapule Highway approaches is the northbound through and southbound left-turn traffic movements which operation at LOS "B" during both peak periods. Traffic queues would periodically form on the Kapule Highway approaches with average queue lengths of 8 to 10 vehicles observed during both peak periods. Occasionally, queues from the downstream intersection with Rice Street would extend through this intersection. However, most of the queues would clear the intersection after each traffic signal cycle change.

The Halau Street approach of this intersection carries 80 vehicles and 104 vehicles eastbound during the AM and PM peak periods, respectively, while the Haoa Street approach carries 162 vehicles and 326 vehicles westbound during the AM and PM peak periods, respectively. The critical movement on these approaches of the intersection is the westbound left-turn traffic movement which operates at LOS "B" during both peak periods. Traffic queues would occasionally form on the eastbound and westbound approaches with the most significant queuing occurring on the westbound approach of Haoa Street during the PM peak period with average queue lengths of

3 to 5 vehicles observed in the left-turn lane. However, most of these queues would clear the intersection after each traffic signal cycle change.

d. Kapule Highway, the Vidinha Stadium Access Road, and Ninini Point Street

At the intersection with the Vidinha Stadium Access Road and Ninini Point Street, Kapule Highway carries 454 vehicles northbound and 658 vehicles southbound during the AM peak period. During the PM peak period, the overall traffic volume is higher with 725 vehicles traveling northbound and 632 vehicles traveling southbound. Both approaches of the highway operate at LOS "A" during both peak periods.

The eastbound and westbound approaches of this intersection currently carry a low volume of traffic during the peak hours of traffic. The Vidinha Stadium Access Road approach carries 12 vehicles and 16 vehicles eastbound during the AM and PM peak periods, respectively, and operates at LOS "C" during both peak periods. Similarly, the Ninini Point Street approach carries 16 vehicles and 14 vehicles westbound during the AM and PM peak periods, respectively, and operates at LOS "B" and LOS "C" during the AM and PM peak periods, respectively.

e. Kapule Highway, Kaana Street, and the Post Office Access Road

At the intersection with Kaana Street and the Post Office Access Road, Kapule Highway carries 455 vehicles northbound and 787 vehicles southbound during the AM peak period. During the PM peak period, the overall traffic volume is approximately the same with 699 vehicles traveling northbound and 530 vehicles traveling southbound. The critical movements on the Kapule Highway approaches are the northbound through traffic movement which operates at LOS "B" and LOS "C" during the AM and PM peak

periods, respectively, and the southbound through traffic movement which operates at LOS "C" and LOS "B" during the AM and PM peak periods, respectively. Traffic queues would periodically form on the Kapule Highway approaches during both peak periods with the most significant queuing occurring on the southbound approach during the AM peak period and the northbound approach during the PM peak period. Average queue lengths of 10 to 12 vehicles were observed on these approaches in the through lanes during the respective time periods. However, these queues would clear the intersection after each traffic signal cycle change.

The Kaana Street approach of this intersection carries 20 vehicles and 70 vehicles eastbound during the AM and PM peak periods, respectively, while the Post Office Access Road carries 16 vehicles and 23 vehicles westbound during the AM and PM peak periods, respectively. The critical movements on these approaches are the eastbound and westbound left-turn and though traffic movements which operate at LOS "C" during both peak periods. Traffic queues would occasionally form on the eastbound and westbound approaches during both peak periods with the most significant queuing occurring on the eastbound approach of Kaana Street during the PM peak period with average queue lengths of 2 to 3 vehicles observed in the left-turn and through lane. However, these queues would clear the intersection after each traffic signal cycle change.

f. Kapule Highway and Ahukini Road

At the intersection of with Ahukini Road, Kapule Highway carries 484 vehicles northbound and 1,211 vehicles southbound during the AM peak period. During the PM peak period, the overall traffic volume is less with 803 vehicles traveling northbound and 595 vehicles traveling southbound. The critical movements on the Kapule Highway approaches are the northbound left-turn traffic movement

which operates at LOS "B" during both peak periods, the northbound through traffic movement which operates at LOS "B" and LOS "C" during the AM and PM peak periods, respectively, and the southbound through traffic movement which operates at LOS "C" during both peak periods. Traffic queues would periodically form on the Kapule Highway approaches during both peak periods with the most significant queuing occurring on the southbound approach during the AM peak period and the northbound approach during the PM peak period. Average queue lengths of 10 to 12 vehicles were observed on these approaches during the respective time periods. However, these queues would clear the intersection after each traffic signal cycle change.

The Ahukini Road approaches of the intersection carry 374 vehicles eastbound and 208 vehicles westbound during the AM peak period. During the PM peak period, traffic volumes are higher with 560 vehicles traveling eastbound and 359 vehicles traveling westbound. The critical movements on Ahukini Road are the eastbound left-turn and westbound through traffic movements which operates at LOS "C" during both peak periods and the westbound left-turn traffic movement which operates at LOS "C" and LOS "B" during the AM and PM peak periods, respectively. Traffic queues would periodically form on the Ahukini Road approaches during both peak periods with the most significant queuing occurring on the eastbound approach during the PM peak period. Average queue lengths of 10 to 12 vehicles were observed in the left-turn lane of this approach during the PM peak period. Most of these queues would clear the intersection after each traffic signal cycle change, but occasionally vehicles had to wait for more than one traffic signal cycle length.

g. Kapule Highway and Kuhio Highway

At the intersection with Kuhio Highway, the Kapule Highway approach carries 514 vehicles and 1,095 vehicles northbound during the AM and PM peak periods, respectively. The critical movement on the Kapule Highway approach is the northbound left-turn traffic movement which operates at LOS "C" during both peak periods. Traffic queues would periodically form on the Kapule Highway approach during the AM peak period with average queue lengths of 8 to 10 vehicles observed in the through lane, but these queues would clear the intersection after each traffic signal cycle change. During the PM peak period, the intersection is coned to allow the northbound through movement to proceed unimpeded through the intersection.

The Kuhio Highway approach of this intersection carries 1,808 vehicles southbound and 526 vehicles eastbound during the AM peak period. During the PM peak period, the overall traffic volume is les with 944 vehicles traveling southbound and 700 vehicles traveling eastbound. The critical movements on the Kapule Highway approaches are the southbound through and eastbound left-turn traffic movements which operate at LOS "D" during both peak periods. Traffic queues would periodically form on the Kuhio Highway approaches during both peak periods with the most significant queuing occurring on the southbound approach during the AM peak period and the eastbound approach during the PM peak period. Average queue lengths of 10 to 15 vehicles were observed on these approaches during the respective time periods. Most of these queues would clear the intersection after each traffic signal cycle change, but occasionally vehicles had to wait for more than one traffic signal cycle length.

h. Kuhio Highway and Ahukini Road

At the intersection with Ahukini Road, Kuhio Highway carries 734 vehicles northbound and 1,108 vehicles southbound during the

AM peak period. During the PM peak period, the overall traffic volume is higher with 1,189 vehicles traveling northbound and 1,037 vehicles traveling southbound. Both approaches of the Kuhio Highway operate at LOS "C" during both peak periods. Traffic queues would periodically form on the Kuhio Highway approaches during both peak periods with average queue lengths of 10 to 15 vehicles observed on both approaches. Occasionally, southbound queues extended beyond the upstream intersection with Ehiku Street and northbound queues extended beyond the upstream intersection with Poinciana Street. However, most of these queues would clear the intersection after each traffic signal cycle change.

The Ahukini Road approach of this intersection carries 305 vehicles and 428 vehicles westbound during the AM and PM peak periods, respectively. The critical movement on the Ahukini Road approach is the westbound left-turn traffic movement which operates at LOS "C" during both peak periods. Traffic queues would periodically form on the Ahukini Road approach with average queue lengths of 8 to 10 vehicles observed during both peak periods. Most of these queues would clear the intersection after each traffic signal cycle change, but occasionally vehicles had to wait for more than one traffic signal cycle length.

