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1991 - Oahu - FEIS - Makaiwa Vol. II

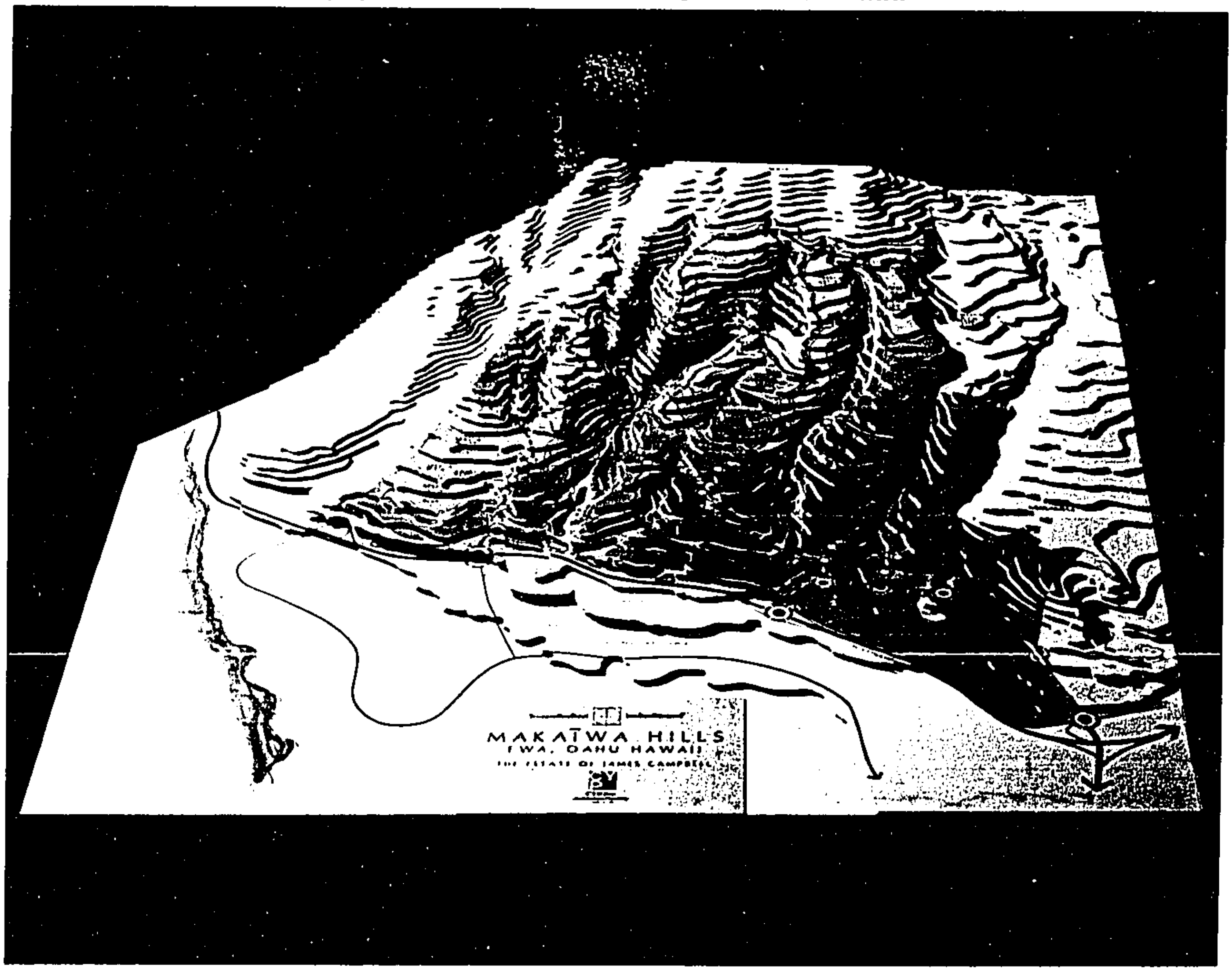
VOLUME II

FINAL ENVIRONMENTAL IMPACT STATEMENT

Makaiwa Hills

EWA, OAHU, HAWAII

prepared for: THE ESTATE OF JAMES CAMPBELL



prepared by: WILLIAM E. WANKET, INC.

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Final
Environmental Impact Statement

Makaiwa Hills

Ewa, Oahu, Hawaii

Volume II

Prepared For:
The Estate of James Campbell

For Submittal To:
Department of General Planning

Prepared By:
William E. Wanket, Inc.

Submitted pursuant to Chapter 343, Hawaii Revised Statutes, Environmental Impact Statement Regulations

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April 1991

LIST OF APPENDICES

[The following Technical Reports, including Consultant Resumes, are contained in *Volume II* of the DEIS.]

Appendix A.

Preliminary Engineering Report for the Proposed Makaiwa Hills

Engineering Concepts, Inc.

PRELIMINARY ENGINEERING REPORT

FOR THE

PROPOSED MAKAIWA HILLS DEVELOPMENT

EWA, OAHU, HAWAII

Prepared for:

The Estate of James Campbell
Honolulu, Hawaii

Prepared by:

Engineering Concepts, Inc.
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January 1991

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EXECUTIVE SUMMARY

The Estate of James Campbell is proposing a 2,130-unit residential subdivision and 156 acres of commercial uses in Ewa, Oahu. The development, known as Makaiwa Hills, will occupy approximately 1,915 acres on the slopes of the Waianae mountain range west of Makakilo City. An 18-hole golf course may be developed at the site in the future. Preliminary engineering information pertaining to the project infrastructure requirements are addressed in this report.

DRAINAGE

There are no existing drainage improvements within the project site. Fifteen culverts of varying size are located adjacent to the site along Farrington Highway. The culverts convey runoff from the 3,662-acre watershed (including the project site) under the highway to downstream drainage facilities at Honokai Hale, Ko Olina Resort, and Campbell Industrial Park. Existing runoff quantities were calculated for the tributary area of each culvert based on a rainfall duration of one hour, and rainfall intensities of 1.9 and 2.3 inches for the 10- and 50-year storms, respectively. Under existing conditions, peak runoff rates of 3,693 cfs (10-year) and 4,474 cfs (50-year) were calculated for the watershed. Corresponding runoff volumes of 236 acre-ft (10 year) and 288 acre-ft (50-year) were also calculated.

As a result of the proposed improvements, the rate of peak runoff and runoff volume are expected to increase by about 17 percent to 4,330 cfs (275 acre-ft) for the 10-year storm and 5,243 cfs (337 acre-ft) for the 50-year storm. The peak runoff rate for the 100-year storm based on the City and County design curve will be used in the design of drainage improvements for drainage areas greater than 100 acres.

Impacts on developments downstream of the Makaiwa Hills site are not expected to be adverse. The makai developments will use the peak runoff criteria of the City and County of Honolulu, Department of Public Works. In general, the impact of increased runoff to the highway culverts can be mitigated by constructing detention basins to dampen peak runoff rates or additional culverts may be installed to increase the existing culvert capacity. Construction of additional culverts may result in short term impacts (traffic disturbances) which can be mitigated by limiting construction hours, implementing an approved traffic control plan, and coordinating other planned construction along the highway.

SOIL EROSION

The Universal Soil Loss Equation (USLE) is used to estimate long term annual soil losses from the project site before and after development. Under existing conditions, the existing soil erosion potential of the site is 44,800 tons/year.

The long term soil erosion potential is expected to decrease significantly after development due to reduction of erodible surfaces, reduction of length and slope of overland flow, and increase in landscaped areas. Based on the proposed residential/commercial development, the long term soil erosion potential for the site is estimated to be 6,100 tons/year--a decrease of 86 percent. Long term soil erosion potential is estimated to decrease another 10 percent to 5,500 tons/year if a golf course is constructed on previously undeveloped land in the future.

Calculations of short term soil erosion potential are based on grading of 80 acres/year over a fifteen year period. Short term soil erosion potential during construction is estimated to be 38,000 tons/year for the Makaiwa Hills development. Mitigating measures (e.g. grassing, limiting grading to no more than 15 consecutive acres, etc.) implemented during construction will reduce the estimated short term soil erosion potential by 17,800 tons per year or 48 percent.

WATER

The Board of Water Supply (BWS) system provides potable water service to the Ewa/Kapolei region. However, the BWS system does not serve the project site at present.

Water demand estimates for the project are separated into potable and nonpotable demand. The average daily potable water demand for the project is estimated to be 1.46 MGD (1.48 MGD with a golf course). The average daily nonpotable water demand for irrigation purposes is estimated to be 0.32 MGD (1.06 MGD with a golf course).

Based on a preliminary analysis, two distinct potable water distribution systems are proposed for the project due to the site topography. The eastern distribution system will require ten reservoirs and nine booster pumping stations for the five service zones. The western distribution system will require four reservoirs and four booster pumping stations for the four service zones. The proposed onsite potable water system will be designed in accordance with the BWS Water System Standards and is intended to be dedicated to the BWS for operation and maintenance.

The proposed project and other developments in the region will impact the existing BWS water system facilities. In an effort to reduce potable water consumption, a dual water system is proposed. Nonpotable water will be used for irrigation in areas other than residential land uses. The Estate of James Campbell is a member of the Ewa Plain Water Development Corporation. Water system requirements for Makaiwa Hills have been considered in regional water system planning.

WASTEWATER

There are no existing wastewater facilities within the project site at present. After development, the total average wastewater flow rate from Makaiwa Hills is estimated to be 1.285 MGD (1.305 MGD upon future development of the golf course). Wastewater generated by the development is expected to be of typical domestic composition.

Connection to the municipal sewer system for conveyance to the Honouliuli WWTP is recommended. The onsite collection system will include gravity sewers, force mains, and sewage pumping stations designed in accordance with City and County standards. A 21-inch offsite sewer will be required to convey wastewater from the project site to the existing Ko Olina interceptor. It is intended that the onsite collection system and 21-inch offsite sewer be dedicated to the City and County for operation and maintenance.

Capacity expansion of the Honouliuli WWTP is expected to precede development of Makaiwa Hills; thus wastewater flows from the project are not expected to create a negative impact on the WWTP capacity. A sewer connection application will be required by the City prior to authorizing connection to the municipal system. Inadequacies in the municipal collection and treatment system will be identified and participation in improving the municipal system will be required for approval. Proposed improvements include relief sewers for the Ko Olina and Makakilo interceptors. These sewers will be designed to accommodate wastewater flows from the Makaiwa Hills and other projects proposed in the region. Construction of the 21-inch offsite sewer may cause a temporary inconvenience to motorists along Farrington Highway. Implementation of an approved traffic control plan will mitigate this potential short term impact.

SOLID WASTE

Solid waste will be generated by the project site during construction and after development. Based on typical per capita generation rates, 17 tons/day is estimated to be generated from the residential areas within the site, requiring 24 truck trips per week for collection. It is anticipated that refuse from residential areas will be collected by the City and County, while private collection companies will service the commercial and future golf course developments.

Generation of municipal wastes will be a long term impact of development. Refuse from the proposed Makaiwa Hills development is not expected to have a significant impact on the Leeward Oahu solid waste disposal facilities. Combustible refuse will be disposed at the H-POWER waste energy recovery facility, with the remaining refuse to be landfilled at the municipal Waimanalo Gulch landfill. Generation of construction wastes as a result of clearing and grubbing the site will be a short term impact. Most of these wastes will be combustible, and the contractor will be responsible for removal of the wastes from the site.

POWER AND COMMUNICATIONS

Under existing conditions, Hawaiian Electric Company (HECO) 138 kv and 46 kv transmission lines traverse the project site. The overhead transmission lines originate at the Kahe Power Plant. In addition, HECO is currently meeting with government officials and the Estate of James Campbell to select and approve a route for a proposed 138 kv transmission line from the Waiau Power Plant to the Campbell Industrial Park Substation. A portion of the route may cross the Makaiwa Hills site.

The estimated power requirement for the development is 6.5 MVA. Discussions between the Estate of James Campbell and HECO are ongoing. Mitigation of potential impacts to the HECO system due to Makaiwa Hills and other projects in the Ewa/Kapolei area are under consideration in the planning of new facilities.

PRELIMINARY ENGINEERING REPORT
FOR THE
PROPOSED MAKAIWA HILLS DEVELOPMENT

INTRODUCTION

The Estate of James Campbell is proposing a residential and commercial development in Ewa, Oahu. The development, known as Makaiwa Hills, will occupy approximately 1,915 acres on the slopes of the Waianae mountain range west of Makakilo (TMK: 9-1-15:5,11,17; 9-1-16:Portion 9; 9-2-03:Portion 2). The project site is bordered to the south by Farrington Highway, to the west by Waimanalo Gulch, to the north by Palehua Road, and by Makakilo City to the east (see Figure 1).

The objectives of this preliminary engineering investigation are to present information on infrastructure requirements for the proposed Makaiwa Hills development. Specifically, this report will address:

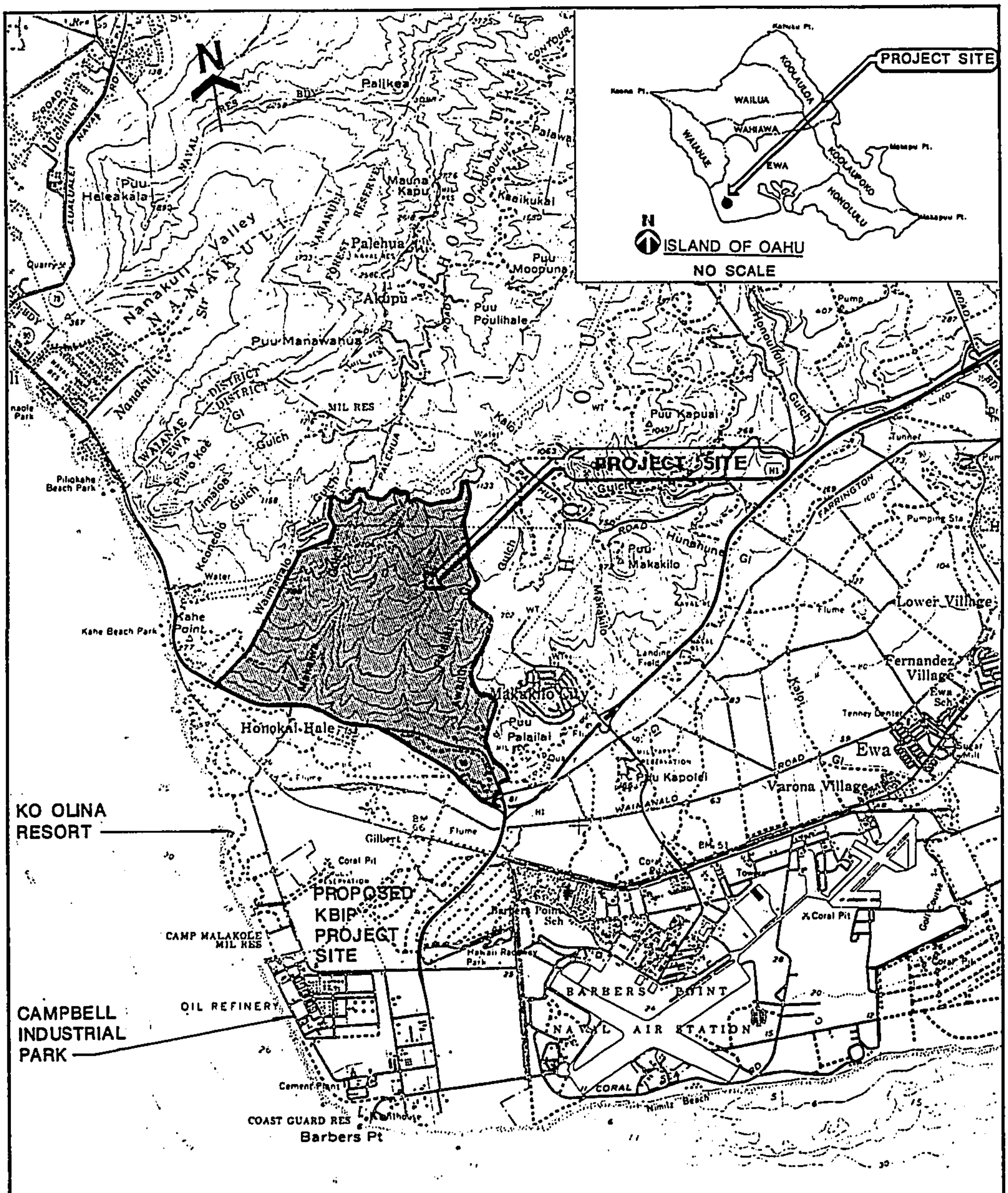
1. background information on the proposed project;
2. existing conditions;
3. modifications after development; and
4. potential impacts due to development and proposed mitigative measures.

PROJECT BACKGROUND

The proposed Makaiwa Hills development will include land uses in the approximate quantities listed in Table 1.

LAND USE AND ZONING

The majority of the project site (approximately 1,875 acres) is currently designated as an Agricultural District by the State. The remaining 40± acres are designated Urban. The City and County Department of Land Utilization has zoned the majority of the project site (approximately 1,779 acres) as AG-2 (General Agriculture). Approximately 96 acres are zoned AG-1 (Restricted Agriculture), and the remaining 40± acres are zoned R-5 (Residential).



GRAPHIC SCALE

0 1/2 1 mile 2 miles

1"=1 mile

FIGURE 1

LOCATION MAP

PREPARED BY: ENGINEERING CONCEPTS, INC.
DATE: OCTOBER 1990

TABLE 1 - PROPOSED LAND USES

LAND USE	ACREAGE
Residential (2,130 units)	726
Commercial	156
Park	16
School	8
Fire Station	1
Circulation/Roads	107
Preservation	901*
TOTAL	1,915

*180 acres may be considered for development of a golf course in the future

EXISTING USES

The project site is presently undeveloped. A portion of the site is leased for ranch lands. Cattle roam along Palehua Road at the northern boundary of the site, and horses graze along the southeastern portion of the site near Farrington Highway.

Camp Timberline (a privately operated facility) and several private residences are located on leased lands north of the project site. Access to Camp Timberline and the private residences is via Palehua Road.

Abandoned military buildings are also located off of Palehua Road, north of the project site. The buildings were associated with the former Nike Station.

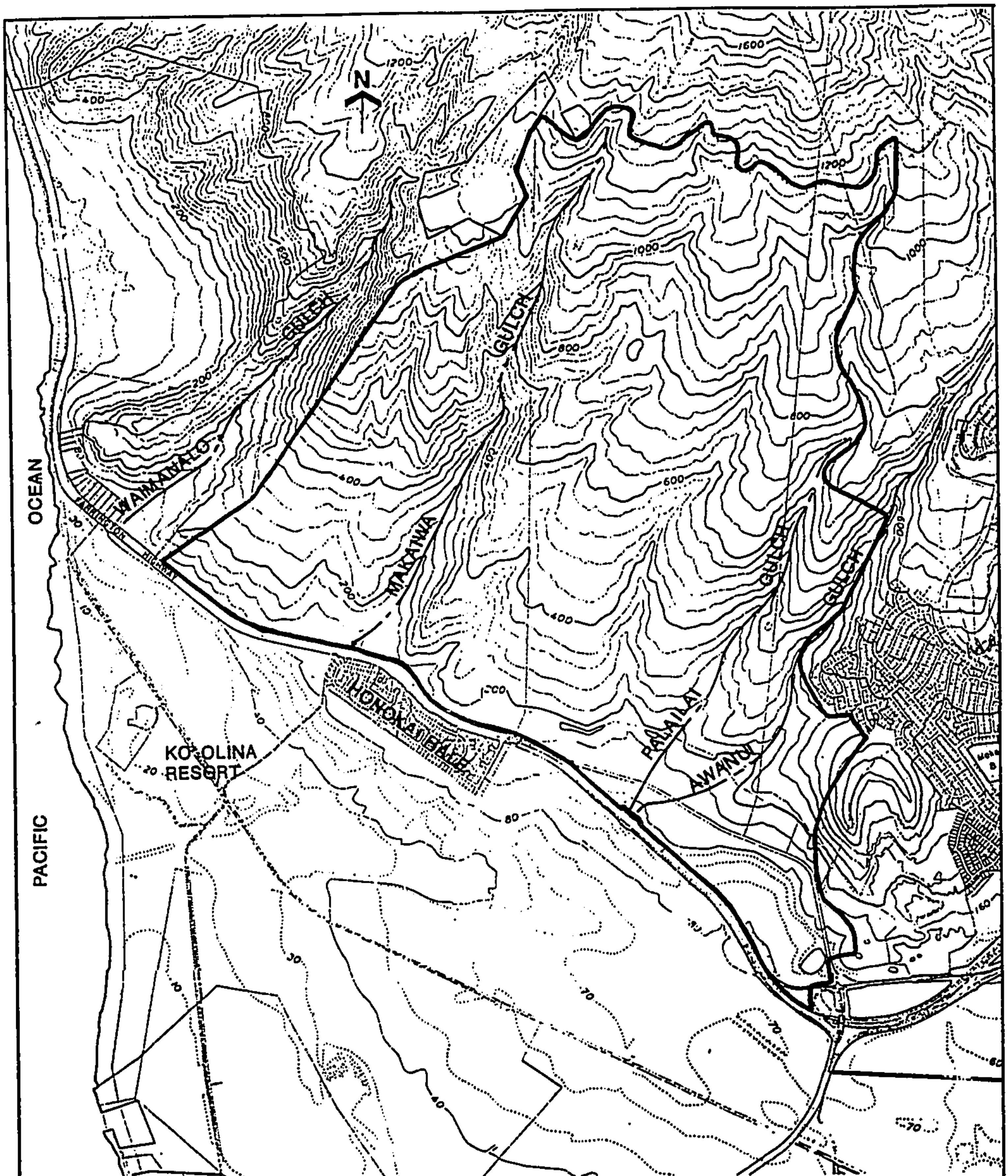
CLIMATE

The climate in the Ewa Plain region is relatively warm and dry. Tradewinds from the northeast occur much of the time, with occasional Kona winds. The normal temperature range for the region varies from the high 60's (degrees Fahrenheit) to the low 90's. Rainfall is light, with mean annual rainfall of about 20 inches near Farrington Highway, and about 30 inches at the northern boundary.

TOPOGRAPHIC FEATURES

The project site ranges in elevation from about 50 feet mean sea level (MSL) at Farrington Highway, to an elevation of about 1,300 feet at the northern boundary.

Three major gulches and three minor unnamed gulches transect the project site from north to south. The major gulches are Awanui Gulch, Palailai Gulch, and Makaiwa Gulch (see Figure 2). Slopes as low as 2 percent exist in the southeastern corner of the site. Across the plateaus and ridges, slopes of about 10 percent are common. Slopes are steeper within the gulches, varying from 15 to 50 percent. Vegetation is mainly characterized by tall grasses with clumps of scattered brush or bushes and eroded patches of ground. Kiawe and koa-haole shrubs are found in the gulch areas.



GRAPHIC SCALE

0 1000' 2000' 4000'

1"=2000'

FIGURE 2

TOPOGRAPHIC MAP

PREPARED BY: ENGINEERING CONCEPTS, INC.
DATE: OCTOBER 1990

SOILS

Soil types within the project site are identified in the U.S. Department of Agriculture, Soil Conservation Service, Soil Survey. The major soil types are listed below and depicted on Figure 3:

- Stony steep land (rsy)
- Lualualei extremely stony clay (LPE)
- Helemano silty clay (HLMG)
- Honouliuli clay (HxA, HxB)
- Mahana-Badland complex (MBL)
- Mahana silty clay loam (McC2, McD2, McE2)
- Lualualei stony clay (LvB)
- Ewa silty clay loam (EaB)
- Molokai silty clay loam (MuC)
- Ewa stony silty clay (EwC)
- Rock land (rRK)

DRAINAGE

EXISTING CONDITIONS

The project site occupies 1,915 acres of a 3,662-acre watershed. The lower watershed boundary has been set at Farrington Highway for simplification. The watershed extends from Makakilo City to the east, to the western ridge forming Waimanalo Gulch to the west. The northern watershed boundary extends over 16,000 feet mauka of Farrington Highway to the crest of the Waianae mountain range. Watershed elevations range from about 50 feet along Farrington Highway to about 2,300 feet at the northern boundary.

There are no existing drainage improvements within the project site. However, approximately fifteen culverts are located adjacent to the project site, conveying storm runoff from the site and mauka areas under Farrington Highway (see Figure 4). The culverts are located along a 2.5 mile stretch of Farrington Highway between Stations 67+75 and 198+20.

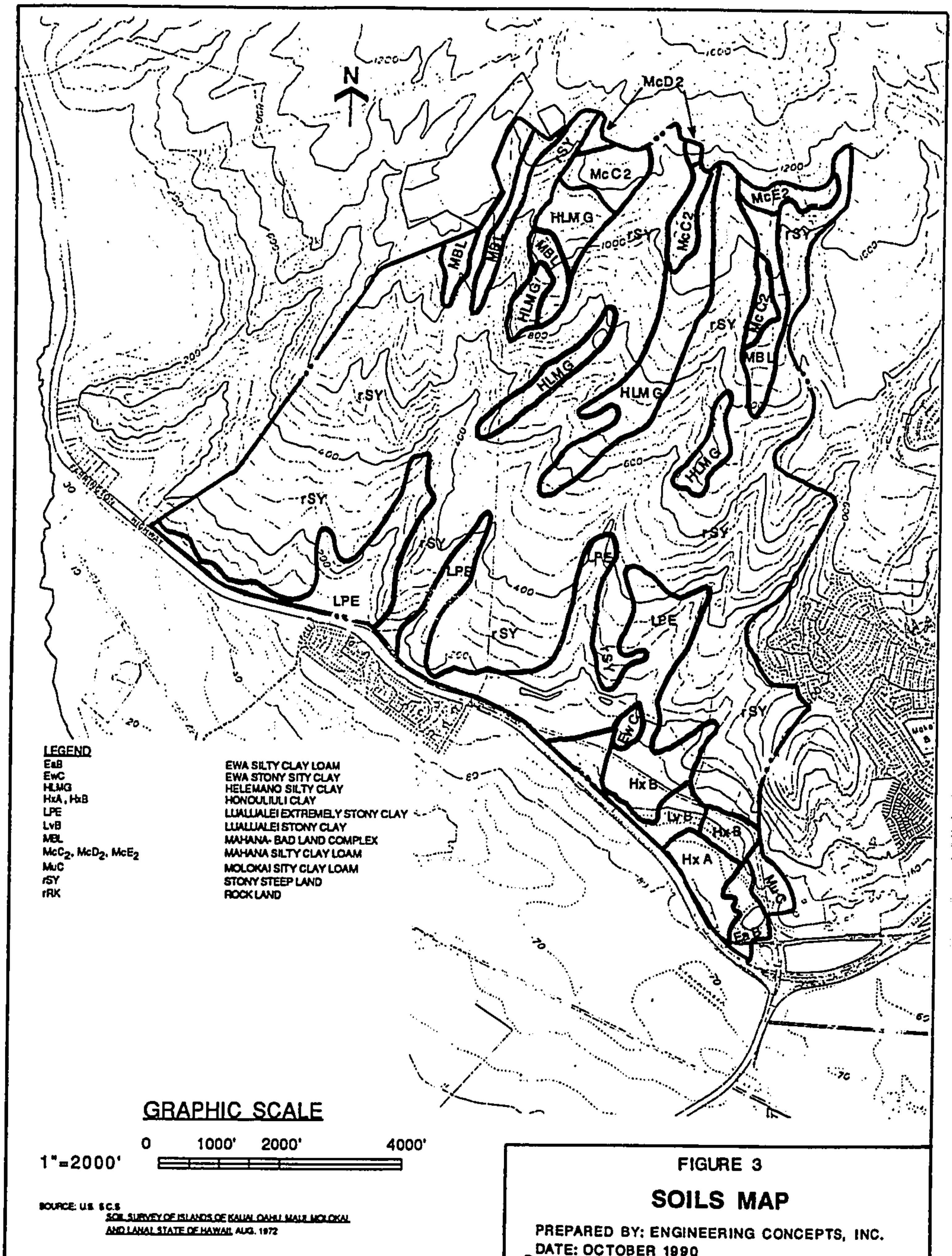


FIGURE 3

SOILS MAP

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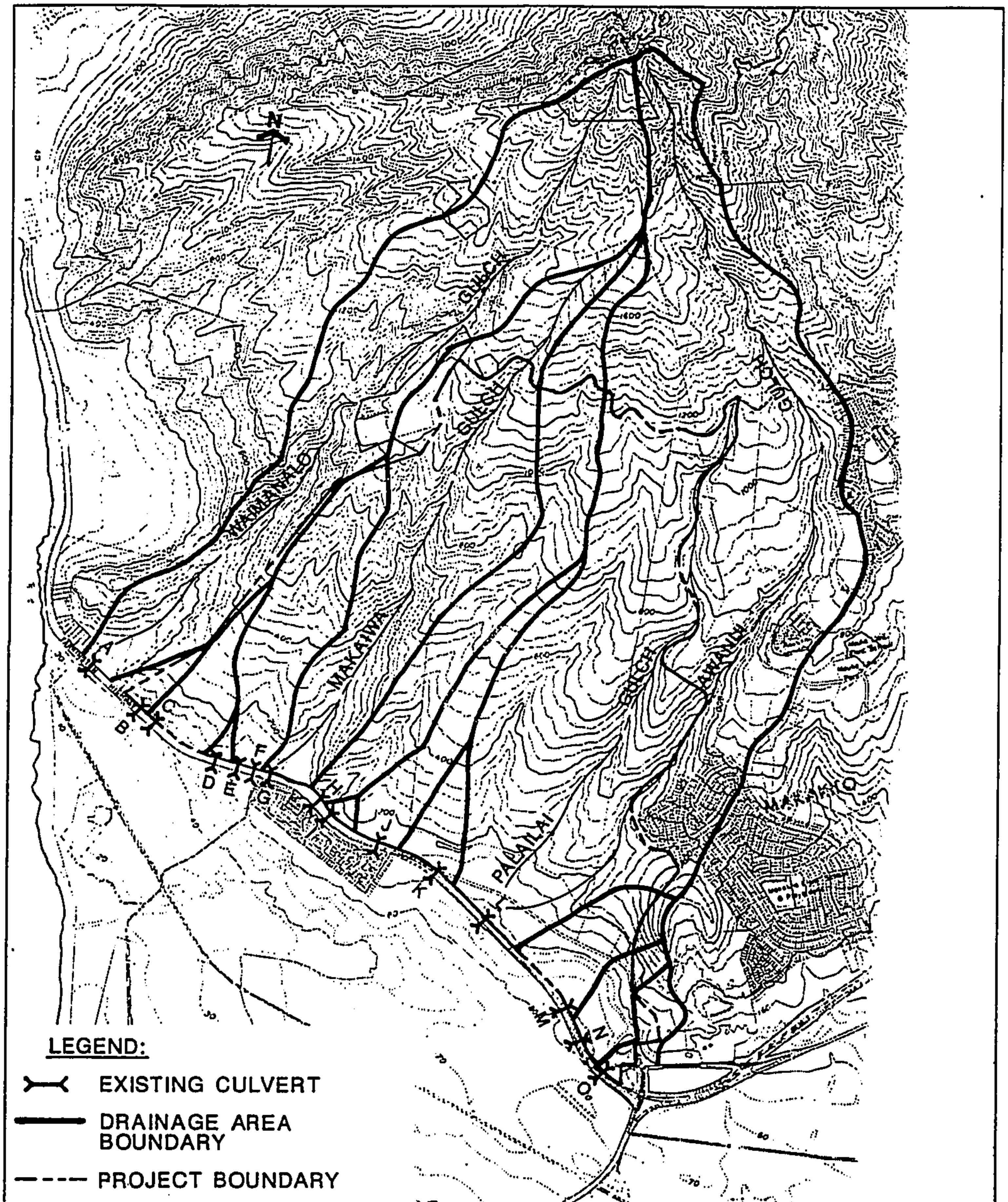

LEGEND:

EXISTING CULVERT

DRAINAGE AREA BOUNDARY

PROJECT BOUNDARY

MAJOR GULCH

GRAPHIC SCALE

1"=2500' 0 1250' 2500' 5000'

FIGURE 4

DRAINAGE AREAS

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DATE: OCTOBER 1990

The area south (downstream) of the project site includes an existing residential subdivision and several developments which are currently under construction or being planned for future construction:

> Honokai Hale. Honokai Hale is a single family residential community on the southern side of Farrington Highway opposite of the project site.
>
> Ko Olina. Ko Olina is a resort development along the coast, located downstream of Honokai Hale and the project site. The Ko Olina Golf Course has been completed. Other phases of the resort development are currently under construction.
>
> Kapolei Business-Industrial Park. Kapolei Business-Industrial Park is a proposed expansion of the existing James Campbell Industrial Park, to be located downstream of the project site, south of the Ko Olina resort.

Flood Hazard

The project site is designated Zone D in the Flood Insurance Rate Map, indicating areas in which flood hazards are undetermined.

Runoff

Runoff from the offsite areas crosses the northern boundary of the project site, combines with onsite runoff, and exits the southern boundary along Farrington Highway. The Farrington Highway culverts convey the existing runoff quantities to the makai side of the highway. Existing runoff quantities were calculated for the tributary area of each culvert and are listed in Table 2. Both peak runoff rate (in cubic feet per second) and the volume of runoff (in acre-feet) were calculated for the 10- and 50-year storms using the Soil Conservation Service TR 20 program. Calculations were based on a rainfall duration of one hour, and rainfall intensity of 1.9 inches for the 10-year storm and 2.3 inches for the 50-year storm.

The largest quantity of onsite and offsite runoff from a single drainage area is collected in the drainage area of culvert L, which includes three gulches: Awanui, Palailai, and an unnamed gulch. The three gulches converge in a broad plain mauka of Farrington Highway prior to reaching culvert L at highway Station 162+25.

TABLE 2 - EXISTING RUNOFF (1-HR DURATION)

Area	Acres	10-YR (cfs)	10-YR (acre-ft)	50-YR (cfs)	50-YR (acre-ft)
A	705	697	46	844	56
B	23	41	1.2	53	1.5
C	62	103	3.6	125	4.5
D	5	10	0.2	12	0.3
E, F	162	208	9.7	252	12
G	508	522	32	631	39
H, I	286	288	18	349	22
J	95	137	5.2	166	6.4
K	31	51	1.7	62	2.1
L	1,615	1,350	109	1,634	132
M	84	141	4.9	171	6.0
N	53	89	2.9	108	3.5
O	33	56	1.9	67	2.3
Watershed*	3,662	3,693	236	4,474	288

*mauka of Farrington Hwy.

Runoff quantities from the tributary area of culvert A are second highest for the watershed. Waimanalo Gulch is the main drainage way for the tributary area. The tributary area for culvert A is almost entirely composed of offsite areas of the watershed.

Runoff quantities from the tributary area of culvert G are the third highest for the watershed. In contrast to the tributary area of culvert A, the majority of the tributary area of culvert G is from onsite areas. Makaiwa Gulch is the main drainage way for the tributary area.

Under existing conditions, runoff from the tributary area of culvert L contributes 37 percent of the total runoff rate and 46 percent of the total runoff volume from the watershed. The tributary area of culvert A contributes 19 percent of the total runoff rate and volume for the watershed, and the tributary area of culvert G contributes 14 percent of the total runoff rate and volume. In comparison, the other tributary areas contribute from 8 percent to less than one percent of the total runoff rate and volume from the watershed.

MODIFICATIONS AFTER DEVELOPMENT

The proposed Makaiwa Hills development will alter the character of the 1,915 acre site. The vegetative cover currently established on the ridges and plateau areas of the site will be replaced with pavement, buildings, and landscaped yards typical of a residential/commercial development.

As a result of the proposed improvements, the rate of peak runoff from the onsite areas and the volume of runoff is expected to increase. Estimated peak runoff rate and runoff volume for 10- and 50-year storms at each of the Farrington Highway culverts is given in Table 3. The runoff for the 100-year storm based on the peak curve of the City and County's Storm Drainage Standards is also shown for drainage areas larger than 100 acres. The percent increase in runoff rate and volume between the existing and developed conditions is listed in Table 4. Both the peak runoff rate and volume of runoff generated by the watershed is expected to increase by about 17 percent for the 10- and 50-year storms after development of the project.

Drainage patterns in the onsite areas proposed for development may be altered slightly from the existing conditions due to the alignment of the proposed roads and culverts. The acreage of tributary areas for the highway culverts may also be altered slightly, affecting

TABLE 3 - FUTURE RUNOFF (1-HR DURATION)

Area	Acres	10-Yr (cfs)	10-Yr (acre-ft)	50-Yr (cfs)	50-Yr (acre-ft)	100-Yr (cfs)**	100-Yr (acre-ft)
A	705	697	46	844	57	2100	135
B	23	53	1.4	64	1.7		
C	62	133	4.3	161	5.4		
D	5	13	0.3	16	0.3		
E, F	152	210	9.9	254	12	675	
G	539	622	37	753	46	1600	95
H, I	287	367	23	444	28	1100	65
J	73	145	5.8	176	7.2		
K	30	51	1.7	62	2.1		
L	1,621	1,626	130	1,969	158	3800	307
M	60	168	5.6	204	6.8		
N	89	204	9.0	247	11		
O	16	41	1.1	49	1.3		
Watershed*	3,662	4,330	275	5,243	337	7000	

*mauka of Farrington Hwy.

** Based on the City & County 100-year peak runoff curve for drainage areas greater than 100 acres

TABLE 4 - PERCENT INCREASE IN RUNOFF

Area	10-Yr (cfs)	10-Yr (acre-ft)	50-Yr (cfs)	50-Yr (acre-ft)
A	0	0	0	2
B	29	17	21	13
C	29	19	29	20
D	30	50	33	0
E, F	1	2	1	0
G	19	16	19	18
H, I	27	28	27	27
J	6	12	6	13
K	0	0	0	0
L	20	19	21	20
M	19	14	19	13
N	129	210	129	214
O	(-)27	(-)42	(-)27	(-)43
Watershed *	17	17	17	17

*mauka of Farrington Hwy.

runoff quantities. For example, the acreage of the tributary area for culvert O is expected to decrease by 50 percent after development, resulting in a decrease in runoff rate and volume through culvert D. It is anticipated that the natural slopes and vegetation of most of the areas planned for preservation would be maintained.

IMPACTS AND MITIGATION

In general, consideration has been given to future development of the Makaiwa Hills site in planning of downstream drainage facilities. Impacts on developments downstream of the Makaiwa Hills site are not expected to be adverse. A drainage master plan will be prepared and submitted to the City and County Department of Public Works for review and approval.

Preliminary hydrologic calculations of storm runoff from the developed Makaiwa Hills site were performed to assess the capacity of drainage structures in Honokai Hale. Based on preliminary analysis the drainage system for Honokai Hale appears adequate to handle the peak storm runoff expected from the future Makaiwa Hills development.

Community Planning, Inc. prepared a hydrologic study for the Ko Olina development. The storm drain system for Ko Olina has been planned to accommodate increases in the peak storm runoff generated from a portion of the proposed Makaiwa Hills development.

Campbell Estate is currently planning to construct a major drainage channel as part of the Kapolei Business-Industrial Park development. Design of this channel will accommodate peak storm runoff contributions from a portion of the proposed Makaiwa Hills development.

The Farrington Highway culverts were analyzed to determine the effect of the proposed Makaiwa Hills development on culvert capacity. In general, the impact of increased runoff to the highway culverts due to development of the project site can be mitigated by constructing detention basins to dampen the peak runoff rates or increasing culvert capacity. The detention basins can be constructed in the areas designated for preservation. In the event a golf course is developed on preservation land in the future, the detention basins may be incorporated into the golf course landscape. As an alternative to constructing detention basins, culvert capacity may be increased by enlarging existing culverts or constructing an additional "relief" culvert parallel to the existing.

Impacts due to the culvert improvements will be short term, related to construction, and may include traffic disturbances, and inconveniences to motorists along the highway. These short term impacts can be mitigated by limiting construction to off-peak traffic hours, implementing an approved traffic control plan, and coordinating construction with any other construction projects along Farrington Highway.

GRADING AND SOIL EROSION

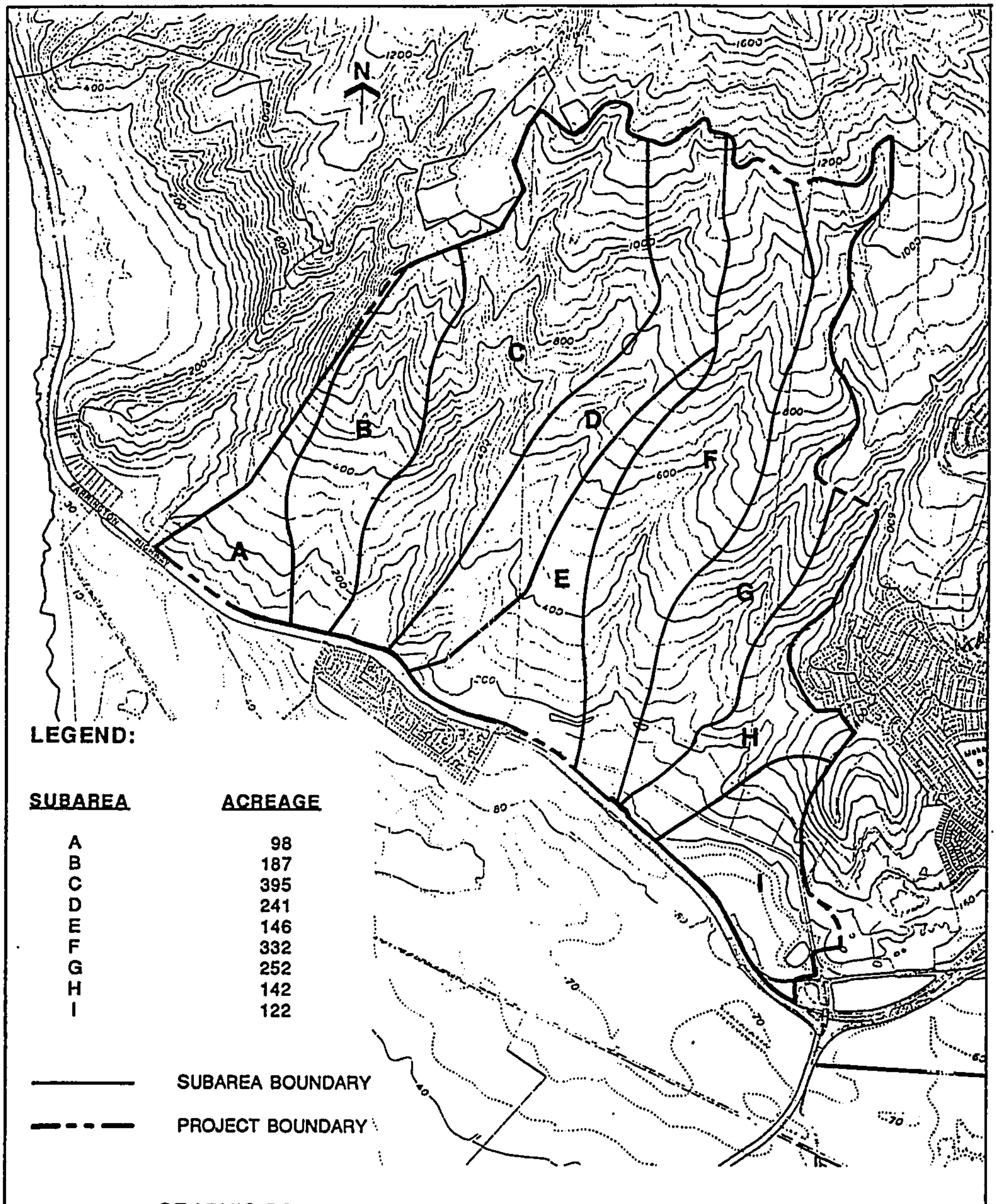
GRADING

It is anticipated that grading within the project site will be limited to the ridges and plateau areas where slopes are less steep, favoring development. The grading concept for the residential lots will be to provide a level pad area for the home rather than leveling of the entire lot. The steep gulch areas will generally remain in a natural or undeveloped state. However, some grading in the gulches may be required to support bridges and roadways between ridges. An effort to balance the earthwork quantities of cut and fill is expected to minimize the cost of purchasing offsite borrow material and disposing excess excavated material at an offsite location. Grading operations will be in conformance with the applicable ordinances of the City and County of Honolulu.

SITE CHARACTERISTICS

The project site is divided into nine subareas for the purpose of calculating soil erosion potential (see Figure 5). These subareas represent sites that vary in soil erosion potential characteristics such as terrain and/or drainage network.

Subarea A, located on the western side of the site, occupies approximately 98 acres. This subarea is a plateau formed between Waimanalo Gulch and an unnamed gulch. Runoff from subarea A generally flows overland toward Farrington Highway. The extreme southwest corner of the subarea has sustained steep, near-vertical cuts as part of the Farrington Highway off-ramp/fly-over to Ko Olina. The cut area has been landscaped to reduce erosion potential. The remaining portion of subarea A is undeveloped and characterized by grassland with scattered trees and shrubs, and eroded areas with sparse vegetation. After development, approximately 50 percent will be zoned residential and 50 percent will be classified as preservation and remain undeveloped. Approximately 70 percent



LEGEND:

SUBAREA	ACREAGE
A	98
B	187
C	395
D	241
E	146
F	332
G	252
H	142
I	122

——— SUBAREA BOUNDARY

— - - — PROJECT BOUNDARY

GRAPHIC SCALE

1"=2000'   0   1000'   2000'   4000'

FIGURE 5

SUBAREAS FOR CALCULATION OF SOIL EROSION POTENTIAL

PREPARED BY: ENGINEERING CONCEPTS, INC.

DATE: OCTOBER 1990

of the preservation land located in the southern portion of the subarea may be developed into a golf course in the future.

Subarea B occupies approximately 187 acres of the drainage area of a minor, unnamed gulch, to the east of subarea A and west of Makaiwa Gulch. The undeveloped subarea is similar to the grassland described in subarea A above. In addition, the gulch area support growths of kiawe trees with a subcanopy of koa-haole shrubs in some places. Approximately 50 percent of the area is planned for residential development with the remaining 50 percent planned for preservation. Approximately 15 percent of the planned preservation land located in the southern portion of the subarea may be developed into a golf course in the future.

The grassland and gulch area described in subarea A and B are typical of the existing conditions found in all the subareas. A brief characterization of each subarea is included in Table 5.

CALCULATION OF SOIL EROSION POTENTIAL

The U.S. Department of Agriculture, Soil Conservation Service, uses the Universal Soil Loss Equation (USLE) to estimate long term average annual soil erosion losses from sheet and rill erosion. It is used to estimate erosion on forest land, farm fields, construction/development sites, and other areas. Soil losses can be estimated for present conditions or for a future condition. The soil loss equation is--

$$A=RKLSCP$$

where:
A=soil loss (tons/acre/year)
R=rainfall factor
K=soil erodibility factor
L=slope length factor
S=slope gradient factor
C=cover and management factor
P=erosion control practice factor

The rainfall factor (R) is based on the U.S. Soil Conservation Service (SCS) Erosion and Sediment Control Guide for Hawaii. A soil erodibility factor (K) was selected for each

TABLE 5 - SUBAREA CHARACTERISTICS

SUBAREA	GULCH/PLATEAU	ACRES	LAND USE AFTER DEVELOPMENT %RESIDENTIAL	%COMMERCIAL	%PRESERVATION (*)
A	plateau	98	50	0	50 (70)
B	minor, unnamed gulch	187	50	0	50 (15)
C	Makaiwa gulch	395	30	0	70 (12)
D	minor, unnamed gulch	241	47	0	53 (9)
E	plateau	146	53	0	47 (100)
F	minor, unnamed gulch	332	59	5	36 (28)
G	Palailai gulch	252	52	4	44 (0)
H	Awanui gulch	142	31	23	46 (0)
I	plateau	122	9	81	10 (0)

*Percent of preservation land considered for future golf course development subarea after evaluating the U.S. Department of Agriculture Soil Survey and City and County of Honolulu Soil Erosion Standards and Guidelines. The K values for the site are based on the weighted average of all K values for soil types in each subarea. The cover and management factor (C) is also based on a weighted average for C values within each subarea and was recalculated accordingly to reflect conditions after development of the Makaiwa Hills project. Both R and K factors will remain the same for the site before and after the proposed project is constructed.

The slope length factor (L) and slope gradient factor (S) are combined into an LS factor for calculations. Each subarea has different factors to reflect the differences in topography. The LS factor decreased after development, because site grading and construction of an underground drainage system is expected to reduce the slope and length of overland flow.

Existing Soil Erosion Potential

The existing soil erosion potential for the nine subareas was estimated using the USLE (see Table 6). The total estimated soil loss under existing conditions is 44,800 tons/year.

Soil Erosion Potential After Development

Two conditions were considered in estimating soil erosion potential after development: A) proposed development without golf course (preservation areas to remain undeveloped), and B) proposed development with the lower preservation area (180 acres) converted into a golf course. The soil erosion potential of developed conditions A and B are estimated in Tables 7 and 8 respectively.

The total estimated soil loss for developed condition A is 6,100 tons/year and the total estimated soil loss for condition B is 5,500 tons/year.

IMPACTS AND MITIGATION

Long Term Impacts

Based on the USLE, soil erosion potential at the project site should decrease after the development of the proposed Makaiwa Hills project. This decrease in soil erosion is attributed to the reduction of erodible surfaces (increase in buildings and pavement);

TABLE 6 - ESTIMATED SOIL LOSS DUE TO STORM RUNOFF (EXISTING CONDITIONS)

SUB AREA	R	K	LS	C	P	A	ACRES	TONS/YR
A	200	0.28	14.14	0.028	1	22.17	98	2,200
B	200	0.28	13.51	0.028	1	21.18	187	3,900
C	200	0.29	20.70	0.028	1	33.62	395	13,300
D	200	0.27	13.74	0.028	1	20.77	241	5,000
E	200	0.27	13.05	0.028	1	19.73	146	2,900
F	200	0.27	15.41	0.028	1	23.30	332	7,700
G	200	0.28	10.43	0.028	1	16.35	252	4,100
H	200	0.28	17.37	0.028	1	27.24	142	3,900
I	200	0.30	8.73	0.028	1	14.67	122	1,800
						TOTAL	1,915	44,800

TABLE 7 - ESTIMATED SOIL LOSS DUE TO STORM RUNOFF (DEVELOPED CONDITION A)

SUB AREA	R	K	LS	C	P	A	ACRES	TONS/YR
A	200	0.28	3.06	0.019	1	3.26	98	300
B	200	0.28	3.06	0.019	1	3.26	187	600
C	200	0.29	3.06	0.023	1	4.08	395	1,600
D	200	0.27	3.06	0.02	1	3.30	241	800
E	200	0.27	3.06	0.017	1	2.81	146	400
F	200	0.27	3.06	0.017	1	2.81	332	900
G	200	0.28	3.06	0.018	1	3.08	252	800
H	200	0.28	3.06	0.016	1	2.74	142	400
I	200	0.30	3.06	0.012	1	2.20	122	300
						TOTAL	1,915	6,100

TABLE 8 - ESTIMATED SOIL LOSS DUE TO STORM RUNOFF (DEVELOPED CONDITION B)

SUB AREA	R	K	LS	C	P	A	ACRES	TONS/YR
A	200	0.28	3.06	0.013	1	2.23	98	200
B	200	0.28	3.06	0.017	1	2.91	187	500
C	200	0.29	3.06	0.021	1	3.73	395	1,500
D	200	0.27	3.06	0.019	1	3.14	241	800
E	200	0.27	3.06	0.01	1	1.65	146	200
F	200	0.27	3.06	0.015	1	2.48	332	800
G	200	0.28	3.06	0.018	1	3.08	252	800
H	200	0.28	3.06	0.016	1	2.74	142	400
I	200	0.30	3.06	0.012	1	2.20	122	300
						TOTAL	1,915	5,500

reduction of length and slope of overland flow due to site grading and construction of a storm drain system; and increase in landscaped area (reduction of bare ground).

The soil erosion potential for the existing conditions and developed conditions are summarized in Table 9. The estimated erosion potential for the project under condition A decreased by 38,700 tons/year or 86 percent and the erosion potential of condition B decreased by 39,300 tons/year or 88 percent.

Short Term Impacts and Mitigation

The construction of the proposed project will involve land disturbing activities that result in soil erosion. These land disturbing activities include removal of existing vegetation (clearing and grubbing) and leveling, removing, and replacing soil.

The USLE can be used to estimate soil erosion potential based on these short-term construction impacts. For the purpose of calculation it is assumed that construction will be in phases and will span a 15 year period. Based on approximately 1,200 acres to be developed, construction of 80 acres per year was assumed for estimating short term soil erosion potential.

In the short term, an estimated 38,000 tons per year of soil erosion may result from the Makaiwa Hills development during the grading period.

Mitigating measures can be implemented to reduce short-term soil erosion. For example, limiting grading to not more than 15 consecutive acres at a time and seeding half of the area will reduce estimated erosion potential for the site by 17,800 tons per year or 48 percent.

Additional erosion control measures would lessen construction impacts even further. These are--

1. Minimize time of construction.
2. Retain existing ground cover until the latest date before construction.
3. Early construction of drainage control features.
4. Use of temporary area sprinklers in nonactive construction areas when ground cover is removed.

TABLE 9 - SUMMARY OF SOIL EROSION POTENTIAL

SUB AREA	EXISTING CONDITION (TONS/YR)	AFTER DEVELOPMENT (TONS/YR) CONDITION A	AFTER DEVELOPMENT (TONS/YR) CONDITION B	PERCENT DECREASE (%) CONDITION A	PERCENT DECREASE (%) CONDITION B
A	2,200	300	200	86	91
B	3,900	600	500	85	87
C	13,300	1,600	1,500	88	89
D	5,000	800	800	84	84
E	2,900	400	200	86	93
F	7,700	900	800	88	90
G	4,100	800	800	80	80
H	3,900	400	400	90	90
I	1,800	300	300	83	83
TOTAL	44,800	6,100	5,500	86	88

NOTE: Condition B is the lower preservation area (180 acres) converted into a golf course.

5. Station water truck on site during construction period to provide for immediate sprinkling, as needed, in active construction zones (weekends and holidays included).
6. Use temporary berms and cut-off ditches, where needed, for control of erosion.
7. Thorough watering of graded areas after construction activity has ceased for the day and on weekends.
8. Sod or plant all cut and fill slopes immediately after grading work has been completed.

Grading and Erosion Control Plans will be prepared in compliance with Chapter 23, Revised Ordinances of Honolulu.

WATER

EXISTING CONDITIONS

The Board of Water Supply (BWS) system provides potable water service to the Ewa/Kapolei region. Wells located in Waipahu, in the vicinity of the Kunia Interchange, are the water source for the system. These wells include the Hoaeae Wells, Kunia Wells I, and Waipahu Wells. Transmission of water from the wells to Ewa/Kapolei is via 30-inch transmission main along Farrington Highway. The transmission main extends to the 3.0 MG, 4.0 MG and 5.0 MG Barbers Point 215 Reservoirs, located at the southeastern corner of the project site. Transmission of potable water continues west along Farrington Highway to Nanakuli via 24-inch transmission main and booster pumps located at the Barbers Point Reservoirs site. The regional potable water system in the vicinity of the project site is illustrated in Figure 6. The BWS water system does not currently serve the project site. The private residences located north of the project site utilize private water catchment systems.

The Estate of James Campbell is a member of the Ewa Plain Water Development Corporation, which was established to assess the water system requirements and coordinate improvements for all developments in the Ewa Plain. Belt Collins and Associates has identified infrastructure required to serve Ewa Plain developments in the Ewa Water Master Plan (revised 1987). The document is currently being updated. Water system requirements for the proposed Makaiwa Hills development will be included in the revised document.

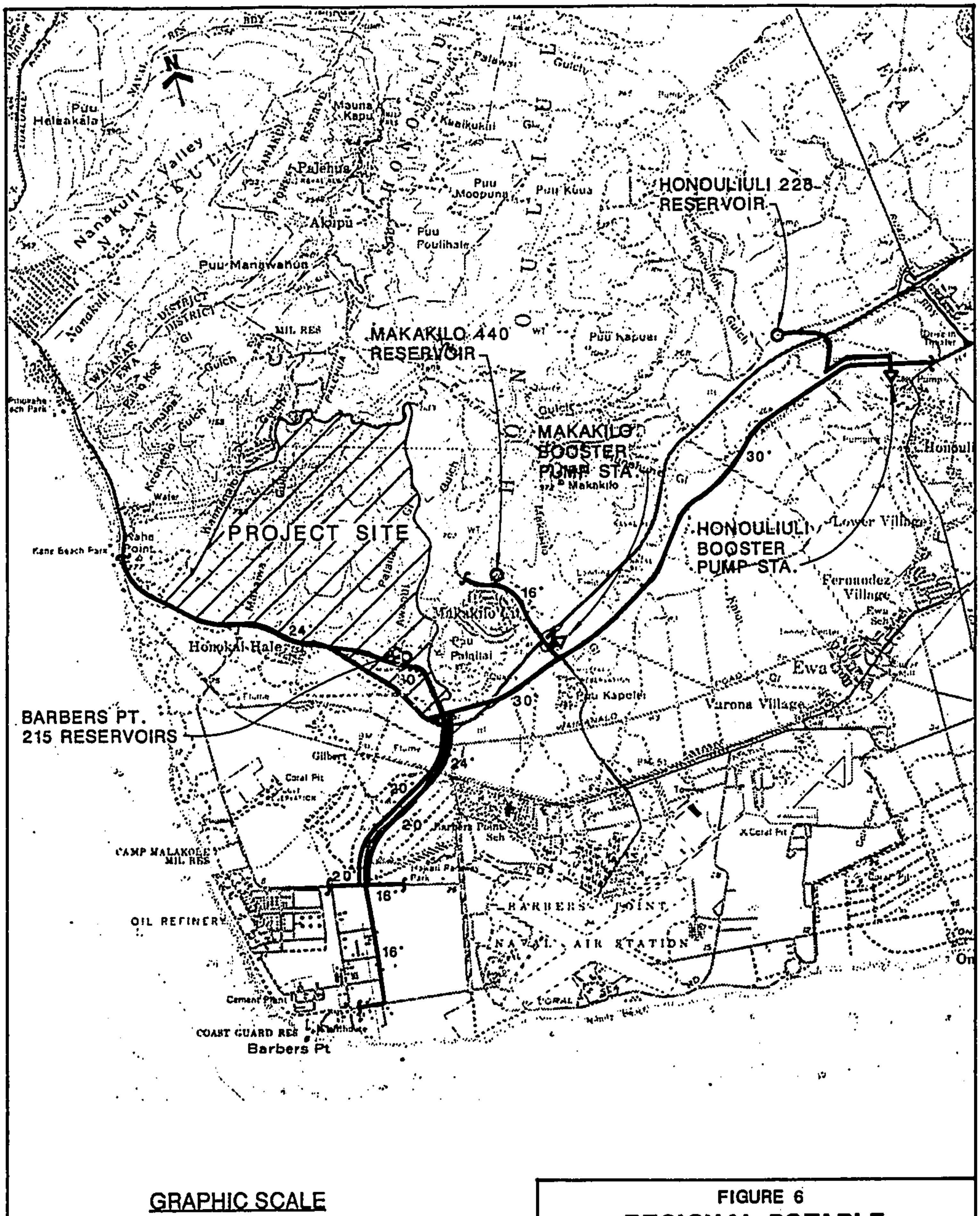


FIGURE 6

REGIONAL POTABLE WATER SYSTEM

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PROJECTED WATER DEMAND

Water demand estimates for the project are based on BWS Water System Design Criteria for the various land uses.

Potable Water

The potable water demand for the project is summarized below:

Land Use	No. of Units	gpd/unit	Average Daily Demand (gpd)
Residential	2160 homes	500	1,065,000
Commercial	156 acres	2160	337,000
School	1000 students	42	42,000
Park	16 acres	720	12,000
			1,456,000
		Say	1.46 MGD

Based on an average daily demand of 1.46 MGD, a maximum daily demand of 2.19 MGD is expected. The corresponding peak hour demand will be 4.38 MGD.

Should a golf course be developed in the future, the associated increase in potable water demand is estimated to be 20,000 gpd. The total average daily potable water demand from the project site including an 18-hole golf course will be 1.48 MGD, with a maximum daily demand of 2.22 MGD and peak hour demand of 4.44 MGD.

Nonpotable Water

The nonpotable water demand for the project is estimated below. Nonpotable water will be used for irrigation purposes only.

Land Use	No. of Units	gpd/unit	Average Daily Demand (gpd)
Commercial	156 acres	1440	225,000
School	1000 students	30	30,000
Park	16 acres	4080	66,000
			321,000
		Say	0.32 MGD

Should a golf course be developed in the future, the associated increase in nonpotable water demand will be 735,000 gpd. This calculation is based on 180 acres irrigated at a rate of 4,080 gpd/acre. The total average daily nonpotable water demand from the project site including an 18-hole golf course will be 1.06 MGD.

PROPOSED WATER SYSTEM

The proposed Makaiwa Hills development will create additional water demands on the BWS system. Potable water demands will include service to the proposed residential developments, and nonirrigation water service only to the areas proposed for commercial development.

It is intended that a private, nonpotable water system will service the proposed commercial development to meet the irrigation demand of this area. Sources of nonpotable water are currently under investigation.

In the event a golf course is developed in the future, potable water will serve the clubhouse to meet the nonirrigation related demand. Irrigation water for the golf course will be provided by the nonpotable water system.

A preliminary hydraulic analysis has been conducted for the proposed Makaiwa Hills development based on available data for the existing BWS system in the vicinity of the site. Preliminary indications suggest servicing the proposed development with separate water distribution systems to prevent transmission mains from crossing the gullies except at proposed road crossings. Water service zones within each distribution system were based on the existing Makakilo system service zones, site topography, and the BWS Water System Standards.

The proposed eastern water distribution system, adjacent to Makakilo, will provide approximately 80 percent of the water demand required for the project (see Figure 7). Draw off from the BWS system is proposed off a 24-inch main from the Barbers Point Reservoirs, provided that the additional storage and transmission facilities proposed in the Ewa Water Master Plan are built. Onsite requirements include ten reservoirs and nine booster pumping stations for the five service zones of the proposed eastern water distribution system.

The proposed western water distribution system, located between Waimanalo Gulch and Makaiwa Gulch, will service the proposed residential development to be located on a

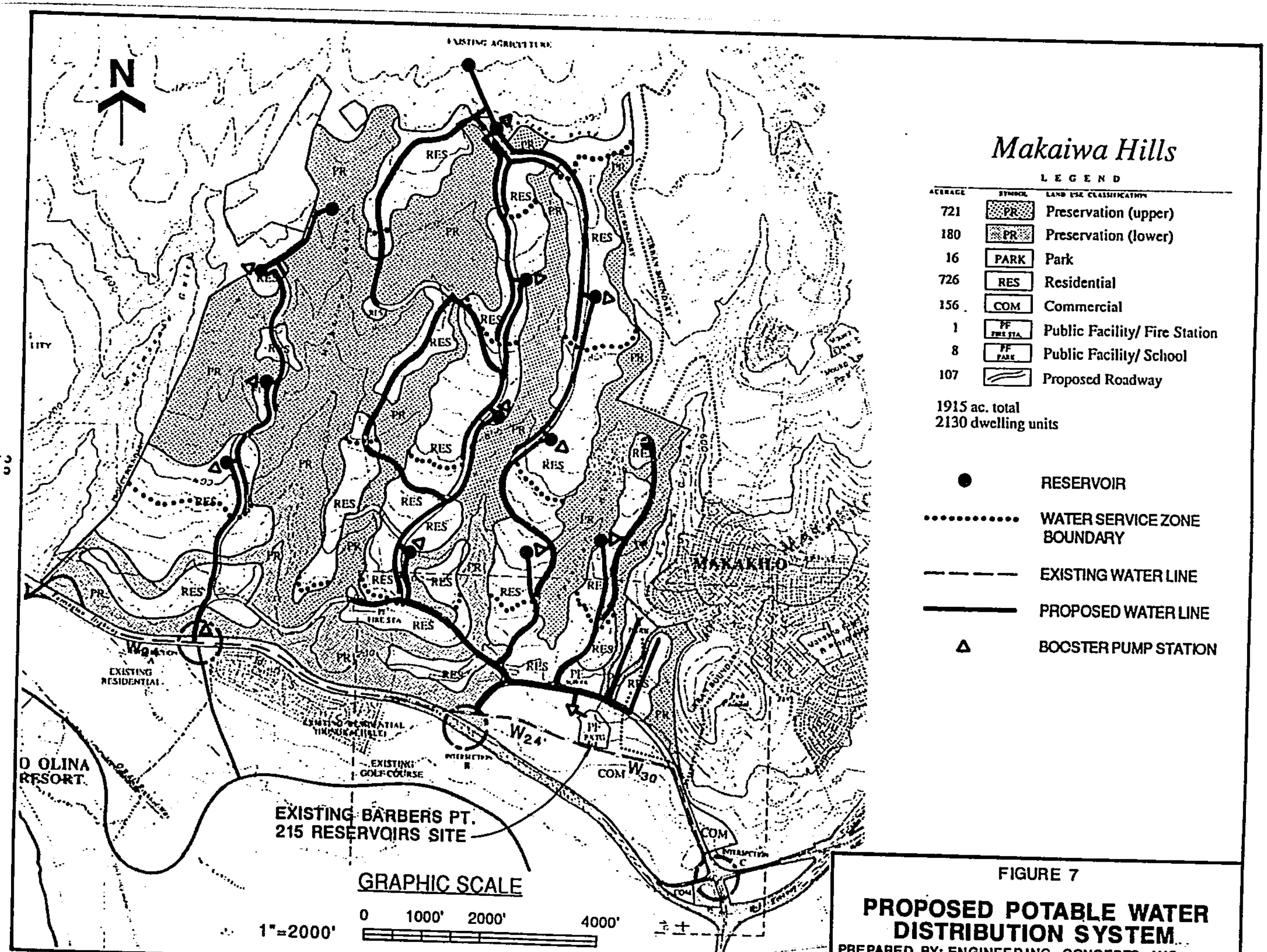

FIGURE 7

PROPOSED POTABLE WATER DISTRIBUTION SYSTEM

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DATE: OCTOBER 1990

single ridge line. Connection to the BWS system is proposed at the 24-inch transmission main along Farrington Highway which fronts the project site. Four reservoirs and four booster pumping stations will be required onsite for the four service zones of the proposed western water distribution system.

IMPACTS AND MITIGATION

Makaiwa Hills is one of the proposed developments in the Ewa/Kapolei area which will impact the existing regional water system by increasing the demand for potable water. In an effort to reduce the potable water requirements of the project, a dual water system is proposed. Nonpotable water is planned for use to irrigate the proposed commercial areas, school and park. If a golf course is developed in the future, nonpotable water would also be used for irrigation.

A well field is in the process of being developed in upper Honouliuli that will satisfy some of the potable water requirements for proposed developments in the Ewa/Kapolei area. Currently, six wells have been developed and are in the process of being dedicated to BWS. Approximately 6.7 million gallons of potable water will be supplied by these six wells, a portion of which will be allocated to Campbell Estate. The Estate of James Campbell is participating with the State of Hawaii Department of Land and Natural Resources in the development of a desalinization plant. The pilot project will initially provide 1 MGD of desalinated water which will be added to the potable water system. The plant can be expanded to provide as much as 10 mgd of desalinated water which would be added to the potable water supply. The Estate, along with Hawaiian Electric Co., is also investigating the use of water from the Waiau shaft to supplement existing potable water sources. Additional sources of potable water are being investigated to meet the demands of the developments in the Ewa/Kapolei region.

The proposed development will also impact the existing potable water storage and transmission facilities. The Ewa Water Master Plan indicates that a parallel main in Farrington Highway from the Honouliuli booster station near the Kunia Interchange to the Barbers Point reservoirs will eventually be required. The Master Plan also identifies other improvements such as storage tanks and additional pump requirements which will eventually be required. Implementation of the improvements will be governed by development schedules of the proposed projects in the Ewa/Kapolei region and will be coordinated by the Ewa Plain Water Development Corporation.

The proposed onsite potable water system (including reservoirs, booster pumps, and distribution mains) will be designed in accordance with the BWS Water System Standards and is anticipated to be dedicated to the BWS for operation and maintenance. A water master plan will be prepared and submitted to BWS for their review and approval. Short term impacts due to the proposed water system will be construction related and may include dust, noise and traffic disturbances along Farrington Highway. Mitigation of these potential short term impacts can be achieved by limiting construction to off-peak traffic hours, use of wind breaks or watering to reduce dust, and the implementation of approved traffic control plans.

WASTEWATER

EXISTING CONDITIONS

Developments in the Ewa/Kapolei region use individual wastewater systems (septic tanks, cesspools) or are served by the City and County collection system with wastewater treatment at Honouliuli Wastewater Treatment Plant (WWTP).

The Honouliuli WWTP is located approximately four miles east of the project site. The WWTP presently operates as a primary treatment facility with design capacity of 25 million gallons per day (MGD). Although the WWTP is not operating at full capacity, the remaining treatment capacity has been committed to other developments. An expansion of the plant to 38 MGD is being designed and is tentatively scheduled for completion by 1994. The development of Makaiwa Hills is not anticipated to precede completion of the Honouliuli WWTP expansion.

The closest municipal sewer in the vicinity of the project site is the Ko Olina interceptor located south of the project along the O. R. & L. Railroad right-of-way. The Ko Olina interceptor is a force main/gravity sewer extending from the Ko Olina Resort along the railroad right-of-way to Fort Barrette Road. At Fort Barrette Road, the Ko Olina interceptor connects to the Makakilo interceptor, a 30-inch sewer which extends from Makakilo along Fort Barrette Road and Renton Road to the Honouliuli WWTP on Geiger Road. The connection between the Ko Olina interceptor and Makakilo interceptor is temporary, and takes advantage of excess capacity in the Makakilo interceptor. The regional wastewater collection system, including proposed improvements is illustrated in Figure 8.

PROJECTED WASTEWATER FLOWS

Wastewater will be generated from the various facilities within the proposed Makaiwa Hills development. The estimated average wastewater design flow is based on estimated water use calculations and the City and County Sewer Standards. Contributions expected from the proposed facilities within the project are listed below:

	Average Wastewater Flow Rate (gpd)	
Residential (2130 units)	682,000	
Commercial	500,000	
School	25,000	
Infiltration	78,000	
		1,285,000
Golf Course*		20,000
TOTAL		1,305,000

*possible future development

For planning purposes, the total average wastewater flow rate for the project is 1.285 MGD. If the lower preservation area is developed into a golf course in the future, the total average wastewater flow rate will be 1.305 MGD. Wastewater generated at the project site is expected to be of typical domestic composition.

MODIFICATIONS AFTER DEVELOPMENT

The proposed wastewater collection system for the project is illustrated on Figure 9 and includes:

1. Construction of onsite gravity sewers, sewage pumping stations (SPS) and force mains to serve the areas proposed for development; and

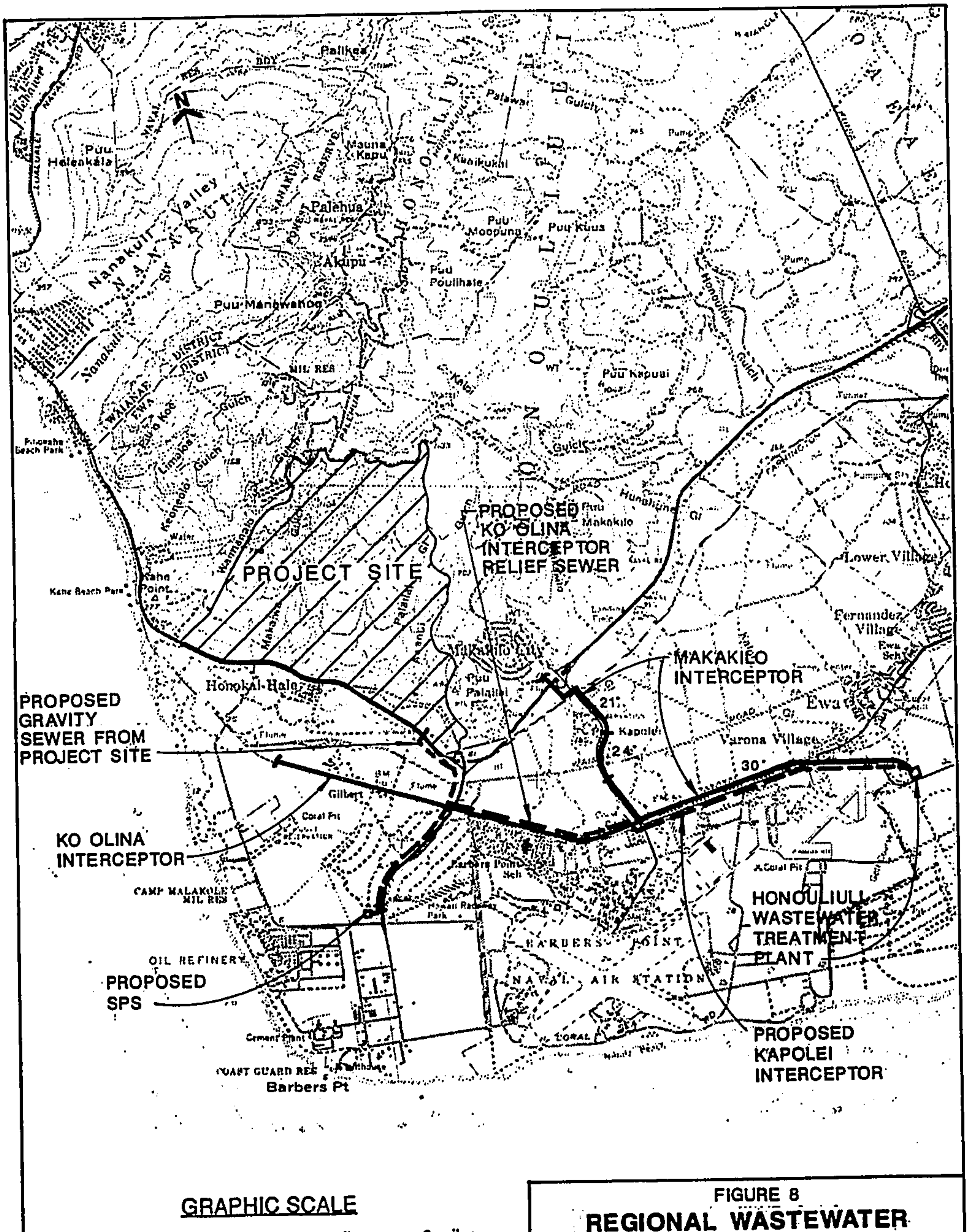

FIGURE 8
REGIONAL WASTEWATER FACILITIES

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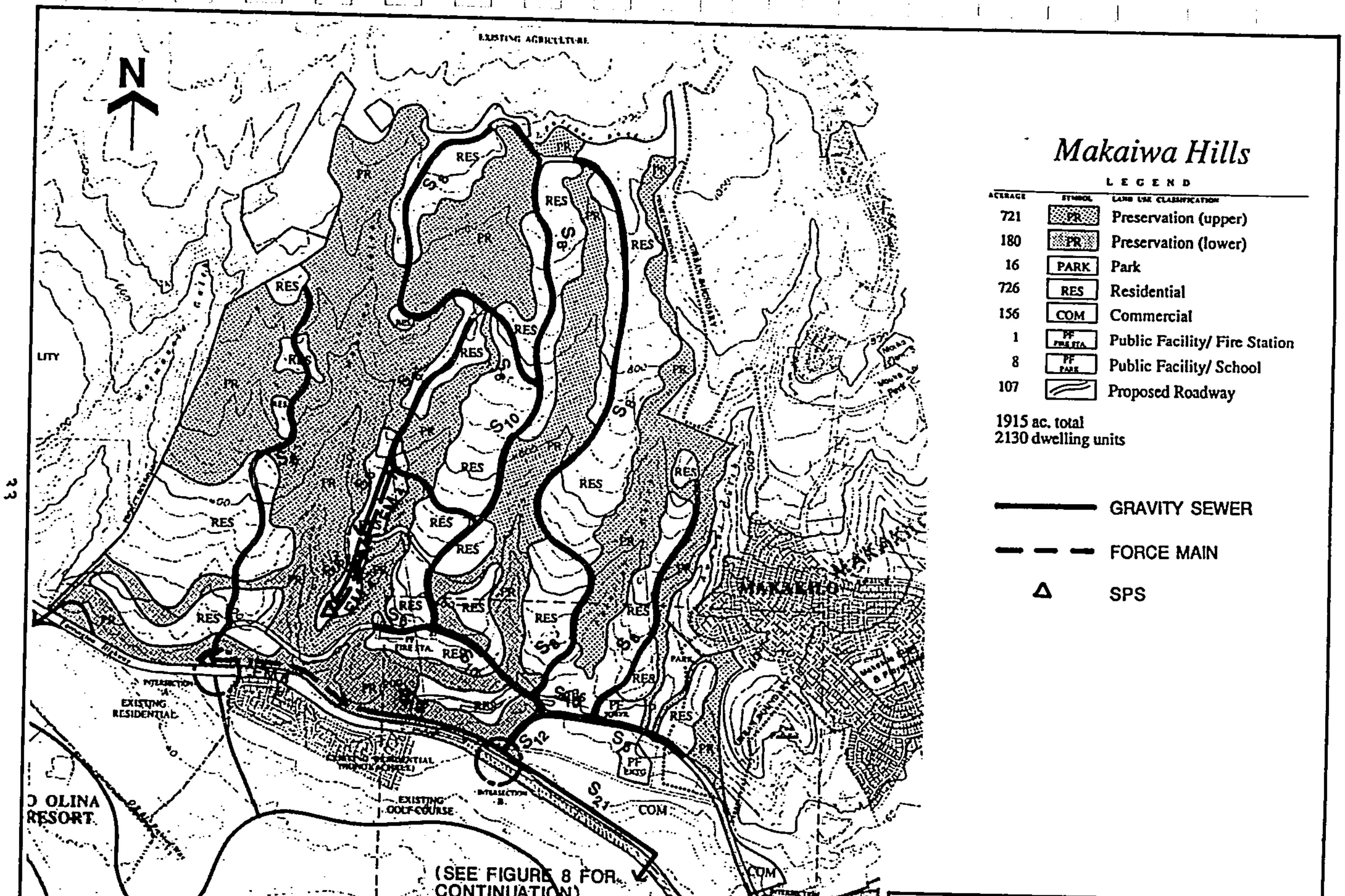

FIGURE 9

PROPOSED WASTEWATER COLLECTION SYSTEM

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2. Construction of a 21-inch offsite sewer to convey wastewater flow from the project site to the existing Ko Olina interceptor, located south of Farrington Highway.

It is proposed that wastewater from the project site be conveyed to the Honouliuli WWTP for treatment. Implementation of proposed collection system capacity expansion projects may be required prior to sewer connection application approval. Specifically, construction of a relief sewer parallel to the Ko Olina interceptor will be necessary to accommodate wastewater generated by the proposed developments of Makaiwa Hills and Kapolei Business-Industrial Park. In addition, construction of the Kapolei Interceptor, is proposed to convey wastewater from Makaiwa Hills and other developments in the Kapolei area to Honouliuli WWTP. The proposed Kapolei interceptor will follow a route parallel to the Makakilo interceptor (see Figure 8).

It is intended that the onsite wastewater collection system and 21-inch offsite sewer be dedicated to the City and County for operation and maintenance. Design and construction of the system will be in accordance with City and County standards.

Implementation of the proposed improvements is subject to approval from the City and County of Honolulu Division of Wastewater Management (DWM). A sewer master plan and an Application for Sewer Connection will be submitted, at which time the DWM will evaluate the capacity of the municipal sewerage system and treatment facility to handle the expected wastewater flow from the project site.

IMPACTS AND MITIGATION

Wastewater impacts related to the proposed development may include the following:

1. Traffic disturbance on Farrington Highway. Construction of the 21-inch offsite sewer across Farrington Highway may cause a temporary inconvenience to motorists. Construction impacts are short term, and can be minimized by implementing an approved traffic control plan. Other mitigative measures are limiting construction to off-peak traffic hours and coordination of construction with any other improvements planned for Farrington Highway.

2. <u>Increased burden on the City and County wastewater collection and treatment facilities</u>. Under existing conditions, the additional 1.3 MGD average wastewater flow from the project site may have a significant affect on the capacity of the Honouliuli WWTP. However, the proposed Makaiwa Hills development is not expected to preceed the planned capacity expansion of Honouliuli WWTP. We understand from discussions with the DWM that connection to Honouliuli is not guaranteed, even with the expansion of the treatment plant. The application for sewer connection will still need to be filed with and reviewed by DWM. Wastewater requirements will continue to be coordinated with DWM. The existing wastewater collection system will also be affected by the estimated flows from the project site. The existing Ko Olina interceptor will not have available capacity for future wastewater flows from Makaiwa Hills. A relief sewer parallel to the Ko Olina interceptor, between Kalaeloa Boulevard and Fort Barrette Road, is proposed to provide additional capacity. The relief sewer will be designed to convey wastewater from Makaiwa Hills and Kapolei Business-Industrial Park to the Makakilo interceptor/Kapolei interceptor at Fort Barrette Road.

   The Makakilo interceptor will not have available capacity to accommodate wastewater generated from the proposed Makaiwa Hills and other developments. Consequently, construction of the Kapolei Interceptor sewer will be necessary to accommodate the additional flows conveyed by the Ko Olina Interceptor and relief sewers. The Kapolei Interceptor sewer is currently in the design process and is expected to be completed prior to the development of Makaiwa Hills. The design flows for the Kapolei Interceptor has included the estimated flows for both the Makaiwa Hills and Kapolei Business-Industrial Park projects. The Kapolei interceptor will parallel the Makakilo interceptor between Fort Barrette Road and the Honouliuli WWTP. An Application for Sewer Connection should identify inadequacies in the municipal collection and treatment system. Participation in improving the system to increase capacity is the proposed mitigation.

SOLID WASTE

EXISTING CONDITIONS

A refuse collection service does not presently serve the project site. Currently, the site is undeveloped and does not generate solid wastes.

PROJECTED SOLID WASTE GENERATION AND CHARACTERISTICS

The proposed project will generate solid waste during construction and after development.

The construction wastes will primarily be made up of vegetation, rocks, and debris resulting from clearing the site prior to construction. Most of these wastes will be combustible.

The typical range of per capita solid waste generation from a municipal source (residential and commercial) is 2.0 to 5.0 pounds per capita per day (lb/capita/day).

Solid waste generation from the residential areas was estimated to be 17 tons/day based on an average per capita generation rate of 4.0 lb/capita/day. The solid waste composition is expected to be typical for a municipal source.

MODIFICATIONS AFTER DEVELOPMENT

It is anticipated that refuse generated by the proposed Makaiwa Hills residential development will be collected by the City and County refuse collection service. It is estimated that residential refuse collection from the site will necessitate 24 truck trips per week. The number of truck trips is based on a manually loaded, 20 cubic yard compactor truck capable of achieving a typical compaction density of 500 pounds per cubic yard.

Refuse from the proposed commercial area will be serviced by a private refuse collection company. Should a golf course be developed in the future, it is anticipated that a private refuse collection company would also serve the facility.

IMPACTS AND MITIGATION

The proposed development will be a new generator of solid waste. Generation of construction wastes due to clearing of the site will be a short term impact. The contractor will be required to remove all debris from the project site to mitigate the environmental impact.

The City and County is currently operating a landfill site in Waimanalo Gulch and the H-POWER waste energy recovery facility on the leeward side of Oahu. Landfill capacity on the leeward side of Oahu is not a problem at present since most of the combustible refuse is disposed at the H-POWER facility. The H-POWER facility is eventually expected to accommodate most of Oahu's solid waste. Refuse from the proposed Makaiwa Hills development is not expected to have a significant impact on the leeward Oahu solid waste disposal facilities.

POWER AND COMMUNICATIONS

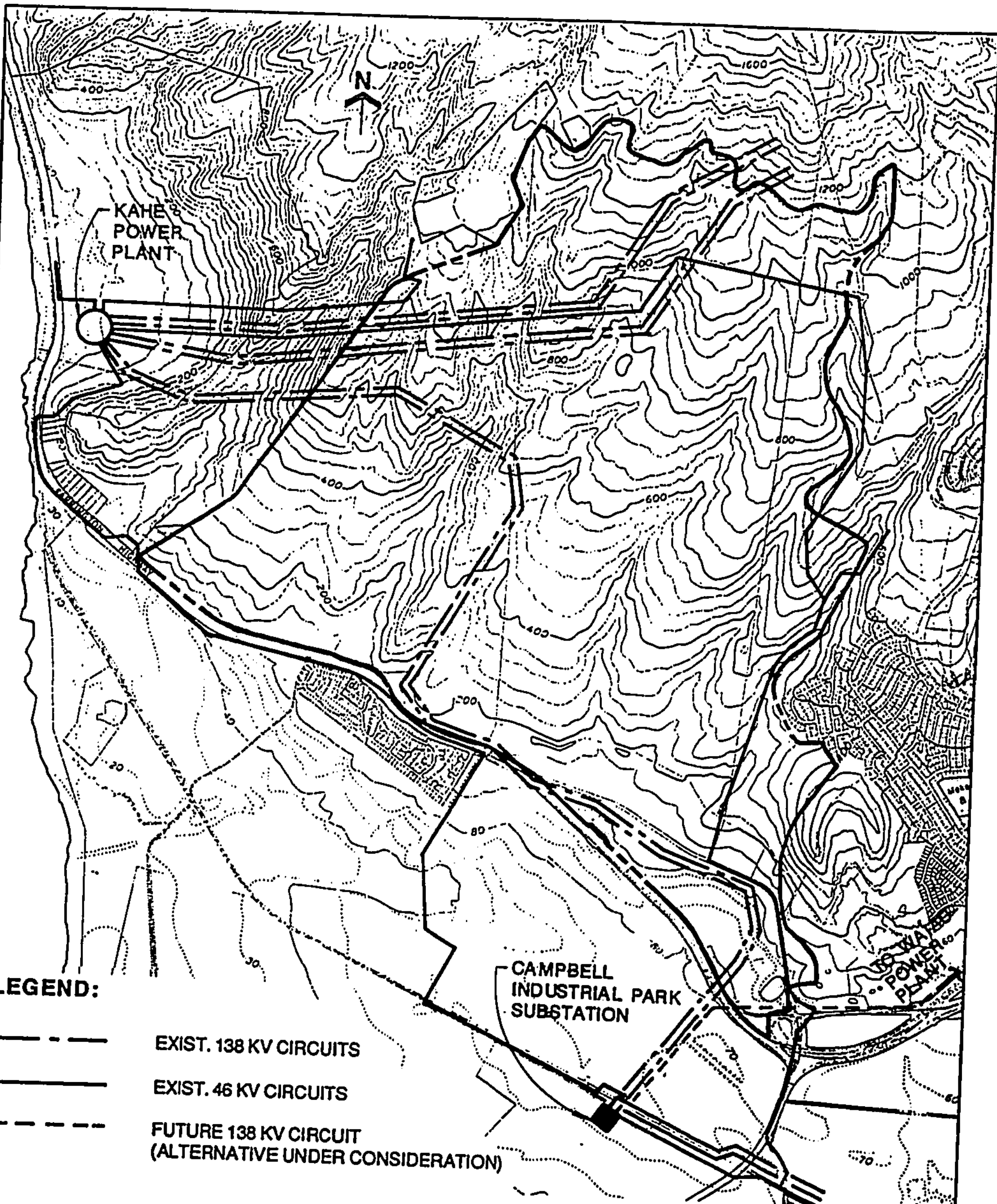
EXISTING CONDITIONS

Hawaiian Electric Company (HECO) maintains two parallel 100-foot wide easements crossing the northwest portion of the project site in a northeast direction. The easements serve 138 kv and 46 kv overhead transmission lines originating from the Kahe Power Plant (see Figure 10). Another 138 kv pair originating from the Kahe Power Plant traverses the project site in a southeast direction on route to the Campbell Industrial Park Substation, located to the south of the project site.

Hawaiian Electric Company is currently meeting with government officials and the Estate of James Campbell to select and approve a route for a proposed 138 kv transmission line from the Waiau Power Plant to the Campbell Industrial Park Substation. Two alignments are under consideration. The "H-1 Mauka Alignment" will cross the Makaiwa Hills site in the vicinity of the existing Farrington Highway interchange at the southeast corner of the site. Should this alignment be selected, a portion of the area planned for commercial development may be affected.

MODIFICATIONS AFTER DEVELOPMENT

It is anticipated that HECO and Hawaiian Telephone Company (HTCO) will provide the necessary electrical and telephone service to the project site. Electrical power requirements for residential units may be conservatively estimated at 5 KVA per unit. Power requirements for the entire development are estimated to be 6.5 MVA. Power is planned to



LEGEND:

EXIST. 138 KV CIRCUITS

EXIST. 46 KV CIRCUITS

FUTURE 138 KV CIRCUIT
(ALTERNATIVE UNDER CONSIDERATION)

GRAPHIC SCALE

1"=2000' 0 1000' 2000' 4000'

FIGURE 10

HECO TRANSMISSION LINES

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be supplied to the site via existing substations at Kahe Point and Makakilo, and the future Kapolei B Substation.

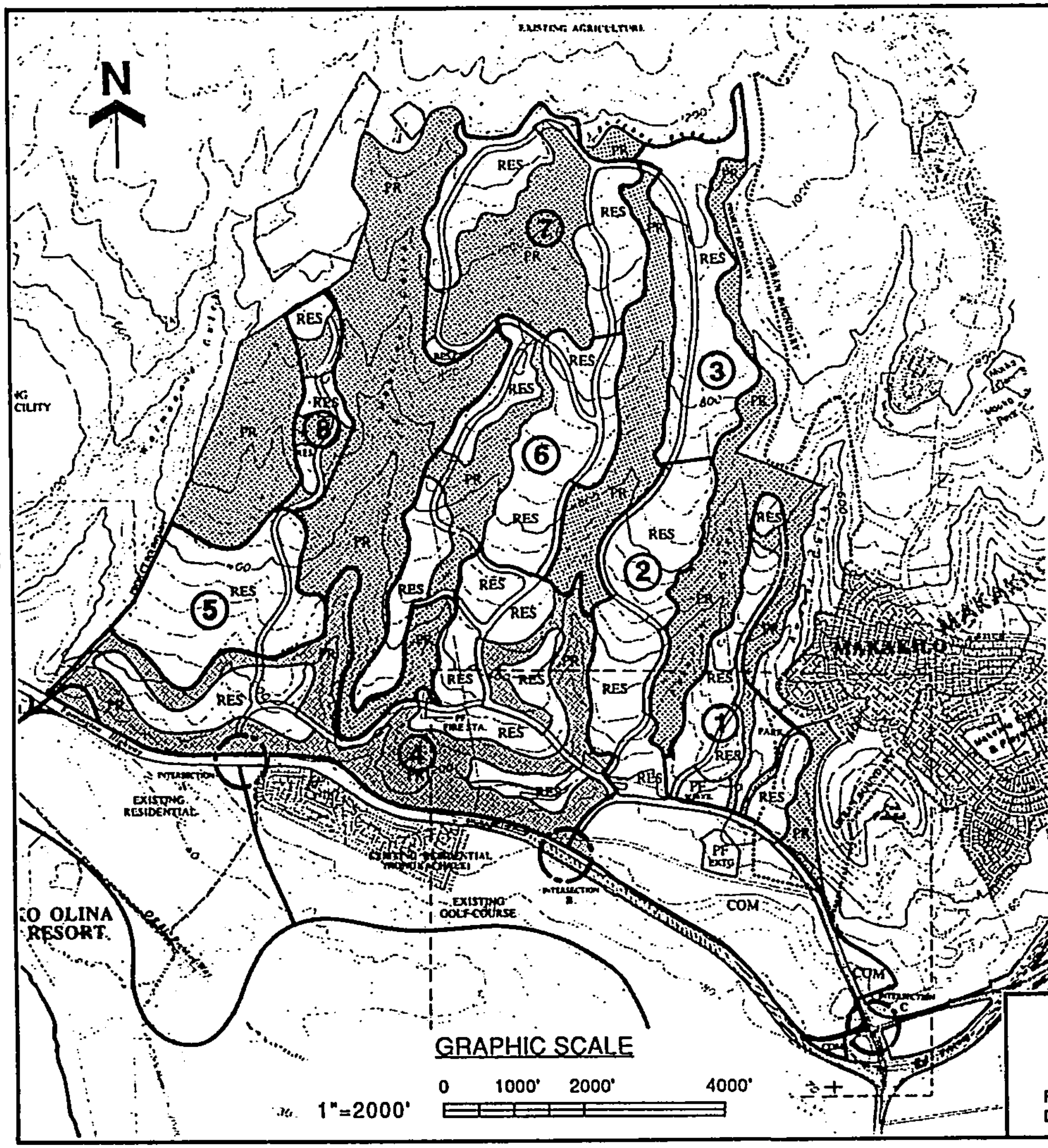
The possibility of relocating the HECO overhead transmission lines underground, within the right-of-way of the proposed development roads, is under consideration.

IMPACTS AND MITIGATION

The proposed Makaiwa Hills development will place additional demands on the utility systems. Discussions between the Estate of James Campbell and HECO are ongoing. Mitigation of potential impacts to the HECO system due to Makaiwa Hills and other projects in the Ewa/Kapolei area are under consideration in the planning of new facilities. Hawaiian Electric has indicate that it has plans for future expansion of its Kahe facility to increase its power generation capabilities. It is also anticipated that the development will consider implementation of energy efficiency design guidelines as recommended by the Energy Division of the State of Hawaii Department of Business, Economic Development and Tourism, in an effort to minimize energy consumption.

PHASING PLAN

The project has been segregated into eight construction phases as shown in Figure 11. In general, the phases proceed from the eastern side of the site to the north and to the west. Approximate land uses within each phase are listed in Table 10.



Makaiwa Hills

LEGEND

ACREAGE	SYMBOL	LAND USE CLASSIFICATION
721	PR	Preservation (upper)
180	PR	Preservation (lower)
16	PARK	Park
726	RES	Residential
156	COM	Commercial
1	PF FIRE STA.	Public Facility/ Fire Station
8	PF PARK	Public Facility/ School
107		Proposed Roadway

1915 ac. total
2130 dwelling units

FIGURE 11

PHASING PLAN

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TABLE 10 - CONSTRUCTION PHASING

PHASE	ACRES	LAND USE
1	63 acres	Residential
	8 acres	School
	16 acres	Park
2	92 acres	Residential
	156 acres	Commercial
3	100 acres	Residential
4	136 acres	Residential
	1 acre	Fire Station
	180 acres	Golf Course *
5	105 acres	Residential
6	122 acres	Residential
7	94 acres	Residential
8	14 acres	Residential

*Conversion of 180 acres of preservation land to a golf course may be undertaken in the future.

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ENGINEERING CONCEPTS, INC.

CONSULTING ENGINEERS

CRAIG S. ARAKAKI **CIVIL ENGINEER**

Education:	University of Hawaii, B.S. in Civil Engineering, 1980
Registration:	Civil Engineer, Hawaii, Certificate #5510, 1983
Professional Affiliation:	American Society of Civil Engineers
Areas of Special Competence:	Land Development Subdivision Planning and Design Grading and Roadways Water Systems Wastewater Systems Drainage Studies

Work Experience:

1987 - Present	Engineering Concepts, Inc., Honolulu, Hawaii, Associate
1980 - 1987	M&E Pacific, Inc., Honolulu, Hawaii, Project Engineer
1980	Hawaiian Dredging & Construction Co., Honolulu, Hawaii, Cost Engineer
1978 - 1980	Walter Lum Associates, Honolulu, Hawaii, Laboratory Technician

General Background:

Mr. Arakaki has been responsible for the planning and design of land development projects including field investigations and the preparation of preliminary engineering reports, infrastructure master plans, construction plans, specifications, and cost estimates for various site improvements such as roads, grading, drainage systems, water transmission and distribution systems, and sewerage systems. He has also been involved in the coordination, review, and approval processes required by government agencies and utility companies.

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Specific Project Experience:

Mr. Arakaki has been responsible for the development of construction plans, specifications, and cost estimates for various commercial, residential, resort, and industrial developments.

- Design of the residential subdivision and the water booster pump station and reservoir for the Waialae-Iki V subdivision.
- Design of site improvements for Kaiser Medical Clinic.
- Design of site work, including utility and drainage improvements, for Waterfront Row, a shopping/restaurant complex.
- Design of site improvements for two proposed hotels on Lanai.
- Design of site improvements for Haleakala Gardens and Village, a residential development on the island of Maui.
- Design of site improvements for Mililani Town Center, a 50-acre shopping complex.
- Design of site improvements for Intelect Building on the Dole Iwilei Cannery property.
- Preliminary engineering during the planning phase for a proposed 1,000-acre Ewa Marina development, including the preparation of water, drainage, and grading master plans.

He assisted in the development of construction plans, specifications, and cost estimates on various projects for the U.S. Navy in Hawaii, Guam, and Diego Garcia, BIOT.

He was responsible for the comparison of the Board of Water Supply's (BWS) Hydraulic Computer Model software program with the WADSY Computer Model Program. Computer models were developed for the Wahiawa and Waipahu water systems for comparison. Work included identifying inadequacies and recommending possible improvements to the BWS program.

Projects:

Residential Development
- Mililani Town Subdivision (Oahu, Hawaii)
- Ahikoe Subdivision (Oahu, Hawaii)
- Waialae-Iki Unit V Subdivision (Oahu, Hawaii)
- Koele Subdivision (Lanai, Hawaii)
- Ewa Marina Community (Oahu, Hawaii)
- Kona 44 Subdivision (Hawaii)
- Haleakala Gardens and Village (Hawaii)

Commercial/Industrial Centers
- Kaiser Medical Clinic, Hawaii Kai (Oahu, Hawaii)
- Mililani Town Center (Oahu, Hawaii)
- Dole Vehicle Maintenance Facility (Oahu, Hawaii)
- Intelect Building (Oahu, Hawaii)
- Waterfront Row (Kailua-Kona, Hawaii)
- Kapolei Shopping Center (Oahu, Hawaii)
- James Campbell Industrial Park (Oahu, Hawaii)

Resort Development
- Turtle Bay Hilton Hotel (Oahu, Hawaii)
- Manele and Koele Hotels (Lanai, Hawaii)

Federal Government
- Diego Garcia Multidiscipline Projects
- Navy Public Works Center Miscellaneous Projects (Guam)
- Erosion Protection, Kaneohe MCAS (Oahu, Hawaii)

Appendix B.

Makaiwa Hills
Traffic Impact Assessment Report
Pacific Planning & Engineering, Inc.

TRAFFIC IMPACT ASSESSMENT REPORT

for

MAKAIWA HILLS

Ewa, Oahu, Hawaii
TMK: 9-1-15: 5,11,17
9-1-16: Portion 9
9-2-03: Portion 2

December 1990

Prepared for:

William E. Wanket, Inc.

Prepared by:

Pacific Planning & Engineering, Inc.
1221 Kapiolani Boulevard, Suite 740
Honolulu, Hawaii 96814

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EXECUTIVE SUMMARY

Pacific Planning & Engineering, Inc. (PPE) was engaged to undertake a traffic impact study to identify and assess future traffic impacts caused by the proposed Makaiwa Hills Residential-Commercial Project. This Report identifies and evaluates the probable impacts of traffic generated by the proposed development in the year 2010 when the project is expected to be completed and fully occupied.

Project Description

The Estate of James Campbell is proposing the Makaiwa Hills residential and commercial development. The project is approximately 1,915 acres in size and is located on the Waianae Mountain Range west of Makakilo in Ewa, Oahu. Figure 1 shows the location and roadway network in the vicinity of the project.

The project consists of approximately 2,130 residential units , a regional shopping center nearly 800,000 square feet in size, an elementary school, fire station, and a 16 acre park. Of the 2,130 residential units, about 555 will be townhouses and 1575 single family units. An 18-hole, 180 acre golf course is a future land use alternative being considered for the project and has been included in this study. The project is expected to be completed and fully occupied by the year 2010.

Access to and from the project will be via the H-1 Freeway and Farrington Highway. Two connections to Farrington Highway will be constructed to provide access to the project, with the Palailai Interchange serving as a third access to and from the project.

Methodology

Analysis was conducted to determine the relative impact of the proposed project on the local roadway system. The following highway facilities were studied:

- Segments of the H-1 Freeway and Farrington Highway in the vicinity of the project.
- Existing Ramps at the Palailai Interchange impacted by the project.
- Proposed Ramps at Farrington Highway and project Access "A".
- Proposed Ramps at Farrington Highway and project Access "B".

The following assumptions and information were used to forecast morning and afternoon peak hour traffic volumes for the year 2010:

- The 2005 forecasts from HALI 2005 Island-Wide Study for Oahu.
- Forecasts for the year 2010 were derived from the 2005 forecasts using a modified Fratar Method. The State M-K forecasts of 2010 land use were used as the base for forecasting.
- Traffic from the Ko Olina Resort and Kapolei Business-Industrial Park developments were forecast based on their traffic studies.
- Peak hour traffic from other proposed developments in the Ewa area were estimated using standard trip generation, distribution, and assignment procedures.
- The proposed Kapolei Parkway and North-South Road as shown in Figure 3 would be completed by 2010.

The Report assesses the impact on freeway and the interchanges by determining the *level-of-service* (LOS) for existing, 2010 forecast without the project, and 2010 forecast with the project traffic conditions.

Conclusions & Recommendations

The proposed Makaiwa Hills project will impact traffic conditions on Farrington Highway and H-1 Freeway when completed in 2010.

Even without the project, the H-1 Freeway and Farrington Highway will operate at LOS D or LOS E in 2010 due to islandwide growth as well as the development of the Ewa region. Practically all of the secondary urban center will be developed by 2010. Thus, the traffic growth due to other developments in the area will be substantial. The Palailai Interchange will experience LOS D to F at the study ramps due to extensive development in the area, which includes Ko Olina, Kapolei City, Barbers Point Harbor, and Kapolei Business-Industrial Park.

In order to accommodate the projected traffic even without the project, some or all of the following types of improvements area may be necessary:

- Major improvements to the Palailai Interchange, such as additional ramps.
- Relocation or deletion of the connection of Farrington Highway to Kalaeloa Boulevard.
- Increased capacity of Farrington Highway.
- Increased capacity of H-1 Freeway.

With the project in 2010, traffic volumes and delays will increase. The LOS along Farrington Highway and H-1 Freeway will worsen at certain segments from LOS D to LOS E. The LOS for ramps at the Palailai Interchange will also worsen.

The Palailai Interchange will need major modifications to allow the ramps to operate at LOS D and the Farrington Highway-Kalaeloa Boulevard intersection to operate under capacity.

The preliminary configurations for Interchanges "A" and "B", shown in Figure 7 on page 18, will require changes to allow the interchanges to operate at LOS D or better. The LOS for Interchange "A" will operate at LOS D or better, except for the Honolulu bound on-ramp which will operate at LOS F. Analysis of an at-grade left turn from Farrington Highway into the project site indicated that it will operate at LOS F. A ramp for this movement would operate at LOS B.

The Waianae bound off-ramp and Honolulu bound on-ramp of Interchange "B" will operate at LOS E and LOS F, respectively. The other ramps will operate at LOS D or better.

Ewa Region Highway Master Plan

The ongoing Ewa Region Highway Master Plan will determine roadway needs along Farrington Highway, H-1 Freeway, and the Palailai Interchange. Due to the major developments planned for the Ewa region, the State Department of Transportation has formed a Working Group which includes the City Department of Transportation Services, major developers of the Ewa region, and other State and City Planning agencies. The Developer Working Group is funding the Ewa Region Highway Master Plan. The purpose of the Master Plan is to forecast future traffic in the region, identify a roadway improvements to accommodate forecasted traffic, and distribution of fair share costs to implement the required improvements for the Ewa region.

We recommend that improvements to Farrington Highway, H-1 Freeway, and Palailai Interchange, including rights-of-way, be identified and implemented under the Master Plan. In addition, the configuration of Interchanges "A" and "B" be determined after completion of the Master Plan because:

1) The Estate of James Campbell is participating in the Ewa Region Highway Master Plan and funding improvements to the highway system that are attributable to its projects; and,

2) Substantial improvements would be required in 2010 for developments other than Makaiwa Hills.

3) The layout of Interchanges "A" and "B" will depend on the improvements identified for Farrington Highway and access routes to the Ko Olina Resort.

PROJECT DESCRIPTION

The Estate of James Campbell is proposing the Makaiwa Hills residential and commercial development. The project is approximately 1,915 acres in size and is located on the Waianae Mountain Range west of Makakilo in Ewa, Oahu. Figure 1 shows the location and roadway network in the vicinity of the project.

The project site is currently undeveloped. A portion of the site is leased as grazing land for cattle and horses.

The project consists of approximately 2,130 residential units on 726 acres, a regional shopping center nearly 800,000 square feet in size on 156 acres, a 500 student elementary school, fire station, and a 16 acre park. Of the 2,130 residential units, about 555 will be townhouses and 1575 single family units. An 18-hole, 180 acre golf course is a future land use alternative being considered for the project and has been included in this study. The project is expected to be completed and fully occupied by the year 2010. Figure 2 shows the project site plan.

Access to and from the project will be via the H-1 Freeway and Farrington Highway. Two grade separated connections (Access "A" and "B") to Farrington Highway will be constructed to provide access to the project. The third access to the project will be from the Palailai Interchange.

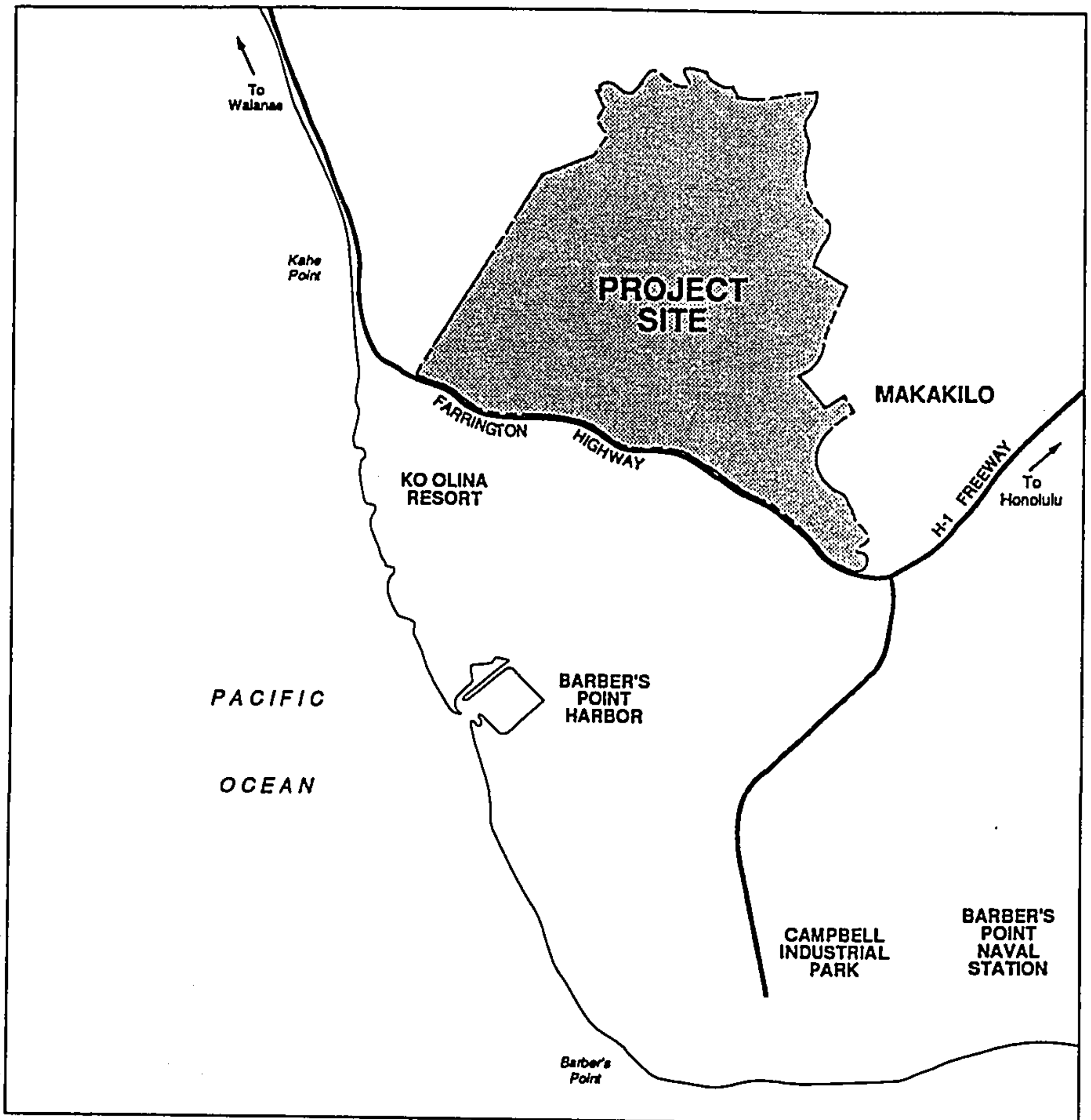
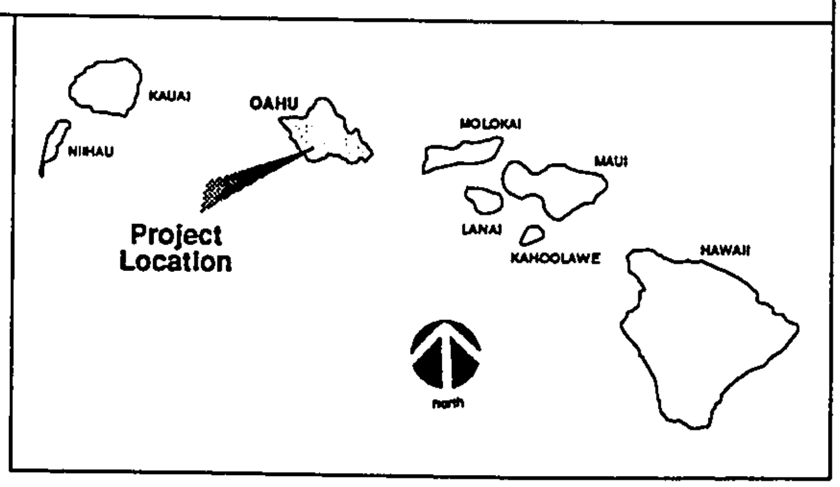


Figure 1. Project Location Map



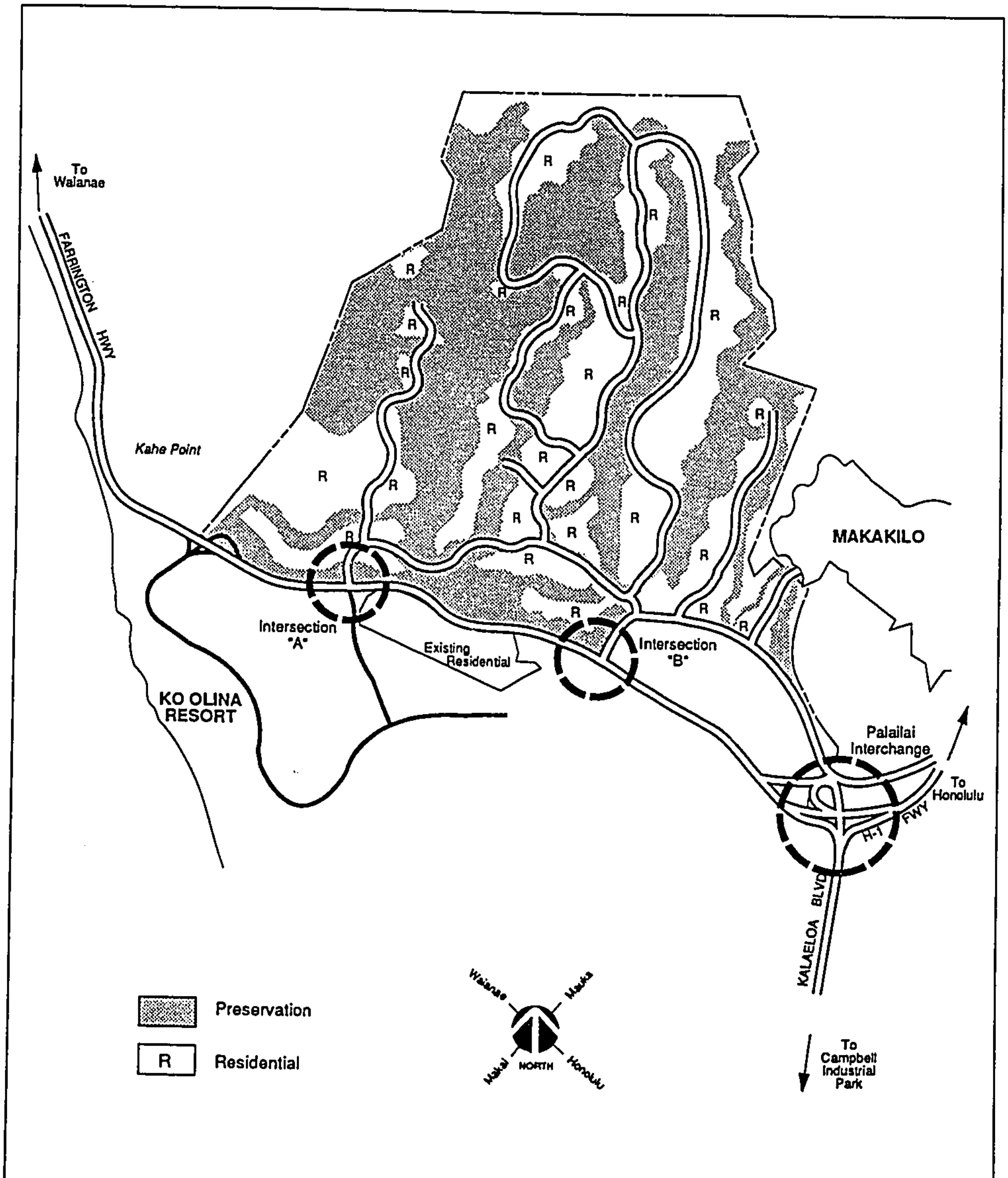


Figure 2. Project Site Plan

EXISTING CONDITIONS

An inventory of existing conditions was conducted to better understand the traffic impact of the proposed project. The review included the land uses in the area, roadway facilities, and existing traffic conditions.

Land Uses

The project is located in a relatively undeveloped area of Oahu. Existing land uses near the project include residential, resort, industrial, military, and agricultural uses. The following land uses are in the immediate area:

- Honokai Hale / Nanakai Gardens (500 homes),
- Makakilo (about 2,500 homes completed to date),
- Kapolei Villages (about 150 homes completed to date),
- Ko Olina Resort (Paradise Cove and Ko Olina Golf Course completed),
- Barbers Point Harbor (Piers under construction),
- Campbell Industrial Park (CIP),
- Barbers Point Naval Air Station (BPNAS), and
- Sugar Cane cultivation.

Roadway Facilities

The H-1 Freeway and Farrington Highway are the main roads serving the Ewa area. Kalaeloa Boulevard, Fort Barrette Road, and Fort Weaver Road provide access to CIP, BPNAS, and Ewa Beach, respectively. Figure 3 shows the roadway network in the area.

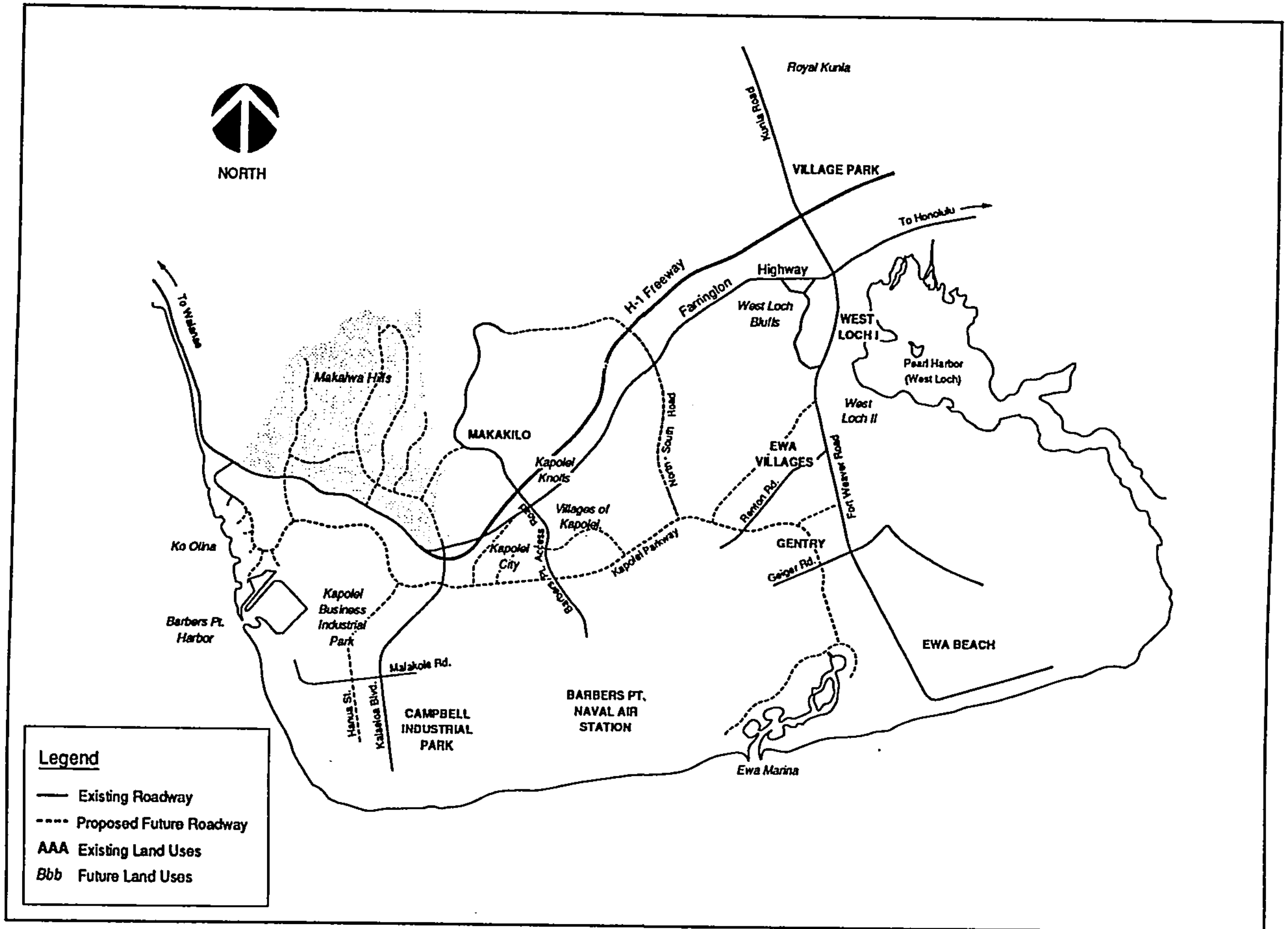


Figure 3. Roadway Network

The H-1 Freeway begins at the Palailai Interchange and is a six-lane divided State freeway with three lanes in each direction. The posted speed limit is 55 miles per hour (mph).

Farrington Highway is owned and maintained by both the State and City & County of Honolulu. The posted speed limit is 35 mph on the two-lane section from Waipahu to the Palailai Interchange and 45 mph on the four-lane section from the Palailai Interchange to Nanakuli.