IV. PROJECTED TRAFFIC CONDITIONS

A. Site-Generated Traffic

1. Trip Generation Methodology

The trip generation methodology used in this study is based upon generally accepted techniques developed by the Institute of Transportation Engineers (ITE) and published in "Trip Generation, 7th Edition," 2003. The trip generation rates were developed empirically by correlating the existing vehicle trip generation data with the number of enplaning passengers. These rates were then utilized to determine the number of additional vehicle trips

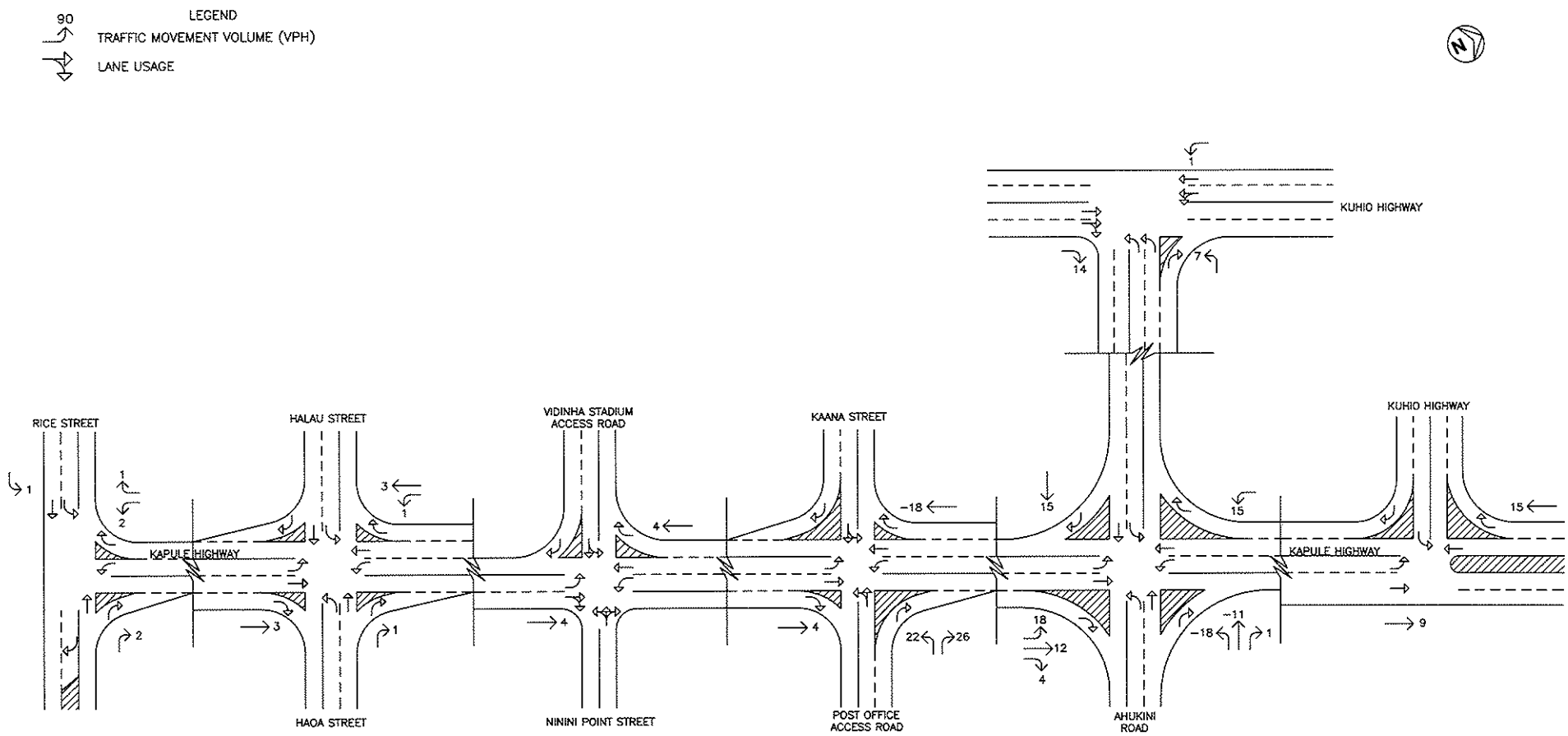
that would be generated by an increase in the number of enplaning passengers. Table 2 summarizes the trip generation characteristics applied to the AM and PM peak hours of traffic to measure the impact resulting from the proposed Lihue Airport Master Plan Improvements.

Table 2: Peak Hour Trip Generation

YEAR 2010		
INDEPENDENT VARIABLE:		PASSENGERS ENPLANED Δ FROM YEAR 2000 = 390 PASS
		PROJECTED TRIP ENDS
AM PEAK	ENTER	34
	EXIT	20
	TOTAL	54
PM PEAK	ENTER	29
	EXIT	35
	TOTAL	64
YEAR 2020		
INDEPENDENT VARIABLE:		PASSENGERS ENPLANED Δ FROM YEAR 2010 = 790 PASS
		PROJECTED TRIP ENDS
AM PEAK	ENTER	68
	EXIT	42
	TOTAL	110
PM PEAK	ENTER	59
	EXIT	71
	TOTAL	130

2. Trip Distribution

Figures 5 to 8 show the reassignment of existing traffic exiting the Lihue Airport, as well as, the distribution of additional site-generated traffic during the AM and PM peak periods at each of the study intersections in Year 2010 and Year 2020. Access to Lihue Airport will be provided via Ahukini Road and the Post Office Access Road. Since the new connection between the Post Office access road and the internal airport roadways will be restricted to exiting traffic only, all entering vehicles are assumed to utilize Ahukini Road while exiting vehicles distributed between the Ahukini Road and the access



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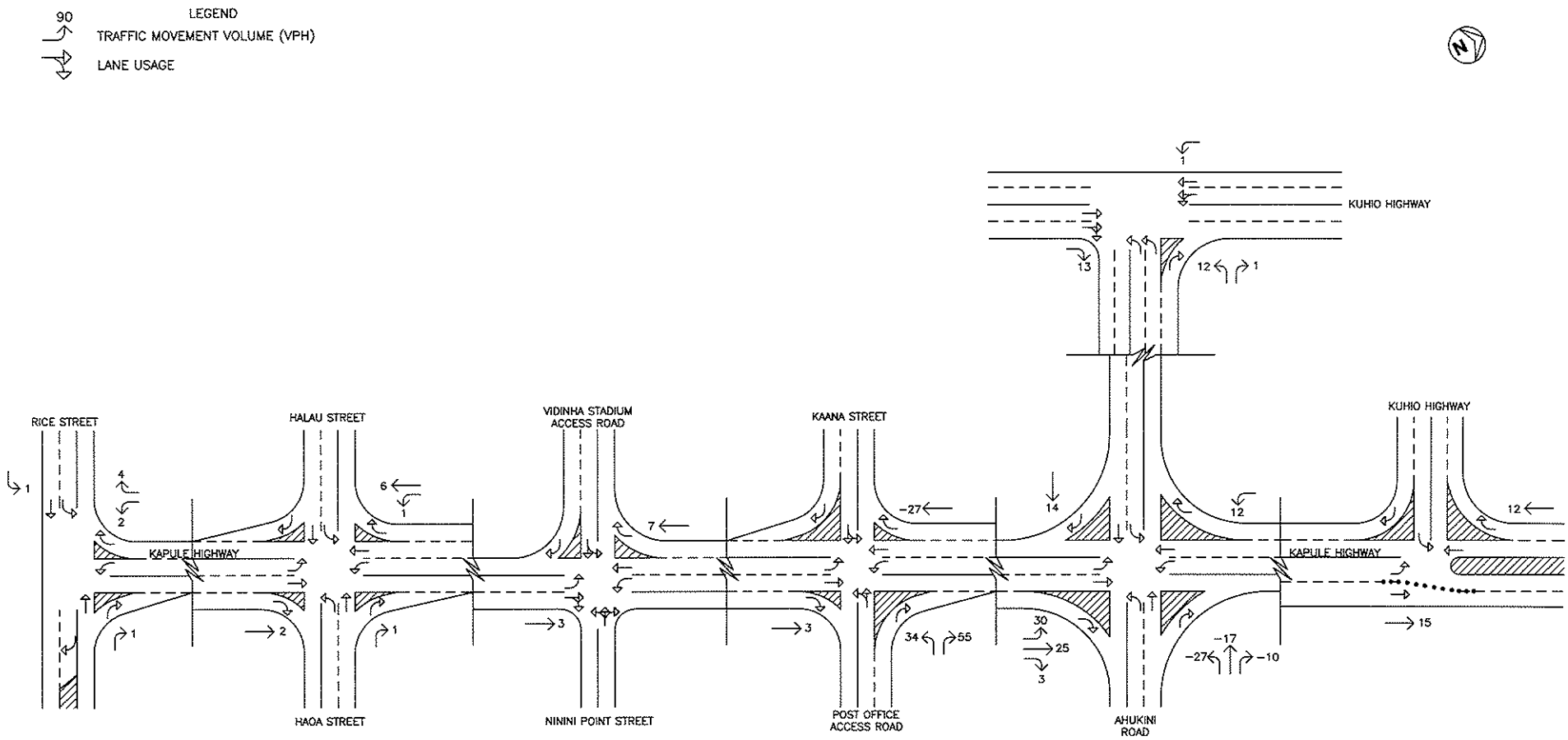
DISTRIBUTION OF SITE-GENERATED TRAFFIC - YEAR 2010 AM PEAK HOUR OF TRAFFIC