Kalaeloa Boulevard is a State maintained four-lane roadway. The posted speed limit is 35 mph. Kalaeloa connects to the H-1 Freeway and Farrington Highway at the Palailai Interchange. Figure 4 shows the Palailai Interchange details.

Traffic Conditions

State Department of Transportation traffic count data for 1989 was reviewed for Farrington Highway and the H-1 Freeway in the project vicinity. Generally, the weekday commuter peak times along H-1 Freeway and Farrington Highway occur between 6:15-7:30 in the morning and 3:15-4:30 in the afternoon.

Manual traffic counts were taken at the Palailai Interchange and Farrington Highway. Figures 5 and 6 shows the present volumes and movements of traffic at the study intersections for the observed peak hours. Manual counts and observations were taken of passenger cars, trucks, buses, bicycles, motorcycles and pedestrians by turning movements and approaches.

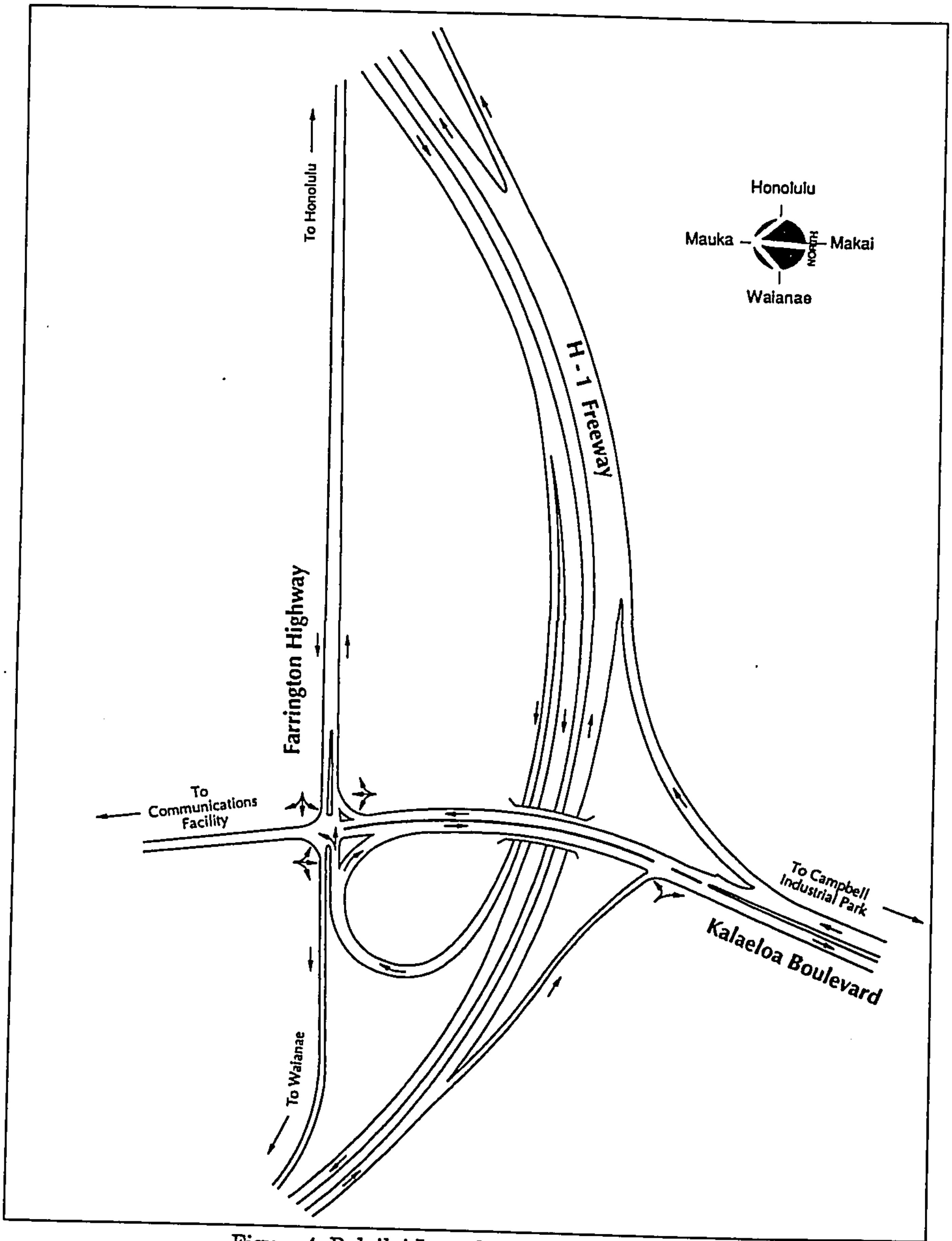


Figure 4. Palailai Interchange Configuration

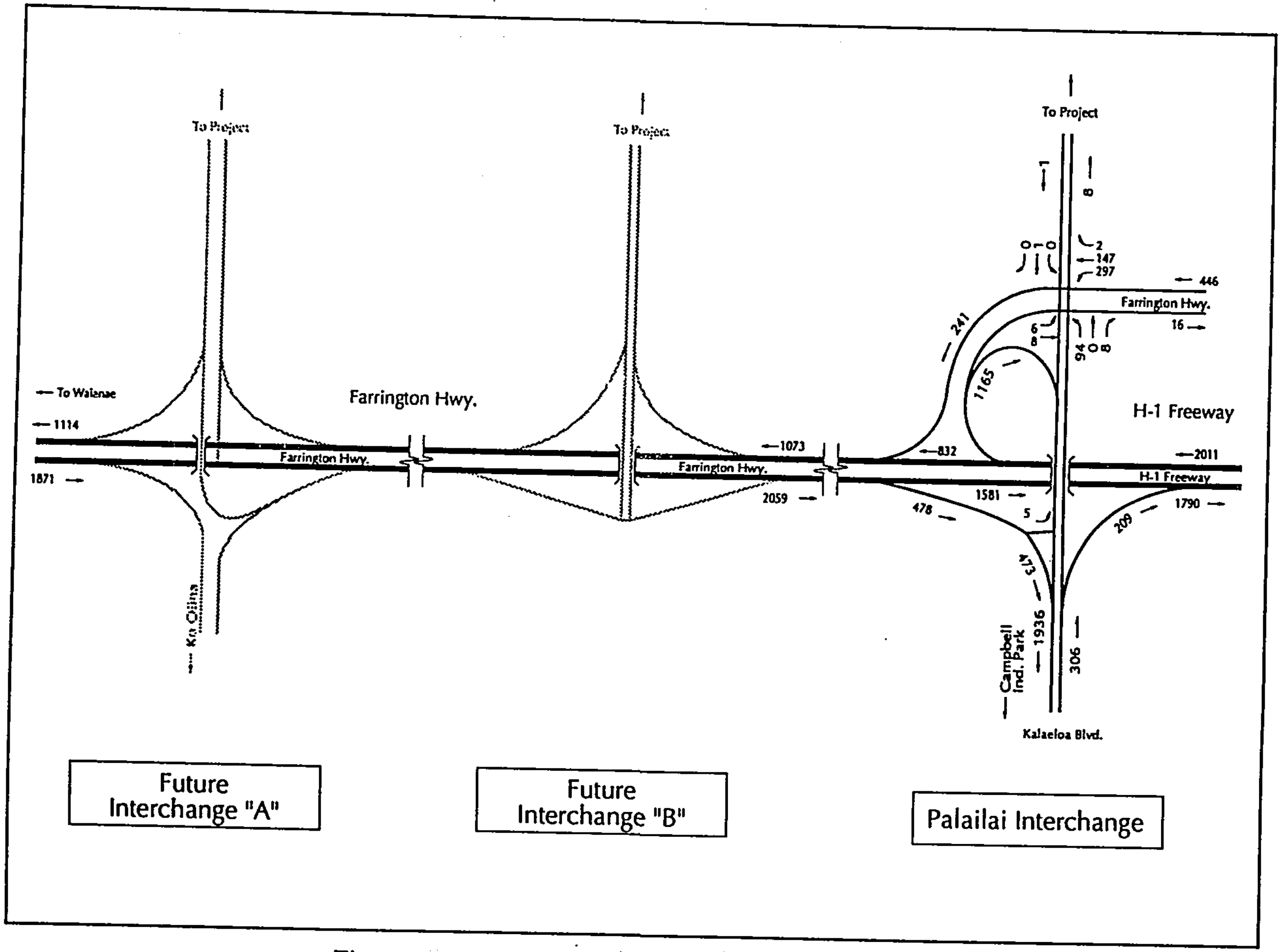


Figure 5. Existing Morning Peak Hour Traffic Volumes

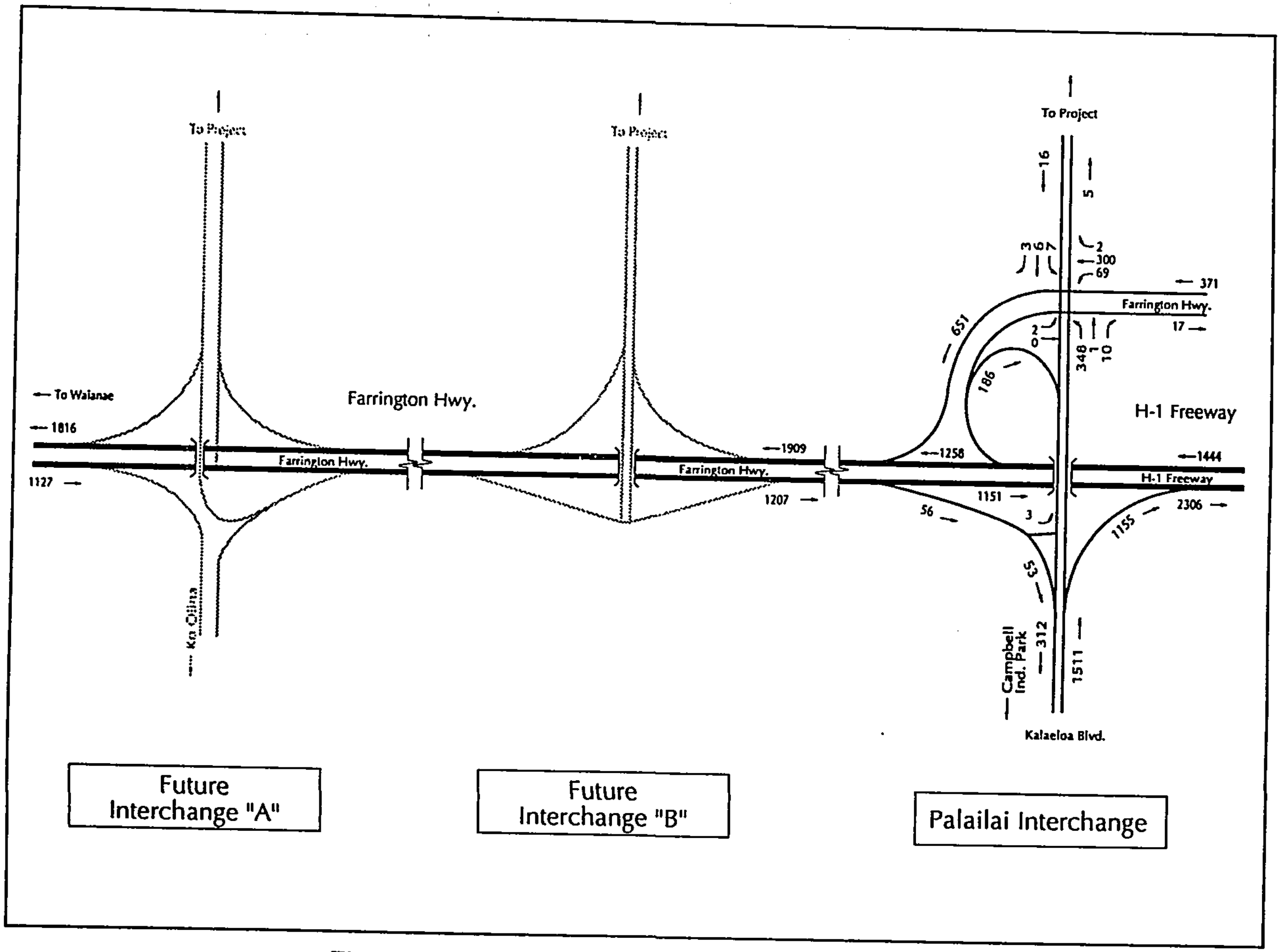


Figure 6 Existing Afternoon Peak Hour Traffic Volumes

The following observations were made during the field survey:

(1) During the morning peak hour, several mauka bound vehicles on Kalaeloa Boulevard were observed using the mauka leg of the Farrington Highway-Kalaeloa Boulevard intersection to make a U-turn and travel back to CIP.

(2) Makai bound vehicles on Kalaeloa Boulevard need to cross over to the makai side of H-1 Freeway make a U-turn on Kalaeloa Boulevard in order to be able to use the Honolulu bound on-ramp to H-1 Freeway.

(3) A few of the larger trucks had difficulty negotiating the left turn from Farrington Highway onto Kalaeloa Boulevard.

FUTURE CONDITIONS

Research of approved planned developments and improvements to transportation facilities was conducted to estimate future traffic conditions at the study intersections.

Land Uses

The following developments are planned to be built or expanded in the immediate area and are shown in Figure 3:

- Estate of James Campbell - Kapolei City
  Office, commercial, retail, residential, and other land uses on 570 acres of land.
- West Beach Estates - Ko Olina Resort
  Hotels, residential units, commercial areas and golf courses on 1000 acres of land.
- Estate of James Campbell - Kapolei Business-Industrial Park,
  Industrial and commercial land uses on 930 acres of land.
- Finance Realty - Makakilo
  2000 additional homes.
- State of Hawaii - Kapolei Villages
  4000 additional homes.
- State of Hawaii - Barbers Point Harbor
  Industrial land uses on 260 acres of land.

Roadway Facilities

Presently, there are no major roadway improvements planned by the State Department of Transportation in the Ewa area. The Ewa Region Highway Master Plan is being developed to identify roadway system improvements necessary to accommodate forecasted future traffic and allocate the cost for improvements to the developers in the region.

Based on current developer plans in the region, highway improvements such as a North-South Road and Kapolei Parkway were assumed to be built by the year 2010. Figure 3 shows the future roadways in the Ewa region that were assumed to be built by 2010.

Two new interchanges would be built with the project to provide access. A preliminary layout of these interchanges is shown in Figure 7.

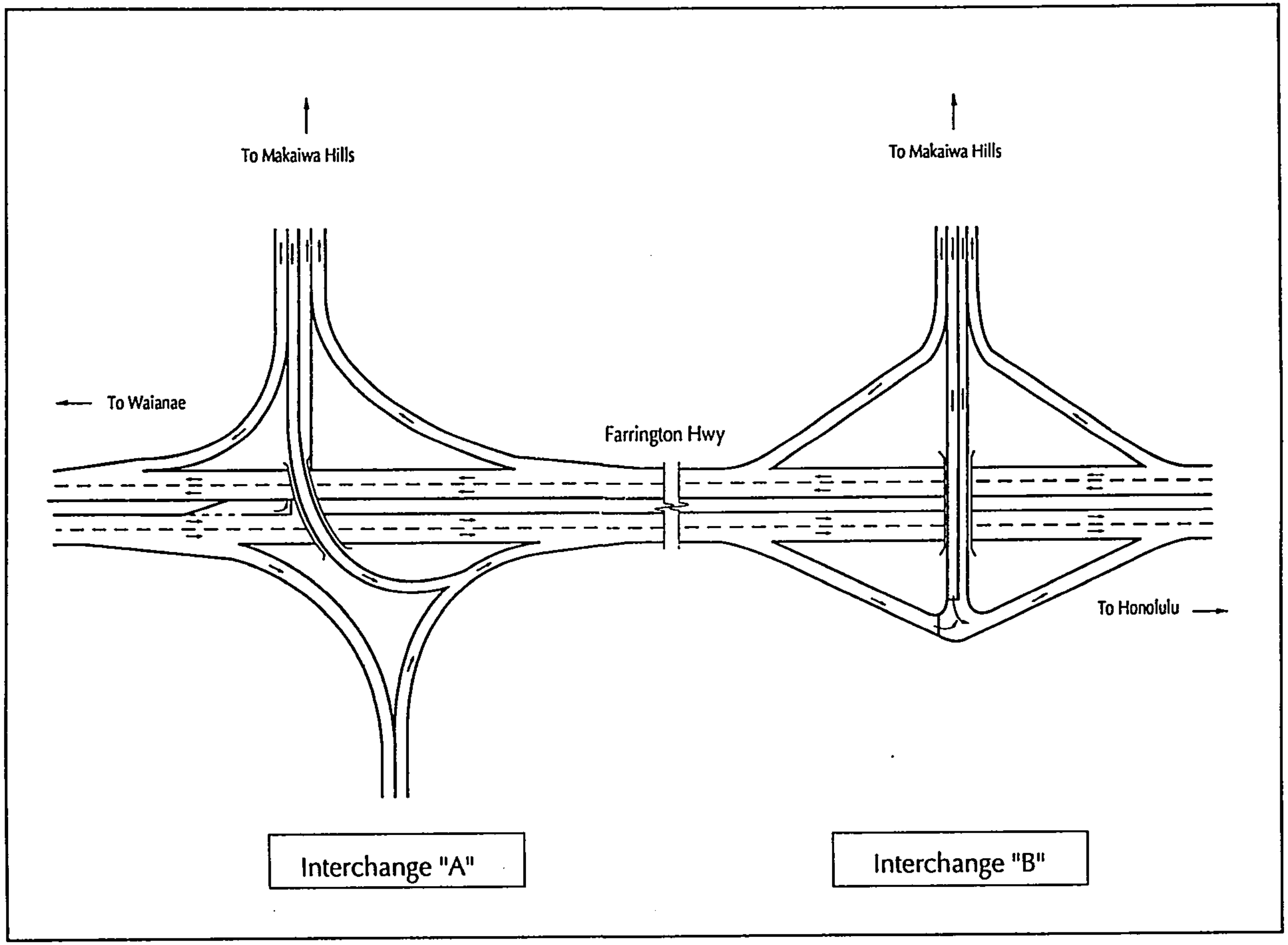


Figure 7. Preliminary Layout for Interchanges "A" and "B"

PROJECTED TRAFFIC CONDITIONS

Future traffic was forecasted for the without project and with project conditions. Traffic forecasts were made for the year 2010 when the project is expected to be completed.

Future Traffic Without Project

Future traffic without project for the year 2010 was forecasted based on the following:

1. Forecasts from the HALI 2005 study for Oahu were increased to forecast 2010 traffic using a modified Fratar Method[1], which uses zonal growth factors to increase trip volumes between different areas. The State M-K forecasts of 2010 land use were used as the basis for increasing traffic.

2. Traffic from the Ko Olina Resort and Kapolei Business-Industrial Park developments were forecast based on their traffic studies.

3. The standard three-step procedure of trip generation, trip distribution and traffic assignment was used to estimate peak hour traffic from other proposed developments in the the Ewa area. The trip generation step estimates the number of trips which would be generated by the land uses in the Ewa region including existing and future land uses listed in the Chapter titled "Future Conditions". The number of trips was estimated from the Trip Generation Report[2]. The trip distribution step

[1]Transportation Engineering, Planning and Design 2nd Edition, Paquette, Ashford, Wright, 1982.

[2]Trip Generation Report, by the Institute Transportation Engineers, Fourth Edition, 1987.

assigns trips to their expected origins and destinations. Trips were distributed to different areas of the island based on the amount of population and employment in each area. Trip tables of vehicle trips for the morning and afternoon peak hours were the result.

4. Forecasted traffic was assigned to the roadway network assumed to be completed by 2010, as shown in Figure 3. The traffic assignment step assigns trips to a specific route on the roadway network that will take the driver from origin to destination. Traffic was assigned using a computer model to determine specific travel routes based on the estimated shortest path or travel time from origins to destinations.

The resultant forecast traffic with project are shown in Figures 8 and 9 for the morning and afternoon peak hours.

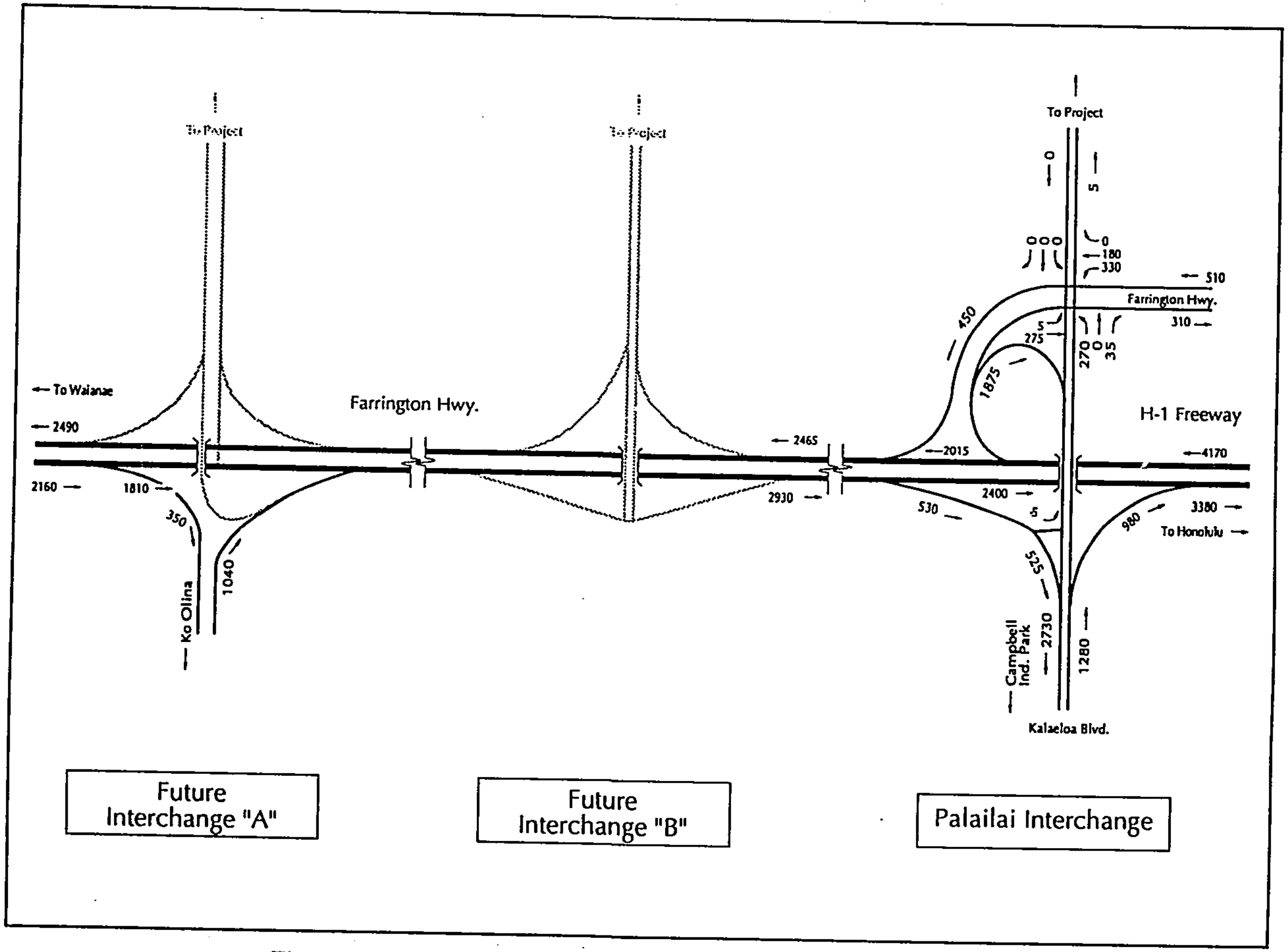


Figure 8. 2010 Without Project Morning Peak Hour Traffic Volumes

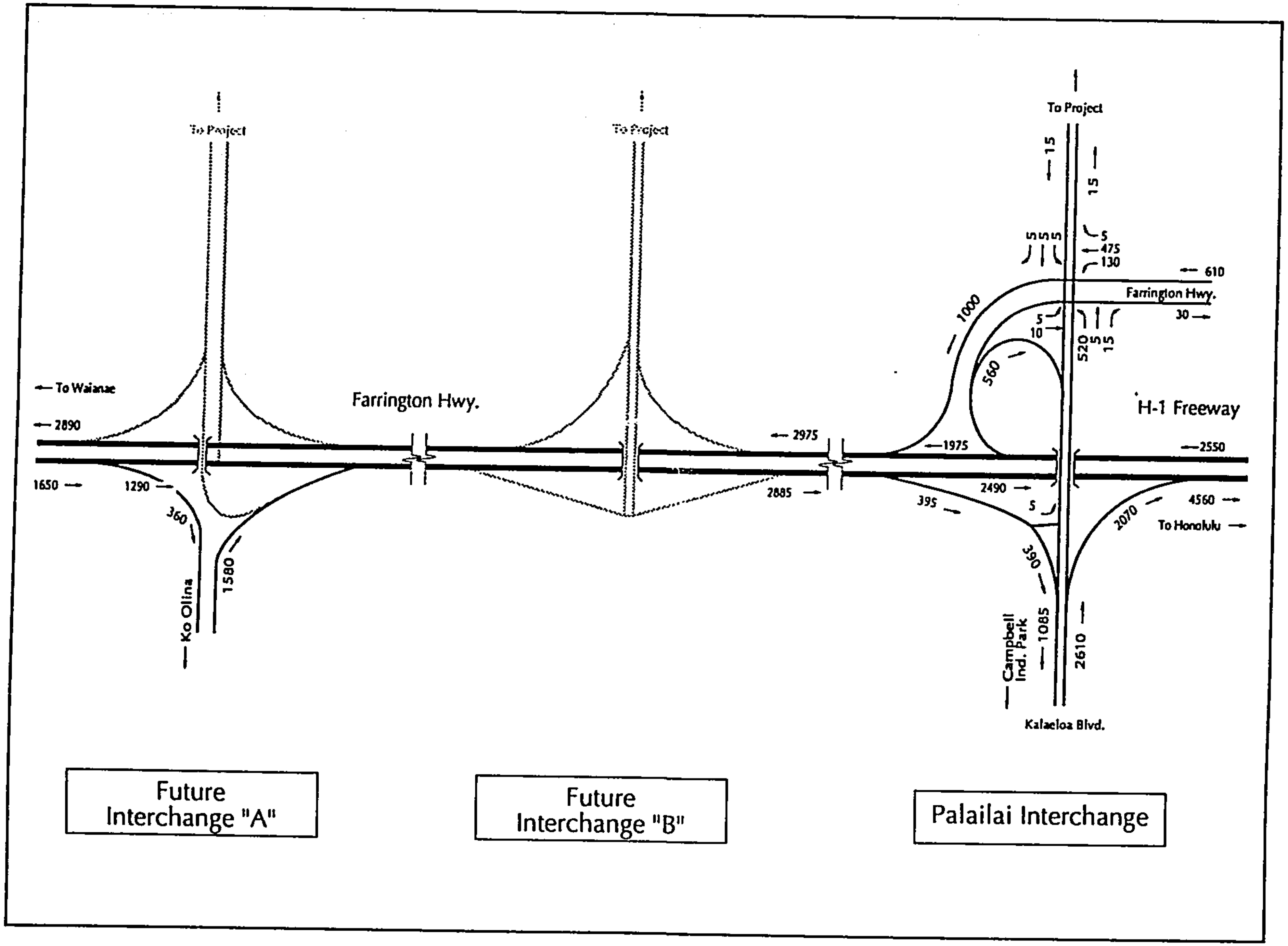


Figure 9. 2010 Without Project Afternoon Peak Hour Traffic Volumes

Future Traffic With Project

Future traffic with project was forecasted by adding the "without project traffic" to the traffic generated by the proposed project. The three step procedure of trip generation, trip distribution, and traffic assignment was used to estimate peak hour traffic from the proposed project.

The number of trips from the project was estimated based on the proposed project land uses and data from the Trip Generation Report. Table 1 shows the number of trips generated. The trip generation equations are shown in Appendix A.

Table 1. Trip Generation for Makaiwa Hills

Land Use	Quantity	Units	Morning Peak Hour		Afternoon Peak Hour	
			Enter	Exit	Enter	Exit
Townhouse	554	units	33	176	177	87
Single Family	1576	units	268	724	915	537
Golf Course	180	acres	38	10	6	64
Park	16	acres	19	19	27	27
Elem School	500	Students	90	60	4	4
Fire Station	1	acres	2	2	2	2
Commercial	800	1000 Sq. Ft	426	183	1149	1296
TOTAL			880	1180	2280	2020

The trip distribution step assigns trips to their expected origins and destinations. Trip distribution for the project was based on the distribution of population and employment on Oahu. The trips were generally distributed as follows:

To/From:	Morning	Afternoon
West (Waianae/Ko Olina)	10%	15%
East (Honolulu)	45%	30%
North (Makakilo/Makaiwa Shopping Center)	15%	25%
South (Campbell Industrial Park/Kapolei City)	30%	30%

The traffic assignment step assign trips to a specific route on the roadway network that will take the driver from origin to destination. Traffic was assigned using a computer model to determine specific travel routes based on the estimated shortest path or travel time from origins to destinations.

The resultant forecast traffic with project are shown in Figures 10 and 11 for the morning and afternoon peak hours.

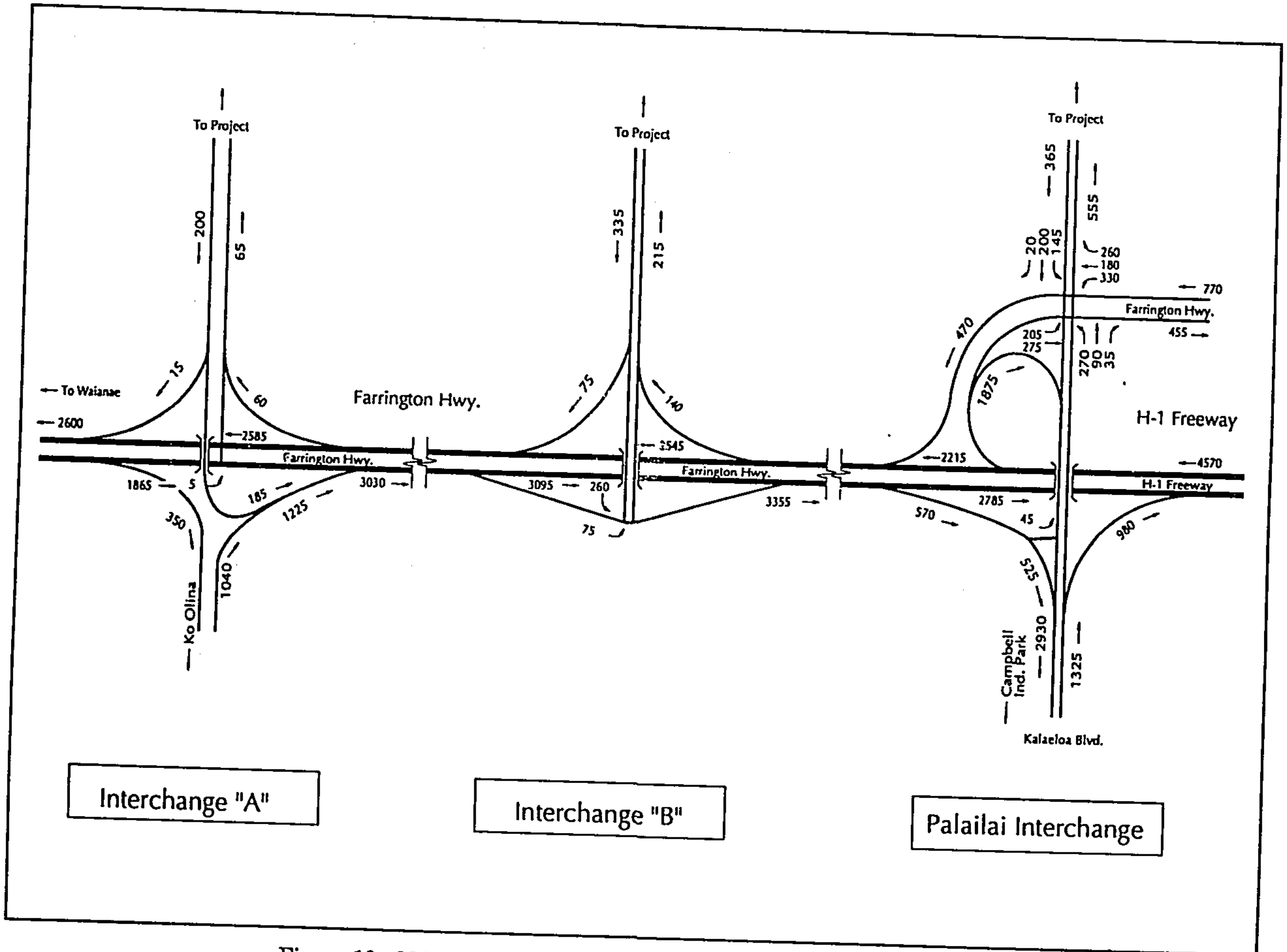


Figure 10. 2010 With Project Morning Peak Hour Traffic Volumes

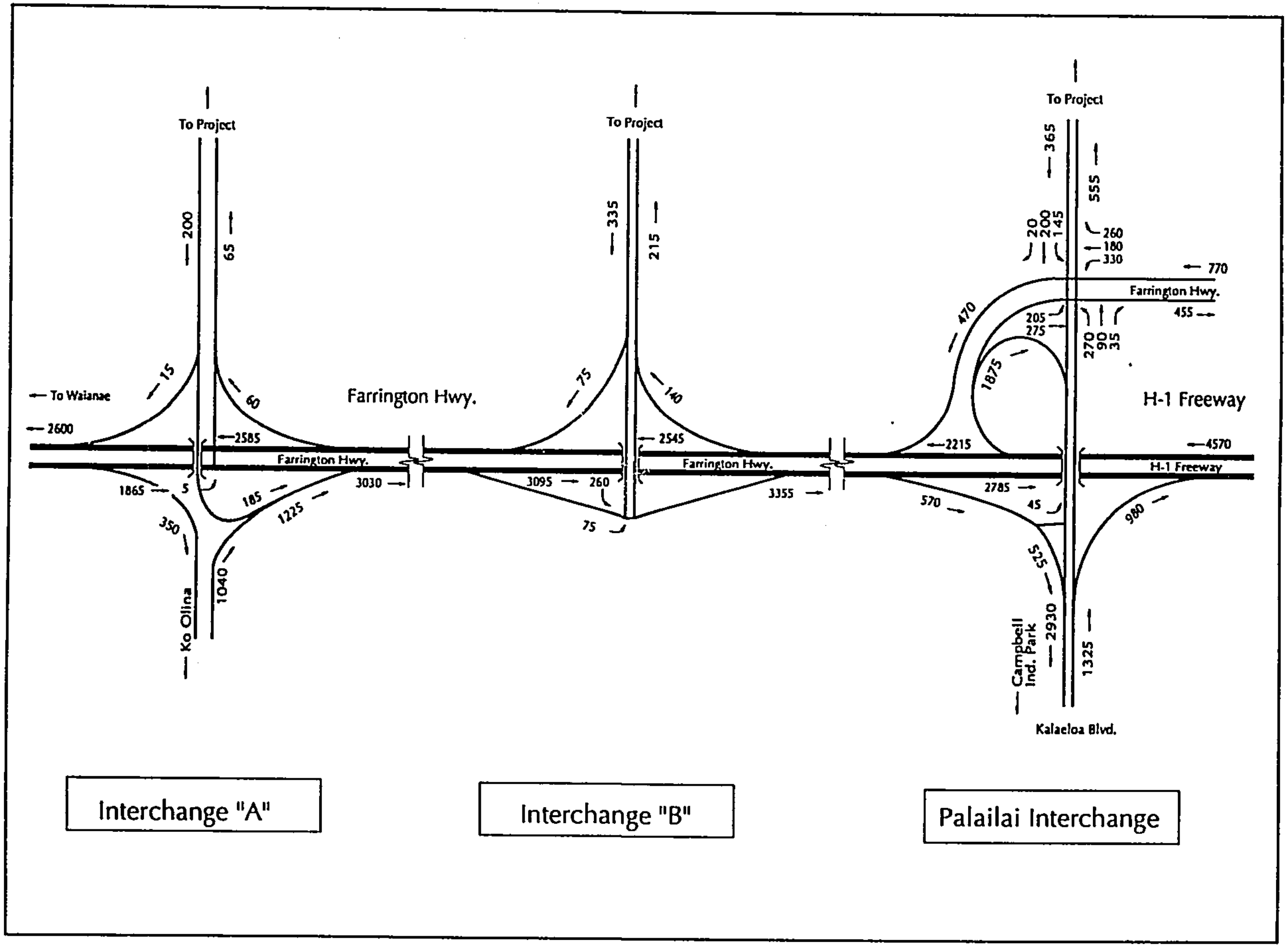


Figure 10. 2010 With Project Morning Peak Hour Traffic Volumes

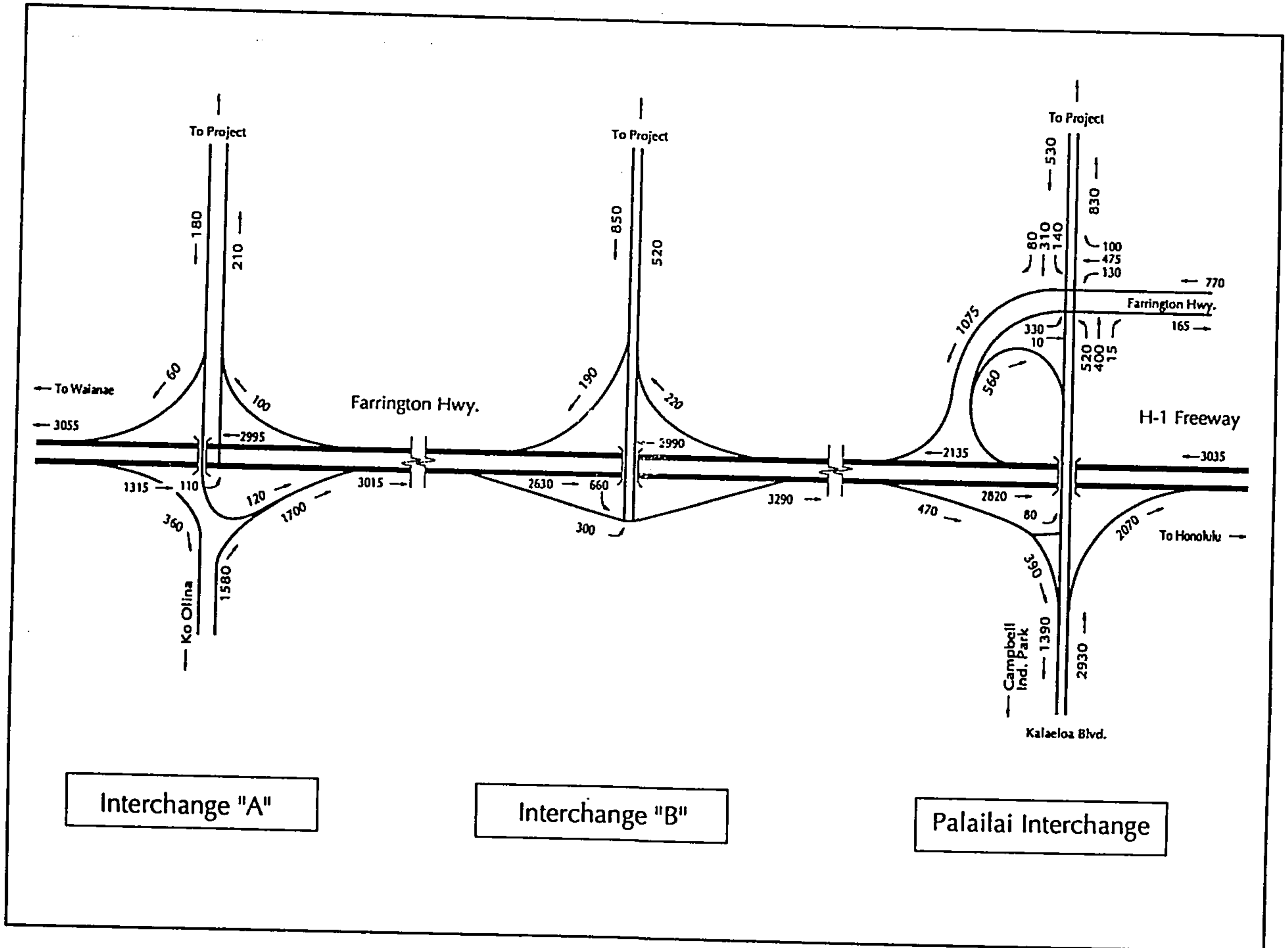


Figure 11. 2010 With Project Afternoon Peak Hour Traffic Volumes

TRAFFIC IMPACTS

The existing, 2010 forecast without project, and 2010 forecast with project traffic conditions were studied for the morning and afternoon peak hours to determine the relative impact of the proposed project on the local roadway system. The following roadway sections and intersections were analyzed:

1) Segments of the H-1 Freeway and Farrington Highway adjacent to the project site;
2) Ramps for Palailai Interchange and Interchanges "A" and "B"; and,
3) Intersection of Kalaeloa Boulevard and Farrington Highway.

Forecast traffic volumes on Farrington Highway, H-1 Freeway, and the Palailai Interchange were analyzed based on the existing roadway geometrics. Interchanges "A" and "B" were analyzed using the preliminary configurations shown in Figure 7.

Analysis Methodology

The freeway segments, freeway ramps, and study intersection, were analyzed using procedures contained in the Highway Capacity Manual[3] (HCM). Sections of Farrington Highway and H-1 Freeway next to the project site were analyzed as freeway segments. The ramps were analyzed using the HCM procedures for ramps and ramp junctions. The Farrington Highway-Kalaeloa Boulevard intersection was analyzed using procedures for unsignalized and signalized intersections.

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[3] Highway Capacity Manual, Special Report No. 209. Transportation Research Board, 1985.

The HCM analysis uses level-of-service (LOS) to measure traffic operational conditions. LOS is divided into six categories ranging from little delays (LOS A) to extremely long delays (LOS F). LOS for unsignalized intersections, freeway ramps, and freeway segments are based on different analytical assumptions and therefore are not directly comparable. The LOS definitions for each type of analysis are given in Appendix A.

Analysis Results

The analysis results for the morning and afternoon peak hours generally show that:

- Farrington Highway and the H-1 Freeway will be operating at LOS D or LOS E in the direction of peak hour traffic without or with the project.
- The Palailai Interchange ramps will be near capacity (LOS D) to over capacity (LOS F).
- At Interchange "A", an unsignalized at-grade left turn from Farrington Highway into the project site will operate with extremely long delays (LOS F). A grade separated ramp for this movement would operate at LOS B. The Honolulu bound on-ramp will operate at LOS F.
- At Interchange "B", the Waianae bound off-ramp and Honolulu bound on-ramp will operate at LOS E or LOS F with the current highway laneage and single lane ramps.
- Several turning movements at the intersection of Farrington Highway at Kalaeloa Boulevard currently operate with extremely long delays (LOS F). As a signalized intersection, it will be over capacity.

The results are summarized in Tables 2 to 6 and discussed on the following paragraphs.

Table 2. H-1 Freeway and Farrington Highway Capacity Analysis

Turning Movement	Existing Traffic 1990	Without Project 2010	With Project 2010
Morning Peak Hour			
Farrington Highway: West of Interchange "A"			
Waianae Bound	B	D	D
Honolulu Bound	C	C	C
Farrington Highway: Between Interchanges "A" and "B"			
Waianae Bound	B	D	D
Honolulu Bound	C	E	E
Farrington Highway: Between Interchange "B" and Palailai Interchange			
Waianae Bound	B	D	D
Honolulu Bound	C	D	E
H-1 Freeway: East of Palailai Interchange			
Waianae Bound	B	D	D
Honolulu Bound	A	C	C
Afternoon Peak Hour			
Farrington Highway: West of Interchange "A"			
Waianae Bound	C	E	E
Honolulu Bound	B	C	C
Farrington Highway: Between Interchanges "A" and "B"			
Waianae Bound	C	E	E
Honolulu Bound	B	E	E
Farrington Highway: Between Interchange "B" and Palailai Interchange			
Waianae Bound	B	E	E
Honolulu Bound	B	D	E
H-1 Freeway: East of Palailai Interchange			
Waianae Bound	A	B	C
Honolulu Bound	B	D	E

Table 3. Palailai Interchange Freeway Ramp Level-of-Service Analysis

Turning Movement	Existing Traffic 1990	Without Project 2010	With Project 2010
Morning Peak Hour			
Waianae Bound Off-Ramp			
Freeway	C	D	D
Diverge Lane	C	F	F
Waianae Bound On-Ramp			
Freeway	A	D	D
Merge Lane	B	D	D
Honolulu Bound Off-Ramp			
Freeway	C	D	E
Diverge Lane	C	D	E
Afternoon Peak Hour			
Waianae Bound Off-Ramp			
Freeway	A	B	C
Diverge Lane	A	B	B
Waianae Bound On-Ramp			
Freeway	B	F	F
Merge Lane	C	F	F
Honolulu Bound Off-Ramp			
Freeway	A	D	E
Diverge Lane	B	D	D

Table 4. Interchange "A" Freeway Ramp Level-of-Service Analysis

Turning Movement	Existing Traffic 1990	Without Project 2010	With Project 2010
Morning Peak Hour			
Waianae Bound Off-Ramp			
Freeway	n/a	n/a	C
Diverge Lane	n/a	n/a	C
Waianae Bound On-Ramp			
Freeway	n/a	n/a	C
Merge Lane	n/a	n/a	C
Honolulu Bound Off-Ramp			
Freeway	n/a	n/a	C
Diverge Lane	n/a	n/a	B
Unsignalized Intersection	n/a	n/a	E
Honolulu Bound On-Ramp			
Freeway	n/a	n/a	E
Merge Lane	n/a	n/a	E
Afternoon Peak Hour			
Waianae Bound Off-Ramp			
Freeway	n/a	n/a	D
Diverge Lane	n/a	n/a	C
Waianae Bound On-Ramp			
Freeway	n/a	n/a	D
Merge Lane	n/a	n/a	C
Honolulu Bound Off-Ramp			
Freeway	n/a	n/a	B
Merge Lane	n/a	n/a	B
Unsignalized Intersection	n/a	n/a	F
Honolulu Bound On-Ramp			
Freeway	n/a	n/a	F
Merge Lane	n/a	n/a	F

Table 5. Interchange "B" Freeway Ramp Level-of-Service Analysis

Turning Movement	Existing Traffic 1990	Without Project 2010	With Project 2010
Morning Peak Hour			
Waianae Bound Off-Ramp			
Freeway	n/a	n/a	D
Diverge Lane	n/a	n/a	D
Waianae Bound On-Ramp			
Freeway	n/a	n/a	C
Merge Lane	n/a	n/a	C
Honolulu Bound Off-Ramp			
Freeway	n/a	n/a	D
Diverge Lane	n/a	n/a	C
Honolulu Bound On-Ramp			
Freeway	n/a	n/a	E
Merge Lane	n/a	n/a	D
Afternoon Peak Hour			
Waianae Bound Off-Ramp			
Freeway	n/a	n/a	F
Diverge Lane	n/a	n/a	F
Waianae Bound On-Ramp			
Freeway	n/a	n/a	D
Merge Lane	n/a	n/a	D
Honolulu Bound Off-Ramp			
Freeway	n/a	n/a	D
Diverge Lane	n/a	n/a	C
Honolulu Bound On-Ramp			
Freeway	n/a	n/a	F
Merge Lane	n/a	n/a	E

Table 6. Level-of-Service for Farrington Highway at Kalaeloa Boulevard

Turning Movement	Existing Traffic 1990	Without Project 2010	With Project 2010
Morning Peak Hour			
Farrington Highway			
Waianae bound - LT	F	F	F
Honolulu bound - LT	A	A	A
Kalaeloa Boulevard			
Mauka bound - LT/TH	F	F	F
Mauka bound -RT	A	C	C
Makai bound - LT/TH/RT	F	F	F
PLANNING ANALYSIS	over	over	over
Afternoon Peak Hour			
Farrington Highway			
Waianae bound - LT	A	A	A
Honolulu bound - LT	A	A	C
Kalaeloa Boulevard			
Mauka bound - LT/TH	E	F	F
Mauka bound -RT	A	A	A
Makai bound - LT/TH/RT	A	D	F
PLANNING ANALYSIS	under	over	over

Farrington Highway and H-1 Freeway

- *Presently*, Farrington Highway and H-1 Freeway operate at LOS C or better in the morning and afternoon peak hours.
- *By 2010 without project*, the LOS for Farrington Highway near the project will decrease to LOS D and E during the morning and afternoon peak hours. H-1 Freeway will operate at LOS D or better.
- *By 2010 with project*, the LOS will decrease to LOS E for the Honolulu bound portion of Farrington Highway between Interchange "B" and Palailai Interchange in the morning and afternoon peak hours. The LOS is not expected to change for the other segments of Farrington Highway. The LOS for H-1 Freeway will decrease one LOS for each movement. In the peak directions (i.e., Waianae bound in the morning and Honolulu bound in the afternoon) the level decreases to LOS E.

Palailai Interchange

- *Presently*, the freeway merge/diverge sections and ramps operate at LOS C or better during the morning and afternoon peak hours.
- *By 2010 without project*, the Waianae bound off-ramp is forecast to operate at LOS F during the morning peak hour and the Waianae bound on-ramp is forecast to operate at LOS F during the afternoon peak hour. The other ramps will operate at LOS D or better
- *By 2010 with project*, the Honolulu bound off-ramp will decrease to LOS E in the morning peak hour. The Waianae bound off-ramp and on-ramp will remain at LOS F during the time periods noted above. All other ramps will remain at LOS D or better.

Interchange "A"

• *By 2010 with project,* the ramps would operate at LOS D or better, except the Honolulu bound on-ramp. Due to the merging of the project traffic with vehicles exiting Ko Olina Resort, the ramp would operate at LOS F during the afternoon peak hour. Analysis of the at-grade left turn movement from Farrington Highway into the project shows that the movement would operate at LOS E and F during the morning and afternoon peak hours, respectively. A grade separated ramp for this movement will operate at LOS B.

Interchange "B"

• *By 2010 with project,* using the existing laneage and single lane ramps, the Waianae bound off-ramp and Honolulu bound on-ramp operate at LOS E and LOS F, respectively, during the afternoon peak hour with the merge and diverge areas for these ramps operating at LOS F.

Farrington Highway at Kalaeloa Boulevard

• *Presently,* the several turning movements operate at LOS F during the morning peak hour. The planning analysis shows that the the existing intersection would be over capacity even with signalization.

• *By 2010 without project,* turning movements in both the morning and afternoon peak hours operate at LOS F.

• *By 2010 with project,* the morning and afternoon peak hours continue to operate over capacity for a signalized intersection with several movements operating at LOS F.

CONCLUSIONS AND RECOMMENDATIONS

The proposed Makaiwa Hills project will impact traffic conditions on Farrington Highway and H-1 Freeway when completed in 2010.

Even without the project, the H-1 Freeway and Farrington Highway will operate at LOS D or LOS E in 2010 due to islandwide growth as well as the development of the Ewa region. Practically all of the secondary urban center will be developed by 2010. Thus, the traffic growth due to other developments in the area will be substantial. The Palailai Interchange will experience LOS D to F at the study ramps due to extensive development in the area, which includes Ko Olina, Kapolei City, Barbers Point Harbor, and Kapolei Business-Industrial Park.

In order to accommodate the projected traffic even without the project, some or all of the following types of improvements area may be necessary:

- Major improvements to the Palailai Interchange, such as additional ramps.
- Relocation or deletion of the connection of Farrington Highway to Kalaeloa Boulevard.
- Increased capacity of Farrington Highway.
- Increased capacity of H-1 Freeway.

With the project in 2010, traffic volumes and delays will increase. The LOS along Farrington Highway and H-1 Freeway will worsen at certain segments from LOS D to LOS E. The LOS for ramps at the Palailai Interchange will also worsen.

The Palailai Interchange will need major modifications to allow the ramps to operate at LOS D and the Farrington Highway-Kalaeloa Boulevard intersection to operate under capacity.

The preliminary configurations for Interchanges "A" and "B", shown in Figure 7 on page 18, will require changes to allow the interchanges to operate at LOS D or better. The LOS for Interchange "A" will operate at LOS D or better, except for the Honolulu bound on-ramp which will operate at LOS F. Analysis of an at-grade left turn from Farrington Highway into the project site indicated that it will operate at LOS F. A ramp for this movement would operate at LOS B.

The Waianae bound off-ramp and Honolulu bound on-ramp of Interchange "B" will operate at LOS E and LOS F, respectively. The other ramps will operate at LOS D or better.

Ewa Region Highway Master Plan

The ongoing Ewa Region Highway Master Plan will determine roadway needs along Farrington Highway, H-1 Freeway, and the Palailai Interchange. Due to the major developments planned for the Ewa region, the State Department of Transportation has formed a Working Group which includes the City Department of Transportation Services, major developers of the Ewa region, and other State and City Planning agencies. The Developer Working Group is funding the Ewa Region Highway Master Plan. The purpose of the Master Plan is to forecast future traffic in the region, identify a roadway improvements to accommodate forecasted traffic, and distribution of fair share costs to implement the required improvements for the Ewa region.

We recommend that improvements to Farrington Highway, H-1 Freeway, and Palailai Interchange, including rights-of-way, be identified and implemented under the Master Plan. In addition, the configuration of Interchanges "A" and "B" be determined after completion of the Master Plan because:

1) The Estate of James Campbell is participating in the Ewa Region Highway Master Plan and funding improvements to the highway system that are attributable to its projects; and,

2) Substantial improvements would be required in 2010 for developments other than Makaiwa Hills.

3) The layout of Interchanges "A" and "B" will depend on the improvements identified for Farrington Highway and access routes to the Ko Olina Resort.

APPENDIX A

TRIP GENERATION EQUATIONS

TRIP GENERATION EQUATIONS

Land Use	Ind Var		Total Number of Trips	Enter	Exit
Townhouse	units	AM	$T = \exp(0.8 \times \ln(A)+0.29)$	16%	84%
		PM	$T = \exp(0.84 \times \ln(A)+0.27)$	67%	33%
Single Family	units	AM	$T = \exp(0.91 \times \ln(A)+0.2)$	27%	73%
		PM	$T = \exp(0.94 \times \ln(A)+0.36)$	63%	37%
Golf Course	acres	AM	$T = 0.266 \times A$	80%	20%
		PM	$T = 0.386 \times A$	8%	92%
Park	acres	AM	$T = 2.431 \times A$	50%	50%
		PM	$T = 3.370 \times A$	50%	50%
Elem School	Students	AM	$T = \exp(0.6 \times \ln(A)+2.4)$	70%	30%
		PM	$T = 2.58 \times A+381$	47%	53%
Commercial	1000 Sq. Ft	AM	$T = 0.22 \times A+90$	60%	40%
		PM	$T = 0.15 \times A$	50%	50%

T = Total number of trips
A = Quantity of independent variable

APPENDIX B

LEVEL-OF-SERVICE DEFINITIONS
FOR
UNSIGNALIZED INTERSECTIONS
FREEWAY RAMPS
FREEWAY SEGMENTS

DEFINITION OF LEVEL-OF-SERVICE FOR UNSIGNALIZED INTERSECTIONS

For unsignalized intersections, the traffic most impacted will be the minor or cross-street with the stop or yield control. The major roadway will have the right-of-way. The level-of-service is the amount of delay expected for the average vehicle desiring to cross or enter the major road. The following gives a general description of the measure.

The concept of levels of service is defined as a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers. A level of service definition generally describes these conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.

Six levels of service are defined for each type of facility for which analysis procedures are available. They are given letter designations, from A to F, with level-of-service A representing the best operating conditions and level-of-service F the worst.

Level-of-Service definitions--In general, the various levels of service are defined as follows for uninterrupted flow facilities:

Level-of-service A represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian is excellent.

Level-of-service B is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is slight decline in the freedom to maneuver within the traffic stream from LOS A. The level of comfort and convenience provided is somewhat less than at LOS A, because the presence of others in the traffic stream begins to affect individual behavior.

Level-of-service C is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user. The general level of comfort and convenience declines noticeably at this level.

Level-of-service D represents high-density, but stable, flow. Speed and freedom to maneuver are severely restricted, and the driver or pedestrian experiences a generally poor level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.

Level-of-service E represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within the traffic stream is extremely difficult, and it is generally accomplished by forcing a vehicle or pedestrian to "give way" to accommodate such maneuver. Comfort and convenience levels are extremely poor, and driver or pedestrian frustration is generally high. Operations at this level are usually unstable, because small increases in flow or minor perturbations within the traffic stream will cause breakdowns.

Level-of-service F is used to define forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go wave, and they are extremely unstable. Vehicles may progress at reasonable speeds for several hundred feet or more, then be required to stop in a cyclic fashion. Level-of-service F is used to describe the operating conditions within the queue, as well as the point of the breakdown. It should be noted, however, that in many cases operating conditions of the vehicles or pedestrians discharged from the queue may be quite good.

Nevertheless, it is the point at which arrival flow exceeds discharge flow which causes the queue to form, and level-of-service F is an appropriate designation for such points.

These definitions are general and conceptual in nature, and they apply primarily to uninterrupted flow. Levels of service for interrupted flow facilities vary widely in terms of both the user's perception of service quality and the operational variables used to describe them.

DEFINITION OF LEVEL-OF-SERVICE FOR FREEWAY RAMPS

Level of service for on and off-ramps is defined in terms of *flow rates.*

Level-of service A represents unrestricted operation. Merging and diverging vehicles have little effect on other freeway flows.

Level-of-service B merging vehicles have to adjust their speed slightly to fill lane 1 gaps; diverging vehicles still do not experience any significant turbulence. Flow may be described generally as smooth and stable.

Level-of-service C Both lane 1 and on-ramp vehicles must adjust their speed to accomplish smooth merging, and under heavy on-ramp flows, minor ramp queuing may occur. Some slowing may also occur in diverge areas. Overall speed and density of freeway vehicles are not expected to be seriously deteriorated.

Level-of-service D Smooth merging becomes difficult to achieve. Both lane 1 and on-ramp vehicles must frequently adjust their speed to avoid conflicts in the merge area. Slowing in the vicinity of diverge areas is also significant. At heavily used on-ramps, ramp queues may become a disruptive factor.

Level-of-service E Represents capacity operation. On-ramp queues may be significant. Diverge movements are significantly slowed, and some queuing may occur in the diverge area. All vehicles are affected by turbulence on freeway.

Level-of-service F All merging is on a stop-and-go basis, and ramp queues and lane 1 breakdowns are extensive. Much turbulence is created as vehicles attempt to change lanes to avoid merge and diverge areas. Considerable delay is encountered in the vicinity of the ramp terminal, and conditions may vary widely, from minute to minute, as unstable conditions create "waves" of alternatively good and forced flow.

DEFINITION OF LEVEL-OF-SERVICE FOR FREEWAY SEGMENTS

Level of service for multi-lane highways is defined in terms of *density*.

Level-of service A describes completely free-flow conditions. Maximum density is 12 passenger cars per mile per lane (pcpmpl) and the ability to maneuver within the traffic stream is high.

Level-of-service B is also indicative of free flow. The maximum density is 20 pcpmpl. Minor disruptions to flow are still easily absorbed at this level.

Level-of-service C represents a range in which the influence of traffic density on operations becomes marked. The ability to maneuver within the traffic stream, and to select an operating speed, is now clearly affected by the presence of other vehicles. The maximum density is 30 pcpmpl.

Level-of-service D borders on unstable flow. Speeds and ability to maneuver are severely restricted because of traffic congestion. The maximum density is 42 pcpmpl.

Level-of-service E represents operations at or near capacity,and is quite unstable. The maximum density is 67 pcpmpl. This is the minimum spacing at which uniform flow can be maintained, and effectively defined a traffic stream with no usable gaps.