FIGURE 5



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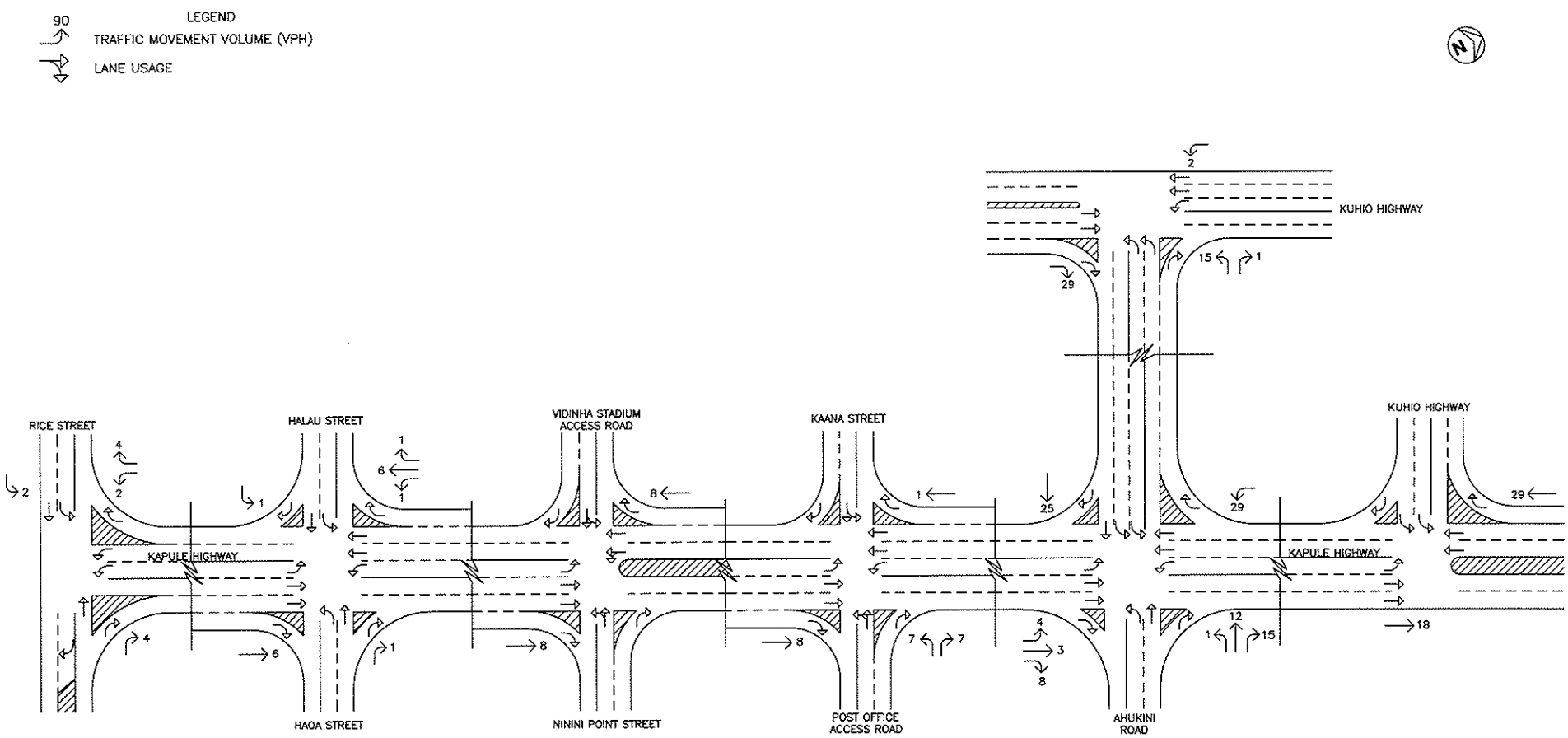
DISTRIBUTION OF SITE-GENERATED TRAFFIC - YEAR 2010 PM PEAK HOUR OF TRAFFIC

FIGURE 6



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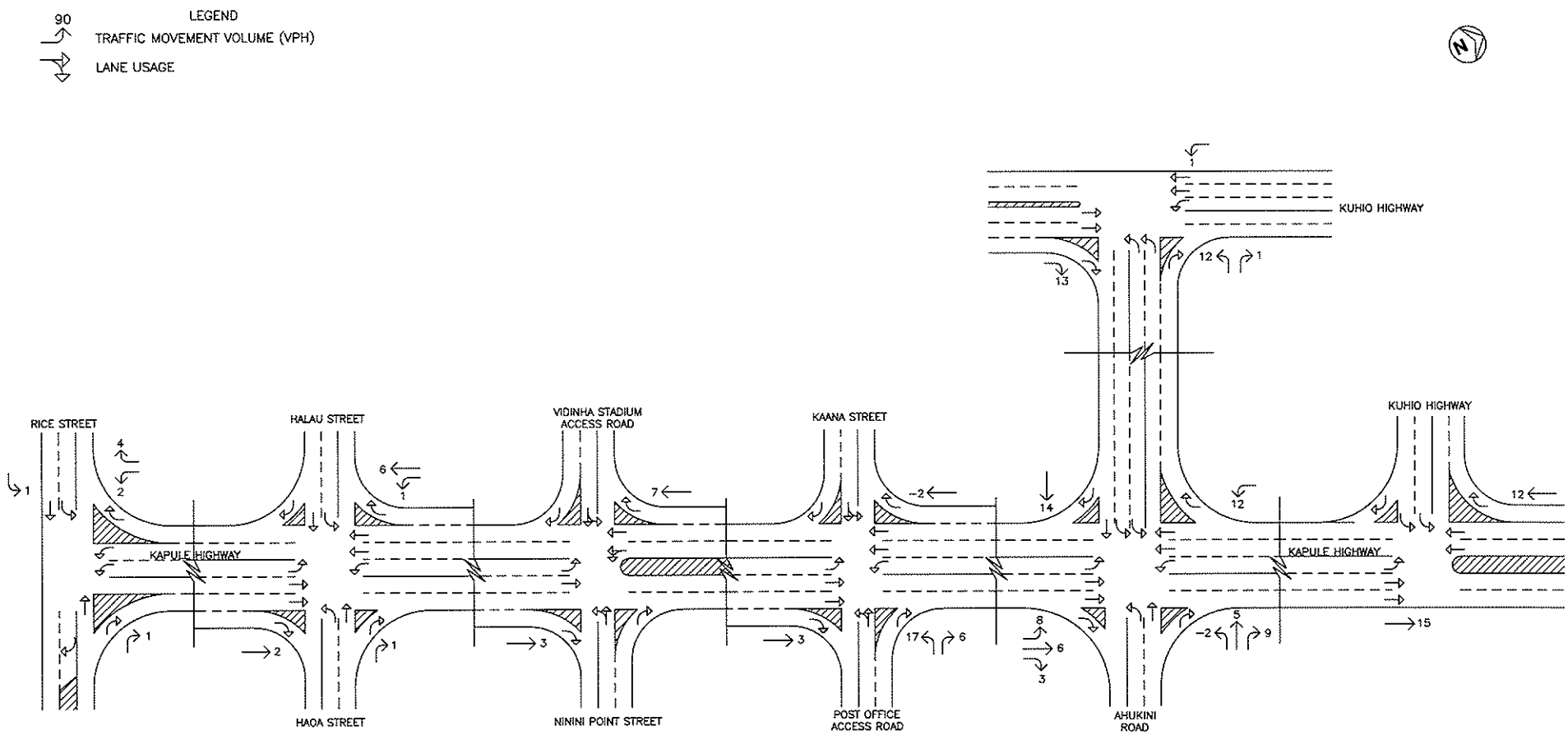
DISTRIBUTION OF SITE-GENERATED TRAFFIC - YEAR 2020 AM PEAK HOUR OF TRAFFIC (FROM 2010)

FIGURE 7



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DISTRIBUTION OF SITE-GENERATED TRAFFIC - YEAR 2020 PM PEAK HOUR OF TRAFFIC (FROM 2010)

FIGURE 8

road. Due to the location of the connection and the anticipated flow of traffic, traffic utilizing the connection is assumed to be primarily comprised of vehicles exiting the rental car facilities located along the west edge of the project site. As such, for the purpose of this report, only 20% of the existing vehicles exiting the airport and additional site-generated vehicles are assumed to utilize the Post Office Access Road.

The reassignment of the existing traffic exiting the Lihue Airport was based upon the existing distribution of traffic at the intersection of Kapule Highway and Ahukini Road. As such, 20% of the westbound right-turning vehicles at the intersection with Ahukini Road are assumed to turn right from the Post Office Access Road instead and head north along Kapule Highway through the intersection with Ahukini Road. Similarly, 20% of the westbound left-turning vehicles at the intersection with Ahukini Road are assumed to turn left from the access road instead and head south along Kapule Highway. Of the westbound through vehicles at the intersection with Ahukini Road, 20% are assumed to turn right from the access road instead onto Kapule Highway then turn left at the intersection with Ahukini Road and head west along Ahukini Road.

The directional distribution of all additional site-generated trips was based on the distribution of population and activity centers on the island of Kauai. As such, 42.7% were assumed to be traveling to/from areas to the north, 36.7% were assumed to be traveling to/from areas to the south, and 20.6% were assumed to be internal trips traveling to/from areas within Lihue. All site-generated vehicles traveling to/from the north were assumed to utilize Kapule Highway to access Kuhio Highway north of Lihue. For site-generated vehicles traveling to/from the south, exiting vehicles utilizing the Ahukini Road access, as well as, all entering vehicles were assumed to utilize Kuhio Highway and Ahukini Road to access the airport while exiting vehicles utilizing the Post Office Access Road were assumed to utilize Kapule Highway and Rice Street. The directional distribution of all internal trips was

based on the relative distribution of traffic between Ahukini Road and Kapule Highway. As such, 45.2% of vehicles were assumed to utilize Ahukini Road during the AM peak period to access areas within Lihue while 54.8% were assumed to utilize Kapule Highway. Similarly, during the PM peak period, 41.9% were assumed to utilize Ahukini Road while 58.1% were assumed to utilize Kapule Highway. The directional distribution of these trips at the study intersections was assumed to remain similar to the existing distribution.

B. Through Traffic Forecasting Methodology

The travel forecast is based upon the average annual traffic growth rate as described in the Kauai Long-Range Land Transportation Plan (KLRLTP). The KLRLTP, prepared for the State of Hawaii Department of Transportation in cooperation with the County of Kauai Department of Public Works and the County of Kauai Planning Department, serves as a guide for the development of the major surface transportation facilities and programs to be implemented within the County of Kauai. The Plan identifies strategies and actions that will lead to the development of an integrated intermodal transportation system that facilitates the efficient movement of people and goods. Use of the KLRLTP more accurately reflects the anticipated impacts of traffic growth in the region than the use of historical traffic count data. Based upon statewide population, employment, and visitor forecasts to the Year 2020, the KLRLTP estimates that the average daily traffic in the project vicinity would increase at an average rate of 0.8% and 1.3% per year during the AM and PM peak hours of traffic, respectively. Using 2005 as the Base Year, the growth factors applied to the AM and PM existing through traffic demands, along Kapule Highway, Kuhio Highway, Ahukini Road, and Rice Street to achieve the projected traffic demands are detailed in Table 3.

Table 3: Ambient Growth Factors

Time Period	Year 2010	Year 2020
AM Peak	1.041	1.067
PM Peak	1.127	1.214

C. Other Considerations

1. Kauai Long-Range Land Transportation Plan

The Kauai Long-Range Land Transportation Plan (KLRLTP) details a number of recommended roadway improvements within the project vicinity that should be implemented to alleviate projected traffic operating conditions. These improvements include the following:

- Realign Ahukini Road to connect with Ehiku Street.
- Widen Ahukini Road to a four-lane divided roadway between Kuhio Highway and Kapule Highway.
- Widen Kuhio Highway to a four-lane undivided highway between Kapule Highway and Mailihuna Road (north of the intersection with Kapule Highway).
- Widen Kapule Highway to a four-lane divided highway between Rice Street and Kuhio Highway.
- Construct the four-lane divided Lihue-Hanamaulu mauka bypass road with two-lane connector roads to Ehiku Street, Nawiliwili Road, and propose Nuhou Road.

Although there is an implementation schedule included in the KLRLTP, the current status of these projects is not known at the time of this report. As such, those projects that were initially scheduled to be completed by the Year 2005 were assumed to be completed by the Year 2020 except for the realignment of Ahukini Road. Therefore, the widening of Ahukini Road, Kuhio Highway, and Kapule Highway are assumed to be completed before the Year 2020. The realignment of Ahukini Road and those projects that were initially scheduled to be completed by the Year 2020 were assumed to be completed beyond the study period of this report. As such, the realignment of Ahukini Road and the construction of the mauka bypass are not included in the Year 2020 scenario.

2. Lihue-Hanamaulu Master Plan Development

The Lihue-Hanamaulu Master Plan development includes the development of residential subdivisions, commercial, industrial, and office uses, a school, and a civic center in the vicinity of the Lihue Airport and is expected to be implemented in five phases over a twenty year period. In addition, the master plan development is expected to include a number of major roadway improvement projects including modifications to the intersection of Kuhio Highway and Ahukini Road. In conjunction with Phases I and II of the master plan development, the westbound approach of Ahukini Road at the intersection with Kuhio Highway is expected to be modified to provide two exclusive left-turn lanes. Phases III, IV, and V are expected to include the provision of additional exclusive turning lanes at this intersection. For the purpose of this report, these phases are assumed to at least provide an exclusive southbound left-turn lane and an exclusive northbound right-turn lane along Kuhio Highway. As described in the "Traffic Impact Report for the Proposed Lihue-Hanamaulu Master Plan Development" prepared by Austin, Tsutsumi and Associates in January 1995, Phases I and II of the proposed project are expected to generate a total of 2,119 trips and 3,224 trips during the AM and PM peak hours of traffic, respectively. Phases III, IV, and V are expected to generate an additional 3,755 trips and 5,889 trips during the AM and PM peak hours of traffic, respectively. Although the study assumed that Phases I and II would be completed by the Year 2006, the current status of this project is not know at the time of this report and, as such, for the purpose of this report, Phases I and II are assumed to be completed by the Year 2010 and are incorporated into the Year 2010 without project scenario. Similarly, Phases III, IV, and V were assumed to be completed by the Year 2016 by the report, but for the purpose of this report, these phases are assumed to be completed by the Year 2020 and are incorporated into that year's scenario. These trips were assigned to the street network in the study area to account for trips generated by the proposed master plan development.

3. Kauai Lagoons Resort Redevelopment

The Kauai Lagoons Resort is located south of the Lihue Airport east of Kapule Highway and the proposed project entails the redevelopment of the current site to include new single-family and multi-family units, condominium/recreational units, hotel units, clubhouse, and spa. In addition, the project will also include the intersection modifications to provide exclusive and/or additional turning lanes and the installation of traffic signal systems at the intersections of Kapule Highway with Rice Street and Ninini Point Street/Vidinha Stadium Access Road. The proposed project is expected to be completed by the Year 2015 and, as such, is incorporated in the Year 2020 scenario. As described in the updated "Traffic Impact Report for the Proposed Kauai Lagoons Resort" dated June 2006, the proposed project is expected to generate 141 trips and 219 trips during the AM and PM peak hours of traffic, respectively. These trips were assigned to the street network in the study area to account for trips generated by the proposed development.

4. Vidinha Stadium Complex Expansion

The Vidinha Stadium Complex is located west of Kapule Highway across from the Kauai Lagoons Resort. The proposed project is expected to include swimming pool facilities, tennis courts, and a gymnasium. In addition, the project is expected to modify the intersection of the stadium's access road with Kapule Highway and Ninini Point Street to provide exclusive left-turn lanes along both approaches of Kapule Highway, an exclusive right-turn lane on the southbound approach of Kapule Highway, and an exclusive right-turn lane along the stadium access road. Although the study assumed that the project would be completed by the Year 2001, the current status of this project is not know at the time of this report and, as such, for the purpose of this report, the expansion is assumed to be completed by the Year 2010. As such, for the purpose of this report, the Vidinha Stadium Complex expansion is incorporated in the Year 2010 without project scenario. As described in the "Traffic Impact Analysis Report for the Proposed Vidinha Stadium Complex

Expansion" dated September 1995, the proposed project is expected to generate an additional 65 trips and 176 trips during the AM and PM peak hours of traffic, respectively. These trips were assigned to the street network in the study area to account for trips generated by the proposed expansion.