Level-of-service F represents forced or breakdown flow. It occurs at a point where vehicles arrive either at a rate greater than that at which they are discharged or at a point on a planned facility where forecasted demand exceeds the computed capacity. Densities are higher than 67 pcpmpl. Queues form behind the breakdowns and are highly unstable.

REFERENCE: Highway Capacity Manual (Special Report 209, 1985)

PACIFIC PLANNING & ENGINEERING, INC.

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JULY 1989

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The Principals of PPE, Inc. are Dr. Jonathan Shimada and Mr. Howard Abe. They have decades of experience and training in management and technical fields.

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-ground transportation
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-media and public relations
-management and technical Workshops
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He has a wide range of experience by having managed a large public works agency with a $120 million annual operating budget and over 800 employees. He has dealt with print and television reporters, small and large airport operators, State Legislature and County Governments, major retail businesses, protocol personnel, airlines, small businesses, ground transportation operators, special interest groups, and attorneys. This provides a strong and effective base for assisting those needing people and solutions who can deal effectively with technical problems, government agencies, and private enterprise. Dr. Shimada is well-known and respected in the world-wide system of airports, and particularly in the Pacific Basin.

Mr. Howard Abe's professional experience has been notable in its ever increasing management responsibilities. His management experiences, technical knowledge and field experience over three decades provide a strong and practical base. He is widely respected by the agencies he has served, and most significantly by government, media, private and community groups with whom he has worked. His awards and recognition are even more noteworthy when one considers they were given in the public service field of highways. He has received awards and recognition from such respected and diverse groups as:

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-State Government
-Maui County
-Newspaper editors
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Lanai Highway Planning
Princeville Airport
Waikiki Convention Center
Honolulu Waterfront Development Project
Lanai City Traffic Circulation
Waikoloa Expansion Project
State Filming Facility
Lihue/Puhi District Project
Ewa Regional Long-Range Transportation Plan
Aloha Stadium Master Plan Update
Honolulu International Airport Intra-Airport Transportation System

Appendix C.

An Archaeological Inventory Survey for the Makaiwa Hills Project Site, Honouliuli, Ewa, Oahu

Cultural Surveys Hawaii

An Archaeological Inventory Survey for the Makaīwa Hills Project Site, Honouliuli, 'Ewa, O'ahu

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Land Use Consultant

by

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04:makaiwa.rep
Revised April 1991

ABSTRACT

Cultural Surveys Hawaii was requested by William E. Wanket Inc., Land Use Consultant for the Estate of James Campbell to undertake an archaeological site inventory survey for the approximately 1,915 acre proposed Makaīwa Hills development project (TMK 9-1-15: 5, 11, 17; 9-1-16: Portion 9; 9-2-03: Portion 2) located in the ahupua'a of Honouliuli, 'Ewa, Island of O'ahu. The survey and limited testing were conducted between September 24 and late October, 1990. During the fieldwork, 34 sites were located, including habitation structures (permanent and temporary), agricultural features (terrace and mounds), rock shelters, a possible rock shelter quarry, petroglyphs, ahu(s) and various other structures associated with sugarcane cultivation attributable to the Ewa Plantation Company.

Eighteen of the 34 recorded sites are considered "likely to yield information important to prehistory and history". Of these 17 sites, four are also evaluated as an excellent example of a site types. Thus, it is recommended that all of the 17 sites that are considered significant be subjected to a program of subsurface testing followed by intensive excavation of selected sites to address scientific/informational significance preceding developmental impact and removal of sites. It is additionally recommended that the four sites evaluated as excellent site types be considered for preservation pending results of subsurface testing.

Site 50-80-12-2893 has been the subject of previous research and as a result has already been recommended for preservation. Based on the present condition of this site, it is strongly urged that the necessary preservation plans be carried out forthwith to avoid any future damage to the site.

Of the 34 sites, sixteen, including structures associated with the Ewa Plantation Company, historic cattle walls and various other amorphous and disturbed mounds and ahu(s), are considered to be no longer significant and are not recommended for further work. Detailed Data Recovery and Preservation Plans should be prepared and submitted to the State Historic Preservation Office (DLNR) for review and approval.

ACKNOWLEDGEMENTS

Recognition is given to Christopher Bailey, Donald Hugo, David Shideler, and Aron Suzuki, who with the authors comprised the field crew over various periods. We wish to thank these individuals for their hard work and support during the sometimes difficult field conditions. We would also like to thank Mr. William E. Wanket and Ms. Lani Nedbalek for supplying the project maps, additional information, and support needed to prepare this report. A great deal of gratitude is also extended to Stephan Clark and Rodney Chiogioji for preparing the maps and figures in their usual timely and proficient manner. We especially thank David Shideler and Rodney Chiogioji for editing this report. Any errors or omissions are the sole responsibility of the authors.

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I. INTRODUCTION

At the request of William E. Wanket Inc., Land Use Consultant for the Estate of James Campbell, Cultural Surveys Hawaii (CSH) conducted an archaeological inventory survey of the approximately 1,915 acre proposed Makaīwa Hills development, located in the ahupua'a of Honouliuli, 'Ewa, Island of O'ahu (Figures 1-3).

The objective of this survey was to locate, inventory and evaluate the significance of and recommended treatment for the cultural resources in the project area. Limited testing was conducted at two of the sites to determine more accurately the nature and age of site cultural deposits and natural stratigraphy in the area.

Fieldwork was conducted over a period of four weeks between September 24 and late October, 1990 by a crew of 4-5 persons. Upon completion of the fieldwork, Ms. Carol Kawachi of the State Historic Preservatión Office (S.H.P.O.) accompanied Dr. Hallett Hammatt and Jennifer Robins during a final field check of the project area.

The project area (TMK 9-1-15: 5, 11, 17; 9-1-16: Portion 9; 9-2-03: Portion 2) is located between the town of Makakilo and Waimanalo Gulch, on the southeast tip of the Wai'anae Range; it is bounded to the south by Farrington Highway and to the north by Palehua Road (Figures 4 and 5). The western boundary of the project area is roughly defined by the east ridge edge of Waimanalo Gulch, extending to the north along the northeast side

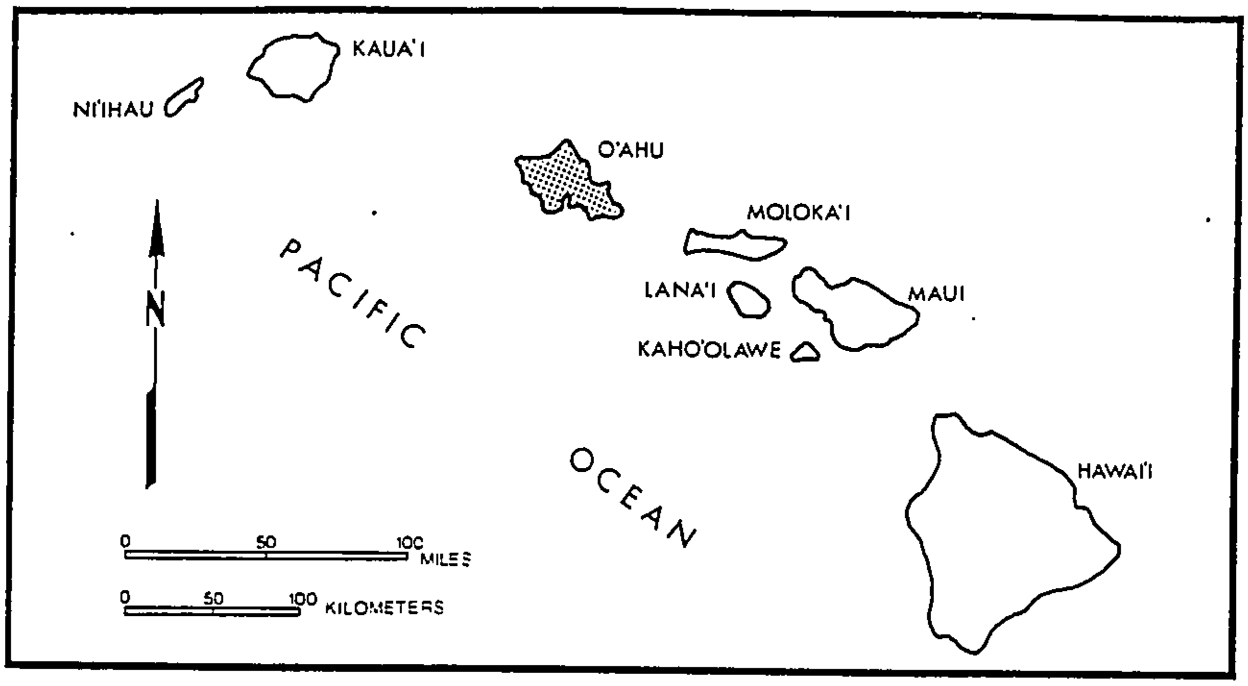

Fig. 1. State of Hawai'i

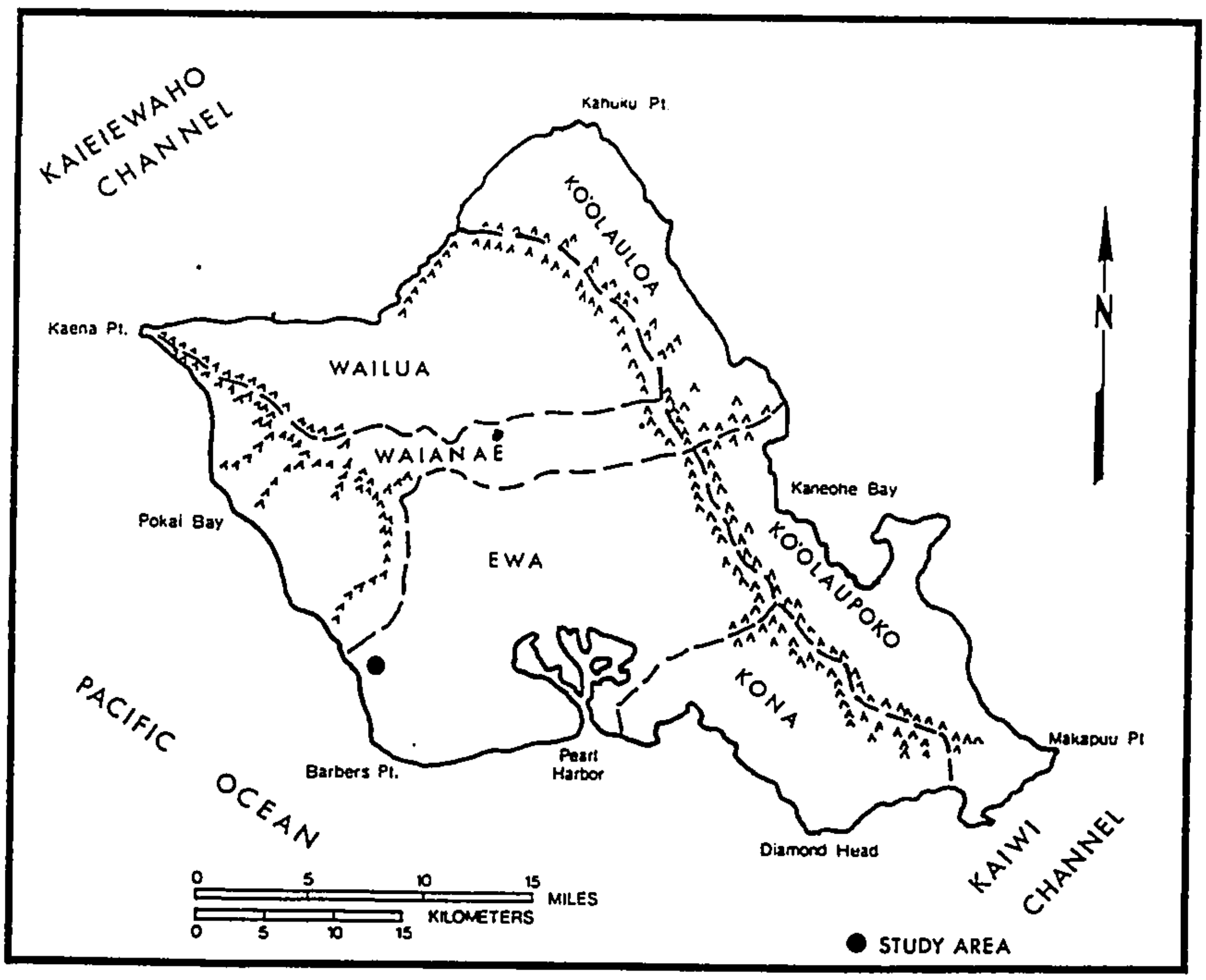

Fig. 2. General Location Map, O'ahu Island.

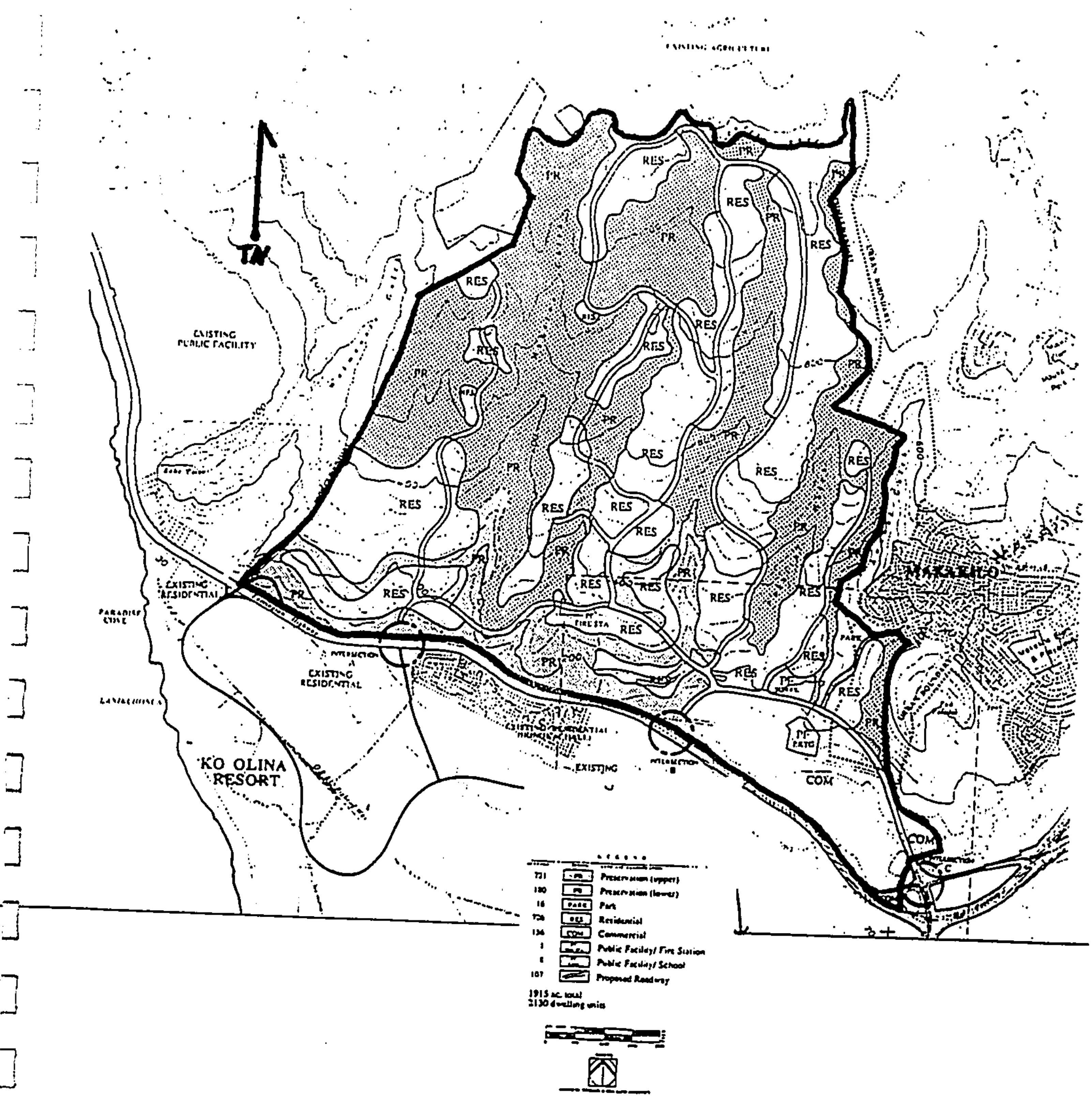

Figure 3 Proposed Makaiwa Hills Development Plan

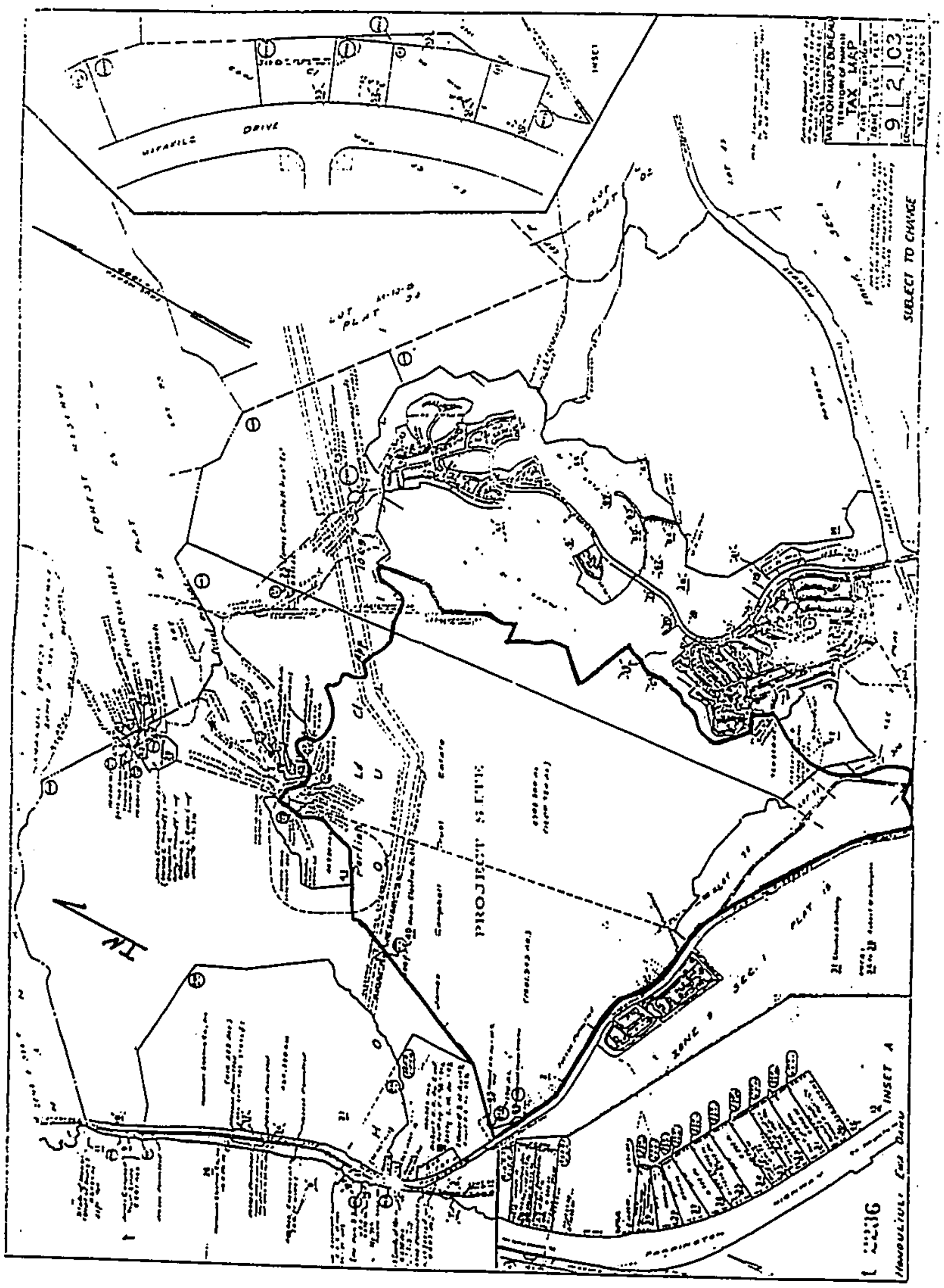

Figure 4 Tax Map of Project Area

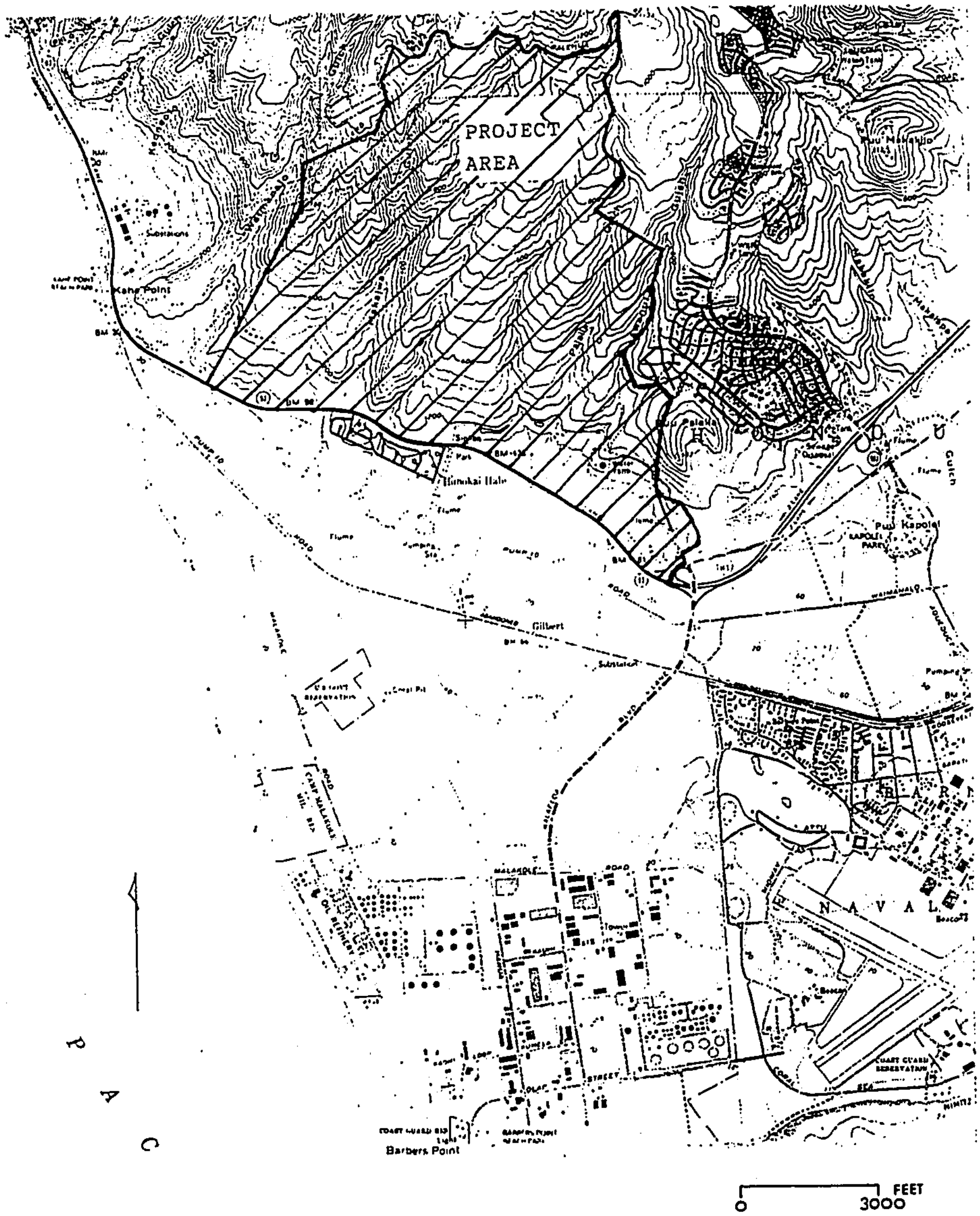

Figure 5 USGS Map Barbers Point Quad, Showing Project Area (Shaded)

of the Nike-Hercules Missile Complex. The eastern project boundary approximately borders the northern portion of Palailai Gulch and the southern portion of Awanui Gulch.

As a result of the survey, 34 sites of varied archaeological significance were identified within the project area (Figure 6).

A. Scope and Methods

The scope of this project consisted of inventory survey including description and mapping of archaeological sites identified within the project area and limited subsurface testing for cultural deposits, as discussed previously. Significance and recommended treatment of the recorded sites were determined on the basis of site complexity, configuration and apparent function (Table 1).

Access to the property was gained from Palehua Road at the north boundary and Farrington Highway and the old Farrington Highway segment at the south boundary. A crew of four to five archaeologists systematically surveyed the property by pedestrian sweeps spaced at intervals, depending on the openness of the terrain, each person typically 15.2 m. (50 ft.) apart. Given the steep topography of the project area, the survey sweeps usually across the contours in a north-south direction. Extremely dense vegetation existing specifically along the stream channel of upper Makaīwa Gulch, often hindered ground visibility and in some cases made a small portion of this area inaccessible for survey.

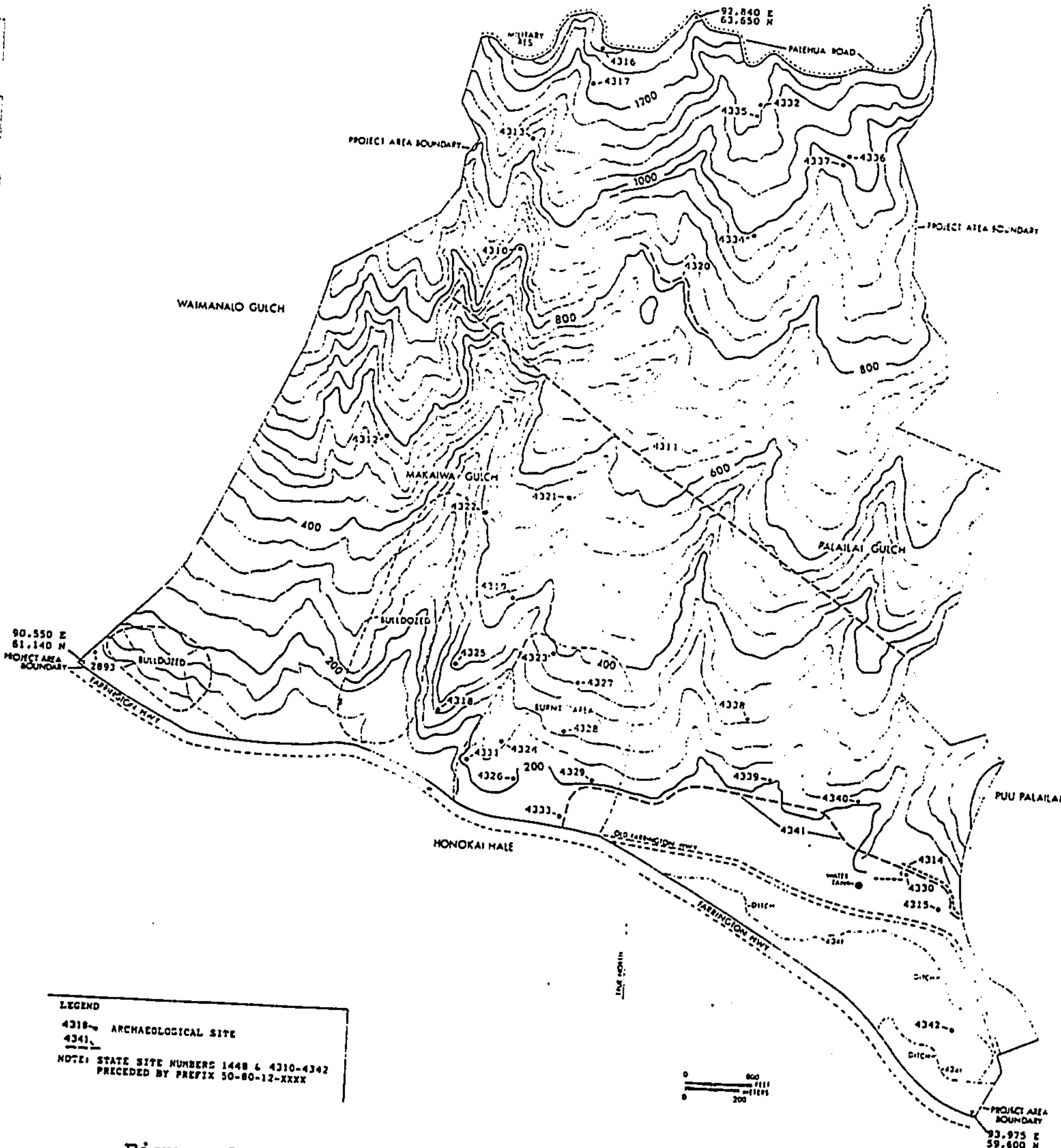

Figure 6 Makaīwa Hills Project Area Showing Archaeological Site Locations (Map based on USGS 7.5 Minute Quad Map of 'Ewa)

Table 1 Site Summary With Recommendations and Significance

CSH Site #	State Site # (50-80-12)	Description/Function	Significance	Recommendations
-	2893	Rockshelters;petroglyphs/Perm. habitation	C,D,E	Preserve
2	4310	Enclosure/Historic hunting shelter	NLS	None
3	4311	Wall/Cattle wall	NLS	None
4	4312	C-Shape enclosure/Temporary habitation	D	Data Recovery
5	4313	Terrace/Agricultural	D	Data Recovery
6	4314	Wall/Associated w/sugarcane cultivation	NLS	None
7	4315	Terrace/Associated w/sugarcane cultivation	NLS	None
8	4316	Wall-alignment/Poss.cattle wall	NLS	None
9	4317	Circular enclosure; platform/Recurrent habitation	D	Data Recovery
11	4318	Circular enclosure/Temp. habitation-shelter	D	Data Recovery
12	4319	Rockshelter w/interior terrace/Perm. hab.	C,D	Data Recovery,P+
13	4320	Retaining wall/Historic road	NLS	None
15	4321	Rockshelter w/interior terrace/habitation	C,D	Data Recovery, P+
16	4322	Rockshelter w/interior *ahu*/Quarry	D	Data Recovery, P+
17	4323	*Ahu*/Marker	NLS	None

CSH Site #	State Site # (50-80-12)	Description/Function	Signi-ficance	Recommen-dations
18	4324	Mound; *ahu*/Agricultural	D	Data Recovery
19	4325	C-shape enclosure; *ahu*/Temp. Habitation	D	Data Recovery
21	4326	Enclosure/Temporary habitation	D	Data Recovery
22	4327	*Ahu*/Marker	NLS	None
23	4328	Rockshelter complex (3)/Permanent habitation	D	Data Recovery, P+
24	4329	Enclosure/Modern	NLS	None
25	4330	Platform/associated w/sugarcane cultivation	NLS	None
26	4331	L-shape enclosure/Temp. habitation	D	Data Recovery
27	4332	Circular enclosure/Temp. habitation	D	Data Recovery
29	4333	Wall Segment & bulldozed pile/Sugarcane cult.	NLS	None
30	4334	Circular enclosure/Temporary habitation	D	Data Recovery
31	4335	Mound/Distrubed clearing mound	NLS	None
32	4336	Rectangular enclosure/Recurrent habitation	D	Data Recovery
33	4337	Circular enclosure/Temp. habitation	D	Data Recovery
34	4338	Rockshelter complex/Permanent habitation	C,D	Data Recovery
35	4339	Platform/Associated w/sugarcane cultivation	NLS	None

CSH Site #	State Site # (50-80-12)	Description/Function	Significance	Recommendations
36	4340	Circular enclosure/Sugarcane cult. pumphouse	NLS	None
37	4341	Ditch/Sugarcane irrigation	NLS	None
38	4342	Circular Structure/Sugarcane cult. reservoir	NLS	None

Key

C Site is an excellent example of a site type

D Site may be likely to yeild infomraiton iiportant in prehistory or history

NLS No Longer Significant

P+ Possible Preservation: Pending Data Recovery Results

Note: Recurrent habitation means periodic or seasonal re-use of a site for the same general purpose

No sites occur here because it is in active flood zone. In these instances and in general, specific attention was directed towards the upper sides of the gulches which are known to include rock shelters.

The survey was completed over a period of 25 days. A total of 125 person days were expended. The field crew (listed in the acknowledgements) under the direction of Ms. Jennifer Robins covered the project area in approximately 60 sweeps, each sweep averaging around 60 m. (200') wide. Survey sweep boundaries were marked with flagging tape (pink as opposed to the yellow flags used to mark sites).

In general, survey conditions were good in terms of visibility as it was conducted during the dry season. Ground cover, low grass and shrub especially along the ridges, was minimal. The major impediment to visibility was kiawe trees, slope angles and boulder-strewn terrain in the gullies. For this reason and because of the possibility of rock shelters and petroglyphs the gulches were covered at closer survey sweep intervals than the even ridge land. Typically, one surveyor followed the base of the gulch with one or two surveyors on each side walking around boulder outcrops.

There is high confidence that the entire project area was adequately surveyed and that all archaeological remains were located. In terms of acres covered per day per person the average was 15 acres which is generally fairly intensive coverage for thinly vegetated leeward environments. The entire 1,915 acres was covered by survey. Concerning the occurrence of apparent thicker density of sites in the lower, recently burned area, visibility was in fact excellent here. However, at similar elevations to the east and west where a comparable density would be expected, the ground has been heavily impacted by bulldozing. To the west are areas that we completely grubbed. At a minimum the terrain (except for the burned area) at this elevation has been criss-crossed by bulldozed roads and disrupted by massive rock collecting. In short, it is not survey visibility which appears to account for this greater density of sites but comparative lack of disturbance in relation of adjacent land. All sites were recorded by formal category and temporary site number. Field work at each site included triangulating and mapping its location onto a project map at a scale of 1 in.=400 ft.; an interpretation of the site's nature, extent, and probable function; and searching for the presence of surface artifacts. Site maps were drawn on a scale of 1 inch = 1.5 m (5') or 1 inch = 3 m. (10') depending on site size. All of the sites were mapped - using a compass and tape - and photographed. Selected examples of maps are included in this report. Sites were flagged with heavy yellow construction tape and edges of sweeps were marked with pink or red flagging tape.

Limited subsurface testing was conducted at two habitation sites including a rock shelter and an enclosure structure. Controlled excavation was extended to bedrock or sterile soil layers with contents screened through 1/8 inch mesh screens.

The few artifacts recovered from the testing were analyzed, cataloged, and processed at Cultural Surveys Hawaii.

Subsequent to the field work all sites were given state site numbers and a few sites were combined into one state number after determining that they represent separate portions of a wall extending across the property. Two sites that were originally given temporary site numbers were later determined to be non-cultural. Consequently, gaps exist in the temporary site number list.

II. PROJECT AREA DESCRIPTION

The area of the present study is situated on the southernmost slope of the Wai'anae Range, approximately 3 miles north of Barbers Point. The project area ranges in elevation from roughly 15.2 m. (50 ft.) a.m.s.l. at Farrington Highway to 396.3 m. (1300 ft.) a.m.s.l. at the northern boundary along Palehua Road.

Topography over the majority of the project area is characterized by three major gulches including Makaīwa Gulch, Palailai Gulch and Awanui Gulch and three unnamed minor gulches, all dissecting the project area from north to south. These gulches represent an early stage of erosional development and lack a well-defined pattern of drainage evidenced for the most part by deep intermittent stream channels coupled by small subsidiary channels transecting the typically wide valley floors. The deeper erosional channels appear to be only seasonally active during the winter months as a result of intense flash-flooding and constant rainfall. Apparently, the stream channels are typically dry during the summer and fall seasons, as was observed at the time of the survey. Although the gulches stand out in the topography as the major geomorphic features, the vast majority of the land is composed of evenly sloping smooth ridges. Because the drainage pattern is parallel, these ridges take on an even, relatively undissected appearance in relief with even contours. These ridges are the most feasible routes for mauka/makai traversing. Some low outcrops are present but the land is generally composed of gently dipping, even lava flows with highly weathered crust.

The major soil types and their distribution in the project area are as follows (Foote et al. 1972):

-Stony steep land (rsy) (ridges - majority of project area)
-Lualualei extremely stony clay (LPE) (lower gulches)
-Helemano silty clay (HLMG) (ridge crests)
-Honouliuli clay (HxA, HxB) (lowlands to southeast)
-Mahana-Badland complex (MBL) (heavily eroded mauka lands)
-Lualualei stony clay (LvB) (low lands to southeast)
-Ewa silty clay loam (EaB) (lowlands to southeast)
-Molokai silty clay loam (MuC) (lowlands to southeast)
-Ewa stony silty clay (EwC) (lowlands to southeast)
-Rock land (rRK) (steep land above Waimanalo Gulch)
-Mahana silty clay loam (MC) (higher soil covered ridges)

The vast majority of the project area (70-80%) is classified as stony steep lands (rsy). The soil cover is generally thin with heavily weathered boulder - cobble rubble. Only in the upper elevations do small, level, non-rocky natural alluvial terraces occur in shallow drainages where soil cover is evenly distributed (MC). These soil areas of mauka elevations may have a relationship to the mauka increase of site density in allowing some limited planting but rainfall here is still below 30 inches per year. The coolness, however, would decrease evapo-transpiration, especially in winter months.

The present vegetation in the project area is predominantly exotic species introduced since 1790 (Frierson, 1972). These species commonly include kiawe (*Prosopis pallida*), koa haole (*Leucaena glauca*), klu (*Acacia farnesiana*), indigo (*Indigofera suffruticosa*), lantana (*Lantana camara*), cactus (*Opuntia megacantha*), Christmas berry (*Scinus terebinthifolius*), 'uhaloa (*Waltheria indica*) with a few trees of java plum (*Syzygium cuminii*), silk oak (*Grevillia robusta*) and Eucalyptus species located within the northern limits of the project area. Various other grasses and xerophytic shrubs are also a common ground cover. Cotton (*Gossypium tomentosum*) and cuts of dry sugar cane (*Saccharum officinarum*) among grass fields and scattered koa haole were found specifically along the lowlands of the property where sugar cane was once cultivated.

Vegetation type and density varies according to the topographical environment and erosional effects within the project area. The vegetation adjacent to the deeply eroded stream channels (within the flood zones) was extremely thick and lush with tall grasses predominating, often reaching a height of 2 m. This growth did not hinder survey because it was confined to the high energy flood channels, which because of their continuous seasonal flooding, would not contain archaeological remains. The upper valley slopes are characterized by clusters of trees and low shrubs and grasses surrounded by pockets of denuded ground surface.

Frierson suggests that - prior to the introduction of exotic vegetation in 1790 - the slopes of the Wai'anae Range extending down to about 152. 4 m. (500 ft.) a.m.s.l. supported a dry forest of native trees and shrubs between an upper ohia wet forest and lower grassy savannah area (Frierson, 1972). Frierson (Ibid.:4) summarizes the following patterns suggested by J.F. Rock (1913) for the indigenous vegetation in the area prior to 1778:

> a) Lowland zone - open grassland on the leeward side
>
> b) Lower Forest - beginning about 1000 feet and richer in species than the rainforest; kukui, ohia ai, koa, kalia, sandalwood, ohia lehua, hau, ti, ape, pia, banana, ginger, birdnest fern and honohono, as well as grasses and cyperaceous plants.
>
> c) Specifically leeward lower forest - ohe, wiliwili, maile, halapepe and alani, with almost no undergrowth.

Historical accounts presented by Frierson (Ibid.:5-6) describe these lower forest species as extending to 500 feet, with the presence of sandalwood observed down to as low as 300 feet. The lower forest then is hypothesized to have covered at least the upper one-third of the project area. The higher site density may correlate to the lower fringes of this forest. Viewing the heavily eroded and fairly open landscape today one is impressed by the dramatic effects of herbivore grazing in the last 150 years in terms of vegetation changes and erosion. This was always a rain shadow slope and we may more accurately envisage a park land community rather than a thick forest.

III. LAND USE

A. Prehistory and Early History

Although no specific documentation of prehistoric or early historic land use is known for the project area, various Hawaiian legends and early historical accounts indicate that the surrounding area of Honouliuli ahupua'a was once widely inhabited by prehistoric populations, including the Hawaiian ali'i. This would be attributable for the most part to the plentiful marine resources available at the coast, along which several sites interpreted as permanent habitations and fishing shrines are located. Other attractive subsistence-related features of the area include the irrigated lowland suitable for wet land taro cultivation (Hammatt and Shideler, 1990), as well as perhaps the lower forest area of the mountain slopes (presumed to have covered most of the project area) to procure forest goods.

Exploitation of the forest resources along the slopes of the Wai'anae Range - as suggested by E.S. and E.G. Handy - probably acted as a viable subsistence alternative during times of famine:

> ...The length or depth of the valleys and the gradual slope of the ridges made the inhabited lowlands much more distant from the 'wao, or upland jungle, than was the case on the windward coast. Yet the 'wao here was more extensive, giving greater opportunity to forage for wild foods during famine time.
>
> (Handy and Handy, 1972:469-470)

These upper valley slopes may have also been a significant resource for sporadic quarrying of basalt for the manufacturing of stone tools. This is evidenced in part by the existence of a probable quarrying site (50-80-12-4322) located in the present study area at 152 m. (500 ft.) a.m.s.l. Many other fine-grain basalt outcrops were observed within the project area.

The Hawaiian ali'i were also attracted to the region, in which existed many places referred to in myth. An extensive summary of various legends and historical accounts of Honouliuli can be found in Sterling and Summers (1978:31-44). One historical account of particular interest refers to an ali'i residing in Ko'olina, an area located immediately south of the project area:

> Ko'olina is in Waimanalo near the boundary of 'Ewa and Wai'anae. This was a vacationing place for chief Kakuhihewa and the priest Napuaikamao was the caretaker of the place. Remember reader, this Ko'olina is not situated in the Waimanalo on the Ko'olau side of the island but the Waimanalo in Ewa. It is a lovely and delightful place and the chief, Kakuhihewa loved this home of his (Sterling and Summers, 1978:41).

John Papa I'i describes a network of Leeward O'ahu trails (Figure 7) which in later historic times encircled and crossed the Wai'anae Range, allowing passage from West Loch to the Honouliuli lowlands, past Pu'u Kapolei and Waimanalo Gulch to the Wai'anae coast and onward circumscribing the shoreline of O'ahu (I'i, 1973:96-98). Following I'i's description, a portion of this trail network would have passed along the southern boundary of the project area, roughly running along the presently existing Farrington Highway.

Other early historical accounts of the general region typically refer to the more populated areas of the 'Ewa district, where missions and schools were established and subsistence resources were perceived to be greater. However, the presence of

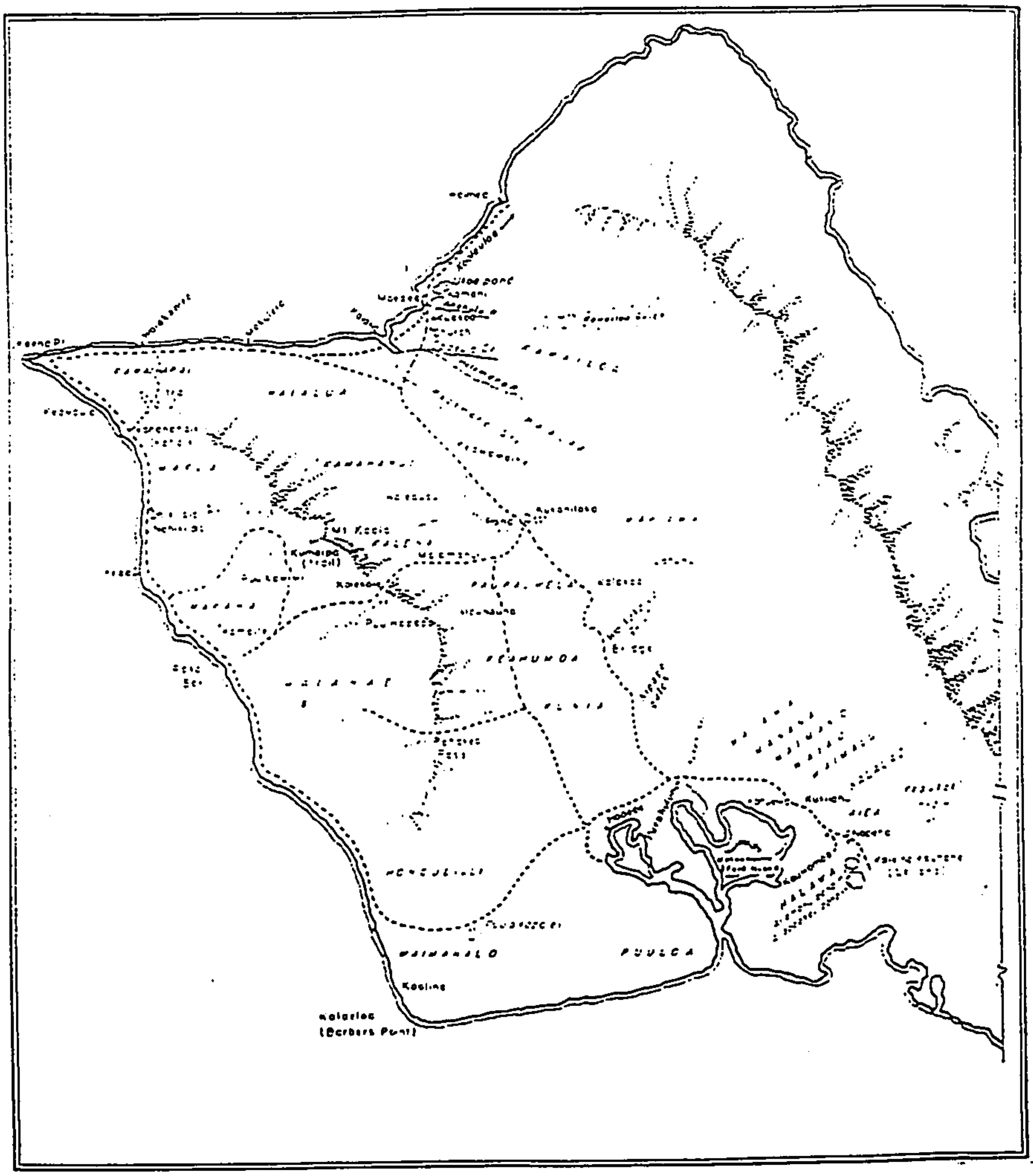

Figure 7 Trails of Leeward O'ahu as Described by Ii: Map by Paul Rockwood

archaeological sites along the barren coral plains and coast of southwest Honouliuli ahupua'a, as well as those identified within the present study area along the slopes of the Wai'anae Range, indicate that prehistoric and early historic populations also adapted to these less inviting areas, despite the environmental hardships.

Subsequent to western contact in the area after ca. 1790, the landscape of the 'Ewa plains and Wai'anae slopes was adversely affected by the removal of the sandalwood forest, and the introduction of domesticated animals and new vegetation species. Domesticated animals including goats, sheep and cattle were brought to the Hawaiian Islands by Vancouver in the early 1790s, and allowed to graze freely about the land for some time after. It is unclear when the domesticated animals were brought to O'ahu; however, L.A. Henke reports the existence of a longhorn ranch in Wai'anae by at least 1840 (in Frierson, 1972;10). During this same time, perhaps as early as 1790, exotic vegetation species were introduced to the area. These typically included vegetation best suited to a terrain disturbed by the dwindling sandalwood forest and erosional effects of animal grazing. The following dates of specific vegetation introduced to Hawai'i are given by R. Smith and outlined by Frierson (1972:10-11):

1) "early", c. 1790:
Prickly pear cactus, Opuntia tuna
Haole koa, Leucaena glauca
Guava, Psidium guajava

2) 1835-1840

Burmuda [sic] grass, Cynodon dactylon
Wire grass, Eleusine indica

3) Lantana, Lantana camara

The kiawe tree was also introduced during this period, either in 1828 or 1837 (Ibid.:11).

Intensive sandalwood harvesting, according to H. St. John (in Frierson, 1972:7) occurred in the islands between 1815-1830. As it is likely that sandalwood forests once occupied the lower, dry slopes of the Wai'anae Range, the present study area was probably extensively impacted by the cutting and burning of these forests.

B. Mid to late 19th Century

During the Great Mahele of 1848, 99 individual land claims in the ahupua'a of Honouliuli were registered and immediately awarded by King Kamehameha III. The present study area appears to have been included in the largest award (Royal Patent 6071, LCA 11216, Apana 8), granted in Honouliuli ahupua'a to Miriam Ke'ahi-Kuni Kekau'onohi on January 1848 (Native Register). Kekau'onohi acquired a deed to all unclaimed land within the ahupua'a, including a total of 43,250 acres.

Kamaukau relates the following about Kekau'onohi as a child:

> 'Kamehameha's granddaughter, Ke-ahi-Kuni Kekau-'onohi...was also a tabu chiefess in whose presence the other chiefesses had to prostrate and uncover themselves, and Kamehameha would lie face upward while she sat on his chest.'
> (in Hammatt and Shideler, 1990:19-20).

Kekau'onohi was one of Liholiho's (Kamehameha II's) wives, and after his death, she lived with her half-brother, Luanu'u

Kahala'i'a, who was governor of Kaua'i (Ibid.:20). Subsequently, Kekau'onohi ran away with Queen Ka'ahumanu's stepson, Keli'i-ahonui, and then became the wife of Chief Levi Ha'alelea. Upon her death on June 2, 1851, all her property was passed on to her husband and his heirs. When Levi Ha'alelea died the property went to his surviving wife, who in turn leased it to James Dowsett and John Meek in 1871 for stock running and grazing.

In 1877 James Campbell purchased most of Honouliuli ahupua'a - including the present study area - for a total of $95,000. He then drove off 32,347 head of cattle belonging to Dowsett, Meek and James Robinson and constructed a fence around the outer boundary of his property (Bordner and Silva, 1983:C-12). By 1881 the Campbell property of Honouliuli prospered as a cattle ranch with "abundant pasturage of various kinds" (Briggs in Haun and Kelly, 1984:45).

In 1889 Campbell leased his property to Benjamin Dillingham, who subsequently formed the O'ahu Railway and Land Company in 1890. To attract business to his new railroad system, Dillingham subleased all land below 200 feet to William Castle who in turn sublet the area to the Ewa Plantation Company for sugar cane cultivation (Frierson, 1972:15). Throughout this time and continuing into modern times, cattle ranching continued in the area, and Honouliuli Ranch - established by Dillingham was - the "fattening" area for the other ranches (Ibid.).

Ewa Plantation Co. grew quickly and continued in full operation up into modern times. As a means to generate soil deposition on the coral plain and increase arable land in the lowlands, the Ewa Plantation Co. installed ditches running from the lower slopes of the mountain range to the lowlands and then plowed the slopes vertically just before the rainy season to induce erosion (Ibid.:17). Two ditches which were likely used for this procedure are still present along the southern boundary of the project area (See Description of Site 50-80-12-4341).

C. Modern Land Use

Sometime after 1959, the United states Army purchased or exchanged land with the Campbell Estate for the construction of the Nike-Hercules anti-aircraft missile base located at the head of Waimanalo Gulch, at the outer edge of the northwest project boundary. The presence of this facility suggests that military activities of some sort may have occurred within the project area as well. Although no clear evidence of military activity in the study area was obsefved during the survey, a few suspiciously modern stone structures identified along the lower portions of the project area may be associated with some type of training exercise.

Presently, the majority of the subject property is being used for cattle grazing. An active water trough and cattle pen are situated just south of Palehua Road and an extensive wire fence including stone wall sections cross cuts the slope at approximately the 600 ft. contour, retaining the majority of the cattle within this northern enclosure.

Other modern activities in the present study area include rock-mining; this is most notably visible along the southern base of Makaīwa Gulch and evidenced by extensive boulder plows and bulldozed roadways.

D. Honouliuli Settlement Patterns

The Physical Layout

The ahupua'a of Honouliuli is the largest traditional unit on the island of O'ahu. Although there has been a noteworthy history of archaeological research within this ahupua'a, the authors can find no ahupua'a-wide perspective on traditional land use and settlement. Such a comprehensive task is not attempted here. However, a broad ahupua'a sketch is needed to place the Makaīwa project area into the time and space of Hawaiian settlement.

Honouliuli (Fig. 7A) includes all the land from the western boundary of Pearl Harbor (West Loch) westward to the 'Ewa Wai'anae District Boundary with the exception of the west side of the harbor entrance which is in the ahupua'a of Pu'uloa (the 'Ewa Beach/Iroquois Point area). This comprises approximately 12 miles of open coastline from Oneula westward to Pili O Kahe. The ahupua'a extends mauka (almost pie-shaped) from West Loch nearly to Schofield Barracks and the western boundary is the Wai'anae Mountain crest running makai to the east ridge of Nanakuli Valley.

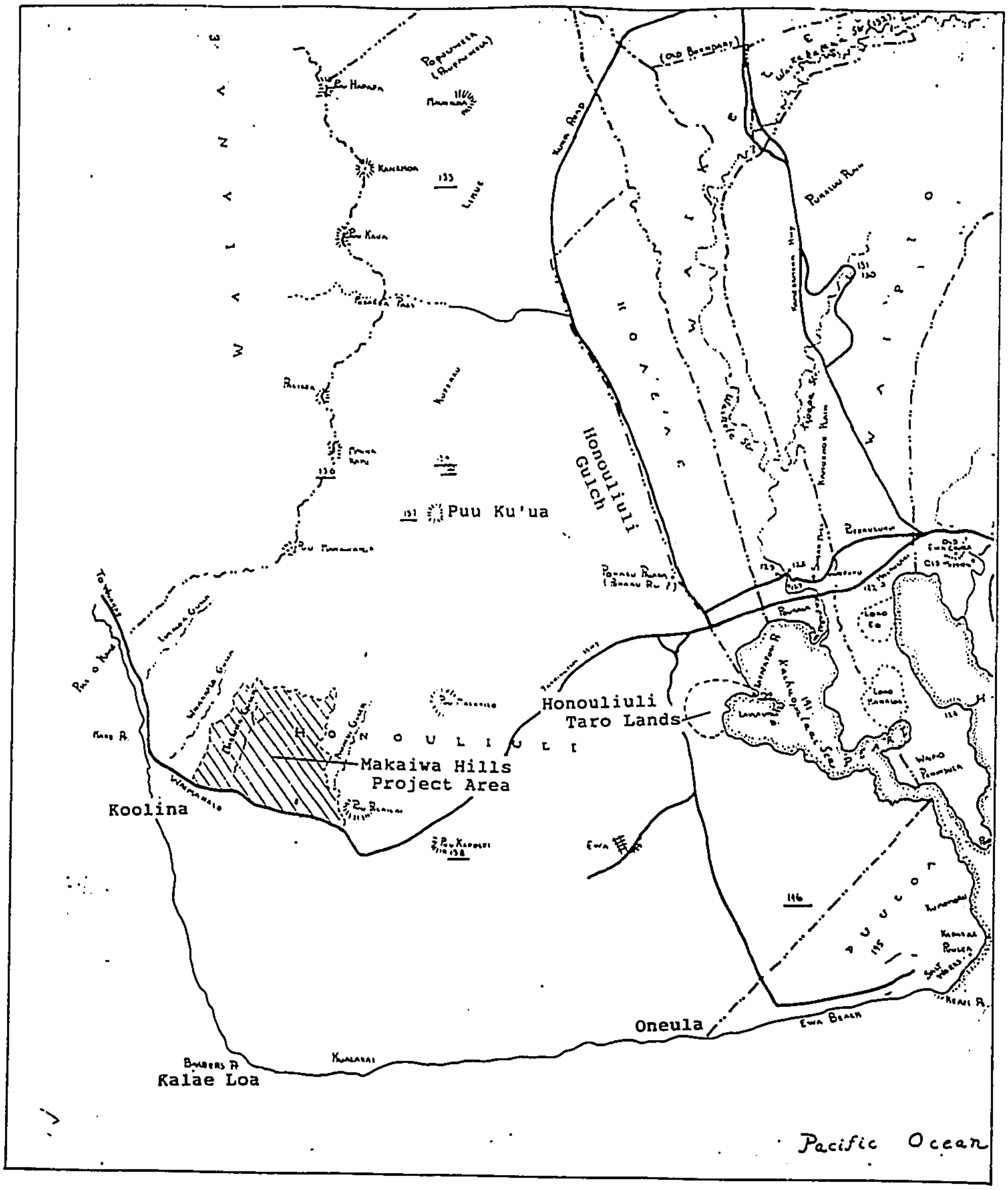

Figure 7A Honouliuli Ahupua'a with Features Discussed in Text. Adapted from Sterling & Summers (1978)

Not only is there a long coastline fronting the normally calm waters of leeward O'ahu but there are four miles of water front along the west side of West Loch. The land immediately _mauka_ of the Pacific coast consists of a flat karstic raised limestone reef forming a level nearly featureless "desert" plain marked in prehistoric times (previous to illuviation caused by sugar cultivation) by thin or non-existent soil mantle. The microtopography is notable in containing countless sinkholes caused by chemical weathering (dissolution) of the limestone shelf. Proceeding _mauka_ from this limestone plain, this shelf is overlain by alluvium deposited through a series of gulches draining the Wai'anae Mountains. The largest of these is Honouliuli Gulch towards the east side of the plain which drains into West Loch. To the west are fairly steep gradient gulches forming a more linear than dendritic drainage pattern. The major gulches are, from east to west: Awanui, Palailai, Makaīwa, Waimanalo and Lumalo'a. These gulches are steep-sided in the uplands and generally of a high gradient until they emerge onto the flat 'Ewa plain. The alluvium they have carried has spread out in delta fashion over the _mauka_ portions of the plain, which comprises a dramatic depositional environment at the stream gradient change. These gulches are generally dry, but seasonal Kona storms carry immense quantities of runoff onto the plain and into the ocean. As typical drainages in arid slopes they are either raging uncontrollably, or are dry and as such do not form stable water sources for traditional agriculture in their upper reaches. The Honouliuli gulches, in contrast to those draining into Pearl Harbor to the east, do not have valleys suitable for extensive irrigated agriculture. However, this lack is more than compensated by the rich watered lowlands of the base of Honouliuli Gulch (the 'ili of Honouliuli).

Honouliuli Ahupua'a, as a traditional land unit had tremendous and varied resources available for exploitation by early Hawaiians. The "karstic desert" and marginal characterization of the limestone plain — which is the most readily visible terrain — does not do justice to the ahupua'a as a whole. The richness of this land unit is marked by the following available resources:

1. 12 miles of coastline with continuous shallow fringing reef which offered rich marine resources.
2. Four miles of frontage on the waters of West Loch which offered extensive fisheries - including mullet, awa, and shellfish - as well as frontage suitable for development of fishponds (for example, Laulaunui).
3. The lower potion of Honouliuli Valley in the 'Ewa plain offered rich level alluvial soils with plentiful water for irrigation from the stream as well as abundant springs. This irrigable land would have stretched well up the valley.
4. A broad limestone plain which, because of innumerable limestone sinkholes, offered a nesting home for a large

population of avifauna. This resource may have been one of the early attractions to human settlement.

5. An extensive upland forest zone extending as much as 12 miles inland from the edge of the coastal plain. As Handy and Handy have pointed out, the forest was much more distant from the lowlands here than on the windward coast, but it was much more extensive (1972:469). Much of the upper reaches of the ahupua'a would have had species-diverse forest with kukui, ohia, sandalwood, hau, ti, banana, etc.

Within this natural setting archaeological and traditional sources show a general pattern of three main areas of settlement within the ahupua'a:.

The Coastal Zone - Kalaeloa (Barbers Point), Ko'olina (West Beach), and Oneula ('Ewa Marina)

Kalaeloa (Barbers Point)

Archaeological research at Barbers Point has focused on the areas in and around the newly constructed Deep Draft Harbor (Barrera, 1979; Davis and Griffin, 1978; Hammatt and Folk, 1981). Many small clustered shelters, enclosures and platforms show limited but recurrent use at the shoreline zone for marine oriented exploitation. This settlement covers much of the shoreline with more concentrated features around small marshes and wet sinks. Immediately behind the shoreline under a linear dune deposit is a buried cultural layer believed to contain some of the earliest habitation evidence in the area.