V. TRAFFIC IMPACT ANALYSIS

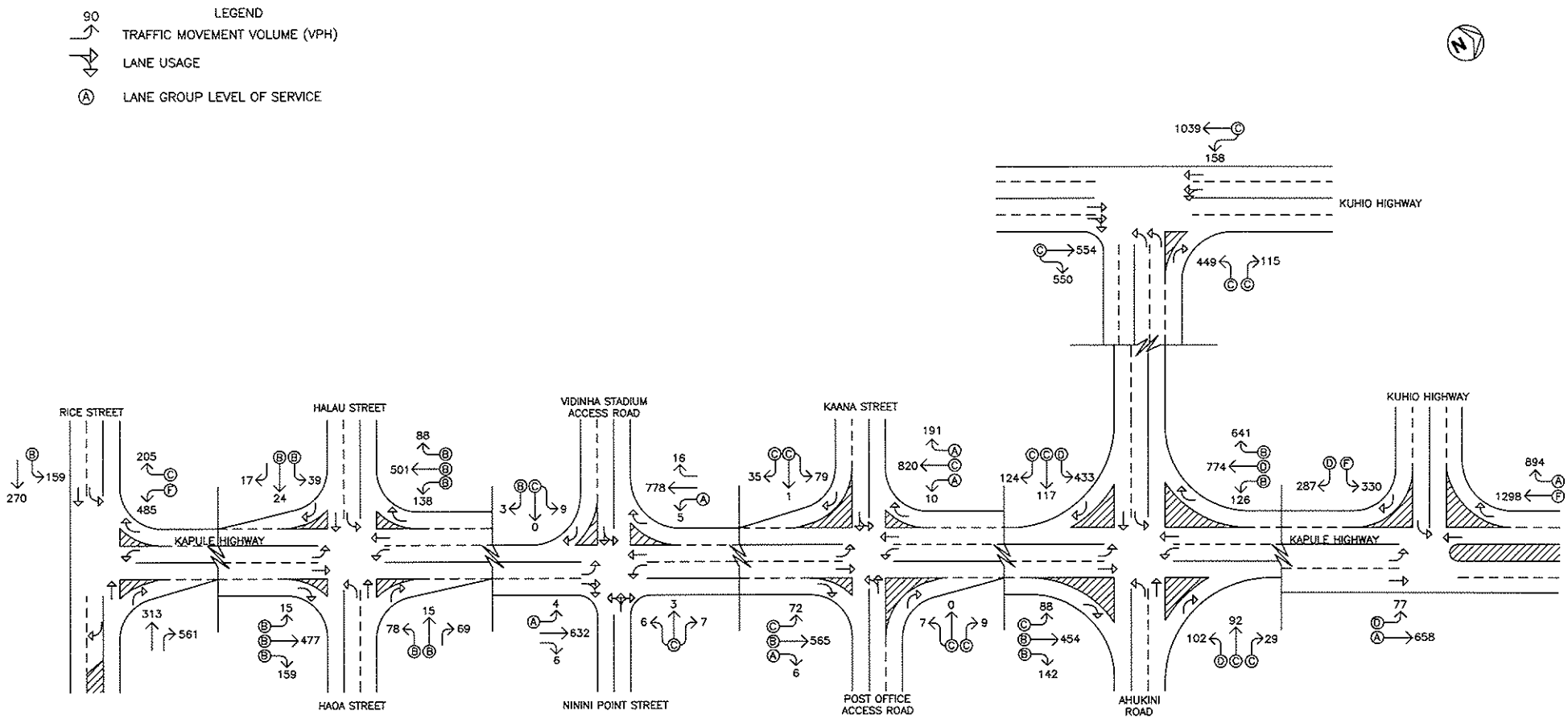
A. Year 2010 Conditions

1. Year 2010 Total Traffic Volumes Without Project

The Year 2010 projected AM peak hour and PM peak hour traffic volumes and operating conditions at the study intersections without the implementation of the proposed Lihue Airport Master Plan Improvements are shown on Figures 9 and 10, and summarized in Table 4. The existing levels of service are provided for comparison purposes. LOS calculations are included in Appendix D.

Table 4: Existing and Projected Year 2010 (Without Project) Traffic Operating Conditions

Intersection	Critical Traffic Movement		AM		PM	
			Exist	Year 2010 w/out Proj	Exist	Year 2010 w/out Proj
Kapule Hwy/ Rice St	Eastbound	LT	A	B	B	B
	Southbound	LT	F	F	F	F
		RT	B	C	C	C
Kapule Hwy/ Halau St/ Haoa St	Westbound	LT	B	B	B	C
	Northbound	TH	B	B	B	C
	Southbound	LT	B	B	B	B
Kapule Hwy/ Vidinha Stadium Access Rd/ Ninini Point St	Eastbound	LT-TH	C	C	C	E
		RT		B		B
	Westbound	LT-TH-RT	B	C	C	D
	Northbound	LT	A	A	A	B
		TH-RT		-		-
	Southbound	LT	A	A	A	B
		TH		-		-
		RT		-		-



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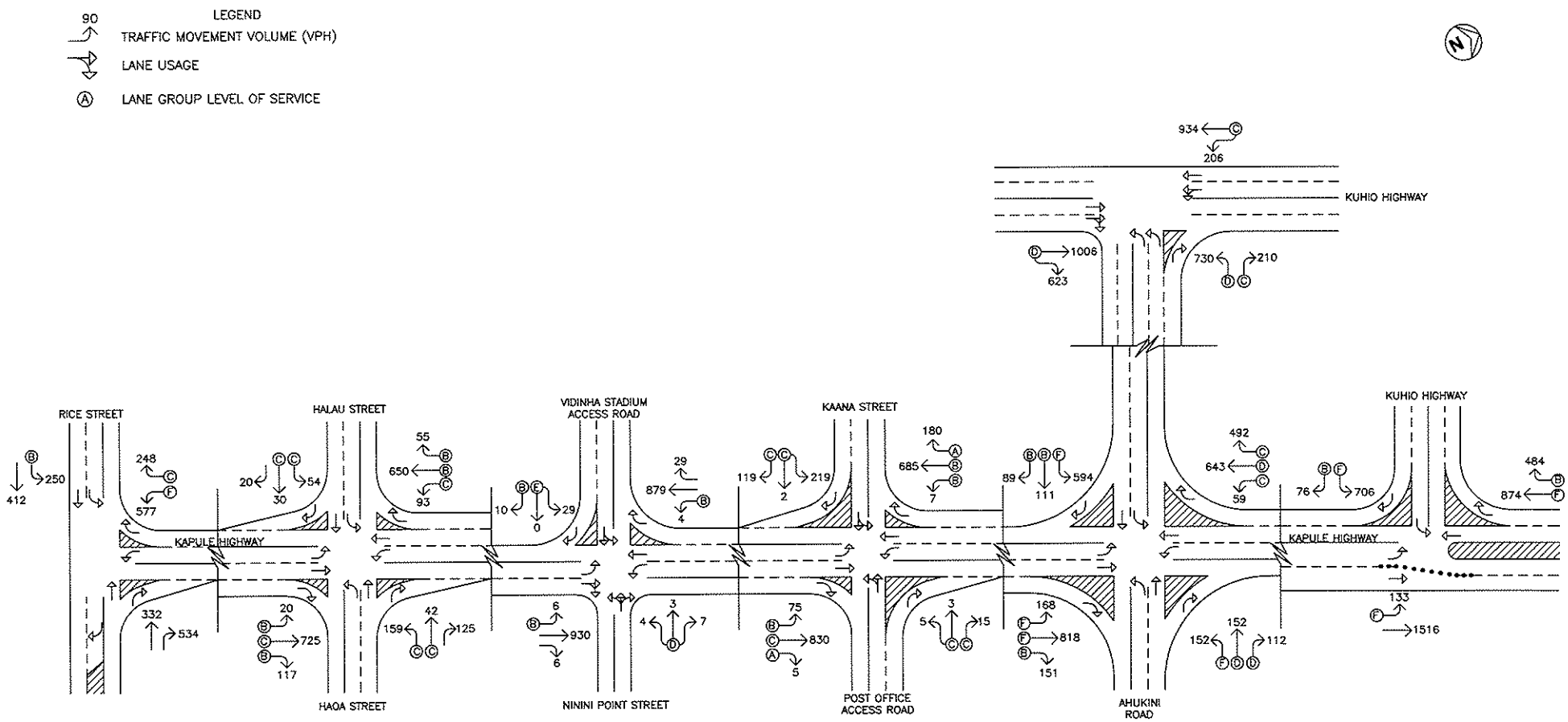
YEAR 2010 AM PEAK HOUR OF TRAFFIC WITHOUT PROJECT

FIGURE 9



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YEAR 2010 PM PEAK HOUR OF TRAFFIC WITHOUT PROJECT

FIGURE 10

Table 4: Existing and Projected Year 2010 (Without Project) Traffic Operating Conditions (Cont'd)

Intersection	Critical Traffic Movement		AM		PM	
			Exist	Year 2010 w/out Proj	Exist	Year 2010 w/out Proj
Kapule Hwy/ Kaana St/Post Office Access Rd	Eastbound	LT-TH	C	C	C	C
	Westbound	LT-TH	C	C	C	C
	Northbound	TH	B	B	C	C
	Southbound	TH	C	C	B	B
Kapule Hwy/ Ahukini Rd	Eastbound	LT	C	D	C	F
	Westbound	LT	C	D	B	F
		TH	C	C	C	D
	Northbound	LT	B	C	B	F
		TH	B	B	C	F
	Southbound	TH	C	D	C	D
Kapule Hwy/ Kuhio Hwy	Eastbound	LT	D	F	D	F
	Northbound	LT	C	D	C	F
	Southbound	TH	D	F	D	F
Ahukini Rd/ Kuhio Hwy	Westbound	LT	C	C	C	D
	Northbound	TH-RT	C	C	C	D
	Southbound	LT-TH	C	C	C	C

Traffic operations in the project vicinity are generally anticipated to deteriorate under Year 2010 without project conditions due to the anticipated increases in traffic along the surrounding roadways as a result of ambient traffic growth and the Lihue-Hanamaulu Master Plan development. The critical movements at the intersections of Kapule Highway with Kaana Street and the Post Office Access Road are anticipated to remain similar to existing conditions while those at the intersections of Kapule Highway with Halau Street/Haoa Street and Kuhio Highway with Ahukini Road are anticipated to operate at slightly lower, but acceptable levels of service. At the intersections of Kapule Highway with Rice Street, Ahukini Road, Kuhio Highway, the critical movements are anticipated to operate at unacceptable levels of service while those at the intersection of Kapule Highway with Ninini Point Street and the Vidinha Stadium Access Road are anticipated to operate to LOS "E" or

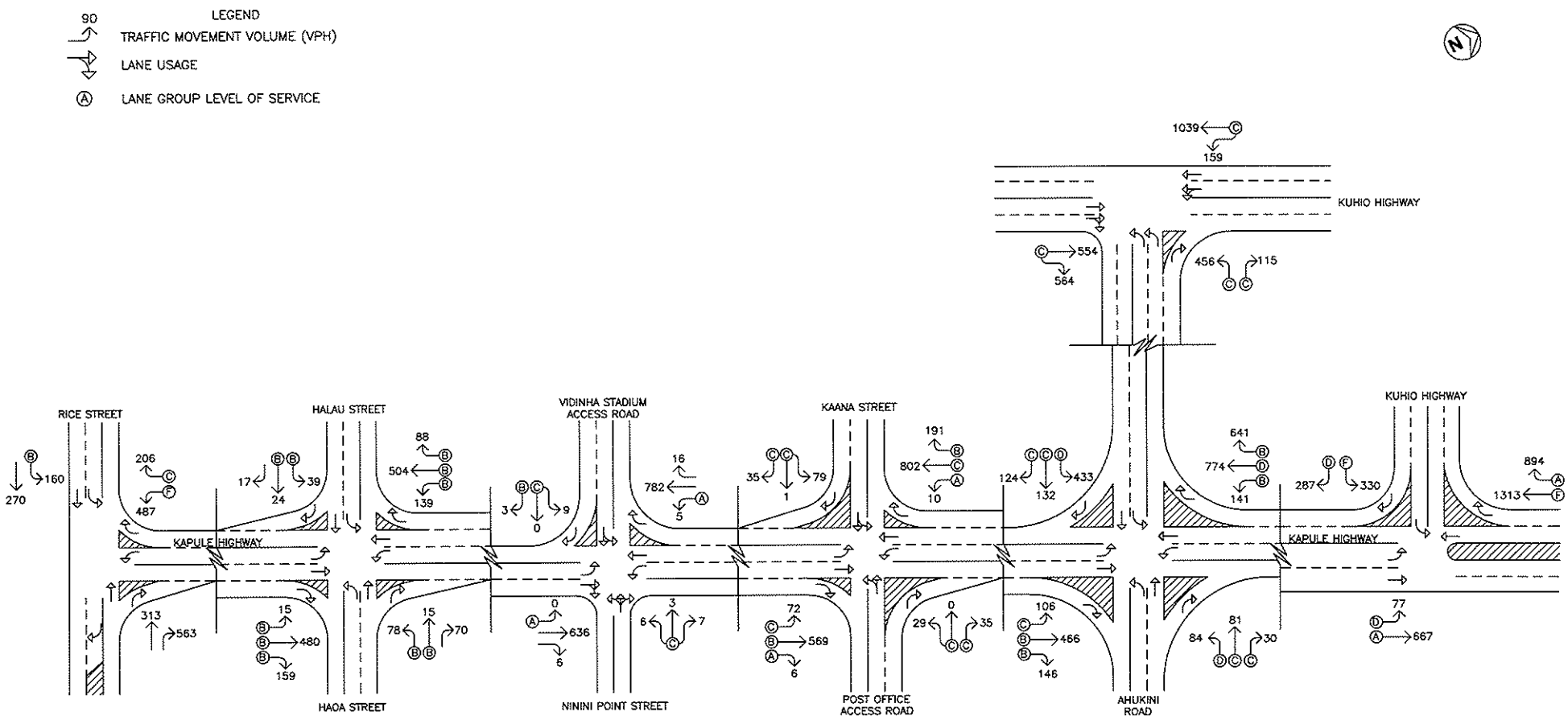
better despite modifications to the highway and the Vidinha Stadium Access Road approach.

2. Year 2010 Total Traffic Volumes With Project

The Year 2010 cumulative AM and PM peak hour traffic conditions resulting from the projected external traffic and the implementation of the proposed Lihue Airport Master Plan Improvements are shown in Figures 11 and 12, and summarized in Table 5. The projected Year 2010 operating conditions without the proposed project are provided for comparison purposes. LOS calculations are included in Appendix E.

Table 5: Projected Year 2010 (Without and With Project) Traffic Operating Conditions

Intersection	Critical Traffic Movement		AM		PM	
			w/out Proj	w/ Proj	w/out Proj	w/ Proj
Kapule Hwy/ Rice St	Eastbound	LT	B	B	B	B
	Southbound	LT	F	F	F	F
		RT	C	C	C	C
Kapule Hwy/ Halau St/ Haoa St	Westbound	LT	B	B	C	C
	Northbound	TH	B	B	C	C
	Southbound	LT	B	B	B	C
Kapule Hwy/ Vidinha Stadium Access Rd/ Ninini Point St	Eastbound	LT-TH	C	C	E	E
		RT	B	B	B	B
	Westbound	LT-TH-RT	C	C	D	D
	Northbound	LT	A	A	B	B
	Southbound	LT	A	A	B	B
Kapule Hwy/ Kaana St/Post Office Access Rd	Eastbound	LT-TH	C	C	C	C
	Westbound	LT-TH	C	C	C	C
	Northbound	TH	B	B	C	C
	Southbound	TH	C	C	B	B
Kapule Hwy/ Ahukini Rd	Eastbound	LT	D	D	F	F
	Westbound	LT	D	D	F	F
		TH	C	C	D	D
	Northbound	LT	C	D	F	F
		TH	B	B	F	F
	Southbound	TH	D	D	D	D
Kapule Hwy/ Kuhio Hwy	Eastbound	LT	F	F	F	F
	Northbound	LT	D	D	F	F
	Southbound	TH	F	F	F	F