The attraction of the area to early Hawaiians was the plentiful and easily exploited bird population. Particular evidence for taking of petrel occurs at Site 2763 (Hammatt and Folk, 1981:107,213). Initial heavy exploitation of nesting seabirds and other species in conjunction with habitat destruction probably led to early extinction.

There is some indication of limited agriculture in mulched sinkholes and limited soil areas. Considering rainfall, this activity would have been limited, but probably involved tree crops and roots (sweet potatoes). The archaeological content of the sites indicates a major focus on marine resources.

Davis and Griffin (1978) distinguish functional classes of sites, based on surface area size and argue that the Barbers Point settlement consists of functionally integrated multi-household residence groups. Density contours of midden (by weight) and artifacts (by numbers) plotted for residence sites by Hammatt and Folk (1981) generally indicate narrowly defined spatial foci of discard, possibly indicating continuous use , or at least with no refurbishing or additions to the structures through time (Hammatt and Folk, 1981). The focus is small habitation sites, typically lacking the full range of features found in large permanent residence complexes such as high platforms, complex enclosures and ceremonial sites. Seasonal camping on a recurrent basis is postulated. It is of interest that Berthell Davis, in his Ph.D. dissertation, in discussing the marine environment along the west coast of O'ahu introduces an element of seasonality:

> I suggest the west coast of O'ahu, including the area off Barbers Point, (a) probably became a well established fishery at least by AD 1000, perhaps much earlier; (b) the initial settlement at Barbers Point also began around this time or possibly earlier; and (c) the settlement initially involved task-specific groups exploiting the adjacent fishery on a seasonal round, probably during the winter months. (Davis, 1990:135).

Davis also points out the seasonality of nesting of various species of birds which is of relevance to the pattern of human habitation of the Honouliuli limestone plain (Ibid.:136).

Ko'olina (West Beach)

There are three recent available studies on the Ko'olina project area which lies directly makai of the Makaīwa project area (Davis et al, 1986a; Davis et al., 1986b; and Davis and Haun, 1987).

Davis documents approximately 180 component features at 48 sites and site complexes consisting of habitation sites, gardening areas, and human burials. Chronologically the occupation covers the entire span of Hawaiian settlement in what Davis and Haun describe as "one of the longest local sequences in Hawaiian prehistory" (Davis and Haun, 1987:37). The earliest part of the sequence relates to the discovery of an inland marsh and early dates were also obtained for the beach front site and an inland rock shelter.

Of particular interest to settlement patterns is his division of the Ko'olina project area into 5 ecozones summarized with archaeological content as follows (Davis and Haun, 1987):

Ecozone I - the entire beach front dune and backshore marsh with seven archaeological sites. These are single feature sites which include cultural deposits without surface structures, one of which dates to AD 420-620 and is thus one of the earliest sites on the leeward coast.

Ecozone II - is the marsh periphery adjacent to the coastal marshlands. It is of limited extent and contains no archaeological sites.

Ecozone III - called the "high ground" and consists of both exposed coral flats as well as alluvial mantle covering the vast majority of the project area.

This zone contained 23 sites which consist of cave shelters, innumerable modified sinkholes and mounds (many of which are interpreted as garden features), habitation layers, burials in sinkholes, shelters, etc. Notable are two rectangular enclosures, the largest of which covers 35 square meters. These enclosures represent the most formal habitation structures in the project area, but are small in comparison to examples in other major shoreline habitation areas elsewhere in Hawaii.

Ecozone IV - consists of former cane lands, mauka of the exposed limestone shelf. Sites are found associated with limestone escarpments and with a marsh underlying the cane alluvium. Four sites consist of burial cultural layers and rock shelters. Radiocarbon dates stretching back to initial Hawaiian colonization were obtained. These sites are associated with buried small wetland valleys which were filed before European contact.

Ecozone V - consists of the volcanic upland which covers only a narrow strip of land fronting Farrington Highway. Eleven sites are identified here. Major sites are a fishing shrine (which is less than 200 feet from the coast) and other coastal sites in the northwestern shoreline of the project area.

The only inland site which is directly adjacent to the Makaīwa project area is located on a lava outcrop adjacent to Farrington Highway (Site 2893) which consists of rock shelters, platforms, midden deposits, and petroglyphs. One rock shelter (2893-1) has deposits which are C14 dated to AD 1400-1665. This rock shelter is within the Makaīwa Hills project and is below a series of approximately 50 petroglyphs of prehistoric form. Other associated sites makai of 2893:1-2 include platforms, a "cairn", midden scatters, and a small rock shelter. These sites are clustered here by virtue of being adjacent to a leeward O'ahu trail described by Papa Ii.

Oneula ('Ewa Marina)

There is currently no information available on excavations in the 'Ewa Marina project area and conclusions regarding settlement there must be based on survey data alone (Davis, 1979; Jordane, 1979). The archaeological perimeters appear to be similar to those documented in the other areas of the coastal limestone plain with clusters of small habitation sites (mostly shelters), modified sinkholes with presumed agricultural use, shallow wells, and burials in sinkholes. The same human relationship with extinct avifauna would exist here as well. The only site which does not appear to fit the normal pattern is a large platform of possible burial or ceremonial function (Davis, 1979).

Honouliuli Taro Lands

Centered around the west side of Pearl Harbor at Honouliuli Stream and its broad outlet into the West Loch are the rich irrigated lands of the _'ili_ of Honouliuli which give the _ahupua'a_ its name. The major archaeological reference to this area is Dicks, Haun and Rosendahl (1987) who documented remnants of a once-widespread wetland system (_lo'i_ and fishponds) as well as dryland cultivation of the adjacent slopes.

Carol Silva has conducted "Historic Research Relative to the Land of Honouliuli" (Appendix A, Dicks et al., 1987) and the reader is referred to this work for an overview of the history of Honouliuli.

This area bordering West Loch was clearly a major focus of population within the Hawaiian Islands and this was a logical response to the abundance of fish and shellfish resources in close proximity to a wide expanse of well irrigated bottom land suitable for wet land taro cultivation. The earliest detailed map (Malden, 1825) shows all the roads of southwest O'ahu coalescing and descending the _pali_ within the project area as they funnel into the locality which gave the district of Honouliuli its name. Dicks et al. (1987:78-79) conclude, on the basis of 19 carbon isotope dates and 3 volcanic glass dates, that "agricultural use of the area spans over 1,000 years." Undoubtedly, Honouliuli was a locus of habitation for thousands of Hawaiians. Prehistoric population estimates are a matter of some debate but it is worth pointing out that in the earliest mission census of 1831-1832, the land (_'āina_) of Honouliuli contained 1026 men, women, and children (Schmitt, 1973:19). It is not clear whether this population relates to Honouliuli Village or district but the village probably contained the vast majority of the district's population. The nature of the reported population structure for Honouliuli (less than 20% children under 12 years of age) and the fact that the population decreased more than 15% in the next 4 years (_Ibid._:22) suggests that the prehistoric population of Honouliuli Village may well have been significantly greater than it was in 1831-1832. A conservative estimate would be that tens of thousands of Hawaiians lived and died at Honouliuli Village.

Pu'uku'ua: Inland Settlement

Documentation of inland settlement in Honouliuli _ahupua'a_ is more problematic in that there is no clear archaeological sources. However, it is probable that the area around Pu'uku'ua, on the east side of the Wai'anae Ridge seven miles inland of the coast, was a Hawaiian place of some importance.

An 1899 Hawaiian Newspaper "Ka Lo ea Kalaiaina" relates a story of Pu'uku'ua as "a place where chiefs lived in ancient times" and a "battle field...thickly populated." The article summarizes:

> 1) This place was entirely deserted and left uninhabited and it seems that this happened before the coming of righteousness to Hawai'i Nei. Not an inhabitant is left. 2) The descendants of the people of this place were so mixed that they were all of one class. Here the gods became tired

and returned to Kahiki (Sterling and Summers, 1978:33).

McAllister recorded three sites in this area – 2 heiau (134, 137) – Pu'u Kuina and Pu'uku'ua (both destroyed) and most interesting, a series of enclosures in Kukuilua which he calls "kuleana sites" (McAllister, 1933). There is no direct archaeological evidence available to the authors' knowledge that Hawaiian settlement occurred here but it is considered as a place of high probability, based on the above indications. Geographically, the area is well-watered and would have had abundant locally available forest resources.

Mr. Thomas Riley, in a letter of July 9,1990 to DLNR, makes mention of the E Kaha Nui Complex--site 1176 located in E Kaha Nui Gulch in upland Honouliuli.

E. Summary

Based on the above summary of areas of Honouliuli settlement the following general considerations are made to place the Makaīwa Hills area in the context of the ahupua'a pattern:

1. There are three areas of Hawaiian settlement in the ahupua'a; 2 are well-documented and one is problematic:
   a. the extensive limestone plain with recurrent use habitations for fishermen and gatherers and sometime gardeners;
   b. the rich cultivated lands of Honouliuli 'ili for extensive wetland taro and clearly the ahupua'a population center;
   c. the uplands around Pu'uku'ua for presently uncertain reasons but probably agriculture and forest resource utilization.

2. Honouliuli is designed as a unit to contain all the geographic elements of a typical Hawaiian valley _ahupua'a_, except they are arranged geomorphically in an atypical relationship. The _ahupua'a_ is not organized around a single drainage network but shares the west portions of Waikele drainage in its upper reaches. A typical and highly advantageous characteristics for human subsistence is included in a vast coastline and fringing reef, an extensive limestone plain which would support only limited agriculture but would be excellent for bird catching in early times - and perhaps most importantly for the Makaīwa Hills Project - a huge expanse of sloping forest land. The richest forest land for foraging for wood, birds, feathers, etc. would have been the east slope of the Wai'anae Range. The _mauka/makai_ route would have been up Honouliuli Gulch or up the Makakilo ridge, paralleling the coast from Honouliuli Gulch to Kahe. The Makaīwa slope forms a kind of "side pocket" or dead space in both the _mauka/makai_ and east/west orientation of trails in the _ahupua'a_ (See Fig. 7). For example, the most convenient route to _mauka_ lands, even from the western end of the coast (Ko'olina) would have been _mauka_ only to the base of the hills and then either up the Makakilo Ridge or northeast to a trail to Pu'uku'ua. The makaī slope is the dry side of the ridge line. Here streams would respond to rainfall quickly but drain quickly leaving little available water for even short-term use. Bordner's survey at

Waimanalo Gulch to the west of the Makaīwa project but still in Honouliuli indicated no evidence of Hawaiian occupation but the gulch has been impacted in modern times (Bordner and Silva, 1983).

3. The Makaīwa Slope as evidenced by the present survey, was not a major thoroughfare. We can see some very limited evidence of part-time agriculture in and around gulches and 2 foci of sparse habitation. The first is limited to <u>makai</u> portions of gulches and lava flats. This habitation is considered a <u>mauka</u> component or continuation of the Ko'olina coastal settlement rather than an independent focus. The second focus, separated from the first by a barren zone, is generally above the 800 foot elevation. This <u>mauka</u> habitation which could have been supported by seasonal dryland planting and forest foraging may be the lower portion of a thinly scattered, but widespread zone of settlement which stretches eastward and northeast along the east Wai'anae Range slopes and may increase in intensity along the more watered lands forming the <u>mauka</u> western boundary of Honouliuli.

4. There is to date no evidence of high status residence in Honouliuli. Large residential structures are not present along the Pacific shoreline where they would be expected. The late prehistoric occurrence of chiefs' houses is not apparent, perhaps because the ocean shoreline, although rich in marine resources, is uninviting for sport and unsuitable

for fishponds. The chiefly focus of 'Ewa District was Waipi'o. Whatever activities of this class occurred in Honouliuli would have occurred in Honouliuli would have been in or near the rich lands fronting West Loch (the ili of Honouliuli) but to date there is no direct archaeological evidence of this. Concerning status associations with Honouliuli, it is interesting to note the connection of the Pu'uku'ua settlement with slaves (kauwā), the lowest class of Hawaiians (Sterling and Summers, 1978:33).

5. The central place of the ahupua'a of Honouliuli in terms of population, as well as cultivated foods, was the 'ili of Honouliuli. There is good reason to assume, given the lack of intensive agricultural resources in other settlement areas of the ahupua'a that at least by late prehistoric times, all other habitation zones were economically and socially co-dependent.

What the Makaīwa slope had to offer to this picture was the following:

a. habitation in good shelter caves and open air sites defining the mauka limit of the coastal settlement zone;

b. localized quantities of adz basalt;

c. limited agricultural potential in the gulches for tree crops and roots;

d. upland zone settlement with limited agriculture and access to forest resources.

IV. PREVIOUS ARCHAEOLOGICAL RESEARCH

The earliest attempt to record archaeological remains in the area was made by Thrum (in Hammatt and Shideler, 1989:7). He reports the existence of a heiau located on Pu'u Kapolei, roughly 1 mile southeast of the present study area. According to legend Pu'u Kapolei was the location on which Kamapua'a, the pig-god, resided with his grandmother, Kamaunuahihio (McAllister, 1933:108). McAllister reports that the site had been dismantled and its stones used to construct a fence or crushed for building material.

In 1930, J. Gilbert McAllister recorded the locations of many archaeological sites, with most being situated at Pearl Harbor or on the uppermost ridges of the Wai'anae Range. The 'Ewa coral plain and Barbers Point area is listed under his site 146. In a general description of site 146 he reports the presence of old stone walls - most being associated with the ranching period around the late 19th century - and suggests that the holes and pits in the coral were used as a shelter or for cultivation by Hawaiian populations (McAllister, 1933:109).

The coral plains of 'Ewa have been the focus of more than 40 archaeological studies over the last two decades, largely as the result of required compliance with county, state and federal legislation. However, very little research has been conducted along the southern slopes of the Wai'anae Range, with the exception of the following few.

Previous archaeological research conducted within the boundary of the project area includes: a survey of the proposed Makaīwa Gulch Landfill site (Bordner, 1977); survey and intensive survey and test excavations of the West Beach Resort development (Barrera, 1985; Davis and Haun, 1987) and a preliminary survey of the proposed Ewa Town Center/Secondary Urban Center development (Haun, 1986).

As part of the West Beach Resort project area which encompassed most of the terrain extending southwest from Farrington Highway to the ocean, a small portion of the southwest corner of the present study area was surveyed and subsequently tested. In this area one site was identified as a habitation complex with associated petroglyphs (site 50-80-12-2893).

This site complex was originally reported by Neller subsequent to Barrera's reconnaissance survey of the West Beach Resort project area and given the site number 50-80-12-2893. In Barrera's survey report (1985) he redesignated the site as 50-80-12-1448. During the intensive survey and test excavations of the West Beach Resort project Davis and Haun once again designated the site with its original number: 50-80-12-2893.

Eight features were identified by Davis and Haun including rock shelters, platforms, midden deposits, and petroglyphs; all of these features were located along the base of a large outcrop ledge above the Farrington Highway. One feature originally identified as a midden deposit at the top of the outcrop ledge by Barrera was not relocated during this latter survey and was believed to have been destroyed due to bulldozing activity in the area (Davis and Haun, 1987:D-14).

Davis and Haun excavated five trenches in various portions of the site complex (Ibid.). The estimated age of the site complex ranges from the 15th century through to the early 19th century. Problematical dates from two trenches excavated below and adjacent to the cliff overhang at the center of the largest petroglyph concentration, placed a single cultural component at A.D. 1405-1665 based on charcoal radiocarbon and at A.D. 1700-1803 based on hydration-rind analysis (Ibid.:D-16). Upon completion of the test excavations, the following recommendations were presented by Davis and Haun:

> Site 2983 (1448) is unique in the Barbers Point region chiefly because it contains numerous petroglyphs and terraced habitation areas. Few petroglyphs have been recorded on O'ahu, and fewer still survive. Further work is recommended to complete the graphic documentation of the petroglyphs which, under any circumstance, should be preserved in place.
> (Ibid.:D:14)

Additional information concerning the present condition of this site is included in the Survey Results section below.

No archaeological sites were identified within the present study area during the Makaīwa Gulch Landfill survey. This project apparently covered most of Makaīwa Gulch from Farrington Highway to approximately the 1000 ft. contour (Bordner, 1970).

The preliminary reconnaissance survey conducted by Haun (1986) covered approximately 200 acres of the southeast portion of the present study area, bordered to the south by Farrington Highway, to the north by an existing ditch and between the slopes of Pu'u Palailai and roughly east of an existing water tank (Ibid.:3). Only one site - an inactive irrigation ditch once associated with Ewa Plantation - was identified. This structure was also observed during the present study and designated site 50-80-12-4341.

V. SURVEY RESULTS

State Site #: 50-80-12-2893

Site Type: Petroglyphs/Terrace/Rockshelters

Function: Art-Ritual/Habitation Complex

Probable Age: Prehistoric - Historic

Condition: Poor - Good

Dimensions: Approximately 40 square meters

Description: Site 50-80-12-2893 was first identified by Neller (1985) and included in the West Beach Resort survey report (Barrera, 1985). Barrera describes seven features in the site complex and designates them A-G (Ibid.: 1-3). Subsequent to this survey Davis and Haun (1987) conducted an intensive survey and test excavations at the site complex and separated some of the grouped features originally designated by Barrera resulting in a total count of eight features. These features were given numerical designations and include rock shelters, platforms, midden deposits, and petroglyphs; all of these features were located along the base of a large outcrop ledge above the Farrington Highway. One feature originally identified as a midden deposit at the top of the outcrop ledge by Barrera was not relocated during this latter survey and was believed to have been destroyed due to bulldozing activity in the area. It should be noted that during the present study bulldozing activity was also in progress upslope in the same area where the midden scatter was apparently identified.

A remnant portion of this site complex is located within the southwest-most corner of the present study area (Figure 8). This site was revisited during the present survey to assess its condition and to obtain basic survey data. Using Davis' and Haun's feature classifications, two of the features of the site complex - Feature 1 and 2 - remain within the project area. Feature 1 is a rock shelter with a terraced activity area. Feature 2 is a petroglyph concentration of approximately 50 figures. All other components of the site are believed to have been destroyed or severely disturbed by construction of the Ko'olina Interchange Road.

Presently, Feature 1 remains in fair condition and consists of a grass covered partially-terraced level ground surface abutting a prominent vertical outcrop ledge. Within this adjacent ledge are two small rock shelters measuring 1.2 m. (3.9 ft.) wide by 1.3 m. (4.2 ft.) deep and 2.4 m. (7.8 ft.) wide by 1 m. (3.2 ft.) deep, respectively. The maximum heights of these two shelters are 90 cm. (2.8 ft.) and 1 m. (3.2 ft.), respectively. Midden was identified on the ground surface beneath a lower overhang separating the two rock shelters. A roughly 1 m. (3.2 ft.) diameter outline of a previous test unit presumably excavated by Davis and Haun was observed within the most western rock shelter.

Feature 2 consists of a concentration of roughly 50 petroglyph figures covering approximately 7.5 m. (24.6 ft.) of the outcrop ledge abutting the two rock shelters in Feature 1.

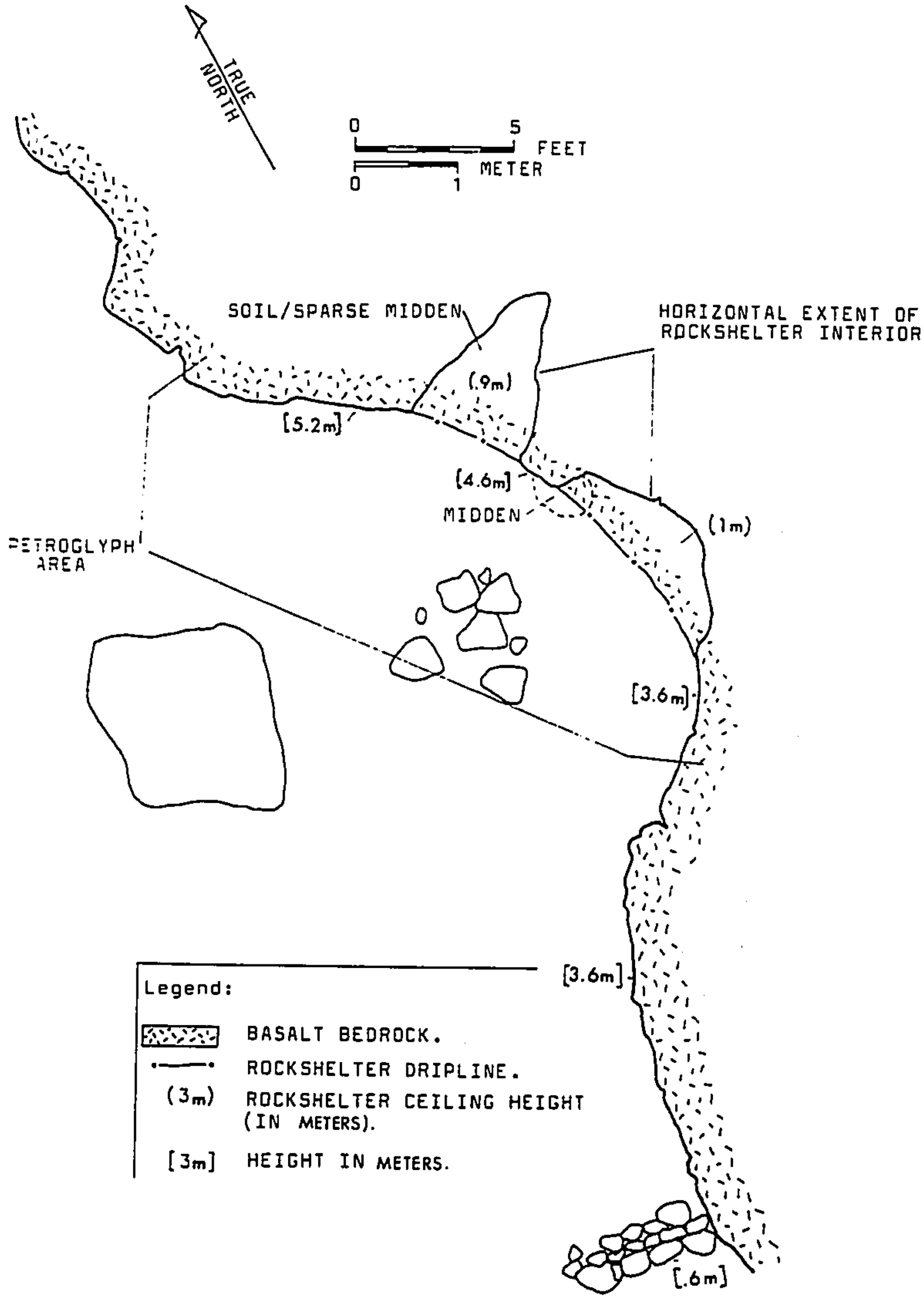

Figure 8 Site 50-80-12-2893; Plan View

These figures are situated at a maximum height of 3.2 m. (10.4 ft.) above the adjacent ground surface. Of these 50 petroglyph figures, most are interpreted as human figures of the wide body and stick figure type (Cox and Stasack, 1988). Some of these appear to represent family groups, runners, an ali'i, a possible ghost form and a man riding a horse or possibly a cow. Less numerous figures represent animal forms such as a goat or possible dog, a chicken and an ambiguous configuration with a fish tail (possible whale). Many of the other petroglyph figures are faded due to weathering and thus cannot be clearly interpreted. According to a local resident of the area (name unknown), the condition of the petroglyphs has extensively deteriorated due to recent landscaping activity and subsequent exposure to the natural elements. This area is presently littered with modern garbage and construction debris.

During the course of the intensive survey and test excavations of the West Beach Resort project, five trenches were reportedly excavated at the site complex (Davis and Haun, 1987: D-14). Two of these trenches were excavated within Feature 1, one placed beneath the overhanging cliff and the second "...further out on the modified talus" (Ibid.:D-15). These specific excavations yielded contradicting dates from a single cultural layer. For example, charcoal recovered from the trench excavated below the cliff overhang revealed a date ranging A.D. 1405-1665, while hydration-rind analysis of volcanic glass recovered from this same trench and cultural layer yielded a date ranging A.D. 1700-1803 (Ibid.:D-16).

Given the explicit cultural significance of this site, it is highly recommended that the appropriate preservation plans be instigated (as recommended by Davis and Haun) to assure that this remaining portion of the site complex be spared any additional disturbance. The petroglyphs have not yet been systematically recorded. We would suggest latex casts be taken and kept for posterity and that the site be preserved in place and interpreted. Details of preservation will be presented in a plan to be submitted to the DLNR for approval.

State Site #: 50-80-12-4310 **CSH Site #:** 2

Site Type: Circular Enclosure

Function: Temporary Habitation

Probable Age: Late Historic - Modern (i.e., less than 50 years old)

Condition: Fair

Dimensions: 2.5 m. (8.2 ft.) exterior diameter

Description: This structure is constructed of roughly stacked boulders, 1-2 courses high. The walls are an average 40 cm. (1.3 ft.) wide and 20 cm. (6 in.) high. This site is located on the west ridge line of Makaīwa Gulch at approximately the 800 ft. (243.9 m.) elevation level. The site offers a commanding view of Makaīwa Gulch and it may have served as a late historic or modern hunting structure.

The interior consists of scattered subangular cobbles and very shallow soil.

State Site #: 50-80-12-4311 **CSH Site #**: 3

Site Type: Wall/Fenceline

Function: Cattle Wall

Probable Age: Historic

Condition: Good

Dimensions: Extends beyond project boundary

Description: This cattle wall extends from the western project boundary at approximately the 900 ft. (274.3 m.) elevation to the eastern boundary on the NW side of Pu'u Palailai at approximately the 320 ft. (97.5 m.) elevation. The wall is oriented on an average bearing of 332 degrees TN and crosses four gulches in the project area. This site consists mainly of fenceline, with the exception of a few constructed wall sections that extend along the slopes of the gulches. These walled sections are generally constructed of stacked boulders and range from 1 m. (3.2 ft.) to 1.7 m. (5.5 ft.) high, 5-6 courses and average 50 cm. (1.6 m.) wide. The walled sections were probably constructed to prevent the cattle from falling off the steep slopes of the gulches and/or possibly because the stakes following the fenceline could not be built into the outcrop ledges. This site also continues to the northwest and southeast beyond the limits of the project area boundary. The presence of this fenceline on the Hawaiian

U.S.G.S. Territory Survey (USGS HTS) Reference maps (1928), indicates that its construction predates at least 1928.

State Site #: 50-80-12-4312 **CSH Site #**: 4

Site Type: Enclosure

Function: Temporary habitation

Probable Age: Prehistoric

Condition: Fair

Dimensions: 2.2 m. (7.2 ft.) E/W by 4.5 m. (14.7 ft.) N/S

Description: This structure is open to the west and walled on three sides with the east side of the enclosure utilizing the slope (Figure 9). The walls are constructed of stacked small to medium boulders standing 40 cm. (1.3 ft.) high, 1-3 courses, and average 40 cm. (1.3 ft.) wide (1 boulder). This site is located on the east side of the most western unnamed gulch in the project area east of Waimanalo Gulch.

State Site #: 50-80-12-4313 **CSH Site #**: 5

Site Type: L-Shaped Terrace Wall

Function: Agricultural

Probable Age: Prehistoric

Condition: Fair

Dimensions: 9.5 m. (31.6 ft.) N/S by 3 m. (9.8 ft.) E/W

Description: This site consists of an L-shaped terrace wall constructed of stacked boulders and cobbles utilizing some large

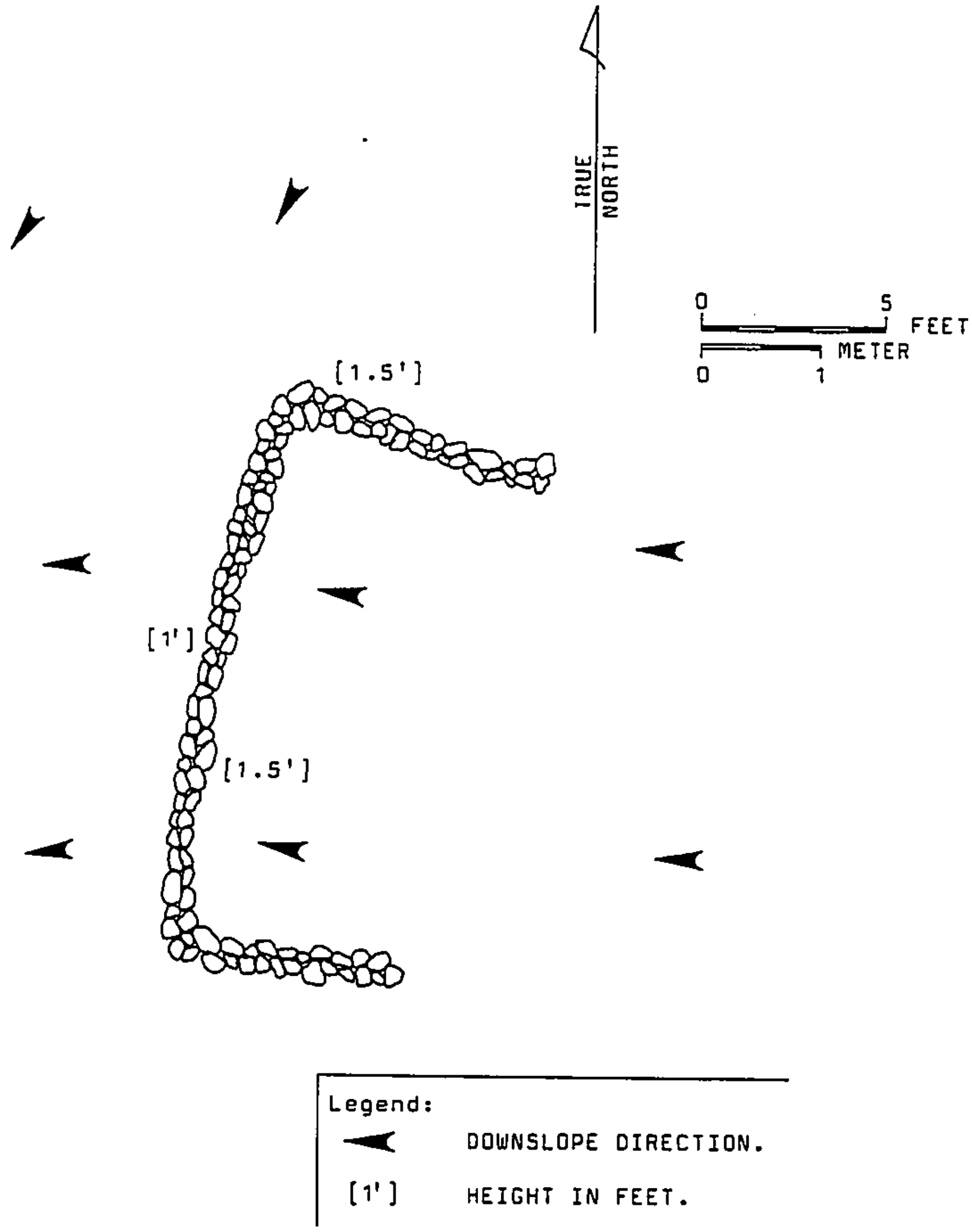

Figure 9 Site 50-80-12-4312; Plan View.

outcrop boulders (Figure 10). The terrace wall has exterior heights that range from 60 cm. (1.9 ft.) to 1 m. (3.2 ft.) high, 3 courses, and 75 cm. (2.4 ft.) wide. This terrace wall retains an area approximately 14.3 m. (46.9 ft.) by 9.5 m. (31.1 ft.) of level soil (presently covered by dense grass). This site is located on the west side of Makaīwa Gulch at an approximate elevation of 1020 ft. (310.9 m.). A deep erosional channel drops roughly 3 m. (9.8 ft.) immediately below the terrace edge at the center of the gulch.

No midden or artifacts were observed at this site. This site has good excavation potential.

State Site #: 50-80-12-4314 **CSH Site #**: 6 **Site Type**:Wall
Function: Associated with sugarcane cultivation
Probable Age: Late Historic - Modern
Condition: Good
Dimensions: Extends beyond project boundary
Description: This wall is constructed of stacked boulders and is cobble filled. On average the wall measures 1 m. (3.2 ft.) high and 1-2 m. (3.2-6.5 ft.) wide. The site runs immediately upslope of an existing ditch (site 4341) along the 200 ft. (60.9 m.) contour line, beginning at the eastern most major water tank to the southeast beyond the limits of the project area.

State Site #: 50-80-12-4315 **CSH Site #**: 7
Site Type: Terrace

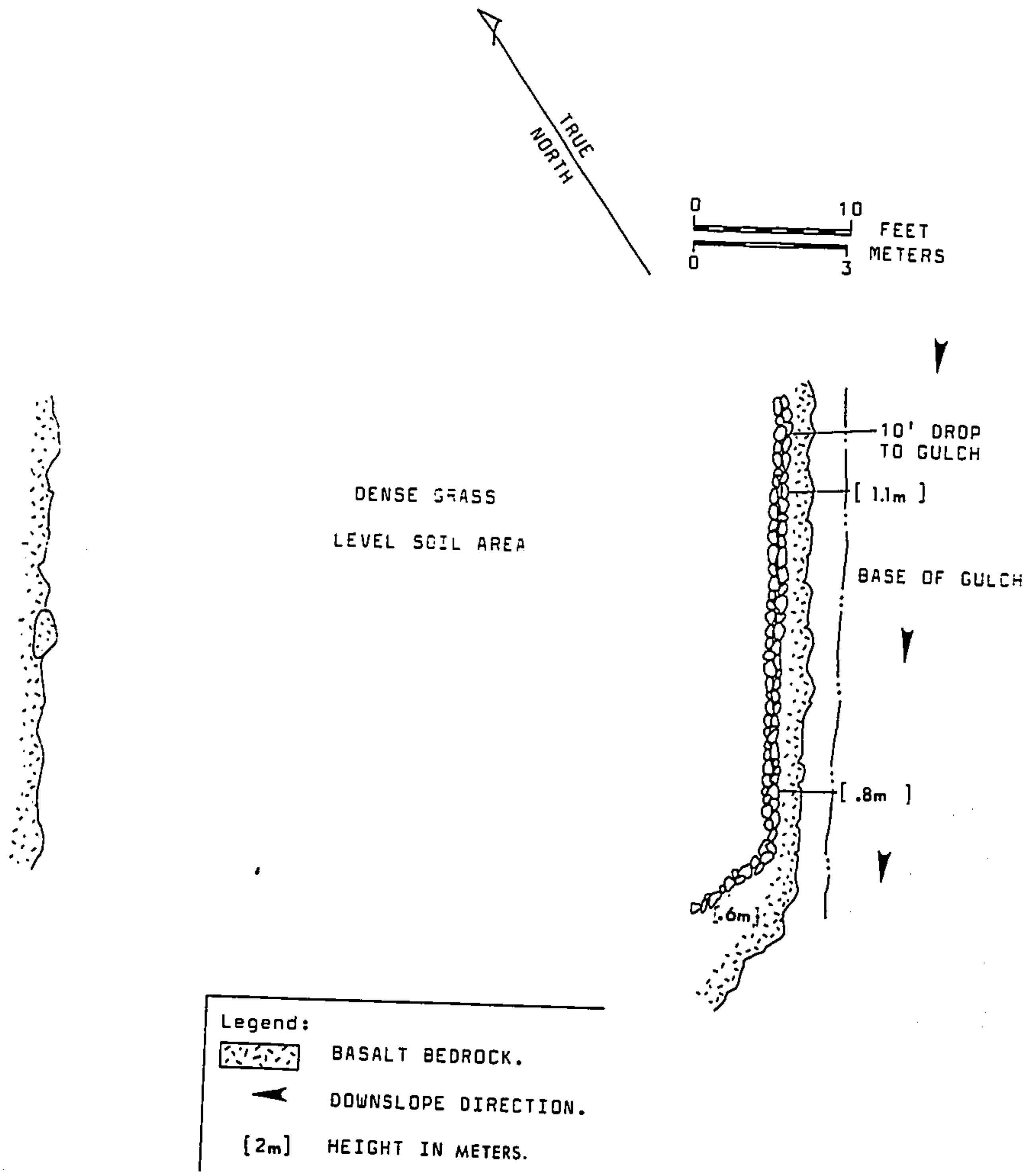

Figure 10 Site 50-80-12-4313; Plan View.

Function: Associated with sugarcane cultivation

Probable Age: Historic - Modern

Condition: Fair

Dimensions: 12 m. (39.3 ft.) NW/SE

Description: This site consists of a terrace measuring 12 m. (39.3 ft.) long NW/SE and constructed of piled and roughly stacked boulders modifying in situ boulders. The terrace is 50 cm. (1.6 ft.) high, 1-2 courses and 1-2 m. (3.2-6.5 ft.) wide. This structure retains an area of approximately 5 m. (16.4 ft.) upslope to an outcrop ridge. This site is located along the southwest base of Pu'u Palailai in the southeast corner of the project area. Directly to the east of this site is an old wooden water tank. The site's configuration and close proximity to the water tank suggest it is late historic or modern in age and likely associated with sugar cultivation. Also located to the northeast of this structure is a concentration of broken fine grain basalt, the result of tunnel blasting.

No midden or artifacts were observed. This site has low excavation potential.

State Site #: 50-80-12-4316 **CSH Site #:** 8

Site Type: Wall

Function: Possible Cattle Wall

Probable Age: Historic

Condition: Fair to Poor

Dimensions: 15.2 m. (49.8 ft.) long

Description: This site is constructed of piled small to medium boulders along the edge of an outcrop ledge which steeply drops 5-10 meters below. This wall stands 50 cm. (1.6 ft.) high, 1-3 courses, and is constructed mostly of rounded boulders; it is discontinuous in some areas probably due to collapse or rock robbing. This site may have functioned as a cattle wall, however, due to its deteriorated condition such a function is difficult to determine. This site is located at an elevation of approximately 1300 ft. (396.3 m.) along level terrain to the east of Makaīwa Gulch.

State Site #: 50-80-12-4317

CSH Site #: 9

Site Type: Circular Enclosure and Platform

Function: Recurrent Habitation (Periodic re-use, seasonal or otherwise)

Probable Age: Prehistoric

Condition: Fair

Dimensions: 4.6 m. (15 ft.) E/W by 10 m. (32.8 ft.) N/S

Description: This site consists of a roughly "U" shaped enclosure open to the northeast with an attached platform (Figure 11). The enclosure is roughly rectangular in shape and is constructed of small boulders and cobbles with mounded walls discontinuous in sections. These walls average 50 cm. (1.6 ft.) high and 1 m. (3.2 ft.) wide.

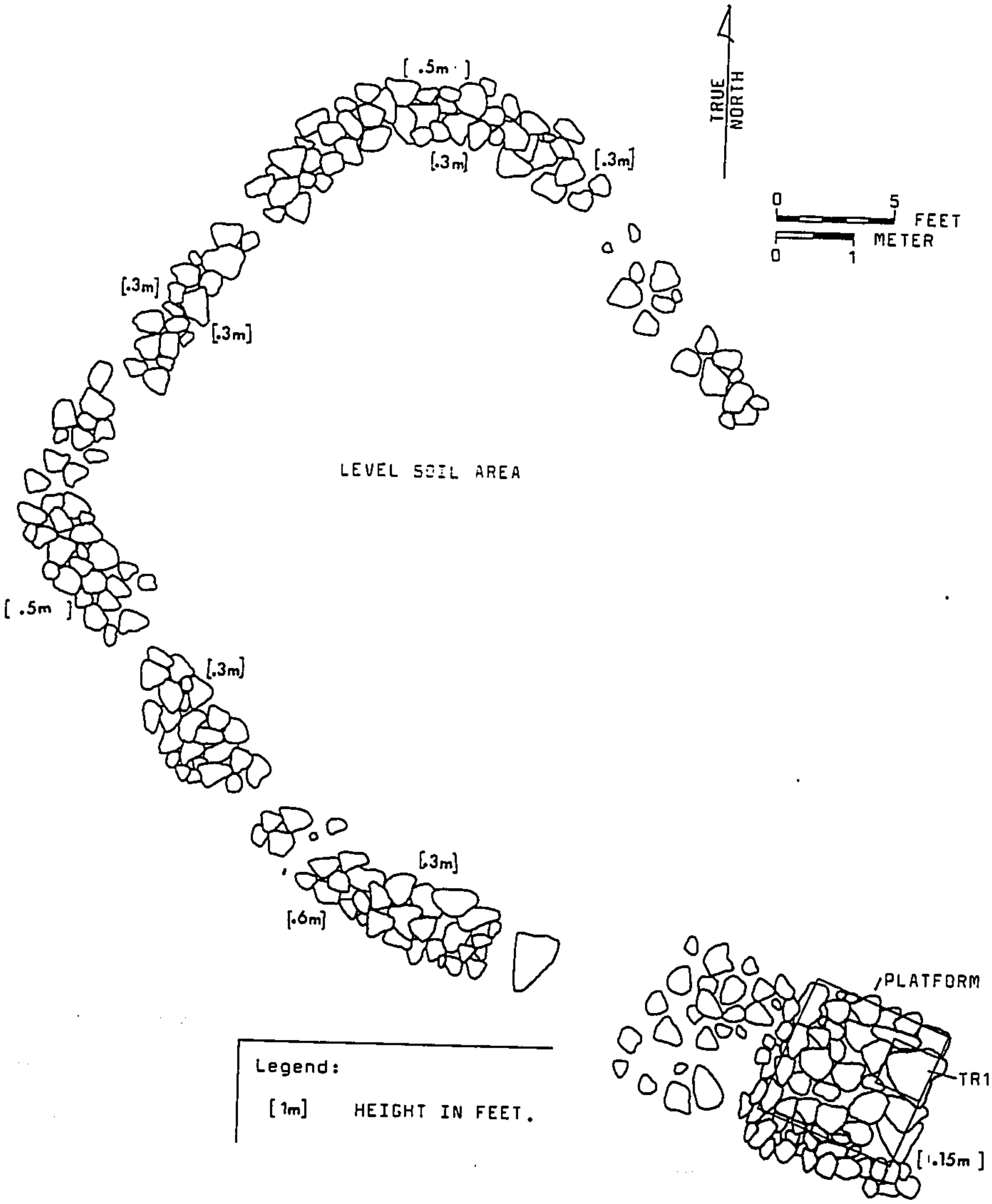

Figure 11 Site 50-80-12-4317; Plan View.

The platform, indistinctly attached to the east end of the enclosure, measures 1.8 m. (5.9 ft.) by 1.9 m. (6.2 ft.). This structure is rectangular in shape and is constructed of small boulders and cobbles rising an average height of 45 cm. (1.4 ft.) above the surrounding ground surface. On the west end of the platform is an alignment of small boulders 20 cm. (6 in.) high.

The site encloses a fairly level interior with compact soil and light grass cover. It is located on the northeast side of Makaīwa Gulch at an approximate elevation of 1200 ft. (365.8 m.). Excavation potential for this site is good.

Testing Results

Preliminary testing at site 50-80-12-4317 was limited to a 50 cm. (1.6 ft.) square trench placed within the eastern portion of the platform structure. Upon removal of the platform rocks, excavation was continued into the underlying soil deposit until reaching culturally sterile soil at a maximum depth of 25 cm. Two soil layers were revealed in the trench profile underlying the platform rocks. Stratum I consisting of dark yellowish brown gravelly silt yielded one cowrie shell fragment and a sparse scatter of charcoal; and is a loose pebbly soil. This soil layer is probably the result of natural and cultural deposits filtering down from the above platform structure. Insufficient charcoal was present to collect for dating. Stratum II was a culturally sterile soil layer and characterized by a compact reddish-brown silt loam (5 YR 4/4). The culturally sterile Stratum II was distinguished from the Stratum I weak cultural layer on the basis of color - reflecting no organic content or degree of weathering. Stratum II is basically loose decomposed bedrock derived from in-place weathering of underlying lava.

State Site #: 59-80-12-4318 **CSH Site #**: 11

Site Type: Circular Enclosure

Function: Temporary Habitation

Probable Age: Pre-historic

Condition: Fair

Dimensions: 4.5 m. (14.7 ft.) N/S by 3.6 m. (11.8 ft.) E/W

Description: This structure is roughly circular in shape and constructed of stacked and piled small to medium cobbles with some small boulders (Figure 12). The enclosure wall stands 30 cm. (9 in.) high on the exterior and 15 cm. (5 in.) above a roughly paved interior; it has an average width of 75 cm. (2.4 ft.). The original configuration of the enclosure probably included an opening to the east, however, this opening has since been covered by scattered tumble falling from the west wall of the site. An _ahu_ constructed of five stacked cobbles is situated along the southwest portion of the enclosure wall. Two additional _ahu_(s) (one located adjacent to site 50-80-12-4325) were identified _mauka_ along this same ridge and may represent in combination with this particular _ahu_ a series of markers delineating a north/south trail along this ridgeline.

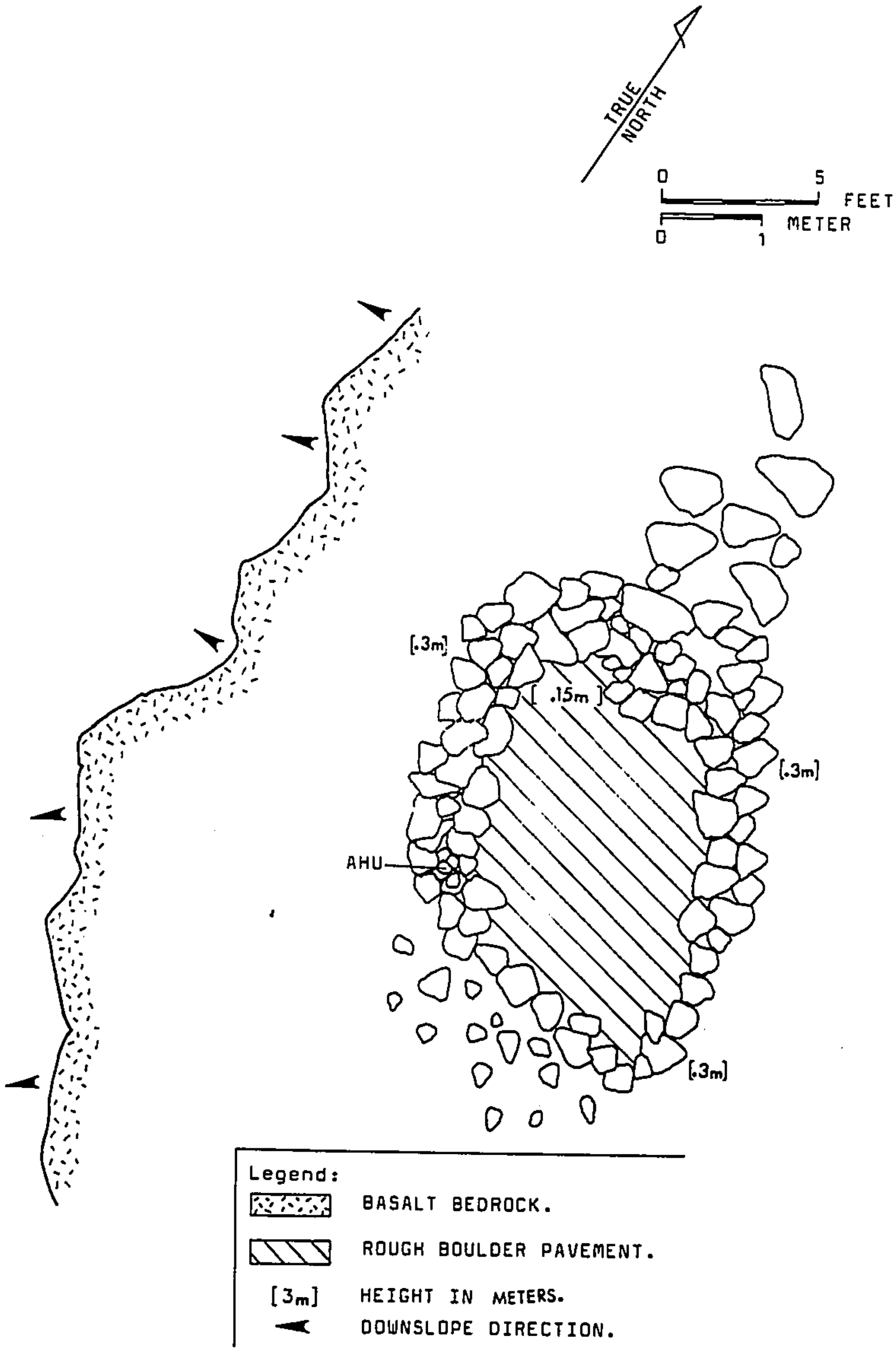

Figure 12 Site 50-80-12-4318; Plan View.

This site is situated on a level bluff of the ridge east of Makaīwa Gulch and affords a spectacular view of the surrounding terrain and southern coastline.

No midden or artifacts were observed. Excavation potential for this site is fair in the interior because of probable mineral soil deposits under the paving. Exterior areas have shallow soil and may contain some thinly stratified cultural material.

State Site #: 50-80-12-4319 **CSH Site #**: 12

Site Type: Rock Shelter with Interior Terrace

Function: Permanent Habitation

Probable Age: Prehistoric

Condition: Excellent

Dimensions: 10.3 m. (33.7 ft.) SW/NE by 5.4 m. (17.7 ft.) SE/NW

Description: This rock shelter measures 10.3 m. (33.7 ft.) wide and 5.4 m. (17.7 ft!) deep (Figure 13). Ceiling heights range from 45 cm. (1.4 ft.) to 1.6 m. (5.2 ft.) high. A stone-faced terrace constructed of 3-5 courses of cobbles and boulder slabs, measures 5.4 m. (17.7 ft.) long and 60 cm. (1.9 ft.) high abovethe shelter floor. The terrace abuts the rear of the cave and retains a soil area measuring 5.4 m. (17.7 ft.) by 2.7 m (8.8 ft.) approximately 1 m. (3.2 ft.) below the rock shelter ceiling. The main entrance to the rock shelter is 2.5 m. (8.2 ft.) high.

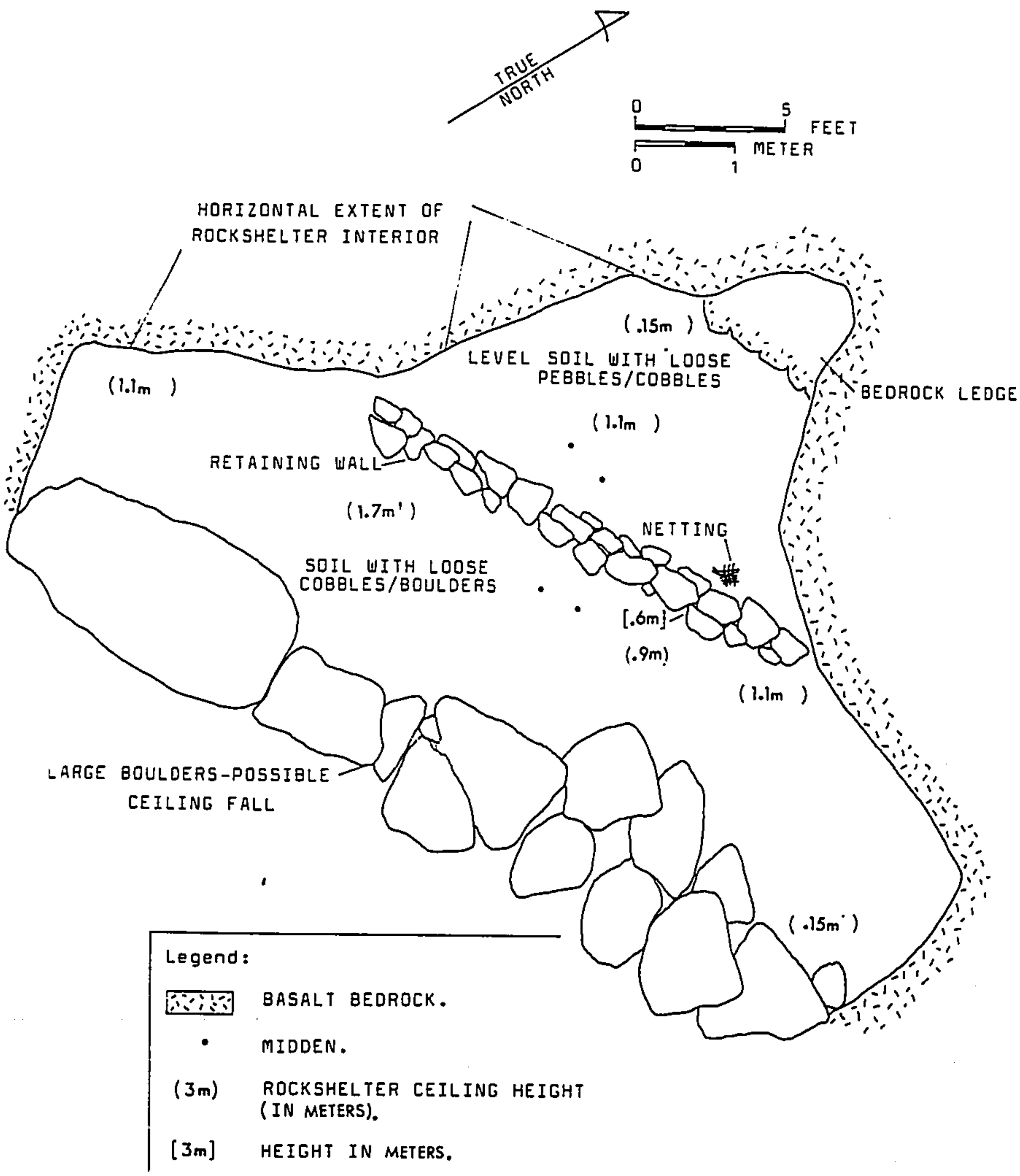

Figure 13 Site 50-80-12-4319; Plan View.

A scattering of grass was observed on the soil surface of the terrace; it probably represents a remnant portion of a sleeping mat which has since been exposed on the surface and damaged due to animal activities in the rock shelter. The interpretation of the grass as matting is based on our observation of similar material in dry caves in Kona which subsequent excavation showed to be woven mat. In addition, a piece of netting was also observed on the eastern portion of the terrace surface and was collected for analysis. This matting was submitted to the Bishop Museum staff who did microscopic examination and determined the material to be almost certainly corded olonā fiber. Since this netting is on the surface of the deposit the cultural layer is probably all prehistoric. The netting and other materials recovered in the survey are being stored at Cultural Surveys Hawaii, awaiting further disposition. The discovery of this netting emphasizes the potential of this cave in yielding valuable well-preserved organic remains.

This site is located on the western lower ridge of an unnamed gulch east of Makaīwa Gulch at an approximate elevation of 400 ft. (121.9 m.).

State Site #: 50-80-12-4320 **CSH Site #:** 13

Site Type: Retaining Wall/Historic Road

Function: Historic Road

Probable Age: Historic

Condition: Good

Description: This site consists of several wall sections retaining an existing dirt road. The majority of these retaining walls were identified within an unnamed gulch located to the east of Makaīwa Gulch and appear to continue to the southeast along the 600 ft. (182 m.) contour line. These walls generally range in height from 1 boulder high to 2 m. (6.5 ft.) of stacked and faced boulders and cobbles. In areas where the dirt road crosses various erosional channels, the walls are more formally and extensively constructed on both sides of the road. One of these particularly massive structures is formally faced with 8-10 courses of cobbles and boulders rising roughly 2.5 m. (8.2 ft.) above the base of the drainage cut.

No historical or modern reference has been recovered during this present study concerning the existence of this road. It is clear, however, that the road was probably used for a particular function (i.e. cattle road or crop access road) for an extensive period of time, based solely on the apparent effort expended to build the various retaining walls.

State Site #: 50-80-12-4321 **CSH Site #**: 15

Site Type: Rock Shelter/Interior Terrace

Function: Recurrent/Permanent Habitation

Probable Age: Prehistoric

Condition: Good/Excellent

Dimensions: 10 m. (32.8 ft.) E/W by 5.7 m. (18.6 ft.) N/S

Description: The rock shelter measures 10 m. (32.8 ft.) wide by 5.7 m. (18.6 ft.) deep (Figure 14). The ceiling heights range from 60 cm. (1.9 ft.) to 1.2 m. (3.9 ft.) high. A stone faced terrace measuring 4.2 m. (13.7 ft.) long retains a soil area of 2.5 m. (8.2 ft.) by 3.0 m. (9.8 ft.) which abuts the rear of the cave. The terrace face is constructed of angular and rounded small boulders and stands 30 cm. (9 in.) high, 2-3 courses, above the shelter floor. The entrance has an average height of 1.3 m. (4.2 ft.).

The interior floor of the rock shelter consists of level soil surface. Several artifacts were observed along the floor surface including a 3-sided coral abrader, grinding stone, and conglomerate sandstone nodules (manuports). An assorted variety of midden including coconut shell fragments and various marine shell fragments was present along the terrace surface and surrounding shelter floor; fine grain basalt flakes and possible primary core fragments were also identified on the terrace.

This site is located on the west side of the gulch located directly to the east of Makaīwa Gulch at an approximate elevation of 500 ft. (152.4 m.), just <u>mauka</u> of another rock shelter Site 50-80-12-4319.

The excavation potential for this site is excellent.

State Site #: 50-80-12-4322 **CSH Site #**: 16

Site Type: Rock Shelter with Interior <u>Ahu</u>

Function: Quarry

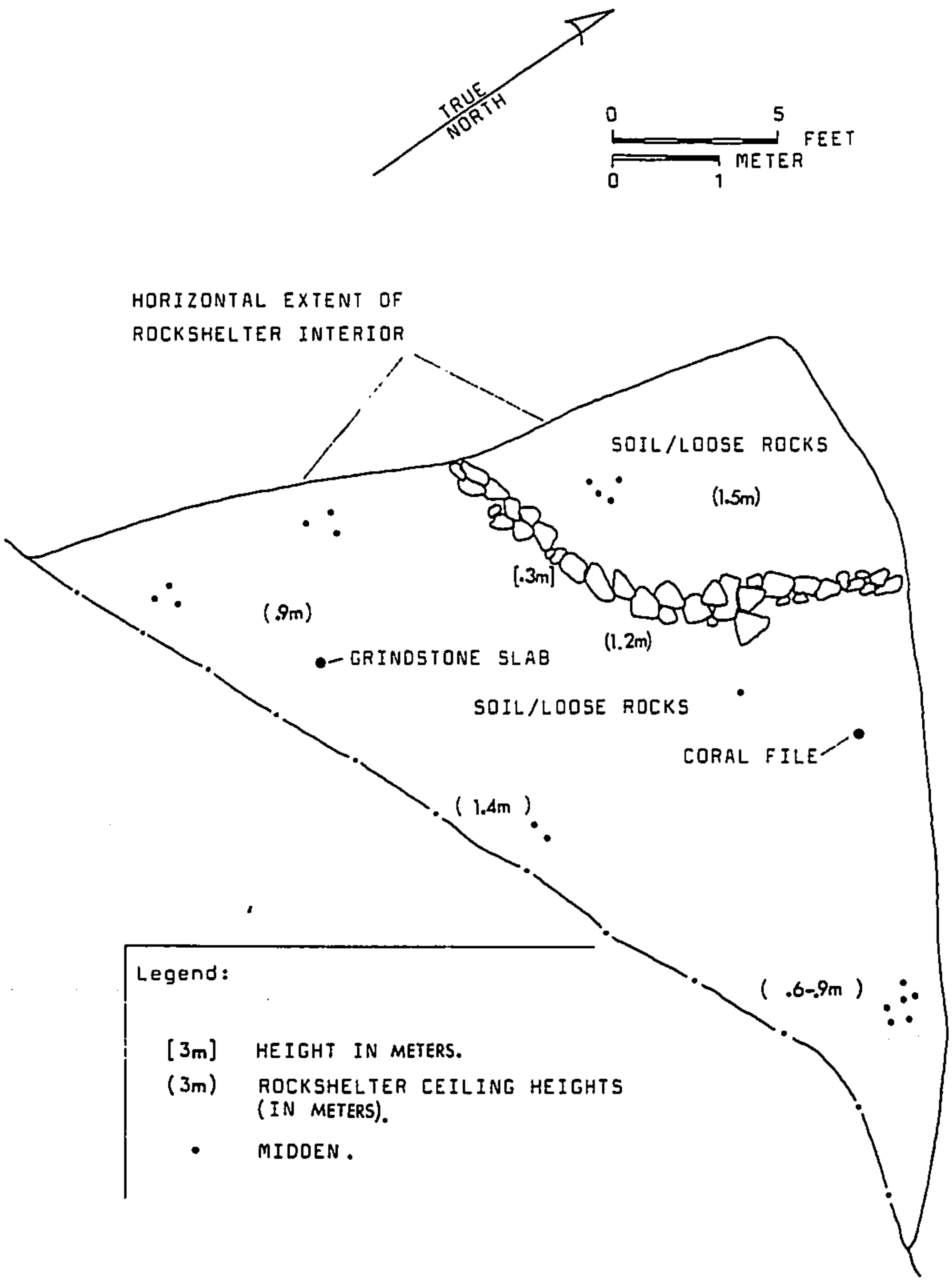

Figure 14 Site 50-80-12-4321; Plan View.

Probable Age: Prehistoric

Condition: Fair

Dimensions: 6 m. (19.6 ft.) E/W by 4.2 m. (13.7 ft.) N/S

Description: This rock shelter (Figure 15) measures 4.2 m. (13.7 ft.) wide and 6 m. (19.6 ft.) deep, with an average ceiling height of 1 m. (3.2 ft). The interior floor slopes moderately to steeply towards the opening of the shelter and is comprised for the most part of piles of broken outcrop that have fallen or were deliberately removed from the ceiling above. Within the rear portion of the cliff overhang several percussion scars are present in the ceiling; an underlying accumulation of what appears to be primary flakes characteristic of quarrying activities lies beneath. Towards the opening of the rock shelter a roughly rectangular depression roughly 50 cm. (1.6 ft.) deep with three vertical faces is present. It was originally suspected that this excavation was conducted in recent times by an avocational archaeologist or a modern day rock-miner. However, after inspecting the site area further, a fine-grain basalt dike was identified along the ceiling of the shelter and was also visible at the base of the excavated trench. Many flaking scars are observable on the dike portion of the bedrock at the base of the trench and small and large primary flakes were also seen within the profile of the trench and the surrounding ground surface.

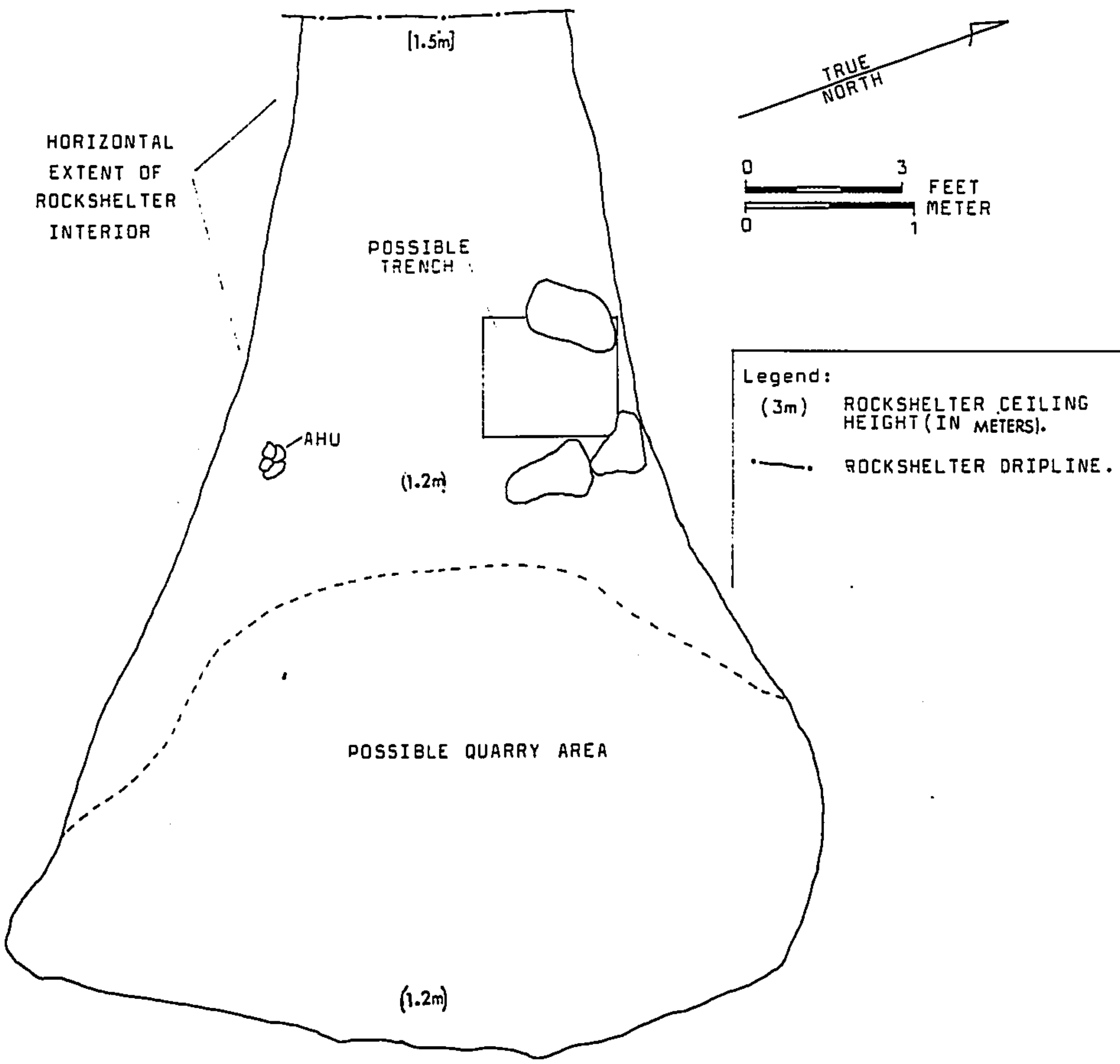

Figure 15 Site 50-80-12-4322; Plan View.

On the basis of these observations it is suggested that some degree of prehistoric quarrying in combination with subsurface mining activities was the main, if not exclusive, activity at this site.

In addition, a small ahu constructed of five stacked large flakes is located roughly 1 m. (3.2 ft.) south of the trench, also within the opening of the rock shelter. Although the structure is too minor to be considered a shrine, it may represent a simple marker for the quarry site.

This site is located on the lower ledge of the east ridge line of Makaīwa Gulch at approximately the 400 ft. (121.9 m.) elevation.

Excavation potential at this site is fair. No organic materials were observed and the probability of their occurring – considering lack of evidence of habitation use – is low. However, the site has potential for yielding information on adz quarrying and sourcing studies. No samples were collected but the cave is available for future studies and sampling for petrographic characterization.

State Site #: 50-80-12-4323 **CSH Site #:** 17

Site Type: Ahu

Function: Marker

Probable Age: Undetermined

Condition: Fair to poor

Dimensions: 1 m. (3.2 ft.) diameter

Description: This ahu is constructed of small boulders and cobbles. This site stands 50-75 cm. (1.6-2.4 ft.) high. It is situated on the east side of an unnamed gulch directly east of Makaīwa Gulch; it is located at an approximate elevation of 400 ft. (121.9 m.). No midden or artifacts were observed at this site.

State Site #: 50-80-12-4324 **CSH Site #:** 18

Site Type: Mound-Ahu

Function: Agricultural

Probable Age: Prehistoric

Condition: Fair

Dimensions: 1.5 m. (4.9 ft.) diameter

Description: This mound measures 1.5 m. (4.9 ft.) in diameter and is 50 cm. (1.6 ft.) high; it is constructed of piled cobbles placed on and between two large bedrock boulders. The site is situated on fairly level terrain characterized by scattered outcrop rubble on the surface. This site is located in the burned zone of the project area on the east side of an unnamed gulch situated directly east of Makaīwa Gulch at approximately the 240 ft. (73.1 m.) elevation. A pig mandible was observed 3 m. (9.8 ft.) west of this mound and is assumed to be associated with activities related to the site. The evaluation of this mound is somewhat problematic considering that it is not associated with other similar features or any clearly defined soil deposits. However, partly by process of eliminating other possible functions an agricultural function seems the most feasible. Isolated seasonal planting of sweet potatoes or gourds in the area is possible.

Excavation potential for this site is fair.

State Site #: 50-80-12-4325 **CSH Site #**: 19

Site Type: C-Shape

Function: Temporary Habitation

Probable Age: Prehistoric

Condition: Fair

Dimensions: 2.4 m. (N/S) by 0.9 m. (E/W)

Description: This site (Figure 16) is constructed of stacked small boulders and cobbles. The walls stand 30 cm. (9 in.) high, 1-2 courses, and 45 cm. (1.4 ft.) wide. The enclosure is open to the east and lies on fairly level terrain covered with grass. An ahu of five stacked cobbles is located 14.6 m. and 215° TN from this site. This particular ahu in combination with two others located mauka and makai (site 50-80-12- 4318) may represent a series of markers delineating a trail running north/south along this ridgeline. This site is located on the eastern ridge line of Makaīwa Gulch at approximately the 320 ft (97.5 m.) elevation.

The site encloses a small area of loose soil and scattered rocks covered with grass; no midden or artifacts were observed. Excavation potential for this site is fair.

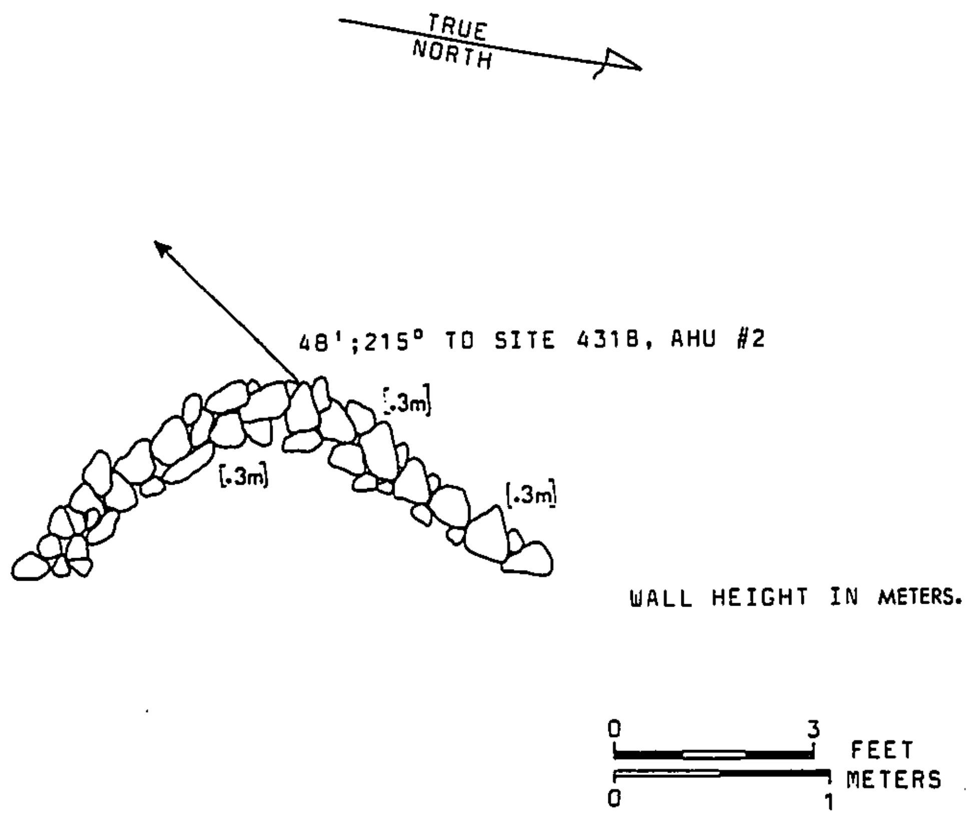

Figure 16 Site 50-80-12-4325; Plan View.

State Site # 50-80-12-4326 **CSH Site #**: 21

Site Type: Wall Section

Function: Temporary Habitation

Probable Age: Prehistoric

Condition: Fair

Dimensions: 3.9 m. (12.7 ft.) long E/W

Description: This short wall section is constructed of stacked small boulders and stands 60-91 cm. (1.9-2.9 ft.) high, 3-5 courses, and 60 cm. (1.9 ft.) wide (Figure 17). It is constructed on the south tip of an outcrop knoll within the presently burned zone of the project area. Between the wall and the south edge of the outcrop knoll a natural or constructed boulder alignment is present and in conjunction with the wall encloses a roughly 1.5 m. (4.9 ft.) by 3 m. (9.8 ft.) shallow soil surface. The outcrop knoll on which the site is situated rises a maximum height of 5 m. (16.5 ft.) above the surrounding terrain and forms a natural enclosure around level soil immediately below the site to the west. This site is located on level terrain on the east side of an unnamed gulch east of Makaīwa Gulch at approximately the 200 ft. (60.9 m.) elevation. This structure may have served as a windbreak or shelter.

The surface surrounding this site consists mostly of shallow soil and loose rocks. No midden or artifacts were observed. The excavation potential for this site is fair.

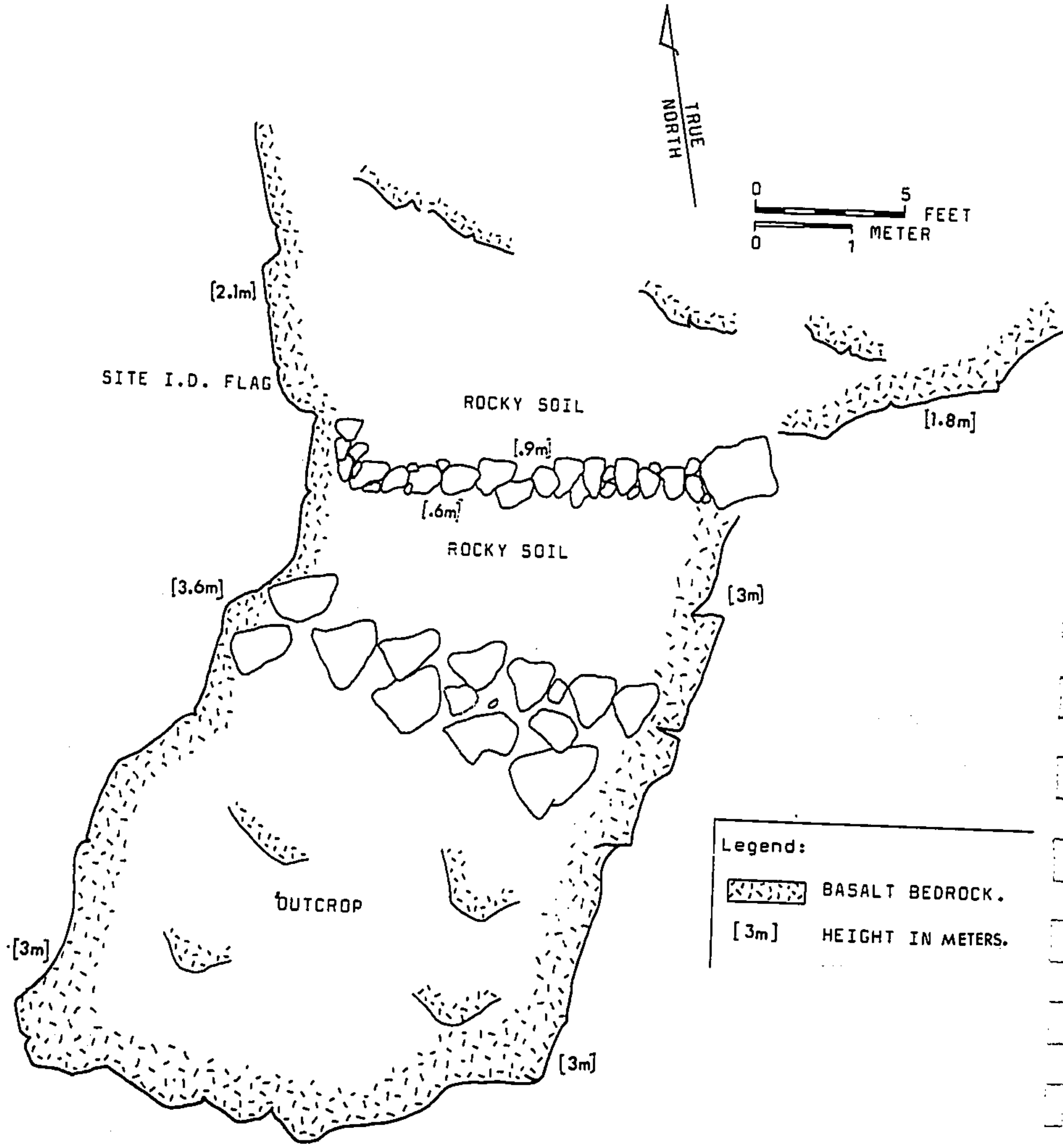

Figure 17 Site 50-80-12-4326; Plan View.

State Site #: 50-80-12-4327 **CSH Site #**: 22

Site Type: Ahu

Function: Marker

Probable Age: Historic - Modern

Condition: Poor

Dimensions: 1.2 m. (3.9 ft.) N/S by 1.5 m. (4.9 ft.) E/W

Description: This ahu is constructed of piled small to large cobbles and measures 90 cm. (2.9 ft.) high. It is situated on top of an outcrop rise approximately 3 m. (9.8 ft.) above the surrounding terrain within the presently burned zone of the project area. This site is located on level terrain on the east side of an unnamed gulch east of Makaīwa Gulch at approximately the 360 ft. (109 m.) elevation.

Minimally this site may represent an historic or modern marker related to topographical survey of the area.

State Site #: 50-80-12-4328 **CSH Site #**: 23

Site Type: Rock Shelter Complex (3 features)

Function: Permanent Habitation

Probable Age: Prehistoric

Condition: Good

Dimensions: 13.4 m. (42.9 ft.) E/W by 13.1 m. (42.9 ft.) N/S

Description: This site consists of 3 rock shelters located on a 2-tiered outcrop bluff. The three individual rock shelters were designated as one site and each was given individual feature designations: A, B and C. Features A and B (Figure 18) are located on the upper tier of the bluff directly above Feature C (Figure 19).

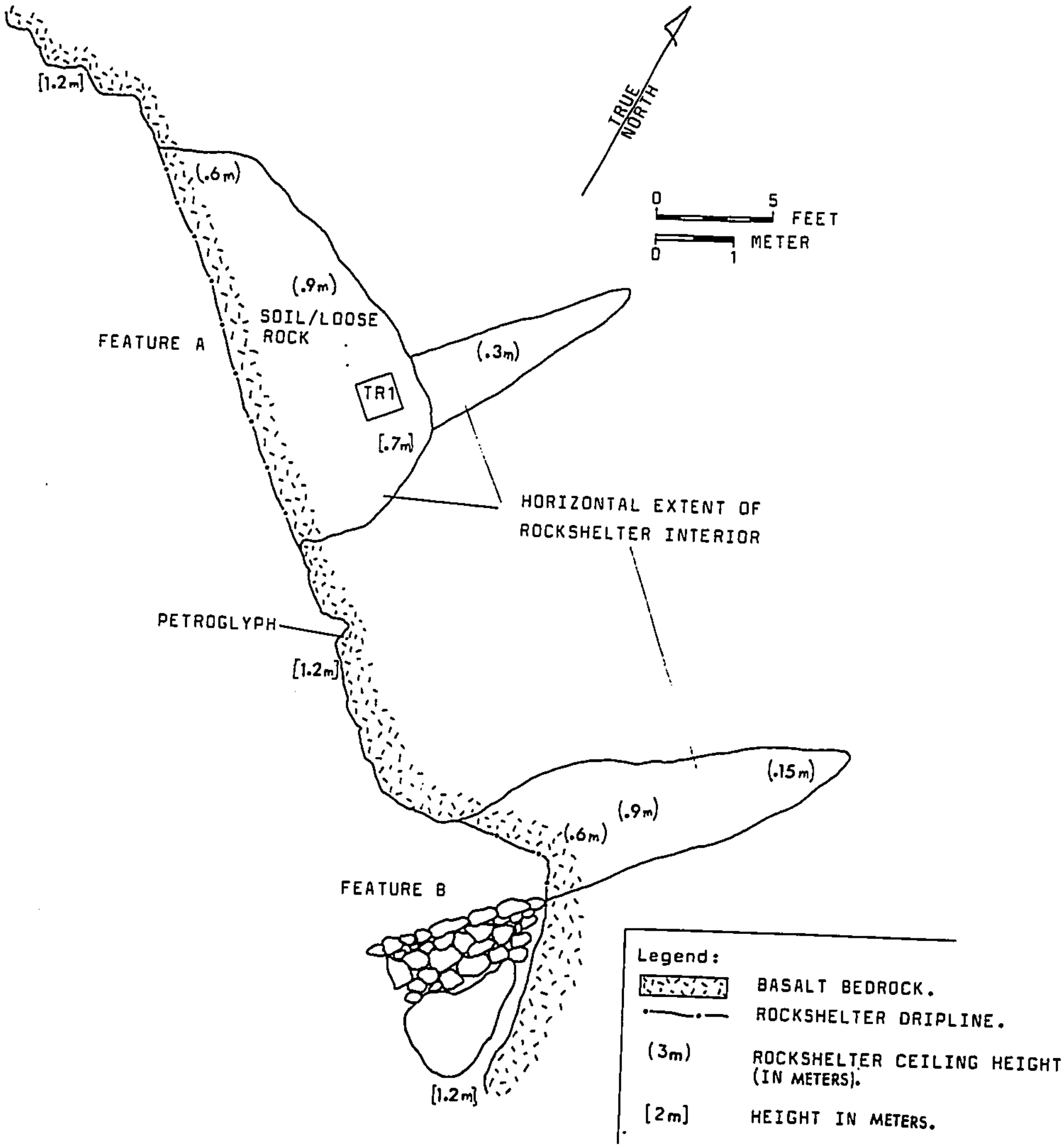

Figure 18 Site 50-80-12-4328, Features A and B; Plan View.

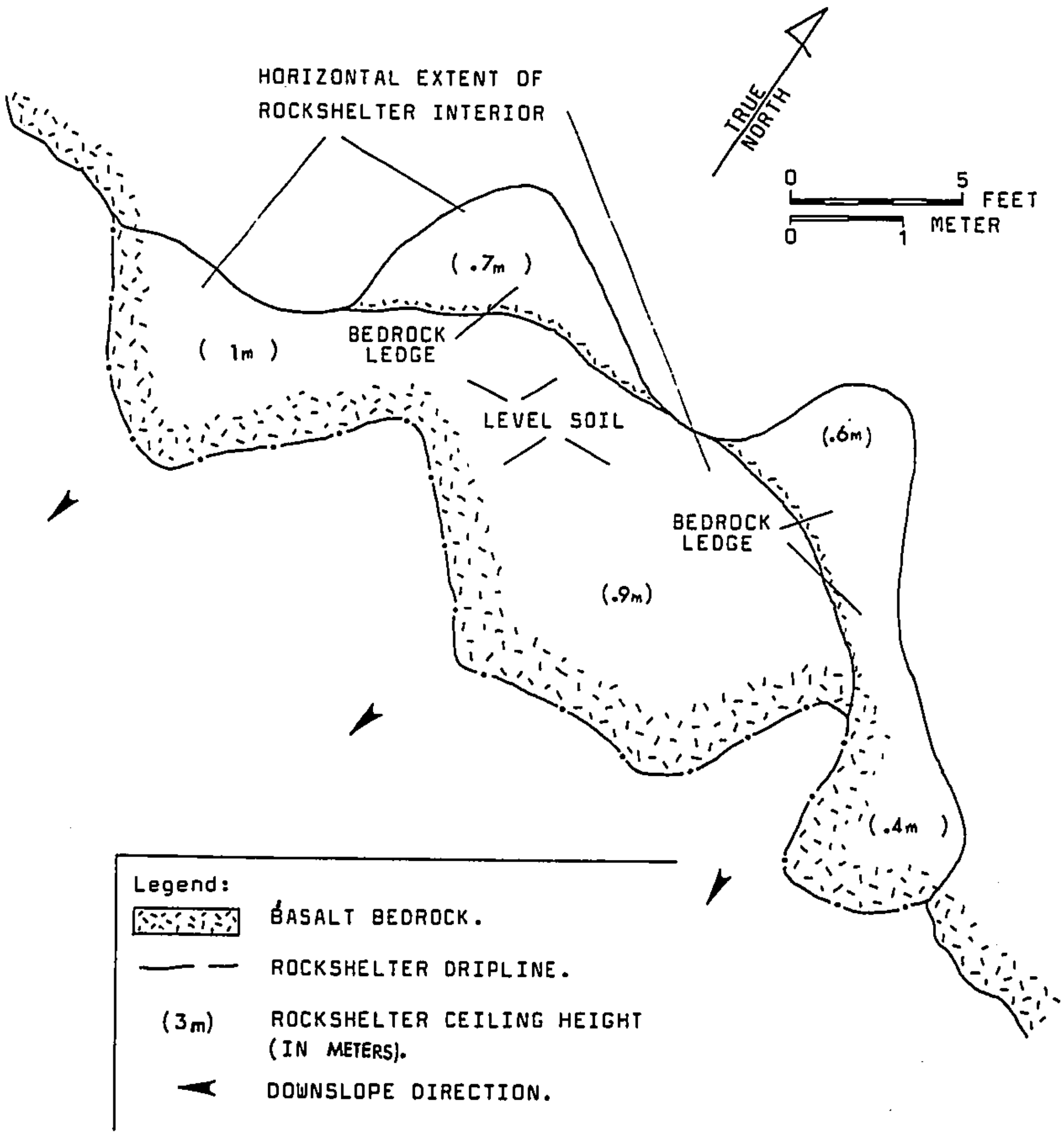

Figure 19 Site 50-80-12-4328, Feature C; Plan View.

Feature A measures 5.4 m. (17.7 ft.) long by 2.1 m. (6.8 ft.) deep. A small chamber measuring 1 m. wide extends for 3 m. (9.8 ft.) from the rear of the shelter. The rock shelter ceiling height ranges from 60 cm. (1.9 ft.) to 1.2 m. (3.9 ft.) high. The interior floor of the shelter is characterized by a level soil surface and a scatter of rocky ceiling fall. Two artifacts were collected from the floor surface of this feature and include a coral file and a sandstone abrader. These two artifacts represent the only cultural material observed within the site overall.

Located 1.5 m. (4.9 ft.) to the east of feature A and 1.2 m. (3.9 ft.) high along the face of the bluff is a very faint petroglyph. This petroglyph consists of a single stick figure.

Feature B consists of a probable sleeping shelter with modifications to the exterior of the rock shelter. It is located 4.8 m. (15.7 ft.) to the east of Feature A. This rock shelter measures 1.5 m. (4.92 ft.) wide and 4.5 m. (14.7 ft.) deep. The ceiling height ranges from 50 cm. (1.6 ft.) to 90 cm. (2.9 ft.) high. The interior floor of the rock shelter is characterized by a compact dry soil and occasional outcrop exposures. A small rough platform abuts the bedrock face directly to the east of the entrance of Feature B. The platform measures 2.5 m. (8.2 ft.) N/S by .91 m. (2.9 ft.) E/W and has a maximum height of 40 cm. (1.3 ft.) above the surrounding ground surface. The east portion of the platform abuts a large bedrock boulder. Due to the small size and linear configuration of Feature B, it is interpreted as a sleeping shelter.

A level plateau delineating the upper tier of the site complex extends roughly 7 m. (22.9 ft.) southwest of features A and B; Feature C is located directly below this outer edge.

Feature C rock shelter measures 9.1 m. (29.8 ft.) wide by 2.7 m. (8.8 ft.) deep. Ceiling height ranges from 45 cm. (1.4 ft.) to 1.2 m. (3.9 ft.) high. Two natural bedrock ledges are located in the rear of this cave. The interior of this feature consists of level soil deposits with no visible midden or artifacts.

This site complex is located at an elevation of approximately 230 ft. (70.1 m.) within the presently burned portion of the project area.

Testing Results

Preliminary testing was conducted at site 50-80-12-4328 with a 50 cm. (1.6 ft.) square trench excavated at the center of Feature A rock shelter. A shallow 10 cm. A-horizon (10 YR 3/2 greyish brown soil of gravelly silt loam contained no cultural material. Below this was a gravelly loamy sand (5 YR 4/4 reddish-brown) stratum with plentiful, naturally weathered angular pebbles. Soft decomposed bedrock was encountered at 25 cm. No cultural remains or human disturbance were encountered in this trench. Excavation potential at Feature B and C, and the unexcavated portions of Feature A is low, considering the results of the testing. However, this limited testing may not be indicative of the potential of other areas of the site.

State Site #: 50-80-12-4329 CSH Site #: 24

Site Type: Enclosure

Function: Undetermined

Probable Age: Modern

Condition: Good - Excellent

Dimensions: 7.6 m. (24.9 ft.) N/S by 6.7 m. (21.9 ft.) E/W

Description: This enclosure is open to the south and is constructed of piled and roughly stacked boulders and cobbles. The walls average 60 cm. (1.9 ft.) high and 91 cm. (2.9 ft.) wide. The eastern wall of this structure is situated on a bedrock ledge oriented N/S with a drop of 1.2 m. (3.9 ft.). The interior consists of shallow soil with no visible midden or artifacts.

Due to the apparently undisturbed condition of this structure coupled with evidence of bulldozing scars on the underlying surfaces of some of the enclosure's cobbles and boulders, it is interpreted to be modern in origin at least post-dating the usage of modern machinery.

This site is located on fairly level terrain in the center of the southern portion of the project area at approximately the 200 ft. (60.9 m.) elevation.

State Site #: 50-80-12-4330 **CSH Site #:** 25

Site Type: Platform

Function: Associated with sugarcane cultivation

Probable Age: Late Historic - Modern

Condition: Fair

Dimensions: 1.0 m. (3.2 ft.) N/S by 4.0 m. (13.1 ft.) E/W

Description: This site consists of a roughly constructed platform partially buried within an underlying soil mound. It is constructed of piled cobbles and boulders and rises a maximum of 30 cm. (10 in.) above the mound surface.

This structure is likely associated with other sugarcane infrastructure located in close proximity and may have served specifically as a platform for machinery.

State Site #: 50-80-12-4331 **CSH Site #:** 26

Site Type: L-Shaped Enclosure

Function: Poss. Agricultural

Probable Age: Prehistoric

Condition: Fair

Dimensions: 2.7 m. (8.8 ft.) N/S by 3.3 m. (10.8 ft) E/W

Description: This site consists of an L-shaped enclosure constructed of small boulders and cobbles (Figure 20). The north and east sides utilize the natural bedrock outcrop to form an enclosure. The low constructed walls stand only 15 cm. (5 in.) to 30 cm. (10 in.) high and are an average of 30 cm. (10 in.) thick. The interior consists of level soil with some loose

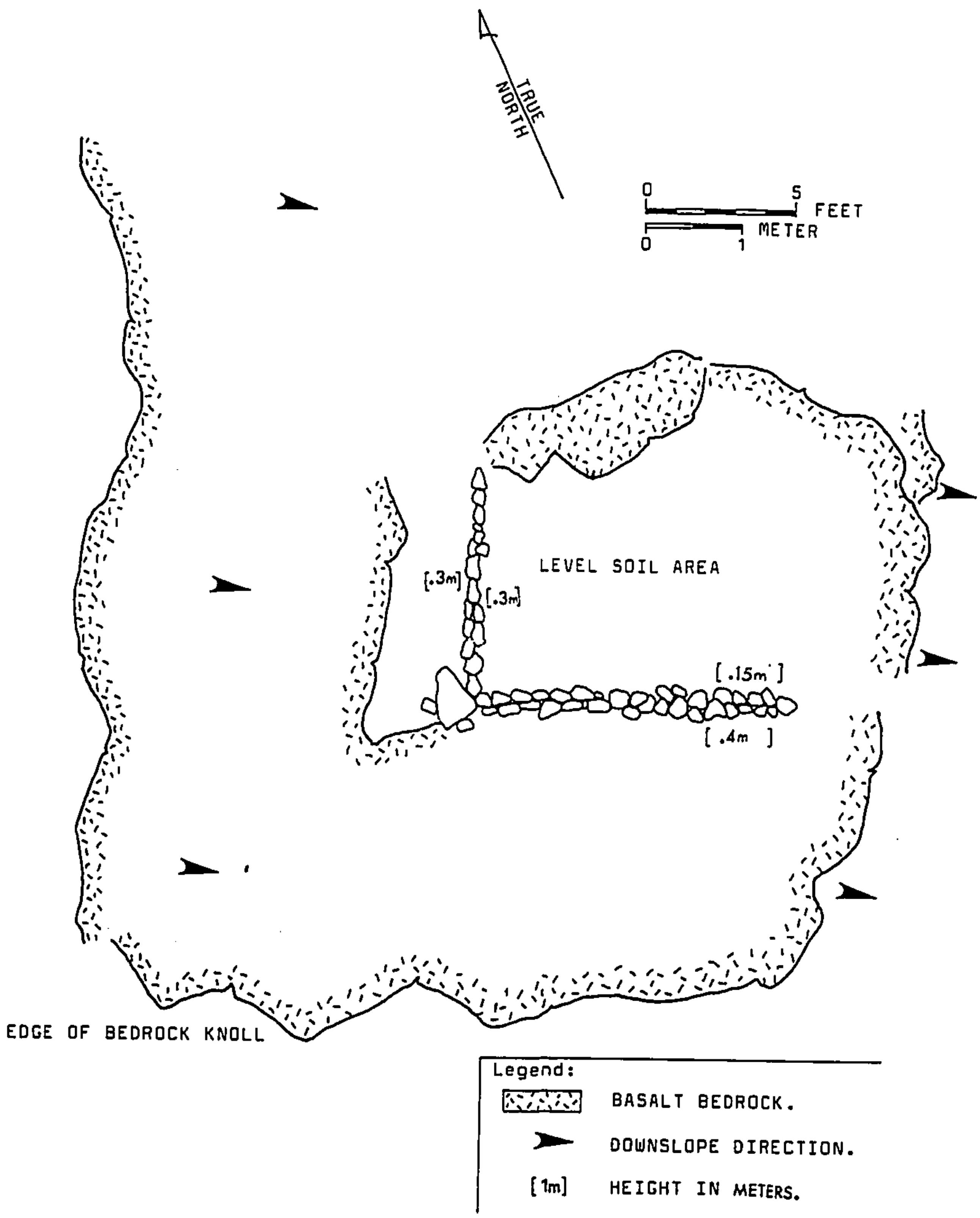

Figure 20 Site 50-80-12-4331; Plan View.

cobbles. This site is situated on the east side of an outcrop bluff located on the east side of an unnamed gulch (east of Makaīwa Gulch) within the burned portion of the project area. It lies at an approximate elevation of 220 ft. (67 m.). No midden or artifacts were observed. Excavation potential for this site is fair.

State Site: # 50-80-12-4332 **CSH Site #**: 27
Site Type: Circular Enclosure
Function: Temporary Habitation
Probable Age: Prehistoric
Condition: Fair
Dimensions: 4.5 m. (14.7 ft.) N/S by 4.8 m. (15.7 ft.) E/W
Description: This site consists of a circular enclosure constructed of piled and stacked boulders and cobbles, forming a possible entrance on the west end (Figure 21). The walls range in height from 15 cm. (5 in.) to 30 cm. (10 in.) high and 60 cm. (2 in.) to 1.2 m. (4 in.) wide. The interior consists of loose rocks and compact soil. No midden or artifacts were observed.

This site is located on the northwest side of the gulch west of Palailai Gulch at approximately the 1120 ft. (341.4 m.) elevation. Excavation potential for this site is good.

State Site #: 59-80-12-4333 **CSH Site #**: 29
Site Type: Wall segment and Bulldozed Pile

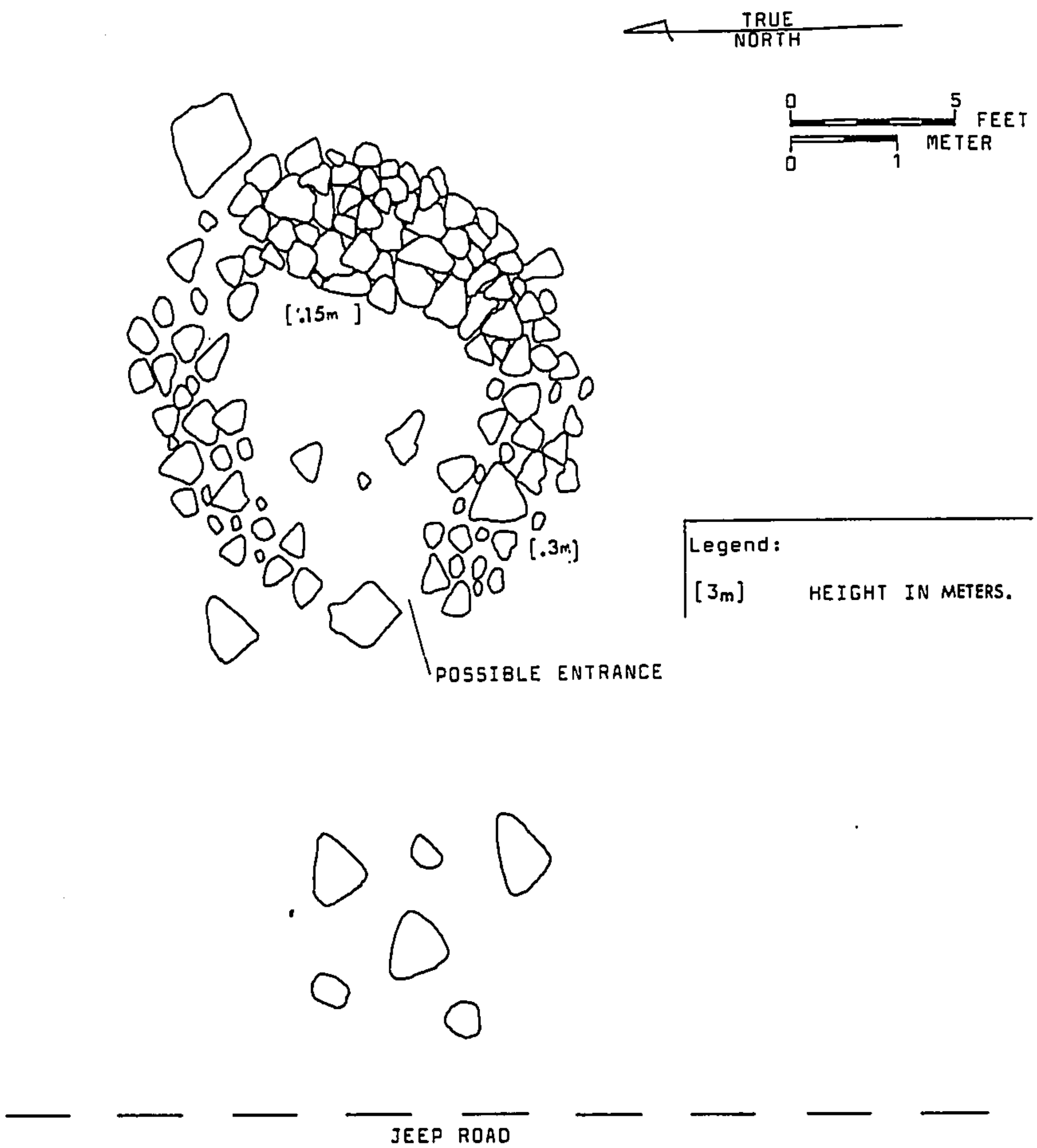

Figure 21 Site 50-80-12-4332; Plan View.

Function: Associated with irrigation ditch

Probable Age: Late Historic - Modern

Condition: Fair

Dimensions: 100 m. (328 ft.) long

Description: This large wall section is situated on the edge of Farrington Highway and extends for roughly 100 m. (328 ft.) to the north, following the irrigation ditch (site 50-80-12-4341) near its east side. The majority of this walled structure is roughly piled with boulders and appears to be disturbed or possibly formed by bulldozing activity in this lower area. A preserved or more formally constructed portion of the wall exists at the site's southern end as it intersects the existing Farrington Highway. This wall section has a height of 1 m. (3.2 ft.) and averages 1 m. wide (3.2 ft.). It has a two sided roughly faced core-filled construction with smaller cobble fill.

This site is located at an approximate elevation of 150 ft. (45.7 m.) and is within the presently burned portion of the project area.

State Site #: 50-80-12-4334 **CSH Site #**: 30

Site Type: Circular Enclosure

Function: Temporary Habitation

Probable Age: Prehistoric

Condition: Fair

Dimensions: 7 m. (22.9 ft.) E/W by 4.5 m. (14.7 ft.) N/S

Description: This structure is constructed of loosely stacked boulders with its north side abutting a sloping ridge (Figure 22). The walls stand 30 cm. (10 in.) to 60 cm. (1.9 ft.) high and range from 60 cm. (1.9 ft.) to 1.8 m. (5.9 ft.) wide. The south wall represents the widest construction while the northwest wall is most formally stacked. A possible entrance located in the west wall measures 1 m. (3.2 ft.) wide. The site encloses a slightly sloped interior consisting of a shallow soil deposit with no visible midden or artifacts. Excavation potential for this site is fair.

This site is located on the west slope of an unnamed gulch west of Palailai Gulch at approximately the 1000 ft. (304.8 m.) elevation. A barbed wire fence associated with an active cattle trough to the north runs adjacent to the site's west side.

State Site #: 50-80-12-4335 **CSH Site #**: 31

Site Type: Mound

Function: Possible Clearing Mound

Probable Age: Possible Prehistoric

Condition: Poor

Dimensions: 4 m. by 3 m. by .30 m. high.

Description: Site 50-80-12-4335 consists of a low mound or scattering of cobbles and small boulders that appears to have been trampled intensively by cattle or possibly impacted by bulldozing activity. The cobbles and boulders are heavily

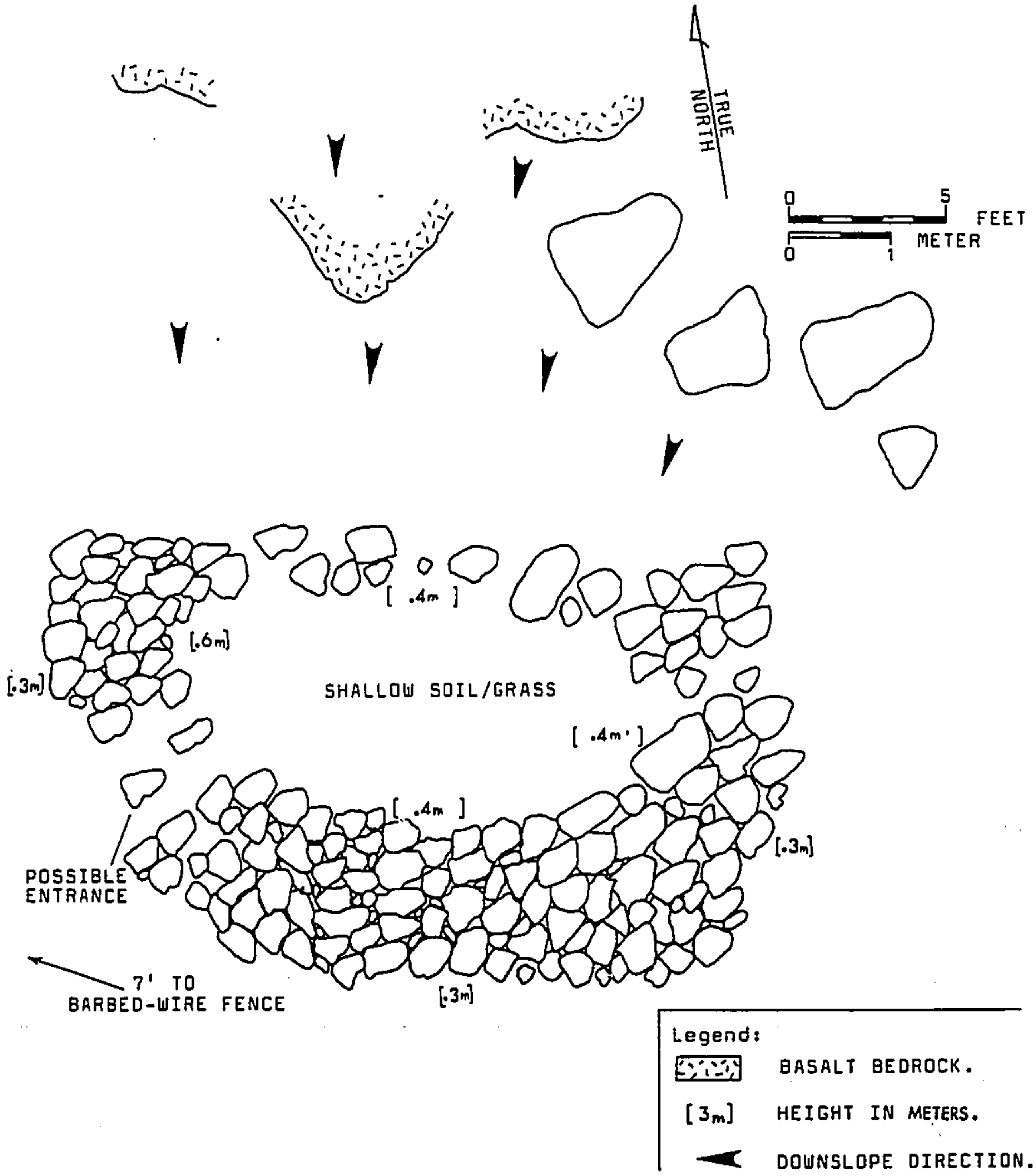

Figure 22 Site 50-80-12-4334; Plan View.

covered in lichen. The site's ambiguous configuration and minimal construction suggests a clearing mound function.

This site is located on the west ridge of an unnamed gulch to the west of Palailai Gulch at an approximate elevation of 1100 (335.3 m.). The excavation potential for this site is poor.

State Site #: 50-80-12-4336 **CSH Site #**: 32

Site Type: Triangular Enclosure

Function: Recurrent Habitation (Periodic re-use, seasonal or otherwise)

Probable Age: Prehistoric

Condition: Fair to good

Dimensions: 12.2 m. (40 ft.) by 7.5 m. (24.6 ft.)

Description: This site is constructed of wall alignments that form a triangular enclosure which opens to the west (Figure 23). The north wall of this structure exhibits the most substantial construction of the site and is oriented east/west. This wall consists of stacked boulders and cobbles and measures 0.8 m. (2.6 ft.) wide by 0.3 m. (10 in.) high. The two other walls on the southeast and southwest sides of the structure are less substantially constructed, often consisting of a single course, single boulder alignment. These walls range from 0.3 to 0.5 m. (1-1.6 ft.) high and 0.5 to 0.8 m. (1.6-2.6 ft.) wide. The interior of this enclosure is covered in grass and contains two boulders. The soil depth was probed and found to be 10 cm. or less in thickness.

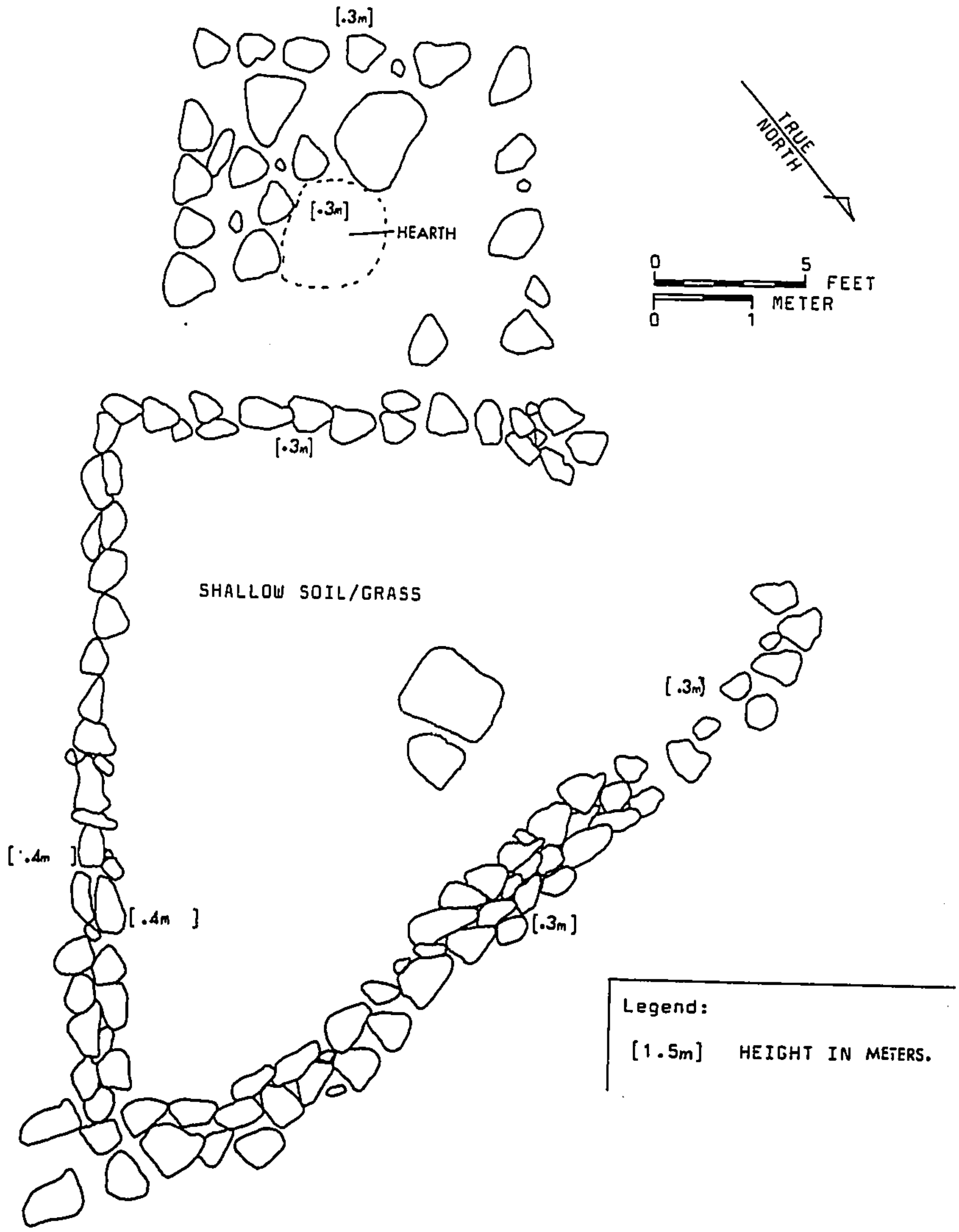

Figure 23 Site 50-80-12-4336; Plan View.

Directly outside the southwest wall of the enclosure there is a possible hearth feature constructed of a roughly 1 m. (3.28 ft.) diameter circular boulder alignment.

This site is located on the southwest edge of a level knoll on the west ridge of Palailai Gulch at an approximate elevation of 1000 ft. (304. m.). The walls of the enclosure appear to be partially buried. These conditions suggest an early construction as well as good excavation potential.

State Site #: 50-80-12-4337 **CSH Site #**: 33

Site Type: Rectangular Enclosure

Function: Permanent Habitation

Probable Age: Prehistoric

Condition: Fair

Dimensions: 8 m. (26.2 ft.) diameter

Description: Site 50-80-12-4337 (Figure 24) consists of a roughly rectangular enclosure with partially tumbled walls measuring 1.5 m. (4.9 ft.) wide and between 0.3 m. (10 in.) and 0.6 m. (1.9 ft.) high. These walls are of a stacked boulder and cobble construction and display extensive lichen growth. There appears to be an entrance to this structure in the NW wall. Another entrance, although possibly the result of cattle disturbance, was observed in the NE wall. The interior of this structure is relatively level, containing grass and soil. The southeast and southwest walls of this enclosure are built on the

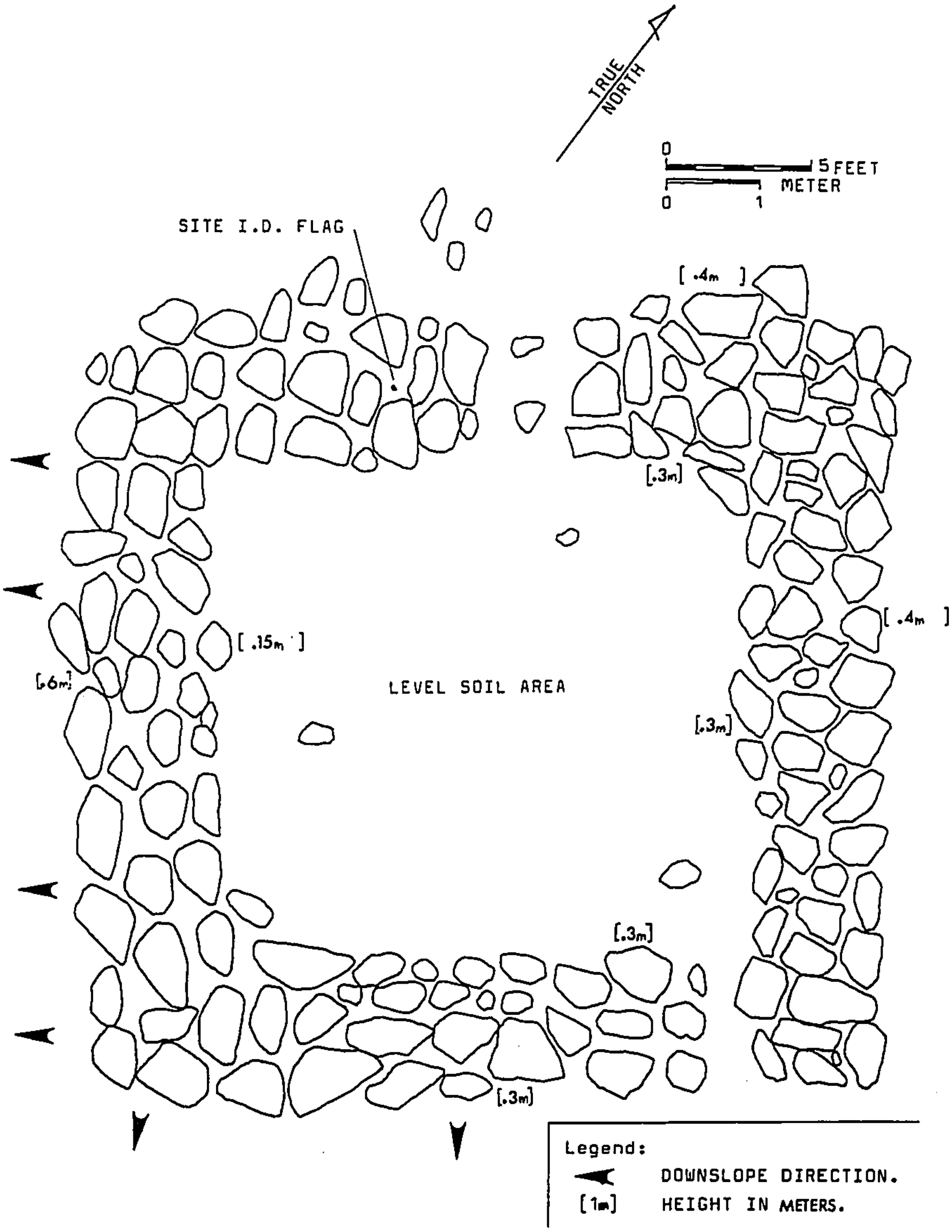

Figure 24 Site 50-80-12-4337; Plan View

edge of a moderate slope of the terrain; a substantial amount of tumble is present along the slope.

This site is located along the east slope of a relatively level gulch valley west of Palailai Gulch at an approximately 1000 ft. (304.8 m.) elevation.

State Site #: 50-80-12-4338 CSH Site #: 34

Site Type: Rock Shelter Complex (3 features)

Function: Permanent Habitation

Probable Age: Prehistoric

Condition: Good

Dimensions: See below

Description: Site 50-80-12-4338 consists of a rock shelter complex that is composed of one large and two smaller modified shelter areas all located along the same roughly E/W oriented outcrop ridge.

The largest shelter, Feature A, is the western most of the three along the ridge and measures approximately 15 m. (49.2 ft.) by 5 m. (16.4 ft.) with ceiling height ranging from 2 m. (6.5 ft.) at the entrance of the shelter to .3 m. (.9 ft.) and .5 m. (1.6 ft.) at the back of the shelter. This large shelter has an undulating ceiling which dips and rises. The floor of the shelter is littered with the tabular talus debris from the collapsing of the ceiling - a process which accounts for the ceiling's uneven surface. At the back of the structure a portion of the ceiling has collapsed, forming a skylight which allows light into the back of the rock shelter. This natural skylight measures approximately 30 cm. in diameter. In the eastern portion of the shelter, the floor surface is covered for the most part by boulder and cobble ceiling collapse. In the western portion, it is mostly covered by soil, pebbles and cobbles. A natural soil terrace extends along the northeastern back wall of the shelter. This terrace is between 75 cm. (2.4 ft.) and 1 m. (3.2 ft.) high and is partially retained by a cobble terrace construction which is in deteriorated condition. Extending back into the northeast wall of Feature A, above the talus cobble terrace, is a small chamber which extends 3 m. (9.8 ft.) to the northeast and measures 1 m. (3.2 ft.) wide and approximately 40 cm. (1.3 ft.) high. The size and configuration of this chamber suggest that it may have been used as a storage or sleeping space. A few pieces of marine shell midden were observed on the floor surface of Feature A.

Feature B is located 4.5 m. (14.7 ft.) east of Feature A and is the next to largest rock shelter in this site complex. The shelter measures 4 m. (13.1 ft.) by 2.5 m. (8.2 ft.) with a ceiling height of .4 m. (1.3 ft.). The entrance and floor of the shelter stand 1 m. (3.2 ft.) above the surrounding ground surface. The entrance has been modified by the stacking of boulders and cobbles up to four courses high, which acts as a low barrier enclosing the shelter to some extent. The interior floor surface of Feature B consists of some soil covered with scattered talus from ceiling collapse. This shelter, due to its linear configuration and small size, and its elevated position, likely served primarily as a sleeping shelter. No midden or artifacts were observed within Feature B shelter.

Three meters further to the east of Feature B is a small cupboard-like shelter designated as Feature C. This shelter measures 1 m. (3.2 ft.) by .5 m. (1.6 ft.) with a ceiling height of .5 m. (1.6 ft.). The floor and opening of this shelter are 1.2 m. (3.9 ft.) above the surrounding ground surface. This entrance is also modified by the placing of four large cobbles, which enclose the shelter's entrance. Feature C would have been an adequate storage feature within the site complex. No midden or other cultural material was observed within Feature C.

Site 50-80-12-4338 is located on the west slope of Palailai Gulch at the 360 ft. (109.7 ft.) elevation. The excavation potential for all three features is good to excellent.

State Site #: 50-80-12-4339 **CSH Site #**: 35

Site Type: Boulder Platform with Small Wall Alignment

Function: Structure related to sugar cane cultivation

Probable Age: Historic/Modern

Condition: Fair

Dimensions: 10 m. by 12 m.

Description: Located at approximately the 200 ft. (60.9 m.) elevation on the SW slope of the lower base of Palailai Gulch this site lies along an eroding bedrock outcrop roughly 15 m. west of the Palailai Gulch drainage bed. This bedrock outcrop is 1.5 m. (4.9 ft.) to 2 m. (6.5 ft.) high and runs roughly N/S with the Gulch. Site 50-80-12-4339 consists of a rectangular boulder platform with a roughly stacked boulder alignment .4 m. high (1.3 ft.), .9 m. wide (2.9 ft.) and 2.75 m. long (9 ft.), running south off of the south side of the structure. The western edge of the platform rests upon the top of the bedrock outcrop. The structure exhibits a gentle slope to the southeast (downslope) following the natural topography from the top of the outcrop to the ground level below. The height of the platform varies with the topography measuring generally 30- 40 cm. (10 in.-1.3 ft.) on the west and north sides and 1-1.4 m. (3.2-4.5 ft.) on the east and south sides.