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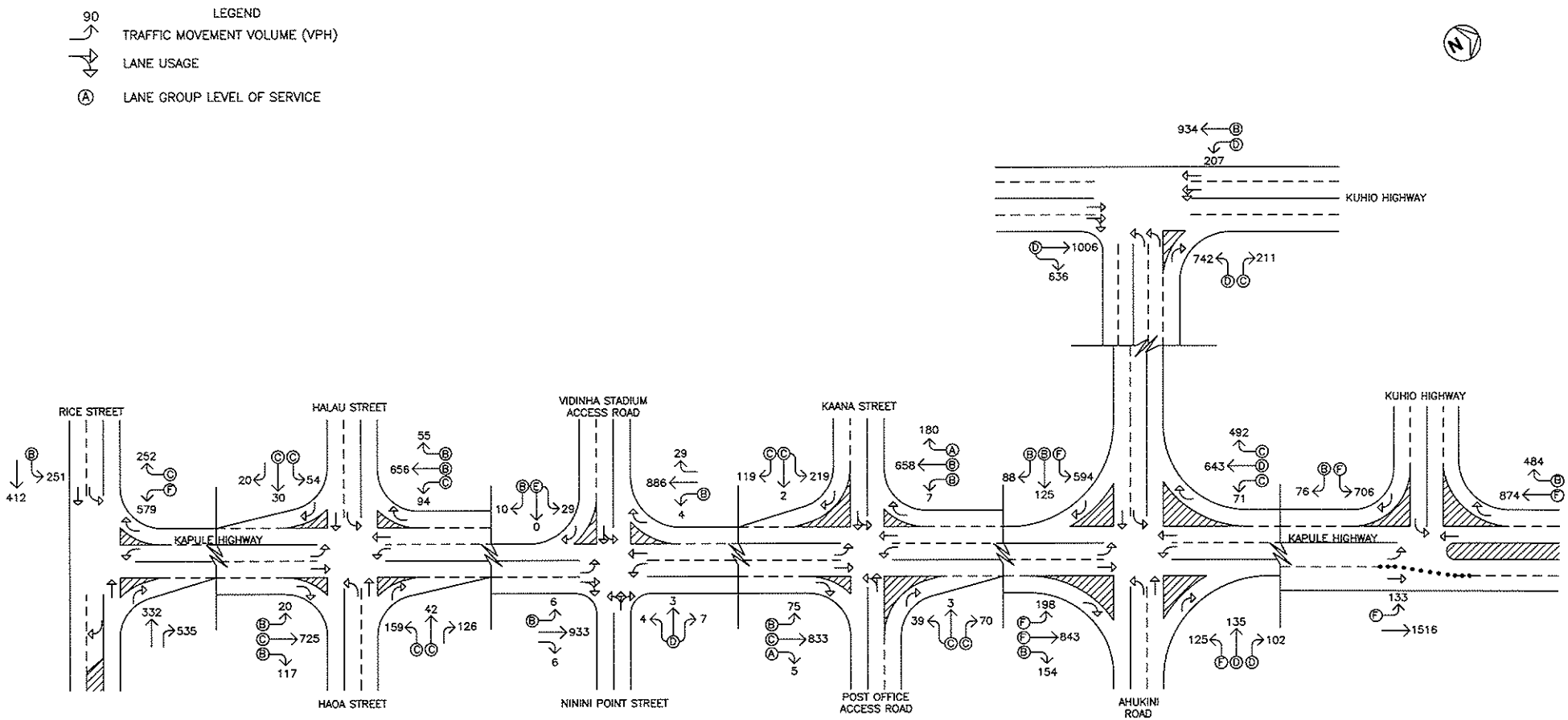
LIHUE AIRPORT MASTER PLAN IMPROVEMENTS

YEAR 2010 AM PEAK HOUR OF TRAFFIC WITH PROJECT

FIGURE 11



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YEAR 2010 PM PEAK HOUR OF TRAFFIC WITH PROJECT

FIGURE 12

Table 5: Projected Year 2010 (Without and With Project) Traffic Operating Conditions (Cont'd)

Intersection	Critical Traffic Movement		AM		PM	
			w/out Proj	w/ Proj	w/out Proj	w/ Proj
Ahukini Rd/ Kuhio Hwy	Westbound	LT	C	C	D	D
	Northbound	TH-RT	C	C	D	D
	Southbound	LT-TH	C	C	C	C

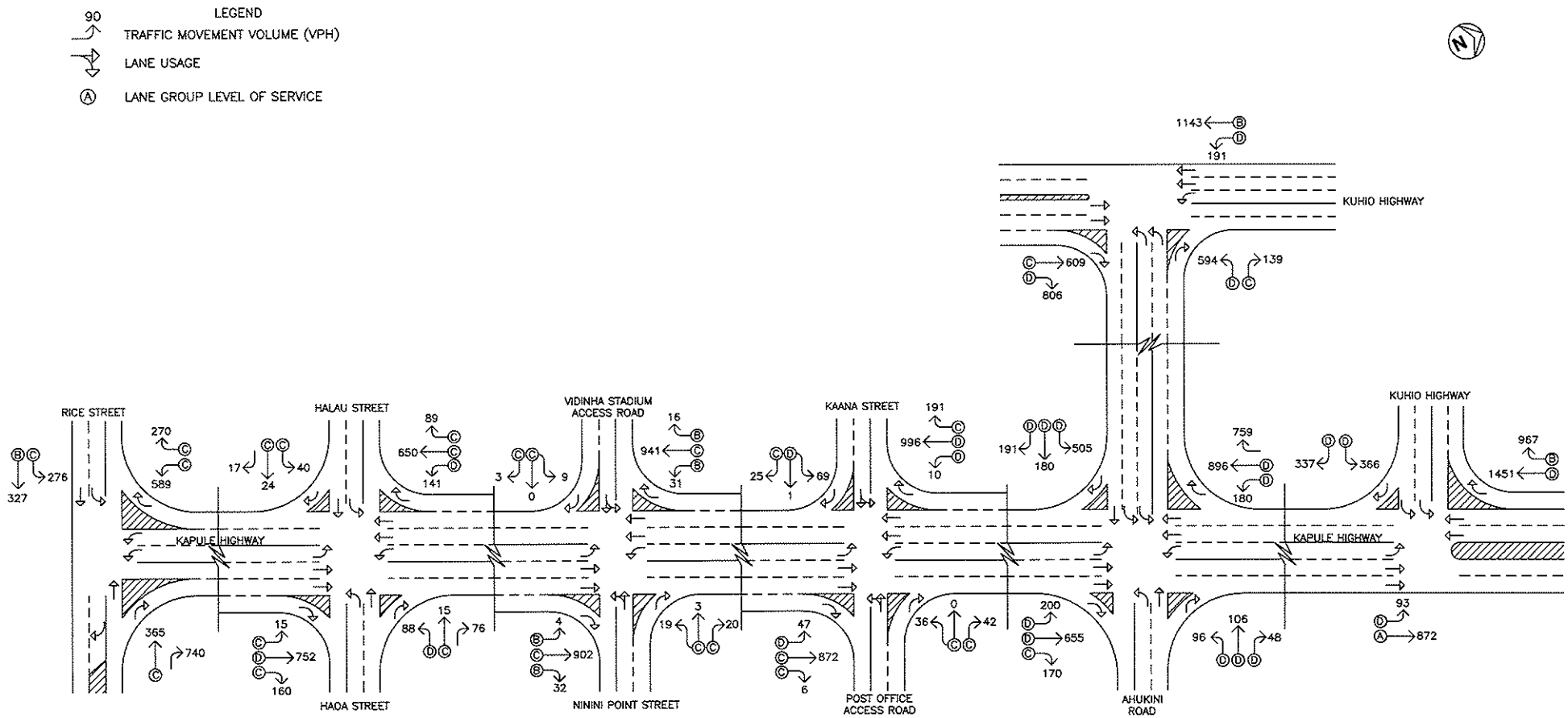
The projected Year 2010 traffic operations with the implementation of the proposed Lihue Airport Master Plan Improvements are generally expected to remain similar to without project conditions during both peak hours of traffic. The critical movements at the intersections of Kapule Highway with Halau Street/Haoa Street and Kaana Street/Post Office Access Road are anticipated to continue operating at LOS "C" or better while those at the intersection of Kuhio Highway with Ahukini Road are anticipated to continue operating at LOS "D" or better. Similarly, the critical movements at the intersections of Kapule Highway with Rice Street, Ahukini Road, and Kuhio Highway are expected to continue operating poorly at LOS "F" or better while those at the intersection with Ninini Point Street and the Vidinha Stadium Access Road are expected to continue operating poorly at LOS "E" or better. The proposed project is anticipated to increase the total traffic volumes at the study intersections along Kapule Highway and Kuhio Highway by less than 1% during both peak periods with the exception of the intersection of Kapule Highway with Kaana Street and the Post Office Access Road. The total volume at this intersection is expected to increase by 2-3% during both peak periods. However, all of these increases in the total traffic volumes are in the range of daily volume fluctuations along this roadway and represent a minimal increase in the overall traffic volumes.

B. Year 2020 Total Traffic Volumes With Project

The Year 2020 cumulative AM and PM peak hour traffic conditions resulting from the projected external traffic and the implementation of the proposed Lihue Airport Master Plan Improvements are shown in Figures 13 and 14, and summarized in Table 6. The projected Year 2010 with project operating conditions are provided for comparison purposes. LOS calculations are included in Appendix F.