Two depressions were observed on the surface of this platform. The larger consists of a 1.5 m. wide channel-like depression that runs directly across the center of the structure oriented east/west. The smaller depression is located on the south side of the platform near the boulder alignment. This circular depression measures .6 m. (1.9 ft.) by .7 m. (2.2 ft.) and .6 m. (1.9 ft.) deep; within this depression are several large boards with protruding spikes and nails. The function of these depressions is unknown, however, the boards covering the smaller of the two strengthen our belief that this structure is historical or modern in age. Another historic/modern indication is a large wooden fence post or telephone pole that protrudes from the platform surface 2 m. (6.5 ft.) north of the circular depression. A kiawe tree and a small cactus are presently growing within the surface of the site.

An archaeological site tag labeled "PHRI site T2 11/5/86" was observed at the site. No mention of this site was found in the report of the survey conducted in the general vicinity by Paul H. Rosendahl Inc. (Haun, 1986).

State Site #: 50-80-12-4340 **CSH Site #**: 36
Site Type: Circular Structure
Function: Sugarcane Pumphouse
Probable Age: Late Historic - Modern
Condition: Good
Dimensions: 2 m. (6.5 ft.) diameter
Description: This site is a concrete seamed cobble structure rising a maximum height of 1.5 m. (4.9 ft.). Its configuration is perfectly circular surrounding a level grass rocky surface. No other structural remains or cultural material were observed within this structure; however, a drainage ditch (site 50-80-12-4331) is situated roughly 50 m. (164 ft.) southwest (downslope) of the site, suggesting clearly that it is associated with some activity related to sugarcane cultivation; its size indicates that it may have functioned as housing for machinery such as a pump.

This site is located at an approximate elevation of 200 ft. (60.9 m.) at the base of Palailai Gulch.

State Site #: 50-80-12-4341 **CSH Site #**: 37
Site Type: Ditch

Function: Irrigation for sugarcane cultivation

Probable Age: Late Historic - Modern

Condition: Good

Dimensions: Extends beyond limits of project area

Description: This site was previously recorded by Paul H. Rosendahl Inc. (Haun 1986:3) and determined to be of modern origin, less than 50 years old. However, because of uncertainty concerning the earliest construction of the site and common knowledge that sugarcane cultivation had occurred within the vicinity before modern times, it has been given a state site number.

The site consists of an irrigation ditch which extends west from the southeastern corner of the project area along the roughly 200 ft. (60.9 m.) contour line, until turning south (below Farrington Highway) directly across from the Honokai Hale community entrance. This irrigation ditch is constructed primarily of concrete, sometimes bordered with stackings of cobbles and boulders. Elevated flumes, constructed of steel and wood, bridge the erosional channels of the gulches.

Two other ditches – of similar construction – located at lower elevations are related to this ditch as part of an irrigation network and have also been assigned site no. 50-80-12-4341.

State Site #: 50-80-12-4342 **CSH Site #:** 38

Site Type: Ewa Plantation Infrastructure

Function: Reservoir

Probable Age: Late Historic - Modern

Condition: Good

Dimensions: Undetermined

Description: This site is characterized by a large circular-shaped structure located below the 200 ft. (60.9 m.) elevation. This is presumed to have once served as a reservoir associated with sugarcane cultivation in the area, as is indicated by its attached network of flumes. It is located within the level extensively disturbed portion of the project area between the existing Farrington Highway and old Farrington Highway turn-off.

VI. SUMMARY AND SIGNIFICANCE

A. Summary of Site Types

Thirty-four archaeological sites were identified in the Makaīwa Hills inventory survey.

Fifteen (42 %) of the archaeological sites located in the project area indicate that some degree of prehistoric habitation occurred along the upper slopes and lower slopes of this portion of the Wai'anae Range. Prehistoric habitation is indicated on the basis of theses sites' structural form and/or the presence of scattered midden or cultural material typically attributable to this time.

Only three (8 %) sites of the site inventory were identified as agricultural. This may indicate a greater emphasis on foraging for wild forest goods within the higher elevations of the project area. The more unequivocal agricultural site (50-80-12-4313) located within this higher elevation remains a mystery given its solitary location. If this site does represent a formal agricultural feature, its usage would inevitably be limited to the seasonal constraints of this dry environment. The lack of obvious agricultural sites in the lower portion of the project area, however, may reflect the ongoing effects of historic and modern landscaping and ground disturbance prominently evident in this area.

One probable prehistoric quarry area (site 50-80-12-4322) was also identified within a rock shelter, in the lower portion of the project area.

Historic and modern European land usage of the present study area is also indicated by the presence of 13 sites related to cattle ranching and/or sugar cultivation.

All recorded sites are given by functional category listing in Table 1. Function as inferred by available data should be considered tentative pending further investigation.

Petroglyphs

Two sites contain petroglyph figures in association with habitation features.

One site (50-80-12-4328) consists of an associated rock shelter complex. Only one faint petroglyph figure was identified along the vertical ledge comprising the rock shelters. This figure is interpreted as a simple straight-bodied human form.

The more noteworthy petroglyph concentration is located within site complex 50-80-12-2893. This site includes two rock shelter features and a terraced open air habitation feature. All of the identifiable petroglyph figures are categorized as "descriptive" (Cox and Stasack, 1988:63) representations of which the intended subject is recognizable. These figures consist mostly of wide- and straight-bodied human forms, and include probable representations of family groups, an ali'i, a ghost, and individual human forms running, flying, and riding a horse or cow. Possible animal forms including a goat or dog, a chicken and a fish-tailed ambiguous form (possible whale) are also present.

This particular petroglyph site may represent the largest concentration known to date on the island of O'ahu. Cox and Stasack point out that petroglyph sites typically occur on or near trails (Ibid.:7). These petroglyphs are also located next to a leeward O'ahu trail described by Papa I'i (1983:96-98). This would indicate that the site was utilized as a resting spot for various travelers passing through the area.

Prehistoric Habitation Sites

Sixteen sites (42 % of the total site inventory) across the project area suggest some degree of prehistoric habitation. These range from a wall section, small L-shape, C-shape and circular enclosures serving as temporary shelters to large enclosure structures and rock shelters serving for recurrent or permanent use.

The most notable sites are five recurrent or possibly permanent rock shelters: sites 50-80-12-2893, 4319, 4321, 4328, and 4338.

As discussed previously site 50-80-12-2893 habitation complex is comprised of two rock shelters with an associated terrace and a petroglyph concentration. Dates obtained by previous excavation in one of the rock shelters places a single occupation - according to radiocarbon charcoal analysis - ranging from A.D. 1405-1665 and - according to hydration-rind volcanic glass analysis - between A.D. 1700-1803 (Davis and Haun, 1987:D16). The hydration-rind dates are obviously problematical due to these conflicting dates. The earlier date is likely more accurate since a second volcanic glass specimen from the overlying stratum was dated to A.D. 1713-1765.

Of the remaining four rock shelters, semi-permanent or permanent habitation is suggested by the presence of interior terrace features and in one case (site 50-80-12-4328) an exterior platform. Other evidence includes surface midden and various other cultural material. Of particular interest is a fragment of netting recovered from site 50-80-12-4319. This sample is almost certainly prehistoric in origin and has been identified as olonā fiber (tentatively) through microscopic comparison to known olonā fiber cord and is currently under analysis.

Two of these rock shelters (sites 50-80-12-4321 and 50-80-12-4319) contained almost identical interior terrace features and shelter configurations. On the surfaces of both of these terraces were a scattered grass cover, likely representing a sleeping mat. Preservation in all of these rock shelters appears to be excellent.

Very limited subsurface testing was conducted within one of the rock shelter features in site 50-80-12-4328 complex. Although no cultural material was recovered from this testing it still remains possible that subsurface deposits exist in the unexcavated portion of this feature or within the two other rock shelters included in the site complex.

This same level of testing was conducted at one of the large enclosure sites (50-80-12-4317) that is suspected to be a semi-permanent or permanent habitation site. No cultural material was recovered during this excavation; however, the testing was limited to dismantling an attached platform feature and excavating the underlying soil deposits.

Agricultural Sites

Only one obvious agricultural feature was identified within the central northern edge of the project area. This site (50-80-12-4313) consists of a relatively formal terrace construction retaining a level soil area propitiously situated adjacent to a major erosional channel in Makaīwa Gulch.

Other more equivocal sites that may be related to agricultural activities include two mounds (sites 50-80-12-4324 and 50-80-12-4335), one of which is almost completely destroyed due to cattle grazing.

Walls

Several walls - mostly attributable to cattle ranching and sugarcane cultivation - were identified within the project area. The most substantial is site 50-80-12-4311 which extends in a northwest/southeast direction over most of the project area. This wall is also plotted on the Hawaiian U.S.G.S. Territory Survey (USGS HTS) Reference maps (1928), which indicates that its construction predates at least 1928.

Another substantial wall (site 50-80-12-4314) and a partially bulldozed wall segment (site 50-80-12-4333) run adjacent to a sugarcane irrigation ditch (site 50-80-12-4341) and likely serve as some type of border to the ditch infrastructure.

Ahu(s)

Two solitary ahu(s) and four others associated with site structures were identified along the edge of outcrop bluffs and ridges within the lower portion of the project area. These are likely markers designating trails, as well as site locations.

The more distinguishable trail delineation is suggested by four ahu(s) associated with sites 50-80-12-4318 and 50-80-12-4325. They are situated along the eastern ridge line of Makaīwa Gulch and are positioned in a north/south orientation to each other. While they mark the location of these temporary habitation sites they also delineate a trail probably running in a north/south direction. Approximately 250 m. (820 ft.) north of the northernmost ahu - along this same ridgeline - is a quarry site (50-80-12-4322) also containing an ahu. Thus, this particular line of ahu(s) may delineate a trail leading to the quarry.

Sugarcane Cultivation Infrastructure

Three prominent sites attributable to sugar cultivation were located within the present study area. These include an irrigation ditch (site 50-80-12-4341), a reservoir (site 50-80-12-4342) and a stone-masoned pumphouse (site 50-80-12-4340). Several stone structures located in close proximity also are likely sugarcane cultivation-related features: the previously discussed walls running adjacent to the irrigation ditch, two platforms (sites 50-80-12-4339, 4330), a rough terrace (site 50-80-12-4315) and large clearing/bulldozed mounds.

B. Summary of Site Distribution

Two major themes of site distribution are evident within the present study area: 1) Hawaiian habitation and 2) historic-modern land use associated with European cattle ranching and sugar cultivation. Although the latter group presents itself obviously in historic documents and common knowledge of the related activities, archaeological evidence of comparable Hawaiian adaptation to this type of environment and climatic constraints is scarcely represented.

One major site pattern that is discernable and which indicates adaptation behavior in the area is the clustering of habitation sites within the higher elevations above 1000 ft. (304.8 m.) and the lower elevations below 500 ft. (152.4 m.) of the project area.

The higher elevations would presumably represent an advantageous recurrent habitation locality during times of famine and drought commonly occurring during the summer months along the lower slopes and 'Ewa coral plain region. At the higher elevations ample forest subsistence resources could be obtained. However, exploitation of the upper forest zone was probably not limited to times of famine and drought. The presence of temporary shelters suggests that these upper elevations were an important resource for gathering of specific forest goods on a continual basis.

Recurrent or possible permanent habitation sites primarily consisting of rock shelters along the lower slopes of the project area indicate, with the presence of marine midden and tools associated with the gathering of marine resources, a direct relationship with coastal adaptation. These areas were likely utilized for recurrent or permanent habitation given their close proximity to the coastal resources and formal interior structures with abundant surface midden. This lower zone may have been a significant locality for quarrying lithic material for the manufacturing of stone tools, as is evidenced by the presence of a quarry site near the various rock shelters. In addition, temporary habitation structures located along the lower ridge edges of the project area provided an excellent lookout perhaps for spotting unwelcome travelers to the general region or observing oncoming schools of fish.

In sum, this site type and patterning sample suggests that prehistoric and historic Hawaiian populations utilized the present study area as a recurrent and temporary habitation area focused mostly on the gathering of specialized goods, such as wild forest plants from the upper elevations and the quarrying of lithic material within the lower elevations. Those rock shelter sites located in the lower zone of the project area may have served as a more permanent habitation area focused primarily on subsistence resources of the near by coast. During times of famine and drought in the lower more populated coral plains, the upper forest zone was probably utilized as an alternate subsistence resource.

C. Significance

Site significance evaluations are summarized in Table 1. A total of 18 sites judged to be significant are present in the project area. These sites are evaluated for significance according to the broad criteria established for the National and State Registers (see Table 1). The seven criteria are listed and briefly applied to the archaeological sites in the project area as follows:

A. Site reflects major trends or events in the history of the state or nation.

   -There are no major economic trends discerned in the sites, and this criterion does not apply to the project area.

B. Site is associated with the lives of persons significant in our past.

   -This would apply in cases in which there is a possibility of associating a feature to specific important individuals. There are no sites in the project area which fall into this category.

C. Site is an excellent example of a site type.

-This criterion addresses quality of construction design, state of preservation, as well as special features or characteristics that make the site stand out. The petroglyph site (2893) clearly falls into this category as it is one of the longest petroglyph concentrations known on O'ahu.

-Three rock shelters – 4319, 4321, and 4338 – are considered excellent examples of site types because they represent the only dry habitation caves above the limestone plain in Honouliuli and perhaps in 'Ewa. A dry undisturbed habitation cave on O'ahu is in itself something of a rarity and all three of the caves are believed to have preserved organics in stratigraphic context.

D. Site may be likely to yield information important in prehistory or history. These are excellent examples because there are so few to compare them to.

-Included in this category are sites which contain cultural deposits and therefore have excavation potential or have well defined surface features which could yield information from further study. Included are habitation sites as well as agricultural features whose excavation and further mapping and recording can shed light on chronology, and sequence of prehistoric habitation and land use.

E. Site has cultural significance to the Hawaiians or other ethnic group

-This category includes religious sites - heiau - sites containing human burials and other sites judged to be of cultural significance to Hawaiians or another ethnic group.

F. Not Significant (NS) - These are sites which are outside any of the above criteria, but are still listed for recording purposes.

G. No longer Significant - These sites were significant only under Criterion D for their informational content, but all information necessary has been recorded. Included are isolated rock mounds, ahu and sites which are disturbed to the point of bare recognition.

VII. RECOMMENDATIONS

A total of 34 sites of varied archaeological significance was identified within the project area. Sixteen of these sites are evaluated as no longer significant because of bulldozing disturbance or lack of cultural or scientific interest beyond their plotted distribution.

Eighteen of the 34 recorded sites are considered "likely to yield information important to prehistory and history". Of these 18 sites, four are also evaluated as an excellent example of a site type. Thus, it is recommended that all of the 18 sites that are considered significant be subjected to a program of subsurface testing followed by intensive excavation of selected sites to address scientific/informational significance preceding developmental impact and removal of sites. It is additionally recommended that the four sites evaluated as excellent site types be considered for preservation pending results of subsurface testing. Data recovery and preservation will be implemented through plans submitted to DLNR for review and approval.

Site 50-80-12-2893 has been the subject of previous research and as a result has already been recommended for preservation. Based on the present condition of this site, it is strongly urged that the necessary preservation plans be carried out forthwith to avoid any future damage to the site. The petroglyphs are of particular concern. They should be systematically recorded and duplicated with latex casts. Preservation plans should include an interpretive program. The rock shelters (4319, 4321, and

4338), if they are to be preserved following testing and/or excavation, should have restricted access by means of a fence or other barrier to prevent vandalism. A detailed and explicit data recovery plan and preservation plan will be prepared for the sites in the project area. These plans will be submitted to DLNR for review and approval. Only the broad concepts and general recommendations are presented here in anticipation of the preparation of these plans.

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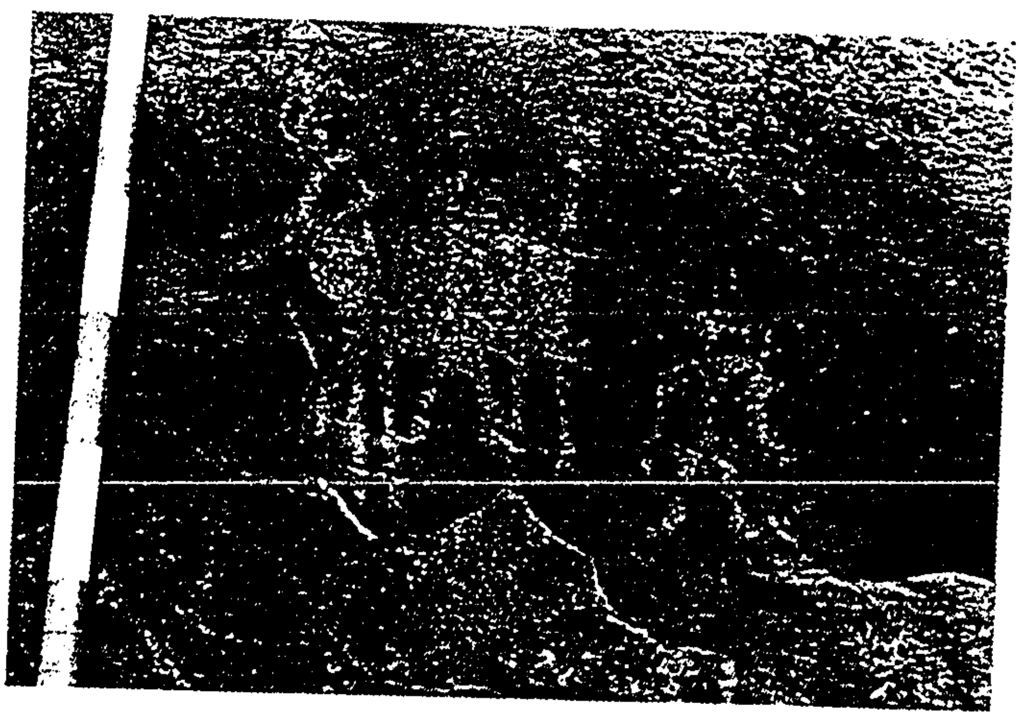
APPENDIX A

Site 50-80-12-2893 Petroglyphs; Note "Ali'i" at Center

Site 50-80-2893 Petroglyphs; Note "Fishtail" Upper Left

Site 50-80-12-2893 Petroglyph Concentration; General View East



Site 50-80-12-2893 Petroglyphs; Left: Possible Goat,

Right: Human Form

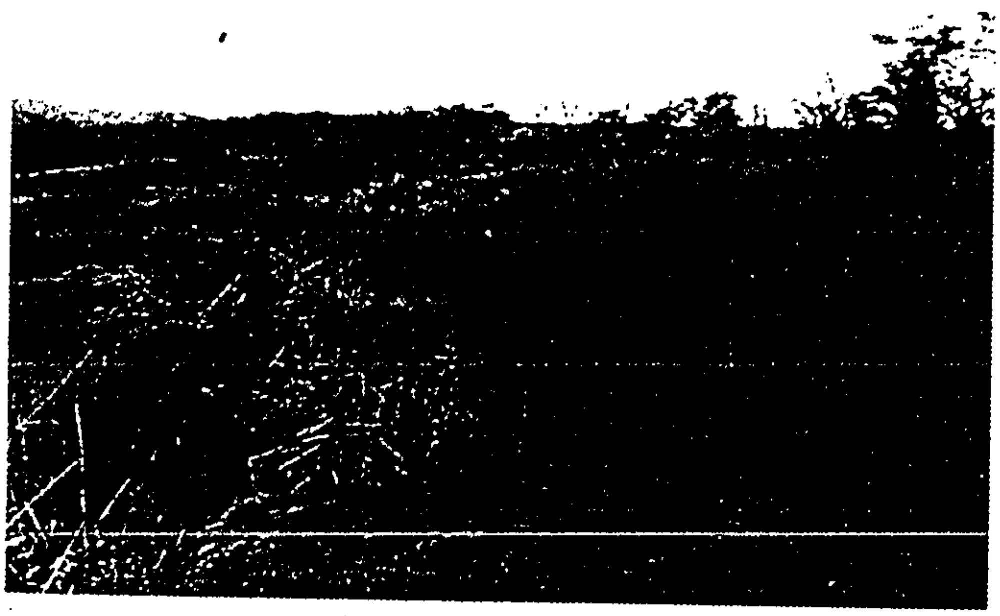
Site 50-80-12-2893 Petroglyph; "Runner"

Site 50-80-12-2893 Petroglyph; "Ghost"

Site 50-80-12-4311 Wall; View West

Site 50-80-12-4314 Wall; View to South

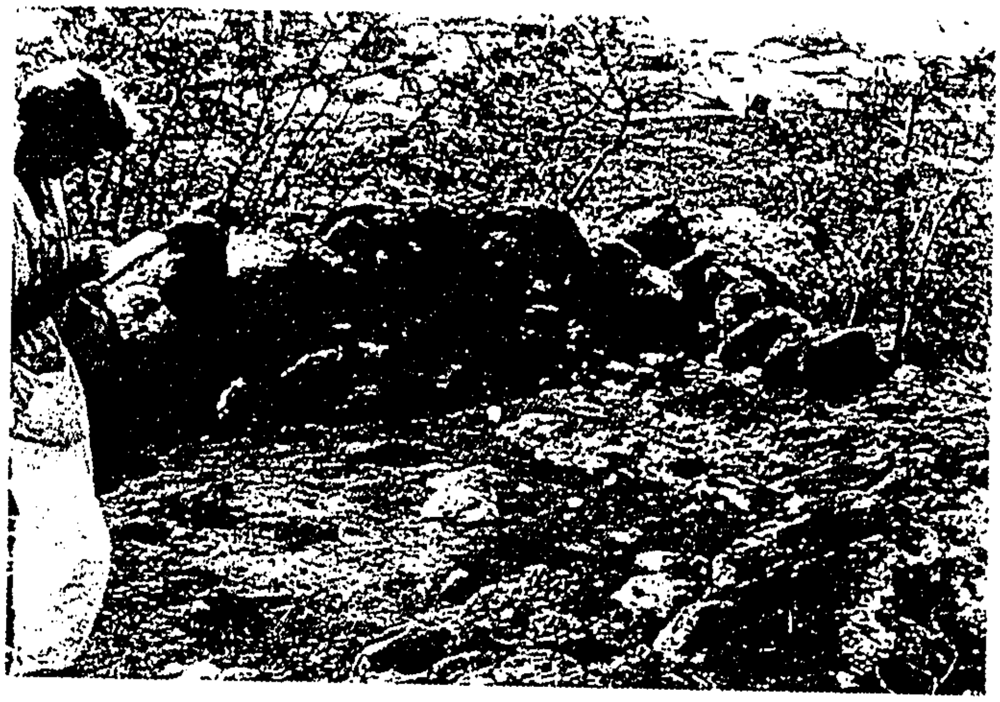
Site 50-80-12-4319 Rock shelter With Interior Terrace; View Northwest



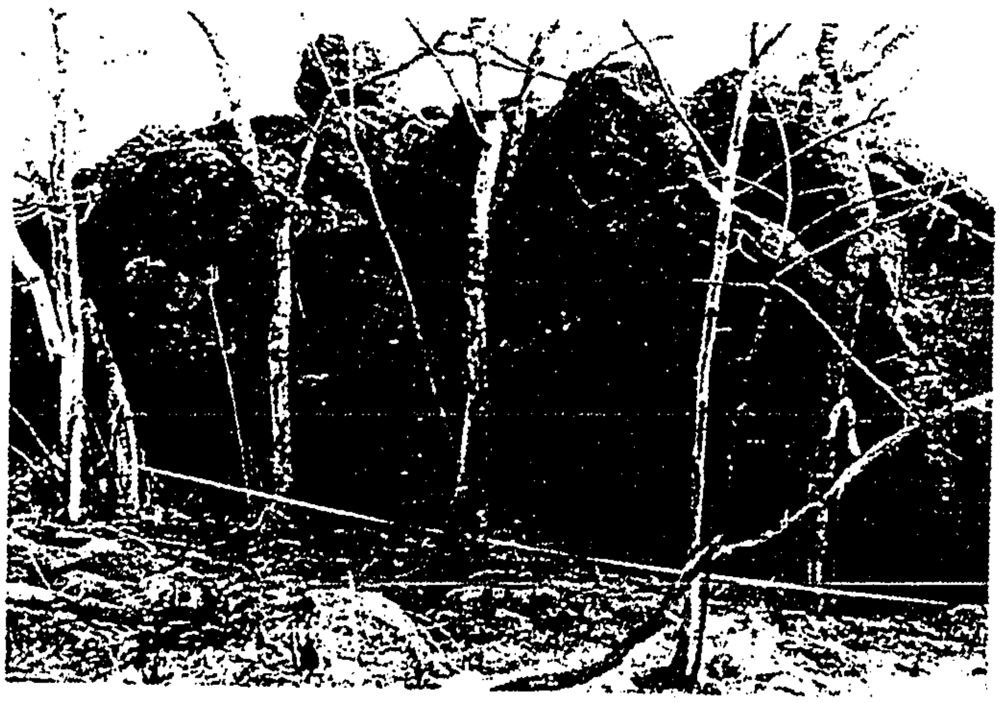
Site 50-80-12-4320 Historic Road With retaining Wall: View North

Site 50-80-12-4321 Rock Shelter; View Northwest

Site 50-80-12-4324 Mound; View East



Site 50-80-12-4326 Wall; View South



Site 50-80-12-4328 Rock Shelter, Feature A; View North

Site 50-80-12-4338 Rock Shelter, Feature A; View Northwest

Site 50-80-12-4338 Rock Shelter, Feature B; View West

Site 50-80-12-4339 Platform; View East

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Personnel and Associates

Hallett H. Hammatt, Ph.D. (Proprietor)

Twenty-six years experience in archaeology, 15 years in Hawaiian archaeology, directed and completed approximately 350 archaeological projects in Hawaii, involving work on all major islands and in most aspects of Hawaiian archaeology. Fourteen years experience in consulting with over 50 governmental agencies and private companies in Hawaii. Member of the Hawaii Historic Places Review Board for 10 years, expert witness at many public hearings.

Douglas Borthwick (Associate)

B.A. in Archaeology, graduate study in Pacific Islands Studies, 14 years experience in Hawaiian archaeology work on all major islands, specialty in site survey, artifact analysis, historical search.

David Shideler (Associate)

B.S. in Zoology, B.A. Anthropology, M.A. Environmental Health Management, 14 years experience in Hawaiian archaeology, founding member of the Hawaii Malacological Society, specialty in floral and faunal identification, ecology, analysis of faunal remains from archaeological sites.

Stephen Clark (Associate)

B.A. in Anthropology, 18 years experience in Hawaiian archaeology, field and laboratory studies, archaeological drafting.

Kirsten Nakamura (Associate)

Field and laboratory assistant, 14 years experience in archaeology, cataloging, illustration.

Mark Stride (Associate)

Field and laboratory assistant, 3 years experience in archaeology, field survey, excavation, cataloging.

Other Associates and Sub-Consultants

William Kikuchi, Ph.D.

Kauai Community College, Crafts Hawaii, volcanic glass dating, petrographic studies, Hawaiian fishponds.

Founded 1982

Michael Pietrusewsky, Ph.D.

University of Hawaii, Manoa, physical anthropology, osteological analysis.

Alan Ziegler, Ph.D.

Zoological Studies, faunal remains.

Other consultants in Hawaiian language, Hawaiian history, radiocarbon dating, botany, floral and faunal identification, planning.

Areas of Experience

Reconnaissance, survey, excavations, coring, site stabilization, site and area management, mapping, aerial survey, recovery of human burials, stratigraphy, historic search, fishponds, beach sites, cave sites, petroglyphs, survey of unaccessible areas, interpretive display development, historic archaeology, urban archaeology, federal and state regulations in historic preservation.

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Pacific Basin Resorts
Gerald Park, Urban Planner
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1988	Archaeological Survey of 1000 acres at Kukuiula, Kaua'i for Alexander and Baldwin
1987	Archaeological Testing of Hawaii Air National Guard Facilities (Hickam Air Force Base)
1986	Archaeological Monitoring at Kaka'ako for Hawaii Community Development Authority
1985-86	Archaeological Excavations at Wai'anae Army Recreation Center, Poka'i Bay, Wai'anae, O'ahu for U.S. Army Corps of Engineers
1984	Archaeological Survey and Excavations for a 9-hole Golf Course Extension, Keauhou, Kona for Keauhou-Kona Resort
1983-84	Archaeological Survey and Excavation of 174 acres, Holualoa, Kona, for Gamlon Corp.
1981	A Management Plan for Archaeological Research at the Keauhou-Kona Resort, for Kamehameha Investment Corp.
1981	Archaeological and Paleontological Investigations at Barber's Point, Ewa, for U.S. Army Corps of Engineers
1980	Archaeological Excavations of a 155-acre parcel, Kona, for Pacific Basin Resorts
1979	Archaeological Investigations at Waioli Mission Hall, Hanalei, Kauai, for the Waioli Church and the State of Hawaii.
1978	Archaeological Survey of the Proposed Kiahuna Golf Village, Koloa, Kauai for Moana Corp.
1978	Archaeological Excavations at Ha'ena State Park, Ha'ena, Kaua'i, for State of Hawaii Division of State Parks

Geographical Experience

Oahu:	Bellows, Olomana, Kualoa, Waiahole, Kaneohe, Kaka'ako, I'olani Palace, Mokapu, Waipio, Pearl Harbor, Barber's Point, Waiau, Moanalua, Ewa beach, Wai'anae Valley, Poka'i Bay, Makaha, Makua, 'Ohikilolo, Keeau, Waimanalo, Nu'uanu, Kipapa, Luluku, Haula, La'ie, Kaena Pt., Urban Honolulu
Hawaii:	Hilo, Puna King's Landing, Waimea, Kohala, Ka'u, South Kona, Keauhou, Kahaluu, La'aloa, Holualoa, Kailua, Kaloko, Keahole, Lalamilo, Honalo, Kawaihae, Keala Kehe, South Point, Lanihau.
Kauai:	Lihue, Koloa, Poipu, Hanapepe, Waimea, Wailua, Hanalei Valley, Waioli, Ha'ena, Kapa'a, Princeville, Kilauea
Lanai:	Manele, Koele
Molokai:	West Molokai - Kaluako'i

Maui:	Ka'anapali, Wailuku, Kihei, Kahului, Haleakala
Kaho'o lawe:	Entire island site survey

Summary of Professional Experience in Hawaii

Directed over 350 archaeological investigations in Hawaii, including reconnaissance, survey, subsurface testing and coring, historical research, archaeological site and area management, site stabilization and reconstruction, intrepretive display development. These studies have involved work on O'ahu, Kaua'i, Lana'i, Moloka'i, Maui, Hawai'i Island and Kaho'olawe.

Investigations include small-scale reconnaissance, surveys of up to 3,000 acres, major excavations on all main islands, recovery of human burials, historic archaeology, investigation of beach sites, cave sites, mapping and investigation of Hawaiian fishponds and aerial surveys. Besides project reports, there are formal publications, professional papers, and research grants.

Special Contributions to Hawaiian Archaeology

- Discovery and documentation of the oldest known human occupation on Kaua'i (Ha'ena, 980 A.D.)
- Documentation of a previously unknown and one of the most complex Hawaiian irrigation systems in Hawai'i, Koloa, Kaua'i.
- Obtaining the first radiocarbon dates on Hawaiian fishponds with a coring technique especially designed for fishponds (Mokapu and Pu'uloa)
- Excavation of the most intact bone fishhook workshop in Hawai'i with documentation of raw materials and stages of manufacture (Kawakiu, Moloka'i)
- Developing the only complete archaeological record of an early Christian Mission Station in Hawai'i (Waioli, Hanalei, Kaua'i)
- Most complete mapping study of a segment of the Kona Field System (Pahoehoe, Kapalaalaea, La'aloa, Kona)
- Rediscovery of extensive Hawaiian agricultural and habitation complexes in upper Hanalei Valley only briefly reported on in 1931
- Rediscovery of Moka'ena Heiau, Ka'ena Point, O'ahu, thought to have been destroyed in 1940s.
- Disinterment of 120 human burials from storm drain excavations at Queen and Punchbowl Street and coordination of reburial in Kawaiaha'o Cemetery
- Excavation of monarchy materials on the grounds of I'olani Palace
- Ongoing cooperative educational project with Punahou School training High School Students in field archaeology

Appendix D.

Social Impact Assessment of Makaiwa Hills

Earthplan

Social Impact Assessment

of

Makaiwa Hills

Prepared for the Estate of James Campbell
by Earthplan

November 1990

1 INTRODUCTION AND BACKGROUND

Earthplan prepared a social impact assessment for the Environmental Impact Statement on Makaiwa Hills, with assistance from independent contractor *Michael P. Mays*. This social impact assessment provides a profile of the existing community to establish the social context in which project impacts may occur. This baseline data is extended by identifying the community's possible future scenario independent of the proposed project. Community issues and concerns are identified, based on community interviews and historical trends to date. In terms of social impacts, this report identifies the likely impacts of the project in terms of (1) population; (2) regional character; (3) nearby uses; (4) on-site uses and (5) public services and facilities.

2 PROFILE OF THE EXISTING COMMUNITY

2.1 EXISTING COMMUNITIES IN THE STUDY AREA

The Study Area for this report is the Ewa Development Plan area. The communities nearest Makaiwa Hills are as follows:

The existing communities makai of the project site are *Honokai Hale and Nanakai Gardens*, two contiguous residential communities. Developed between the mid-1960s and early 1970s, these communities include 290 residential units. Located east of the project site Gulch is *Makakilo*, a 23-year old residential community offering mid-priced, single family and multi-family housing, and support public and commercial facilities.

Ko Olina Phase 1 is located between Farrington Highway, Honokai Hale/Nanakai Gardens and the ocean. The development program includes 5,200 residential units and 4,000 visitor units. Already completed is an 18-hole golf course and currently under construction are (1) a 500-slip marina, (2) four newly-created sandy beaches, (3) a Hawaiian cultural center, (4) two shopping centers and (5) restaurants.

2.2 EMPLOYMENT

Figures 1 and 2 present estimates of jobs in the Ewa region in 1985. *Figure 1* shows that military jobs were the largest category of employment, with about 39 percent of the total 11,121 Ewa region jobs. *Figure 2* confirms this by showing that almost half of Ewa's jobs were located at the Naval Air Station, Barbers Point. The area from Ewa Villages to Honokai Hale contained over one-fifth of Ewa's total jobs; almost half of Ewa's industrial jobs are in this area, with the presence of the Campbell Industrial Park. Makakilo, a predominantly residential community, contained only three percent of Ewa's total jobs.

2.3 POPULATION AND HOUSING

Between 1980 and 1989, Oahu's population grew about ten percent, from 762,564 in 1980 to 841,600 persons in 1989. Most of the island's 282,330 dwelling units in 1989 were used for residential purposes; only about three percent of these were resort condominium units. In 1980, approximately 52 percent of the islandwide residential units were single-family residences; this share decreased slightly to 49.6 percent in 1989.

Population growth in the Ewa region was proportionally smaller than the Oahu population increase. *Figure 3* shows that the Ewa region grew from 36,324 persons in 1980 to 39,338 persons in 1989, for an eight percent population increase. Most of the 1980s growth occurred between 1985 and 1989. In terms of average annual growth rates, the Ewa region experienced strong growth in the 1970s, remained virtually stable between 1980 and 1985, and started to grow again between 1985 to 1989, as indicated in *Table 1.*

Figure 4 illustrates the growth patterns of the separate communities. In the 1970s, most of Ewa's growth occurred in Ewa Beach, where the population almost tripled during that decade and remained around 12,300 persons thereafter. Makakilo's population more than doubled between 1970 and 1989 for a recent population of about 10,000 persons. Growth in the Ewa to Honokai Hale/Nanakai Gardens region has been slow but steady since 1970; since 1985, however, growth has been accelerating due to the addition of Ewa Gentry units.

Table 2 indicates that, in 1989, the Ewa region contained 10,192 housing units. About 60 percent are single-family units, while only 17 percent are multi-family units. Approximately 23 percent of Ewa's housing units are in military housing. Compared to the islandwide household size of 2.9 persons in 1989, Ewa had an average of 3.8 persons per household.

2.4 OTHER POPULATION CHARACTERISTICS

Compared to islandwide proportions, Ewa had the following characteristics in 1980 (*Table 3*):

* slightly younger than the rest of the island, with a median age of 25.6 (Oahu: 28 years);
* significantly higher proportions of Caucasians and Filipinos, a moderately higher proportion of Hawaiians, and fewer Japanese and Chinese people.
* fewer people born in Hawaii and more people born in other parts of the United States;
* slightly less educated, with 12.4 percent completing four-year college (Oahu: 21.7 percent)
* lower mean family income.

2.5 PROFILE OF COMMUNITIES NEAREST THE PROJECT SITE

The communities nearest the project site are Honokai Hale / Nanakai Gardens, and Makakilo. Because of the proximity and potential for interaction with Makaiwa Hills, these communities are further described. Note that Honokai Hale / Nanakai Gardens area is included with Ewa Villages in the census district and traffic assessment zones; thus, the Ewa-to-Honokai Hale area includes these communities in this discussion.

Population and Housing -- Based on an average household size of 4.1 persons, about 1,200 persons resided in Honokai Hale / Nanakai Gardens in 1989. An estimated 9,928 persons lived in Makakilo. Hence, approximately 11,100 people lived near the project site in 1989. Makakilo is expected to continue growing.

Employment -- The Ewa-to-Honokai Hale area contained one-fifth of Ewa's total jobs. Because of its strong residential character, Makakilo accounted for only two percent of Ewa's total jobs.

Social and Economic Characteristics -- With a median age of 33.1 years, Ewa-to-Honokai Hale was the oldest community in Ewa. The median age of Makakilo was similar to the regional median. Of all of these communities, Makakilo tended to resemble the regional ethnic breakdown and had similarly large proportions of Caucasians and Filipinos. The Ewa-to-Honokai Hale area had the lowest proportion of Caucasians, and a high proportion of Filipinos. Makakilo and Ewa-to-Honokai Hale had higher proportions of Hawaii-born residents.

Compared to the islandwide residents, Ewa communities had proportionally fewer people completing a four-year college, although Makakilo's share was higher than the regional average.

3 POLICIES AND PROPOSALS WHICH WILL AFFECT THE COMMUNITY'S FUTURE

The baseline data provided in Section 2 was expanded with an analysis of public policies and other major public and private developments. As shown in *Table 4*, Ewa is targeted to accommodate 12 to 13.3 percent of the total islandwide population. These proportions translate to a range of 119,940 to 132,934 persons in Ewa. The 2010 target population means that Ewa's population is anticipated to increase over three times the 1989 population.

Given such public policies, as well as proposed developments in the Ewa region, a likely scenario for the Ewa region without Makaiwa Hills is as follows:

1. *Significant increase in residential population* -- *Table 5* presents an estimated Ewa population of 131,400 persons by the year 2010.

2. *Significant increase in employment* -- Public policies call for establishing job centers in Ewa which will ideally redirect traffic activity away from the Primary Urban Center. Market study projections indicate that job opportunities within the planning region are projected to increase about 600 percent over a twenty year period.

3. *Establishment of city-related mixed uses and secondary urban center in "western" Ewa* -- Kapolei City, Ko Olina Phase 1 and the James Campbell Industrial Park, all situated in the western half of the Ewa Development Plan area, are major employment generators -- which essentially create the city-like environment in the "secondary urban center," as defined by the City and County of Honolulu General Plan. This urban environment would

complement and support nearby residential communities which include the Kapolei Villages, Kapolei Knolls, Makakilo, and Honokai Hale/Nanakai Gardens.

4. *Intensification of residential uses in eastern Ewa* -- The City and County of Honolulu General Plan designates the eastern half of Ewa, generally the area along Fort Weaver Road, as Ewa's urban-fringe and this area is intended primarily for residences.

5. *Retention of military uses* -- The NASBP and the IPP Military Family Housing will likely continue their operations.

6. *Land banking in eastern Ewa* -- The State is working towards reserving over 2,000 acres in eastern Ewa for future uses.

4 PRELIMINARY COMMUNITY ISSUES ON MAKAIWA HILLS

4.1 Community Issues Independent Of The Proposed Project

The types of issues addressed by a Neighborhood Board often reflect values and concerns of the constituent population. This study examined the minutes of the Ewa Neighborhood Board No. 23 over a three-year period. Generally, this Board dealt with two areas of community issues:

1. *Problems typically associated with stable, active and predominantly residential communities* -- These included controlling and minimizing crime, improving the quality and facilities in the public education system, improving roadway infrastructure and circulation, monitoring and improving recreational facilities, and improving the delivery of ambulance, police and fire protection services. As a whole, the Board maintained an ongoing working relationship with the Ewa Beach, Makakilo and Honokai Hale Community Associations. This Neighborhood Board also worked closely with public officials in advocating community improvements.

2. *Potential effects of proposed developments* -- This Neighborhood Board is somewhat unique among the other neighborhood boards in that Ewa is a community in constant transition. New communities and development proposals were discussed at virtually every meeting during this two-year period. Generally, this Neighborhood Board tended to support these developments, providing that (1) the proposal is consistent with the Kapolei Master Plan of The Estate of James Campbell and (2) the proposal addresses the necessary infrastructure and public service requirements.

Major issues and concerns within the last year included (1) gang violence; (2) transportation and traffic; (3) height changes; and (4) concern over some proposals, including potential heavy industrial use at the proposed Kapolei Business-Industrial Park and noise and light impacts of a proposed Ko Olina Tennis Center. Further, even though the Board supported the existing and temporary Hawaii Raceway Park, members encouraged that a permanent site be found outside the Ewa region.

The Estate of James Campbell assembled the Community Advisory Committee on the Secondary Urban Center which provides community input into the Estate's planning process. In 1987, a series of community workshops were held to define community issues and needs for community services and facilities. Although the information may be dated, it nevertheless provides a good indication of the community's desires and expectations of their future community.

Participants envisioned an array of governmental services, ranging from a fully-operational police station in the Ewa (Kapolei) Town Center to a secondary City Hall providing a full range of services and auxiliary state offices. They wanted to see developers set aside relatively level and "expandable" sites for all schools and advocated moving West Oahu College to Ewa. Further, there was a desire for active recreation and cultural facilities at the planned Kapolei Regional Park and a central library and museum adjacent to the Kapolei Regional Park.

4.2 Community Issues on Makaiwa Hills

Earthplan conducted interviews with 32 community residents and organization leaders to supplement information from printed sources of material regarding community needs and values, and to identify community issues and concerns relative to Makaiwa Hills. No attempt was made to assess the extent or "quantity" of project support or opposition.

As of this writing, project presentations have been made to community associations near the project site, but not to the Ewa Neighborhood Board. The Development Plan/Environmental Assessment for the project or Summary Sheet were mailed to some of those interviewed, including those who were officers in community organizations and those who own property adjacent to the project site.

This identification of issues is preliminary. As the study progresses, and as more people learn about specific aspects of Makaiwa Hills, the issues may change to reflect greater awareness of the project and changing community values.

Except for reactions to the project's housing component, there were no extremes in opinion to either development in Ewa or the Makaiwa Hills project. The proposed project generated neither overwhelming support nor strong opposition; instead Makaiwa Hills stimulated discussion primarily about Ewa development and secondarily about people's concerns regarding the site and project components.

The following summarizes reactions and opinions shared in the interview process:

1. Moderation of Support/Acceptance of Ewa Development.

Ewa organizations, and presumably the constituents they represent, have historically supported the development of a second city. This support continues, but informants are exhibiting slightly more caution about growth than previously found in other studies.

Most of those interviewed felt that Ewa development is generally good, but stressed that public facilities and services must keep pace with this development. Some expressed resignation at an inevitable future of an urban environment; they neither liked or disliked what was to come. A few felt overwhelmed by the pace of change; two people indicated that they planned to leave in a few years because of the increased population.

The effect of Ewa development on property values was a concern. Although some appreciated higher property values, others feared that older residents would be unable to keep up with increased property taxes.

2. Predominance of Regional Issues

Most of the issues raised by those interviewed concerned the effects of Makaiwa Hills on the region, rather than on the immediate environs. Almost all of those interviewed wanted developers and public officials to make sure that regional infrastructure systems are improved at the same pace as development. Some stressed that they did not necessarily hold private developers responsible for the infrastructure. Rather, they felt that the public sector, having advocated the second city concept, should be spearheading efforts to improve facilities. Further, informants were concerned that, even though much planning is going into the development of Kapolei, infrastructure improvement may end up being reactionary rather than pro-active.

Well-planned adequate infrastructure systems were desired by most:

* Informants questioned the adequacy of the existing water supply; some urged desalination while a few did not want to see valuable water used to keep golf courses green.

* The capacity of Honouliuli Sewage Treatment Plant was a concern of many, and they wanted to see secondary treatment established before major growth occurs.

* Traffic was the most frequent issue, and many felt that growth is already taking its toll. Wider roads and fixed transit were recommended.

* People were also concerned about whether the existing and planned public schools were adequate to meet the increased demand resulting from the project.

The other regional issue was housing. Most of those interviewed did not object to upscale and executive housing. They suspected that there is a market for such housing and that the project would only be built if it were an economically-feasible venture. There was also a feeling that the more affluent residents would help Ewa's economy and "round out" the social characteristics of the Ewa region. Those who had no objection to upscale housing generally did not mind locating the project's affordable requirements off-site.

Others wanted to see a more mixed community. They felt that there should not be any kind of exclusivity in Ewa. To them, the affordable units should be on-site, and that there should be more multi-family units.

3. Site Specific and Non-Housing Project Components.

The site specific issues were raised by residents of Honokai Hale/Nanakai Gardens and Makakilo, as well as by other users near the project site. Ewa Beach and Ewa Villages residents tended to deal with region-wide issues.

Residents and users makai of the project site were very concerned that the development of the project site may cause drainage problems for the lower areas. These informants also expressed apprehension that construction impacts of dust and noise would directly impact them because of prevailing tradewinds. Makakilo residents were not worried about construction.

Honokai Hale/Nanakai Gardens residents remembered that the on-site Makaiwa Gulch was previously proposed for a landfill. They felt that Makaiwa Hills is a much better alternative.

People who lived or operated an activity mauka of the project site were concerned about how the project might decrease their isolation.

The only reaction regarding the commercial component was favorable; nearby residents wanted the convenience of a new regional shopping center. A possible golf course received mixed reactions. Some felt it would improve the project site's frontage along Farrington Highway; others either did not see a need for the golf course or felt that it was a waste of water. There was also concern that the on-site school may end up being "exclusive" because of the upscale nature of the project.

5 POTENTIAL SOCIAL IMPACTS OF MAKAIWA HILLS

5.1 POPULATION IMPACT

Table 7 shows that Makaiwa Hills will increase the Ewa region population by an estimated 6,400 persons. When compared to the potential population allowed by current Development Plan designations, the project-related population is expected to be less than that already accommodated. It is estimated that the 103 acres designated Low Density Apartment and the 40 acres designated Residential, net an estimated 25 percent for roadways, infrastructure and common areas, would accommodate approximately 2,678 units. Based on an average household size of 3.03 persons, current Development Plan designations could allow a population of 8,100 persons, which is over 1,600 persons more than what the proposed Makaiwa Hills would generate.

It is estimated that, with the projects already appropriately designated on the Ewa Development Plan Land Use Map, the 2010 Ewa population is projected to reach 131,400. With the Makaiwa Hills project, the estimated Ewa population for 2010 would decrease by about 1,600 persons to 129,800 persons. Makaiwa Hills is therefore within the 2010 population guidelines set forth by the City and County of Honolulu General Plan.

Recommended Mitigation -- No mitigation is required, since the project is within population guidelines.

5.2 IMPACTS ON THE REGIONAL CHARACTER OF THE AREA

Probable Changes Without Makaiwa Hills.

Current proposals for residential development in Ewa could accommodate a population two to three times that of the current Ewa population. In the vicinity of the project site, the City of Kapolei is intended to be the nucleus of the secondary urban center. The existing community will therefore have been undergoing a gradual adaptation to this major influx of new people by the time Makaiwa Hills begins implementation.

Independent changes which may have begun as the project is implemented are as follows:

* *Population and cultural diversification* -- When the project begins implementation, the residential profile of the Ewa area will have begun to gradually reflect more of a cross-section of the islandwide community. Though many of the Ewa developments will offer affordable housing, many of the new residents will be part of the market housing segment and will therefore have incomes above the current median income level for the Ewa area. It is also expected that, given the diversity in housing types, Ewa's household sizes will decrease to resemble those in Central Oahu and East Honolulu. Age and ethnic mixes are likely to be more in line with Oahu proportions. With these changes will come cultural diversity.

* *Disruption of the slow-paced lifestyle* -- The initial impact of impending change is an alteration in the current slow-paced lifestyle which characterizes the residential communities of the Ewa region.

* *Competition for and increase in public facilities and services* -- Concurrent with the influx of new residents will be competition for public facilities, such as parks, and increased usage of public services, including police and fire protection. New public facilities and expanded public services are needed to keep pace with the population increase.

* *Shift in employment patterns and increased job competition* -- As Makaiwa Hills is developed, the Ewa region will be experiencing an increased diversity in types of employment. Many current Ewa residents who are working outside Ewa will have jobs closer to home. Ewa's new residents will also be competing for the same jobs.

* *Introduction of visitor industry to the Ewa region* -- Ewa residents will have begun to adapt to having a resort community at Ko Olina in their region.

Potential Project Impacts on the Regional Character.

* *Consistency with Growth Policies* -- Part of the Campbell long-range master plan for Ewa, Makaiwa Hills is the last planned community to begin efforts in seeking land use approvals. Other planned communities either have secured their State and Development Plan approvals, or have had their initial phases approved. The proposed project is an integral part of public and private efforts to establish a secondary urban center in

Kapolei. Makaiwa Hills addresses the island's housing need and will provide economic opportunities and employment at the proposed regional shopping mall.

Recommended Mitigation: No mitigation is recommended, since the project is consistent with public policies regarding growth in the secondary urban center.

* *Addition of Another Hillside Development* -- Ewa's landscape changes every day as construction machinery clears the land and replaces a portion of the plain's vastness with homes, streets, landscaped greenery and hotels. The mountains are also changing as Makakilo extends its community to the east and west. Makaiwa Hills will join Makakilo as another hillside community, thus transforming the predominant open space character of the mountains into an extension of the makai urban environment.

  Makaiwa Hills is not expected to adversely affect the regional character. The project is not a high-density community, nor will it be continuous rows of houses forming a hillside grid. Rather, the proposed project is envisioned as pockets of well-designed townhouses and single-family homes punctuated by gulches and ravines. As pointed out earlier, almost a half of the project site is proposed for Preservation designation. Further, it is noted that, because of the site's topography, much of the upper portion of the project site will not be visible from makai communities or the freeway.

  Recommended Mitigation: As long as the site's topography is incorporated into design and the project site does not undergo extensive grading and filling, it is expected that Makaiwa Hills would provide an attractive backdrop to the urbanized makai landscape. Hence, no mitigation other than sensitive planning is required.

* *An Upscale Community* -- The project is part of an overall private and public effort to attract, house and employ people in the upper income range. In the overall housing scheme for Ewa, Makaiwa Hills would provide housing choices for executives working at Kapolei City, thereby adding to locational and economic choices in the high-end housing market. Hence, Makaiwa Hills functions as an integral part of the Second City concept.

  Whether or not Makaiwa Hills contributes to or causes social conflict because of its upscale nature is unknown at this time. The acceptance of Makaiwa Hills depends on the community attitudes prevalent during and subsequent to project implementation. There is a potential for acceptance if the community is socially and economically integrated at the time of project implementation. There needs to be a wide range and locational mixing of housing types. Community organizations should be easily accessible for residents and there should be no apparent exclusionary groups, facilities or areas. People feel comfortable with socio-economic diversity if they believe they have physical, legal and some economic access to most facilities. They need to believe that they have -- or can attain -- the same ability as others to compete for jobs and public services.

Recommended Mitigation: Public officials and private developers need to monitor the social development of the Ewa region, as well as the market for the proposed project. If conditions at the time of implementation signal potential disharmony or social conflict, then effort is needed to work with the future Ewa community to mitigate anticipated problems.

5.3 IMPACTS ON THE NEARBY USES

Overview of Existing Uses.

North or mauka of the Makaiwa Hills project site are three separate activities, two of which occur on lands owned by the Estate of James Campbell. *Camp Timberline* sits on ten acres of Estate property above Makaiwa Hills. Owned by the St. Andrews Priory School, Camp Timberline is a mountain retreat. The *Palehua Solar Observatory* is one of the sole network of six facilities throughout the world which maintain a 24-hour watch of solar activity. The only networked facility in Hawaii, the Palehua Solar Observatory has an optical telescope and a series of radio telescopes. The observatory is located on approximately five acres owned and operated by the U.S. Air Force. The Estate maintains *17 "campsite leases"* above the camp and observatory. The ten-year leases were initiated in the 1940s and cover areas ranging from .16 to 15.8 acres. The twenty houses situated here are used as second homes and primary residences.

Makai of the project site are the residential communities, *Honokai Hale and Nanakai Gardens*. Further makai of the project is *Ko Olina*. These were previously described.

Located east of the project site Gulch is *Makakilo*, a 23-year old residential community which was previously described in this report. The privately-owned and -operated *Palailai Sanitary Landfill* is located near the lower portions of the project site; the landfill is closed and is being monitored. Eventually, this area will be converted into a park.

The *Waimanalo Gulch Landfill* is in the gulch just west of the Makaiwa Hills project site. The public landfill accepts both ash from HPOWER, which is mono-filled, or stored in a separate area, and non-combustible waste from all over Oahu. According to the private operator under contract with the City, the landfill has a 14-year remaining life, after which the land can be transformed into a park.

Impacts on Nearby Residential Uses.

* *Honokai Hale/Nanakai Gardens* -- Given the other changes in the area, such as the Ko Olina Resort and the City of Kapolei, this community is likely to undergo physical and social changes. As property values increase, residents of these communities may take financial advantage of this appreciation for home improvements, or may choose to sell their units at these higher prices. For those with fixed incomes, increased property taxes may be a hardship. An obvious change in the community will be larger units, as people add home improvements. Unless the relatively small lots are consolidated, it is unlikely that much physical change will occur beyond that.

With Makaiwa Hills, Honokai Hale/Nanakai Gardens will be sandwiched by a makai upscale resort residential community and a mauka residential community characterized by executive homes. The project will therefore add to the situation of increased property values and corresponding property tax increases. The proposed project will also alter the mountain backdrop by transforming the predominant open space character into an extension of the makai urban environment.

Makaiwa Hills may have drainage impacts on the communities located makai of Farrington Highway, and in the interviews conducted for this study, Honokai Hale/Nanakai Gardens residents expressed apprehensions about surface runoff. Possible short-term impacts on Honokai Hale/Nanakai Gardens residents may arise from construction activities. Dust and noise may adversely affect makai neighbors, particularly because of the prevailing tradewinds.

Recommended Mitigation -- There is no mitigation which can be undertaken by Makaiwa Hills to change the property value increase occurring in Honokai Hale/Nanakai Gardens. This is an impact which is already occurring due to the Ko Olina and Kapolei developments; this trend would continue even if Makaiwa Hills were not built.

Makaiwa Hills is not expected to adversely affect views of the mountain as seen by Honokai Hale/Nanakai Gardens residents; no mitigation is required. It is assumed that the engineering studies conducted in this Environmental Impact Statement process will recommend measures to avoid drainage impact.

The residents of Honokai Hale/Nanakai Gardens have been experiencing the effects of construction for many years, with the construction of the Barbers Point Deep Draft Harbor, Ko Olina and freeway improvements. It is recommended that the developer of Makaiwa Hills meet with the residents to see what kinds of additional measures might be necessary to ensure minimal or no impact.

* Makakilo -- Unlike Honokai Hale/Nanakai Gardens, Makakilo's changes will be driven by both external and internal forces. The external forces which will change Makakilo are related to all of the development activities occurring makai of the freeway. The internal force for change is the master plan for Makakilo, as directed by Finance Realty. Both external and internal changes are already occurring.

The likely trend of increased property values, to which Makaiwa Hills will contribute, is the same for Makakilo as for Honokai Hale/Nanakai Gardens. The project is expected to have minimal construction impacts on Makakilo residents because of prevailing tradewinds. The proposed regional shopping center would be conveniently located for Makakilo residents.

Recommended Mitigation -- As with Honokai Hale/Nanakai Gardens, there is no mitigation which can be undertaken by Makaiwa Hills to change the property value increase occurring in Makakilo. No mitigation is necessary to mitigate visual impacts. Because no or minimal construction impacts are expected to affect Makakilo residents nearest the project site, no mitigation is recommended except for strict adherence to public regulations governing such activities.

Impacts on Ko Olina

The two phases of Ko Olina, as well as other developments in Kapolei, include commercial uses. While the Makaiwa Hills shopping center may be yet another amenity for Ko Olina guests and residents, it would also introduce another competitive element.

The proposed project will also alter the mountain backdrop by transforming the predominant open space character of the mountains into an extension of the makai urban environment. Makaiwa Hills is not expected to have a negative impact on views, however, because Ko Olina has a distinct ocean orientation.

Recommended Mitigation -- Because Makaiwa Hills would not necessarily have a negative impact on Ko Olina's commercial uses, no mitigation is required. It is noted that the Makaiwa Hills shopping center will not be the only competitor to the commercial uses of Ko Olina. Within Ko Olina, there will be separate commercial areas in its Phases 1 and 2 which may compete with each other. The Kapolei Business-Industrial Park also has a commercial component, as does the City of Kapolei. The project is not expected to negatively affect mauka views from Ko Olina and no mitigation is recommended.

Impacts on Other Uses.

* *Camp Timberline, Palehua Solar Observatory and "Campsite" Leases* -- These three uses are located mauka of the project site and all share a need or desire for isolation.

  The potential decrease in isolation for Camp Timberline would not necessarily hurt their operations. First, campers would not see rows of houses, but large homes separated by open space. Second, the project would not displace camp activity. Finally, although isolation is desirable, it is not imperative and the camp could continue its operation.

  The Palehua Solar Observatory and other similar facilities depend on isolation because of (1) the need for security and (2) the equipment's sensitivity to nearby radio waves, noise and dust. In discussions with the detachment commander for this facility, three possible project impacts were identified. First, there are possible short term construction-related impacts, including noise and dust, which may interfere with the operations of radio and optical telescopes. Second, a long-term impact is potential radio interference of nearby machinery. Third, on-site security may need to be increased because of the proximity to more people.

  A desirable aspect of the "campsite" leases is the isolation. Residents and those who occasionally use their on-site second homes are drawn to the this mountain because, within minutes of urban Honolulu, they enjoy seclusion and scenic panorama amidst natural beauty. It is believed that

Makaiwa Hills would have minimal impact on these sites because Camp Timberline and the Palehua Solar Observatory provide a buffer between the proposed project and these sites.

Recommended Mitigation -- Seclusion is part of Camp Timberline's selling point. To retain Camp Timberline's isolation, the Estate of James Campbell should establish a buffer of forested land between the camp and the uppermost houses. This would provide privacy to both project residents and campers.

The Air Force has been added to the list of consulted parties for the Environmental Impact Statement. Further study by the Air Force is needed to see how Makaiwa Hills might affect the observatory's operations and to recommend mitigation measures.

Minimal or no project impact is expected for the Estate campsite leases and thus no mitigation is required.