Table 6: Year 2010 and 2020 With Project Traffic Operating Conditions

Intersection	Critical Traffic Movement		AM		PM	
			Year 2010 w/ Proj	Year 2020 w/ Proj	Year 2010 w/ Proj	Year 2020 w/ Proj
Kapule Hwy/ Rice St	Eastbound	LT	B	C	B	C
		TH	-	B	-	B
	Westbound	TH	-	C	-	C
	Southbound	LT	F	C	F	C
		RT	C	C	C	C
Kapule Hwy/Halau St/ Haoa St	Westbound	LT	B	D	C	D
	Northbound	TH	B	D	C	D
	Southbound	LT	B	D	C	D
Kapule Hwy/Vidinha Stadium Access Rd/ Ninini Point St	Eastbound	LT-TH	C	C	E	C
		RT	B	C	B	C
	Westbound	LT-TH	C	C	D	C
		RT		C		C
	Northbound	LT	A	B	B	B
		TH	-	C	-	C
		RT		B		B
	Southbound	LT	A	B	B	B
		TH	-	C	-	C
		RT	-	B	-	B
Kapule Hwy/ Kaana St/ Post Office Access Rd	Eastbound	LT-TH	C	D	C	D
	Westbound	LT-TH	C	C	C	C
	Northbound	TH	B	C	C	D
	Southbound	TH	C	D	B	D



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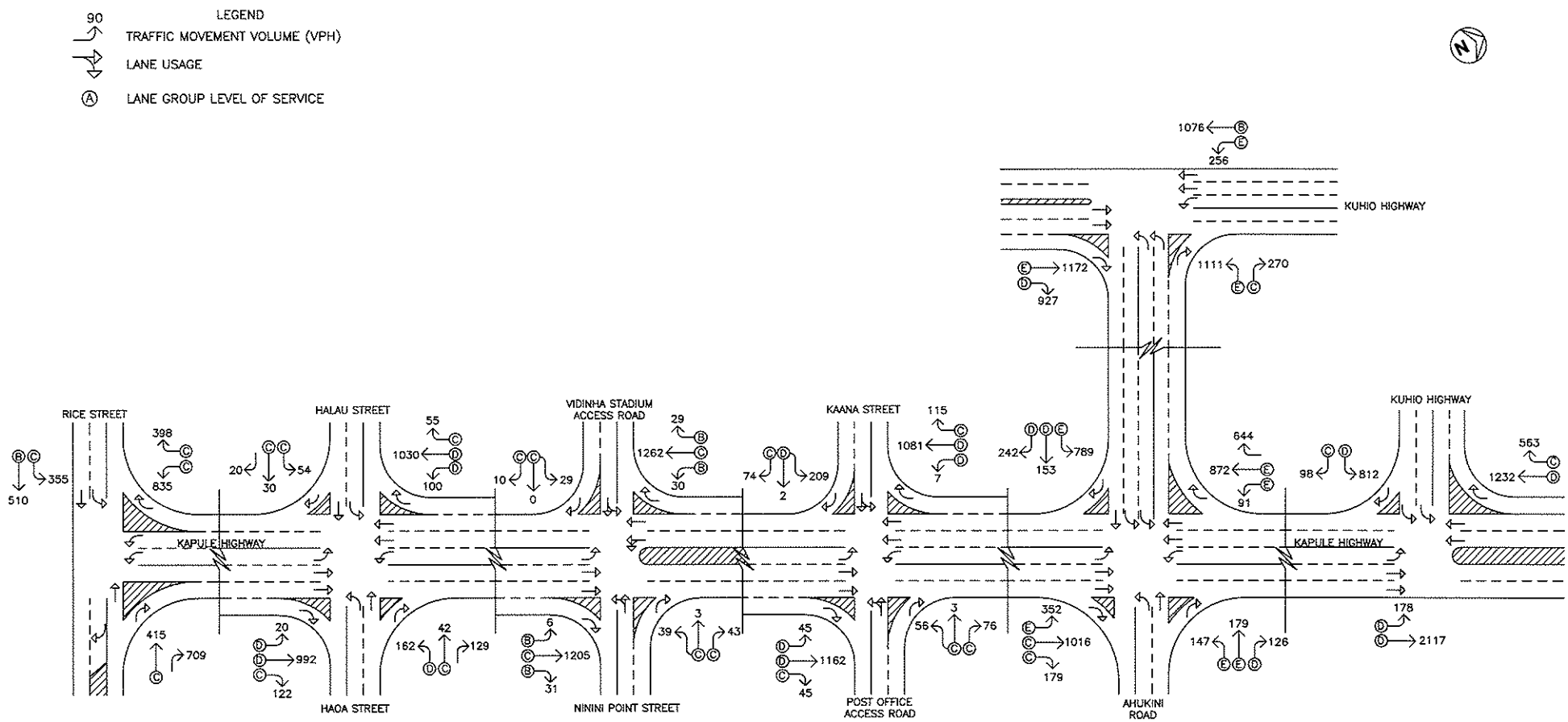
YEAR 2020 AM PEAK HOUR OF TRAFFIC WITH PROJECT

FIGURE 13



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LIHUE AIRPORT MASTER PLAN IMPROVEMENTS

YEAR 2020 PM PEAK HOUR OF TRAFFIC WITH PROJECT

FIGURE 14

Table 6: Year 2010 and 2020 With Project Traffic Operating Conditions (Cont'd)

Intersection	Critical Traffic Movement		AM		PM	
			Year 2010 w/ Proj	Year 2020 w/ Proj	Year 2010 w/ Proj	Year 2020 w/ Proj
Kapule Hwy/ Ahukini Rd	Eastbound	LT	D	D	F	E
	Westbound	LT	D	D	F	E
		TH	C	D	D	E
	Northbound	LT	C	D	F	E
		TH	B	D	F	C
	Southbound	TH	D	D	D	E
Kapule Hwy/ Kuhio Hwy	Eastbound	LT	F	D	F	D
	Northbound	LT	D	D	F	D
	Southbound	TH	F	D	F	D
Ahukini Rd/ Kuhio Hwy	Westbound	LT	C	D	D	E
	Northbound	TH	C	C	D	E
		RT		D		D
	Southbound	LT	C	D	C	E
		TH		B		B

Traffic operations in the project vicinity are generally anticipated to improve under Year 2020 with project conditions despite the anticipated increases in traffic along the surrounding roadways due to planned improvements to Kapule Highway, Kuhio Highway, and Ahukini Road, and the installation of a traffic signal systems at the intersections of Kapule Highway with Rice Street and Ninini Point Street/Vidinha Stadium Access Road. The critical movements at the intersections of Kapule Highway with Rice Street and Ninini Point Street/Vidinha Stadium Access Road are anticipated to operate LOS "C" or better while those at the intersections with Halau Street/Haoa Street, Kaana Street/Post Office Access Road, and Kuhio Highway are anticipated to operate at LOS "D" or higher. At the intersections of Ahukini Road with Kapule Highway and Kuhio Highway, the critical movements are expected to operate at LOS "D" or better during the AM peak period and LOS "E" or better during the PM peak period.

The anticipated increases in traffic in the project vicinity are primarily due to ambient growth in traffic and the development of other projects in the vicinity such as the Lihue-Hanamaulu Master Plan development. The proposed Lihue Airport Master Plan Improvements are anticipated to increase the total traffic volumes along Kapule Highway and Kuhio Highway by an additional 1-2% during both peak periods. These increases in the total traffic volumes are in the range of daily volume fluctuations along this roadway and represent a minimal increase in the overall traffic volumes.

VI. RECOMMENDATIONS

Based upon the analysis of the traffic data, the following are the recommendations of this study:

1. Maintain adequate sight distances for motorists to safely enter and exit all airport driveways/roadways.

2. Maintain adequate turning radii at all project driveways/roadways to avoid or minimize vehicle encroachments to oncoming traffic lanes.

3. Maintain adequate on-site loading and off-loading service areas and prohibit off-site loading operations.

VII. CONCLUSION

The proposed Lihue Airport Master Plan improvements are not expected to have a significant impact on traffic operations in the vicinity of airport. Although significant increases in traffic volumes along the surrounding roadways are projected, these increases are primarily due to the ambient growth in traffic and the development of other projects in the vicinity such as the Lihue-Hanamaulu Master Plan development. By Year 2010, the total traffic volumes at the study intersections along Kapule Highway and Kuhio Highway are expected to increase by less than 1% during both peak periods due to the project with the exception of the intersection of Kapule Highway with Kaana Street and the Post Office Access Road. The total volume at this intersection is expected to increase by 2-3% during both peak periods. By Year 2020, the total traffic volumes at the study intersections are expected to increase by an additional 1-2% during both peak periods. These increases in the total traffic volumes are in the range of daily volume fluctuations along these roadways and represent a minimal increase in the overall traffic volumes. However, the implementation of

planned improvements along Kapule Highway, Kuhio Highway, and Ahukini Road, and the installation of a traffic signal systems at the intersections of Kapule Highway with Rice Street and Ninini Point Street/Vidinha Stadium Access Road should help to alleviate projected traffic operating conditions due to ambient growth and other developments.