* *Waimanalo Gulch Landfill* -- Makaiwa Hills is not expected to impact landfill operations. Rather, the sanitary landfill may produce occasional short-term discomforts for nearby residents, such as bad smells resulting from large quantities of organic material during Kona winds. The landfill would not cause long-term visual impacts, since exposed portions are covered at the end of each day. Because of the safety precautions undertaken by the private operator, such as lining to prevent gas escape, the landfill in not expected to threaten the health or well-being of nearby residents. A long-term benefit is the potential use of the covered landfill as a park, which would not occur until the 14-year life expectancy is completed.

  Recommended Mitigation -- A possible mitigation to offset some of the short term impacts is project phasing. The areas nearest the landfill could be left as one of the last to develop, and construction could coincide with landfill closure.

5.4 IMPACTS ON ON-SITE USES

Impacts on Existing Uses.

The Estate maintains two separate grazing leases at the Makaiwa Hills project site. First, on approximately 100 acres of flatlands along the H-1 Freeway, less than two dozen cattle and horses are grazed in a single-person operation under a month-to-month tenancy.

Second, the Estate is currently negotiating new 15-year leases with former sublessees of Tongg Ranch and the operation is expected to continue as Palehua Ranch. Palehua Ranch will comprise three parcels, the largest of which will be operated as Rocker G. Livestock Company. Of the company's 3,800 leased acres, 1,800 are part of the Makaiwa Hills project site. Rocker G. Livestock Company grazes about 200 mother cows and their calves on the ranch. Additional income is derived by allowing 400 to 500 head of cattle from other ranches to graze on its land from about December through May. The nine part-time jobs generated by the company's operation are equivalent to two full-time jobs.

Makaiwa Hills will not impact the 100-acre single-person operation, which will be phased out in favor of the planned nursery operations (see "Possible Interim Uses").

The proposed project will remove about 1,800 acres from the grazing operation of Rocker G. Livestock Company. Although this will not require a reduction in the number of its own herd, the project will cause the elimination of temporary grazing of cattle from other ranches. No employment changes are expected.

Recommended Mitigation -- No project-generated mitigation is needed for the 100-acre single-person operation, since no project impacts are anticipated.

Although Makaiwa Hills will not effect a reduction on in Rocker G. Livestock Company's employees or its herd, the project will cause a permanent reduction in acreage available to other ranches for grazing, as well as an undetermined loss in revenues. This impact is irreversible, and no mitigation can offset project impacts.

Impacts on Possible Interim Uses.

Before Makaiwa Hills is developed, the Estate of James Campbell plans to develop two nurseries on the project site. On a portion of the flatlands now used for the single-person grazing operation, a nursery will be a grow-out area for ornamental trees to be used for Ewa projects. A few acres in the southeast corner of the project site will be part of another 20-acre nursery.

K. P. Harvest, a private company, is proposing to conduct flight testing of a helium motorized spherical dirigible, the "Skywalker" on 50 acres between the 300 to 500-foot elevation from the Estate; only 10,000 square feet would be used with the remaining land serving as a safety buffer. Company officials are currently in discussion with the FAA to see if this testing would interfere with existing flight patterns.

Recommended Mitigation -- The phase-out of these nurseries are planned by the Estate and the project itself is not the cause of termination. The project would not impact the Skywalker" testing since the project is short-term; no mitigation is necessary.

5.5 IMPACTS ON PUBLIC SERVICES AND FACILITIES

Police Protection.

The project site is located in District III, which extends from Red Hill to Kaena Point and Kipapa Ridge, and is handled by the Pearl City Police Station. Currently, there are three shifts of one police officer dispatched to each of the four beats in a 24-hour period; hence twelve beat officers operate in Ewa within a 24-hour period.

In terms of short-term plans, the Police Department is requesting funds for two officers per shift. Long-term plans include adding a new full-service station in Kapolei, with the establishment of Ewa and the Waianae Coast as a new district. In addition, two substations, one in Ko Olina and the other in Ewa Beach, are proposed by the Police Department.

Makaiwa Hills will increase the demand for police services in Ewa. The project demand is part of the cumulative need anticipated by public officials, who have based proposed facilities and staffing on the Ewa Master Plan. Makaiwa Hills has been a part of the Ewa Master Plan and is within the anticipated population count.

Police officials have expressed concerns about the regional impacts of Makaiwa Hills. These concerns include (1) effects on traffic conditions and (2) the cumulative demand for police services (letter dated 13 November 1990 from Chester E. Hughes, Assistant Chief of Police, Support Services Bureau, Honolulu Police Department to William E. Wanket, Inc.).

> *Recommended Mitigation* -- As part of the Ewa Master Plan, Makaiwa Hills has been included in programs to upgrade police facilities and increase police officers. No additional mitigation beyond those already planned is necessary at this time.
>
> A possible crime-deterring mitigation measure is on-site security and project design. Current project plans imply distinct pockets of residences. Visitors could be monitored by private security guards for each community. Further, the communities could be designed to limit major ingresses and egresses to reduce access possibilities. Neighborhood watch programs are also effective in crime detection and deterrence. Finally, design measures, such as well-lit roads, sidewalks, and parking and common areas, would help eliminate crime opportunities.

Fire Protection.

The project site is currently being serviced by the Makakilo Fire Station, which is an engine company staffed by five firefighters per shift. Back-up service is provided by the Nanakuli, Ewa Beach and the Waipahu Fire Stations.

Two new fire stations are planned for the immediate vicinity of the project site. Budget requests have been submitted for facilities at Ko Olina (engine and ladder company) and the James Campbell Industrial Park (future battalion headquarters with an engine and ladder company). Other new facilities being planned for the Ewa area include the relocation of the Ewa Beach Fire Station to the Ewa Marina project, and a fire station at Ewa Villages.

The project will increase the area's population over a larger area than currently planned, and will increase the need for fire protection services.

> *Recommended Mitigation* -- The project includes a one-acre site for a new fire station. Further discussion with Fire Department officials is needed to determine the exact site and scale of the new facility, as well as staffing requirements.

Educational Facilities.

Makaiwa Hills is estimated to generate approximately 200 to 250 elementary school-aged children, 85 to 100 intermediate school students, and 125 to 150 high school aged students.

The schools in the vicinity of Makaiwa Hills, including Makakilo Elementary, Ilima Intermediate and Campbell High Schools, are expected to be operating well beyond capacity at the time the project is constructed. Hence, the proposed on-site school is necessary to serve students living in Makaiwa Hills. Schools in the Kapolei Village area will probably serve the project residents during an interim period.

> *Recommended Mitigation* -- The proposed school at Makaiwa Hills will mitigate project impacts on existing and off-site school facilities. Further, as suggested by the State Department of Education, the developer will donate the land for the school or pay a fair share of the costs to build additional classrooms to accommodate the enrollment growth.

Child Care.

As Kapolei develops, the need for child care services within the region will increase as more and more people live and work in the Second City. Sites at West Loch, Ko Olina and Royal Kunia (near the eastern border of Ewa region) have already been committed for child care purposes. In addition, three potential child care centers are being explored in Kapolei.

Makaiwa Hills will increase the regional demand for child care services because of the (1) increase in residential population and (2) employment generated by the proposed regional shopping center. Currently, there is no rule of thumb in projecting child care needs and requirements for specific development proposals have been determined on a case-by-case basis.

> *Recommended Mitigation* -- The extent of the increase in demand for child care services generated by Makaiwa Hills is unknown at this time. Also undetermined is the degree to which proposed child care centers may meet this requirement.
>
> Makaiwa Hills should include a site for a child care facility, since a sheer increase in demand is anticipated. As with sites for other public facilities, this site would be dedicated to the City and County of Honolulu. The location and size of this site should be determined in conjunction with the City Office of Human Resources.
>
> In addition, there are employer-based options, including (1) major employer subsidy of on-site care; (2) pre-tax contributions to qualified employees; and (3) direct voucher provided by employers to employees who demonstrate their use of qualified child care facilities. These will require the cooperation of and commitment by the actual owner and operator of the regional shopping center, neither of which are chosen at this time.

Medical and Emergency Facilities.

Three hospitals (the Kaiser Foundation Health Plan Hospital, the Pali Momi Medical Center and the St. Francis Hospital-West) are within reasonable travelling distance of the project site. As Kapolei City progresses, additional medical facilities will be required to serve the increased population. The proposed project is expected to be adequately served by the existing and additional medical facilities.

Emergency services are provided by City ambulances located in Aiea. Further, the Waipahu Fire Station contains an ambulance unit which serves Pearl City, Waipahu, Ewa Beach, Makakilo and parts of Waianae. Also eight-hour service is provided to the Makakilo Fire Station by the Waipahu unit. Twenty-four hour ambulance service at the Makakilo Fire Station is currently in the planning stage. All of the new fire stations described earlier will have an extra stall for ambulances if deemed necessary in the future.

Recommended Mitigation -- No mitigation is needed at this time.

Recreation.

The parks nearest the project site are those which serve Honokai Hale/Nanakai Gardens and Makakilo. Makaiwa Hills is not expected to impact existing or planned parks of other communities. To serve its residential community, the project includes 16 acres for park use and will contain hundreds of acres of preservation land, some of which may be usable for passive recreation.

The City Department of Parks and Recreation has commented on the suitability and adequacy of the proposed park relative to Makaiwa Hills future residents. Park officials prefer a site which is (1) more conducive, in terms of topography, to active recreation facilities and (2) centrally located for the future residents.

Recommended Mitigation -- No mitigation regarding existing and proposed off-site parks is necessary since no impact is expected. Regarding the suitability and adequacy of the proposed park relative to Makaiwa Hills future residents, further discussion between park and Estate officials is needed to properly site and design this park.

Social Impact Assessment

of

Makaiwa Hills

Prepared for the Estate of James Campbell
by Earthplan

November 1990

Contents

Tables and Figures

Tables

Figures

(Note: Underline indicates addition; [Bracket] indicates deletion)

Addendum Item #1

On page 47:

5.3 IMPACTS ON NEARBY USES

5.3.1 Overview of Nearby Uses

1. **North or Mauka of the Project Site**

Four (Three) separate operations currently occur above the Makaiwa Hills project site, two of which are on lands owned by the Estate of James Campbell:

Addendum Item #2

On page 48:

3. The Estate maintains *17 "campsite leases"* mauka of the project site [above the camp and observatory]. The ten-year leases were initiated in the 1940s and cover areas ranging from .16 to 15.8 acres. The twenty houses situated here are used as second homes and primary residences. A general caretaker lives on-site, and some of the lots contain caretaker cottages.

4. Also mauka of the project site is a non-profit drug and alcohol rehabilitation clinic called "A Second Chance, Inc."

Addendum Item #3

On page 52:

A desirable aspect of the "campsite" leases is the isolation. Residents and those who occasionally use their on-site second homes are drawn to the this mountain because, within minutes of urban Honolulu, they enjoy seclusion and scenic panorama amidst natural beauty. It is believed that Makaiwa Hills would have minimal impact on these sites because [Camp Timberline and the Palehua Solar Observatory provide a buffer] of the distance between the proposed project and these sites. Makaiwa Hills may slightly alter the environment of these homes and vacation homes by bringing large-lot residential development closer to these people. Nighttime quality may change due to the introduction of street and house lights, albeit far away. The effect of Makaiwa Hills on the daytime environment is expected to be minimal. The largest lots -- which may include acre-lots -- would be closest to the campsite leases, and houses and development may only be visible from the southernmost campsites.

The operations at A Second Chance, Inc. should be unaffected by the proposed project because of the distance between Makaiwa Hills and the rehabiliation clinic.

1 INTRODUCTION AND BACKGROUND

1.1 DESCRIPTION OF THIS REPORT

1.1.1 Purpose Of This Report

The Estate of James Campbell is seeking land use approvals to develop Makaiwa Hills, a planned community which would occupy 1,915 acres in the Ewa region on Oahu.

Currently, over 93 percent of the project site is designated Agriculture on the Ewa Development Plan Land Use Map, with the remainder of the site designated Residential and Low Density Apartment. The Estate is requesting amendments to the Ewa Development Plan which would allow the development of Makaiwa Hills. Approximately 47 percent of the project site would be left open in Preservation designation.

Earthplan prepared this social impact assessment for the Environmental Impact Statement on Makaiwa Hills.

1.1.2 Preparers Of This Report

This report was prepared by Earthplan whose office is located at 81 South Hotel Street, Suite 211. *Berna Cabacungan*, principal of Earthplan, was the project manager, and principal researcher and writer. Independent contractor *Michael P. Mays* assisted in conducting interviews with community informants.

1.1.3 Report Organization

This report contains five major sections. The remaining portions of Section 1 describes Makaiwa Hills and describes the social impact assessment process relative to the proposed project.

Section 2 provides a profile of the existing community to establish baseline information, or the social context, in which project impacts may occur. Information includes employment, population, housing and other social characteristics. Where available, information on the communities nearest the project site is presented.

Section 3 describes extends the baseline data by presenting a likely scenario for the Ewa region without Makaiwa Hills. Public policies and major public and private developments are included in this analysis.

Section 4 identifies preliminary community issues and concerns on this project, based on historical trends to date and interviews held with some members of the Ewa community.

Section 5 identifies potential social impacts of the Makaiwa Hills. This section identifies the likely impacts of the project on the nearby communities, in terms of (1) population; (2) regional character; (3) nearby uses; (4) on-site uses and (5) public services and facilities.

1.2 PROJECT DESCRIPTION

Makaiwa Hills is envisioned as a planned community which would comprise of residential neighborhoods linked by large continuous open space transition areas.

These open space areas, which are proposed for Preservation designation on the Ewa Development Plan, will be the dominant feature of Makaiwa Hills. Open space would cover approximately 47 percent of the 1,915 acres, or 901 acres. The open space area located in the makai portion of the project site, or nearest Farrington Highway, may be used as a golf course in the future, but is not currently designated as such.

Residential uses would occupy 726 acres, or approximately 38 percent of the total project site. A total of 2,130 units are proposed, ranging from townhouses in the southeastern portions of the site, to grade-adaptive custom lots in the uplands and ridge slopes. Given the site's topography, the residential lots will increase in size as one moves mauka; selling prices will increase accordingly.

Three options are being considered for providing affordable housing. Such housing will either be (1) located at Makaiwa Hills, or (2) off-site in proximity to existing and planned employment centers, or (3) provided in a combination of the first two options.

Commercial uses are proposed for 156 acres located in the lower southeastern portion of the project site. Most of this site, or 103 acres, is currently designated for Low Density Apartment. The focal point of this commercial area will be a regional shopping center.

Sixteen acres near the shopping center are proposed for a park. Also near the shopping center are eight acres for a school. A fire station would be located on one acre in the central southern portion of the project site.

1.3 SOCIAL IMPACT ASSESSMENTS AND ITS APPLICATION IN THIS PROJECT

Social impact assessment is a field of applied social science which has to do with the development and disclosure of social information relevant to (1) informing the decision-making process, and/or (2) developing management actions to deal with problematic social outcomes of a proposed project. It *draws* sometimes from social science, but other times from organizational development, political analysis, or simple journalism.

Commonly identified uses of social impact assessments include (1) understanding the ability of a community or group to adapt to changing conditions; (2) defining the problems or clarify the issues involved in a proposed change; (3) illuminating the meaning and importance of anticipated change, and (4) identifying mitigation opportunities or requirements.

The emphasis of this process varies, based on the particular land use characteristics of a project, the extent of development in nearby areas and the requirements of the different permit processes.

This report serves as the mechanism to identify potential social impacts for in efforts to secure amendments to the Ewa Development Plan.

In the overall social impact assessment *process*, this report can be useful in further and ongoing community dialogue between the Estate of James Campbell and the affected parties. The ongoing nature of this process can lead to an informed community and project team, possible project modifications, and, ideally, consensus on proposed actions.

2 PROFILE OF THE EXISTING COMMUNITY

This section provides information on the existing community to establish a baseline of information, upon which potential social impacts can be identified and examined.

Section 2.1 defines the study area used in this report. In Section 2.2, this study area is described in terms of in-area employment, population and housing trends and certain socio-economic characteristics. Makakilo and Honokai Hale/Nanakai Gardens, the existing communities nearest to Makaiwa Hills, are described further in Section 2.3.

2.1 STUDY AREA DESCRIPTION

The project site is located in the Ewa region, or Development Plan area. From north to south, the Ewa region extends from the lower slopes of the Waianae mountain range to the coastline. From west to east, Ewa extends from Kahe Point to the West Loch of Pearl Harbor.

Historically, three major forces have shaped the existing Ewa community. These include national defense needs, the growth of large-scale sugar cultivation and the growth of suburban community. The result of these influences is a region with pockets of military and residential communities separated by vast agricultural fields.

The Study Area for this report is the Ewa Development Plan area and the following describes the different areas and uses in this region:

* The existing communities makai of the project site are **Honokai Hale and Nanakai Gardens**, two contiguous residential communities. These communities include 290 residential units and are across Farrington Highway. Nanakai Gardens is the older of the two, having been developed in the mid-1960s; that subdivision contains 130 single-family units. Honokai Hale contains 160 single-family units and was built in the early 1970s.

* Located east of the project site Gulch is **Makakilo**, a 23-year old residential community offering mid-priced, single family and multi-family housing, and support public and commercial facilities. Most of the 2,800 residential units (as of December 1989) are single-family units.

* **Ko Olina Phase 1** is located between Farrington Highway, Honokai Hale/Nanakai Gardens and the ocean. The development program includes 5,200 residential units and 4,000 visitor units. Already completed is an 18-hole golf course and currently under construction are (1) a 500-slip marina, (2) four newly-created sandy beaches, (3) a Hawaiian cultural center, (4) two shopping centers and (5) restaurants.

* **Barbers Point Harbor** is a new state-owned harbor located on the west coast of the Ewa region and developed by the State Department of Transportation, Harbors Division.

* **James Campbell Industrial Park** is located southeast of the project site. Approximately 1,360 acres of this 2,400-acre industrial park are currently in use. Major park tenants include two oil refineries, a concrete manufacturing plant, a cattle feed lot operation, large building material supply yards, and a motor vehicle raceway park.

* Also located southeast of the project site is the **Naval Air Station Barbers Point (NASBP)**, which covers 3,672 acres and contains 854 military housing units. The station's mission is to support aviation activities and units of the Navy. Aircraft operations are conducted on a 24-hour basis and consist primarily of fixed-winged propeller aircraft with most flights conducted during the daylight hours. The station has three major runways (U. S. Navy, 1985).

* **Ewa Villages** is in the east central portion of the Ewa region. This community comprises the existing Varona, Tenney, Renton and Fernandez plantation villages.

* **Honouliuli** is in the northeastern portion of Ewa. This community includes a mixture of residential uses, few support commercial establishments, and small-scale agricultural operations.

* Also in the eastern portion of the Ewa region is the new community of **Ewa Gentry**. Already built are Soda Creek Increment 1 (459 units), Palm Villa Increment 1 (352 units) and Palm Court Increment 1 (220 units) (personal communication with Tosh Hosoda, Chief Planner, The Gentry Companies, September 18, 1990).

* **West Loch** is located in the northeastern portion of the Ewa region. Its 593-unit Phase 1 is scheduled for completion by the end of November of this year (personal communication with Gail Kaito, Deputy Director, City Department of Housing and Community Development, September 18, 1990).

* **Ewa Beach** is in the southeastern section of the Ewa region. This is an older residential community, with a small commercial center along Fort Weaver Road.

* The **Iroquois Point Puuloa Military Family Housing (IPP Military Family Housing)** is also located at the southeastern portion of the Ewa region. This community houses Navy, Army and Marine personnel.

* Oahu's largest sugar producer, **Oahu Sugar Company** (OSCO) cultivates approximately 8,000 acres in the Ewa region. Nearly all of the Ewa land under cultivation are leased from the Estate of James Campbell with a lease expiration date of 1995.

For the purposes of describing Ewa, the two sources of information include (1) 1980 census information and (2) estimates provided by Traffic Zones as available at the City Department of General Planning, Planning Information Branch. The following indicates the delineation of communities and areas, based on these sources:

Makakilo is a portion of Census Tract 86.01 (which also includes Kunia) and is in the City Traffic Zone (TZ) 140.

The *Ewa to Honokai Hale* area includes Honokai Hale/Nanakai Gardens, Ewa Villages, Ewa Gentry, Honouliuli and the James Campbell Industrial Park. This area is in Census Tract 86.02 and TZ 142.

Naval Air Station Barbers Point, or *NASBP* is in Census Tract 85, which covers the same area as TZ 139.

West Ewa Beach includes the portion of Ewa Beach west of Fort Weaver Road and is in Census Tract 84 and TZ 138.

The *East Ewa Beach* area covers the communities to the east of Fort Weaver Road, and includes the IPP Military Family Housing, and the portion of Ewa Beach generally east of Fort Weaver Road. This area is in Census Tract 83 and TZ 137.

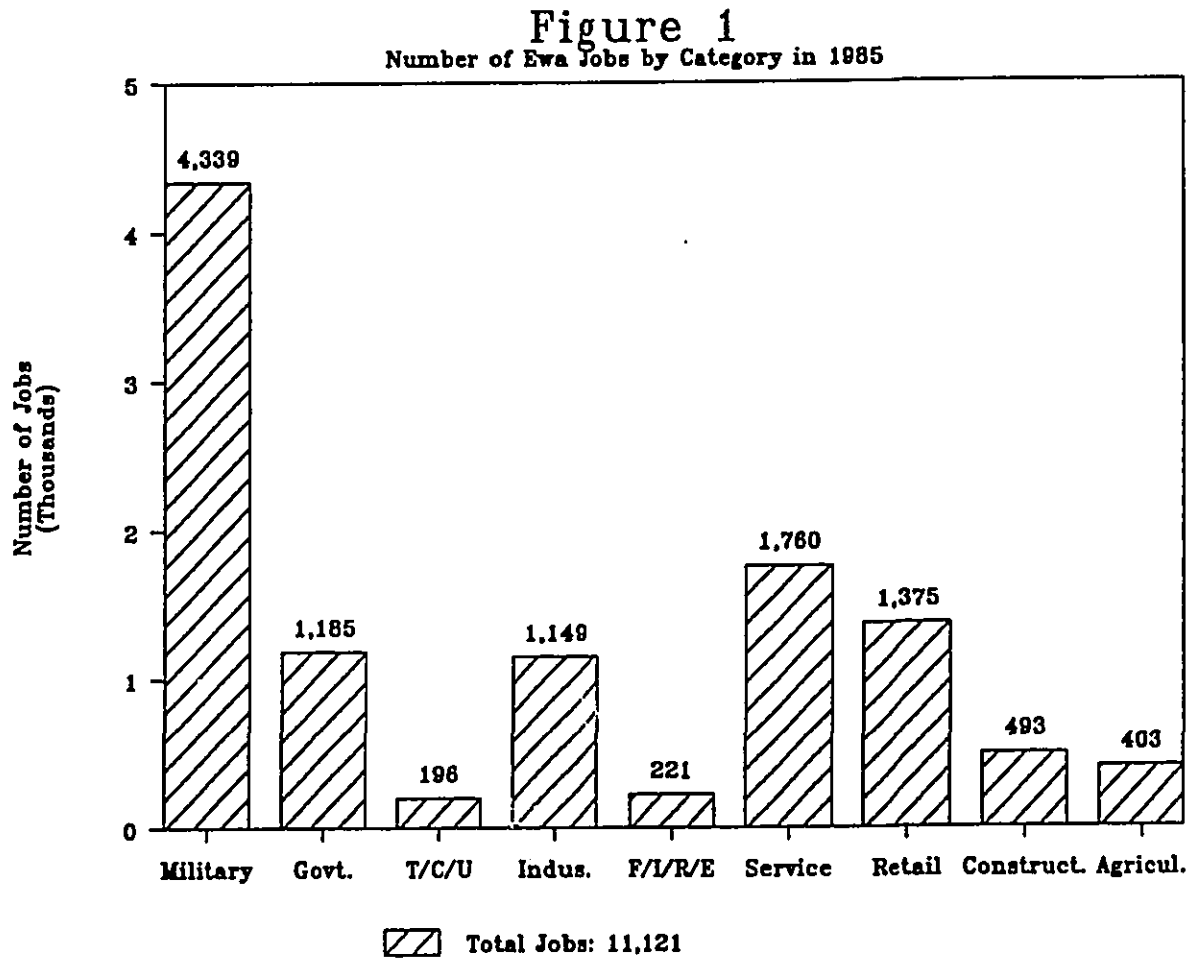
2.2 OVERVIEW OF EWA

2.2.1 Employment Profile

Figures 1 and 2 present estimates of jobs in the Ewa region in 1985. *Figure 1* shows that the region's primary employment generator is military activity. Military jobs were the largest category, with about 39 percent of the total 11,121 Ewa region jobs. Service jobs were the next largest category; 16 percent of the total jobs were service-related.

Figure 2 indicates how the area's 11,121 jobs are allocated by area. Highlights of this table are as follows:

1. About half of the jobs in the Ewa region were located at the NASBP. As expected, this area accounted for virtually all of the area's military jobs.
2. The area from Ewa Villages to Honokai Hale contained over one-fifth of Ewa's total jobs. Almost half of Ewa's industrial jobs are in this area, with the presence of the Campbell Industrial Park.
3. Makakilo, a predominantly residential community, contained only three percent of Ewa's total jobs.

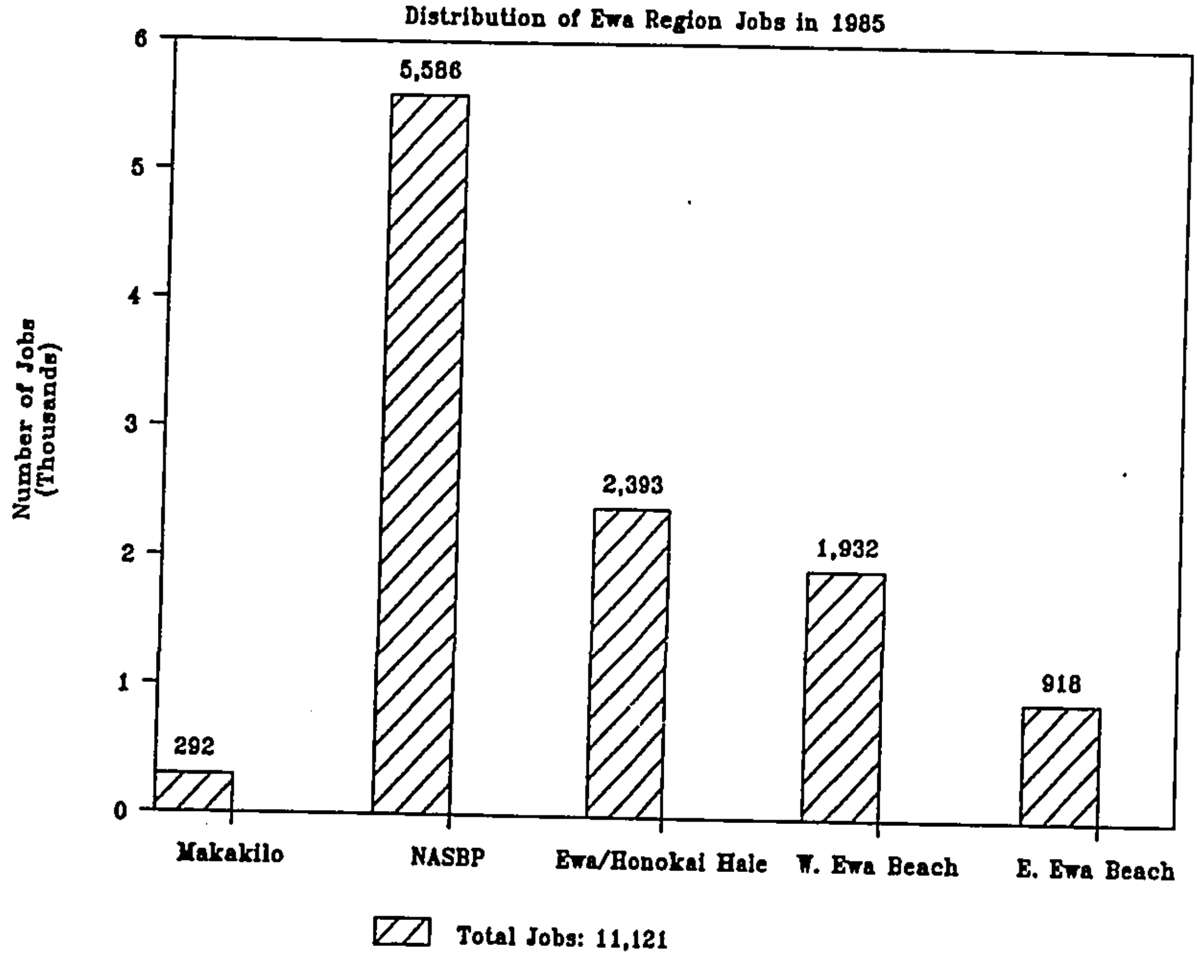


T/C/U: Transport, Communications and Utilities
F/I/R/E: Finance, Insurance, Real Estate

Source: City and County of Honolulu Department of General Planning, Planning Information Branch. 1985 Adjusted Employment (Jobs) bt DGP Sector by TAZ. October 1987.

Figure 2

Distribution of Ewa Region Jobs in 1985



Source: City and County of Honolulu Department of General Planning, Planning Information Branch. Traffic Assessment Zones. October 1987.

4. West Ewa Beach contained 17 percent of Ewa's total jobs and East Ewa Beach contained eight percent.

2.2.2 Population And Housing Trends

Between 1980 and 1989, Oahu's population grew by about ten percent, from 762,564 in 1980 to 841,600 persons in 1989 (City Department of General Planning, Planning Information Branch, 1990). Housing characteristics are characterized as follows:

* There were 282,330 dwelling units in 1989. Most of the dwelling units were used for residential purposes; only about three percent of these were resort condominium units.

* The 1989 dwelling unit count represents a ten percent increase over the 1980 unit count of 255,499 dwelling units.

* In 1980, approximately 52 percent of the islandwide residential units were single-family residences. With the increase in multi-family units, the share of single family residences decreased slightly to 49.6 percent in 1989 (City Department of General Planning, Planning Information Branch, 1990).

Population growth in the Ewa region was proportionally smaller than the Oahu population increase. *Figure 3* shows that the Ewa region grew from 36,324 persons in 1980 to 39,338 persons in 1989, for an eight percent population increase (as compared to Oahu's ten percent). As the graph illustrates, very little growth was experienced in the first five years of this last decade. Most of the recent growth occurred between 1985 and 1989.

In terms of average annual growth rates, the Ewa region experienced strong growth in the 1970s, remained virtually stable between 1980 and 1985, and started to grow again between 1985 to 1989. As indicated in *Table 1*, the Ewa region grew 4.2 percent a year during the 1970s. This is very high, compared to Oahu's 1.9 percent.

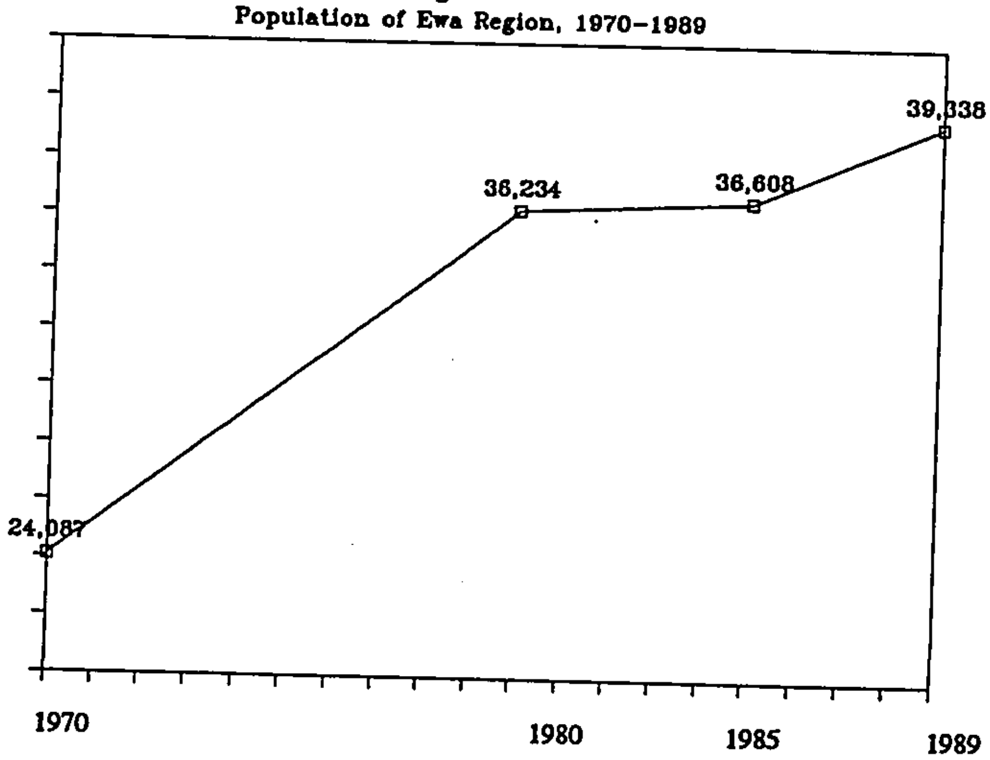
In the early 1980s, while Oahu's population grew at a rate of 1.2 percent a year, the Ewa region experienced almost no increase in population. In the latter part of the 1980s, Oahu's average annual growth rate continued to decline to one percent a year. For the Ewa region, however, with the new projects being developed, the population has increased at an average annual rate of 1.8 percent between 1985 and 1989.

Figure 4 illustrates the growth patterns of the separate communities:

* In the 1970s, most of Ewa's growth occurred in Ewa Beach, where the population almost tripled during that decade and remained around 12,300 persons thereafter.

* Makakilo's population more than doubled between 1970 and 1989. The latest estimate indicate that about 10,000 people live in that community.

Figure 3
Population of Ewa Region, 1970–1989



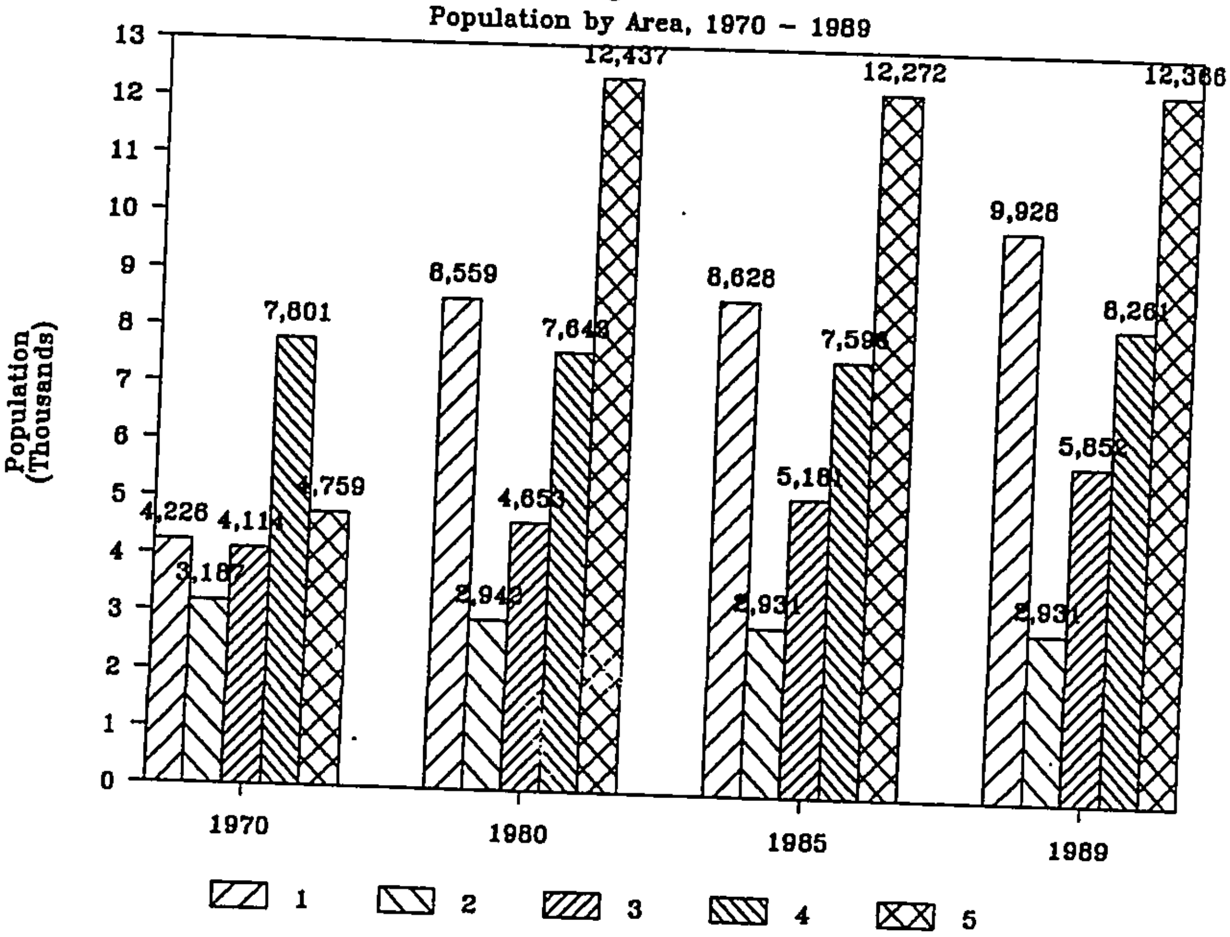
Sources: 1970 and 1980 figures are compilations of Census Tracts 83 through 86.02 based on U. S. Bureau of the Census, 1983. Population figures for 1985 and 1989 are estimates compiled for Traffic Zones 137 through 140, based on the City and County of Honolulu, Department of General Planning, 1987 and 1990.

Table 1
Average Annual Growth Rates for
the City and County of Honolulu, the Ewa Region and
Ewa Sub-Areas, 1970 through 1989

	1970 to 1980	1980 to 1985	1985 to 1989	1970 to 1989
City and County of Honolulu	1.9%	1.2%	1.0%	1.5%
Total Ewa Region	4.2%	0.5%	1.8%	2.8%
Makakilo	7.3%	1.5%	3.6%	4.6%
NASBP	-0.8%	-0.2%	no change	-0.4%
Ewa to Honokai Hale	1.2%	2.1%	3.1%	1.9%
West Ewa Beach	-0.2%	-0.1%	2.1%	0.3%
East Ewa Beach	10.1%	-0.3%	0.1%	5.1%

Figure 4

Population by Area, 1970 – 1989



1 -- Makakilo, which is part of Census Tract 86.02 and Traffic Zone 140
2 -- Naval Air Station, Barbers Point, which is Census Tract 85 and Traffic Zone 139
3 -- Ewa to Honokai Hale, which is Census Tract 86.01 and Traffic Zone 142
4 -- West Ewa Beach, which is Census Tract 84 and Traffic Zone 138
5 -- East Ewa Beach, which is Census Tract 83 and Traffic Zone 137

Sources: U. S. Bureau of the Census, 1983; City and County of Honolulu Department of General Planning, 1987 and 1990

* Growth in the Ewa to Honokai Hale/Nanakai Gardens region has been slow but steady since 1970; since 1985, however, growth has been accelerating due to the addition of Ewa Gentry units.

* The other Ewa communities have experienced very little or no growth.

Table 2 indicates that, in 1989, the Ewa region contained 10,192 housing units. About 60 percent are single-family units, while only 17 percent are multi-family units. Approximately 23 percent of Ewa's housing units are in military housing. Historically, the average household size in Ewa is larger than the islandwide household size. Compared to the islandwide household size of 2.9 persons in 1989, Ewa had an average of 3.8 persons per household.

Housing characteristics of specific communities are as follows:

* The Ewa to Honokai Hale/Nanakai Gardens region is dominated by single-family units. This area had a large average household size of 4.1 persons, and, with an estimated population of 5,852, accounted for 15 percent of the total Ewa population.

* Makakilo is the most diverse in terms of civilian housing types. Almost 38 percent of its housing units are in multi-family structures. Its average household size was similar to that of the total Ewa region. With about 9,928 persons in 1989, Makakilo accounted for 25 percent of the total Ewa population.

* NASBP housing is all military-related, and one-fifth of the total population lived in group living quarters or barracks. This military installation had the smallest household size with an average of 2.7 persons. Approximately 2,900 people, which is only seven percent of Ewa's population, lived here.

* West Ewa Beach is dominated by single-family units and its average household size was similar to that of the total Ewa region. About one-fifth of the total Ewa population lived in West Ewa Beach.

* Slightly over half of East Ewa Beach's residential units are military housing because of the presence of the Iroquois Point/Puuloa Military housing. East Ewa Beach had the largest average household size (4.2 persons), and, with over 12,300 residents, contained over 30 percent of the total Ewa population.

Table 2
Housing Information by
Ewa Region and Sub-Areas, 1989

	Oahu	Total Ewa Region	Makakilo	NASBP	Ewa to Honokai Hale	West Ewa Beach	East Ewa Beach
Total Population	841,600	39,338	9,928	2,931	5,852	8,261	12,366
Persons Living in Households	95.6%	97.9%	99.7%	78.8%	99.6%	99.7%	98.8%
Persons in Group Living Quarters	4.4%	2.1%	0.3%	21.2%	0.4%	0.3%	1.2%
Total Housing Units	282,330	10,192	2,826	854	1,406	2,211	2,895
Single Family Units	49.6%	60.3%	62.5%	0.0%	92.7%	94.1%	34.4%
Multi-Family Units	43.7%	16.8%	37.5%	0.0%	7.3%	5.9%	14.4%
Military Housing	6.8%	22.9%	0.0%	100.0%	0.0%	0.0%	51.2%
Percent Occupied	97.3%	97.6%	97.3%	98.5%	97.3%	97.3%	98.1%
Average Household Size (does not include persons in group living quarters)	2.9	3.8	3.5	2.7	4.1	3.7	4.2

Source: City and County of Honolulu Department of General Planning, Planning Information Branch, 1990. Percentages computed by Earthplan.

2.2.3 Other Population Characteristics

Table 3 compares social and economic characteristics of Oahu, the entire Ewa Development Plan area, and each sub-area. Based on 1980 census information, the following are highlights of this comparison:

1. **Age.**

   As a whole Ewa is slightly younger than the rest of the island. In 1980, the median age on Oahu was 28 years of age, as compared to Ewa's 25.6 years of age. There were major differences between the different communities. The oldest community was the Ewa to Honokai Hale area, whose median age was 33.1 years of age. By comparison, and as expected, the military bases contained much younger populations with median ages of 22.1 in Naval Air Station Barbers Point and 21.3 in the East Ewa Beach/IPP Military Family Housing.

2. **Ethnicity.**

   Compared to the islandwide population, Ewa has significantly higher proportions of Caucasians and Filipinos, and a moderately higher proportion of Hawaiians. On the other hand, there were proportionally fewer Japanese and Chinese people. The Naval Air Station Barbers Point and East Ewa Beach/IPP Military Family Housing had large segments of Caucasians, who accounted for almost three-quarters of the former installation. High proportions of Filipinos were found in Ewa to Honokai Hale (53.7 percent), Ewa Beach (20.8 percent), Makakilo (19.9 percent) and East Ewa Beach/IPP Military Family Housing (24.8 percent).

3. **Place of Birth.**

   Ewa had proportionally (1) fewer people born in Hawaii, (2) more people born in other parts of the United States, and (3) slightly less foreign-born residents. The differences between the communities are notable. Ewa Beach, Ewa and Honokai Hale all had significantly higher proportions of people born in Hawaii than the Oahu-wide population. The Naval Air Station Barbers Point and East Ewa Beach/IPP Military Family Housing had relatively higher percentages of people born in other parts of the United States. One-third of the Ewa to Honokai Hale area population was born in another country.

4. **Education.**

   In 1980, Ewa residents were slightly less educated than the islandwide community. Compared to the 21.7 percent of Oahu residents completing a four-year college, Ewa has only 12.4 percent. Among the different communities, the percentage of people who completed a four-year college ranged from seven percent in the Ewa to Honokai Hale area to 18.4 percent in Makakilo.

Table 3
Selected Social and Economic Characteritics
Oahu, Ewa and Sub-Areas, 1980

	Oahu	Ewa D. P. Area	Makakilo	NASBP	Ewa to Honokai Hale	West Ewa Beach	East Ewa B. & Iroquois Pt.
Resident Population							
1970	629,176	24,087	4,226	3,187	4,114	7,801	4,759
1980	762,565	36,234	8,559	2,942	4,653	7,643	12,437
percent change	21.2%	50.4%	102.5%	-7.7%	13.1%	-2.0%	161.3%
Median Age	28.0	25.6	25.9	22.1	33.1	24.8	21.3
Ethnicity							
Caucasian	33.1%	44.5%	44.1%	73.9%	11.0%	37.5%	47.4%
Japanese	24.9%	8.8%	10.6%	1.5%	19.1%	11.8%	5.1%
Chinese	6.9%	2.0%	2.9%	0.2%	1.0%	2.4%	1.1%
Filipino	12.6%	24.4%	19.9%	11.5%	53.7%	20.8%	24.8%
Hawaiian	10.5%	12.4%	12.6%	1.1%	8.3%	14.2%	12.4%
Other	11.8%	7.5%	9.9%	11.8%	6.8%	13.3%	9.6%
Place of Birth							
Born in Hawaii	55.1%	49.5%	53.5%	8.6%	62.8%	61.4%	44.1%
Other U.S. Born	30.1%	36.0%	37.2%	78.5%	4.1%	26.8%	42.7%
Foreign Born	14.8%	14.5%	9.3%	12.9%	33.1%	11.8%	13.2%
Education (selected persons 25+ years)							
8 years or less	14.4%	14.3%	8.4%	4.0%	39.1%	14.3%	9.2%
Completed high schoo	35.5%	43.0%	46.1%	54.8%	26.9%	43.9%	45.8%
College	21.7%	12.4%	18.4%	8.7%	6.9%	9.1%	13.2%
Potential Labor Force	574,903	23,862	5,878	2,193	3,296	5,325	7,260
In labor Force							
Civilian	59.1%	49.5%	56.4%	12.5%	56.3%	58.8%	41.5%
Military	11.5%	27.0%	12.9%	63.2%	2.2%	6.2%	25.0%
Mean Family Income	$27,318	$21,000	$26,059	$10,377	$21,465	$22,789	$18,015
Families Below Poverty Level	7.5%	7.2%	3.1%	10.5%	7.2%	8.5%	7.4%
Housing Vacancy Rate	8.2%	3.4%	9.9%	5.2%	2.4%	1.2%	2.3%
Persons Per Household	3.31	3.96	3.66	3.81	4.07	3.77	4.37
Owner-Occupied Units	49.9%	50.2%	70.5%	0.0%	26.6%	60.0%	42.9%

Makakilo is Census Tract 86.01, which also includes Kunia
NASBP is in Census Tract 85
Ewa to Honokai Hale is in Census Tract 86.02
West Ewa Beach is in Census Tract 84
East Ewa Beach and Iroquois Point Puuloa Navy Housing is in Census Tract 83

Source: U.S. Bureau of the Census, 1983

5. Mean Family Income.

As a whole, Ewa's mean family income in 1980 of $21,000 was lower than Oahu's $27,318. The mean family income ranged from $10,377 in Naval Air Station Barbers Point to $26,059 in Makakilo.

2.3 PROFILE OF HONOKAI HALE/NANAKAI GARDENS AND MAKAKILO

The communities nearest the project site are Honokai Hale/Nanakai Gardens and Makakilo. Because of the proximity and potential for interaction with the Makaiwa Hills, these communities are further described. Honokai Hale/Nanakai Gardens is included with Ewa Villages in the census district and traffic assessment zones; thus, the Ewa-to-Honokai Hale area includes these communities in this discussion.

1. Population and Housing.

Based on an average household size of 4.1 persons, about 1,200 persons resided in Honokai Hale / Nanakai Gardens in 1989. An estimated 9,928 persons lived in Makakilo. Hence, approximately 11,100 people lived near the project site in 1989. Makakilo is expected to continue growing.

2. Employment.

The Ewa-to-Honokai Hale area contained one-fifth of Ewa's total jobs and the major categories were government (23 percent), industrial (24 percent) and retail (23 percent). Because of its strong residential character, Makakilo accounted for only three percent of Ewa's total jobs; the largest categories were construction (33 percent) and industrial (27 percent).

3. Social and Economic Characteristics.

In 1980, the Ewa regional median age was 25.6 years. With a median age of 33.1 years, Ewa-to-Honokai Hale was the oldest community in Ewa. The median age of Makakilo was similar to the regional median.

Of all of these communities, Makakilo tended to resemble the regional ethnic breakdown and had similarly large proportions of Caucasians and Filipinos. Of all of the Ewa sub-areas, the Ewa-to-Honokai Hale area had the lowest proportion of Caucasians and, over a half of its residents were Filipinos.

As compared to the 49.5 percent of the regional population born in Hawaii, Makakilo and Ewa-to-Honokai Hale, had higher proportions of Hawaii-born residents with 53.5 and 62.8 percent, respectively. Compared to the islandwide residents, all of these communities had proportionally fewer people completing a four-year college, although Makakilo's share was higher than the regional average.

3 POLICIES AND PROPOSALS WHICH WILL AFFECT THE COMMUNITY'S FUTURE

The three major forces which have shaped the existing Ewa community are national defense needs, the growth of large-scale sugar cultivation and the growth of suburban community. Public policies add a fourth major force in shaping Ewa. Government efforts are directing large-scale residential growth to this area, and construction is already underway for new planned communities. Makaiwa Hills is being proposed as part of this community in transition.

This section examines public policies and proposed changes to understand what is anticipated to occur in Ewa independent of the proposed project. Section 3.1 describes public policies for Ewa, and identifies proposed amendments to the Ewa Development Plan. Section 3.2 provides an overview of the projects which will help shape the secondary urban center. In Section 3.3, a description of a likely scenario without Makaiwa Hills is provided.

3.1 DIRECTION OUTLINED IN GENERAL AND DEVELOPMENT PLAN POLICIES

The City and County of Honolulu General Plan encourages the development within the secondary urban center at Kapolei and the Ewa and Central Oahu urban-fringe areas to relieve developmental pressures in the remaining urban-fringe and rural areas and to meet housing needs not readily provided in the primary urban center.

Consistent with this policy is the General Plan's residential population distribution for the year 2010. As shown in *Table 4*, Ewa is targeted to accommodate 12 to 13.3 percent of the total islandwide population. These proportions translate to a range of 119,940 to 132,934 persons in Ewa. The 2010 target population means that Ewa's population is anticipated to increase over three time the 1989 population.

There are currently four land use changes included in the 1990 Annual Amendment Review package for the Ewa Development Plan Land Use Map. These proposals are (1) the Kapolei Business-Industrial Park; (2) the expansion of Barbers Point Harbor; (3) a re-configuration of land uses in Ewa Gentry; and (4) a re-configuration and redistribution of land uses in Ko Olina Phase 2. These proposals are further discussed in the next section.

3.2 MAJOR DEVELOPMENT PROPOSALS IN THE STUDY AREA

As the major landowner in Ewa, the Estate of James Campbell has taken the lead in preparing the master plan for this region. The first Ewa Master Plan was prepared in 1955 and revised in the early 1960s. In a 1974 update of this plan, the concept of a self-contained city began to evolve. The planning firm of Helber, Hastert & Kimura, Planners prepared an update of this plan, in 1984, and identified a major "City Center" located between Makakilo, Campbell Industrial Park and NASBP.

Table 4
Population Projections by Development Plan Area, 2010

	General Plan Distribution of Residential Population (1)	2010 Population Range Based on Series M-K Projections (2)
Primary Urban Center	45.1% - 49.8%	450,774 - 497,751
Ewa	12.0% - 13.3%	119,940 - 132,934
Central Oahu	14.9% - 16.5%	148,926 - 164,917
East Honolulu	5.3% - 5.8%	52,974 - 57,971
Koolaupoko	11.0% - 12.2%	109,945 - 121,939
Koolauloa	1.3% - 1.4%	12,994 - 13,993
North Shore	1.6% - 1.8%	15,992 - 17,991
Waianae	3.8% - 4.2%	37,981 - 41,979
Total Oahu	95.0% - 105.0%	949,525 - 1,049,475

Notes:

(1) City Council, "Resolution Relating to Amending the General Plan of the City and County of Honolulu, No. 88-404, Cd-1, FD-1

(2) Table 18 of the State of Hawaii Data Book 1988 provides a population projection of 999,500 persons for the City and County of Honolulu in 2010

In 1986, the Honolulu City Council subsequently amended the Ewa Development Plan to adopt the Estate's Master Plan land use pattern in the "City Center" area. After the Estate commissioned a detailed implementation plan for the 890-acre City Center, then re-named Kapolei, the State Land Use Commission granted incremental approval of a 135-acres "First Increment" in mid-1988 (Helber, Hastert & Kimura, Planners, 1989).

The most recent master plan for this region was prepared in May 1989. Note that, as with all long-range plans, the plan represents a process which is in constant flux in that it anticipates and reacts to economic, social, environmental and political forces. The following summarizes the development projects anticipated for the Ewa region, beginning with the projects closest to Makaiwa Hills. Except where indicated, this information was extracted from the most recent Kapolei Master Plan (Helber, Hastert and Kimura, Planners, 1989).

Kapolei Town Center, the City of Kapolei, and the Kapolei Shopping Center. Located south of the project site and encompassing approximately 879 acres, the Kapolei Town Center is the major nucleus of the long range Kapolei Master Plan. The 570-acre City of Kapolei, or Kapolei Town Center Core, is a triangular shaped parcel located at the heart of this larger project area. The development concept for the City is (1) to provide an urban nucleus in and around which secondary land uses can be located and (2) to provide a self-contained economic center which will accommodate the employment needs of Oahu's growing population.

The overall development program calls for about two million square feet of office space on approximately 100 acres of land; one million square feet of commercial space on 113 acres of land; and 860,000 square feet of public facilities. The latter includes 333,000 square feet of light industrial uses on 23 acres, 173 acres of park and 127 acres of open space/circulation. Approximately 3,040 residential units are also proposed in the overall development program (Helber, Hastert & Kimura, Planners, 1988).

The overall project is expected to be implemented in three phases.

- Phase 1 is the implementation of the 30-acre Kapolei Shopping Center; sitework has begun.

- Phase 2 encompasses 135 acres, 67 of which would be for commercial and office uses. Approximately 39.5 acres would be used for circulation and open space; 19.5 acres, for public facility; and 9.5 acres for light industrial uses (Helber, Hastert & Kimura, Planners, 1988). The State Land Use Commission has reclassified these lands to the Urban district. Ordinance 89-141 provides the appropriate Development Plan designations.

- Phase 3 is the remaining proposed uses and will be developed in response to market demands.

Ko Olina Phase 2. The Ko Olina Phase 2 project site encompasses 372.6 acres. The project is intended to complement the resort, residential and recreational uses of Phase 1, which is currently under construction. The project includes 1,500 low-density apartments, 2,000 medium-density apartments, a golf course and support facilities, and a shopping center with retail-commercial development and a low-rise garden office complex (West Beach Estates, June 1990).

Kapolei Business-Industrial Park. Approximately 1,040 acres of the existing 2,400-acre industrial park, located southeast of the Makaiwa Hills project site, has yet to be developed. Development of this land is adjacent to the OR&L right-of-way and will be limited to light industrial uses, compatible with uses in the neighboring Ko Olina and Kapolei City projects. Sufficient appropriately-zoned lands are available for industrial expansion in the near term.

Currently before the City Council is a proposal to amend the Ewa Development Plan Land Use Map for the Kapolei Business Park. Involving the re-designation of approximately 552.1 acres, this project includes 56 acres to be used by the State for future expansion of Barbers Point Harbor, 53.3 acres for industrial uses, 423.6 acres for intensive industrial uses and 19.2 acres intended for commercial use (Wanket, 1989). This project is being evaluated for amendments to the Ewa Development Plan.

Makakilo Expansion. Expansion plans include adding between 2,000 and 3,000 residential units over the next ten to 15 years. Also, a golf course is planned for the slopes of Puu Makakilo. The developer, Finance Realty, is marketing a number of different home-styles in various areas of the development and is currently constructing a bridge to Palailai. Near the Makaiwa Hills project site is the West Cliff project. Currently, 107 single-family units in West Cliff are under construction; ultimately between 700 to 900 residential units will be built in this area.

Kapolei Villages. To be developed by the State of Hawaii Housing Finance and Development Corporation, this residential community is located east of the project site. The development concept emphasizes a major residential component of 4,300 units with a 60/40 percent balance between affordable and market units. Other components of this 830-acre project site are intended to serve the residential population and include recreation, parks and open space on 22 percent of the entire site, civic uses on two percent, schools on six percent, and commercial uses on one percent (R. M. Towill Corporation, February 1988). This project received Urban designation from the State Land Use Commission, and the first increment, Kumu Iki, is being completed.

Kapolei Knolls. The Lusk Company proposes to develop 79.5 acres located north of Kapolei Villages into a residential community. The plan calls for 500 single-family residential units and a park (Environmental Communications, Inc., 1988). Development Plan approvals are already secured.

Ewa Gentry. Located in the eastern portion of the Ewa region, this 1,000-acre planned community will ultimately contain 7,500 residential units, a golf course and community facilities, such as schools, parks and greenways. The project area has been granted Urban designation, and 531 acres have received necessary Development Plan approvals for a total of 5,300 residential units. Approximately 1,030 units have already been built and Increment 2 of Palm Villa is soon to commence (personal communication with Tosh Hosoda, Chief Planner, The Gentry Companies, September 18, 1990).

Ewa Villages. The City and County of Honolulu is preparing a master plan which will include the Ewa Villages, Renton and Tenney Villages and a golf course. The total area is approximately 470 acres and 870 residential units will be programmed. Part of the master plan will address the development and revitalization of Tenney and Renton Villages and Ewa Elementary School to create the design character of a plantation village (Office of Environmental Quality, 1990).

West Loch. West Loch is being developed by the City and County of Honolulu Department of Housing and Community Development in two phases. The first phase, which is currently under construction, includes 600 residential units, a golf course, and shoreline park. By the end of November of this year, almost all of Phase 1 will be completed. A lottery for the 1,007-unit second phase has recently been held. Other Phase 2 components include a neighborhood park, elementary school, park-and-ride and day care facilities, and a commercial area. Implementation for Phase 2 is anticipated to begin in August 1991 (personal communication with Gail Kaito, Deputy Director, City and County of Honolulu Department of Housing and Community Development, September 18, 1990).

Ewa Marina. HASEKO (Hawaii), Inc. proposes to develop 1,100 acres into a recreation-oriented community with 4,850 residential units, 1,600 boat slips to be accommodated in marina basins and waterway systems, golf courses, and a variety of commercial centers and visitor accommodations related to the residential and recreational activities. Phase 1 includes the marina and residential components. Major land use approvals have been secured and HASEKO (Hawaii), Inc. is currently seeking Federal, State and City permits for the marina configuration, location and construction. Planning and design for the first housing increment are also in process, with construction of the affordable housing anticipated for 1990. Phase 2, which includes 1,500 visitor units has received Urban designation by the State Land Use Commission.

East Kapolei. The State Board of Land and Natural Resources proposes to acquire 2,284 acres, located in the eastern portion of the Ewa Plain, from the Estate of James Campbell. The State intends to reserve this land for future uses and no changes will be made to the existing land uses at this time. The land is currently in sugar cane cultivation; the State will lease the land to Oahu Sugar Company to allow continued agriculture (R. M. Towill Corporation, 1990).

3.3 LIKELY SCENARIO WITHOUT MAKAIWA HILLS

As indicated in Sections 3.1 and 3.2, the Ewa Development Plan area is targeted for major growth and numerous projects are paving the way to achieve the objectives for a secondary urban center. Without Makaiwa Hills, the following scenario is likely to occur:

1. **Significant increase in residential population.**

   The target population for Ewa is between 119,940 to 132,934 persons in 2010. This implies that public policy intends that the Ewa region more than triple in population over the next twenty years.

   Table 5 presents an estimated Ewa population of 131,400 persons by the year 2010. The basis for this estimate is a total 2010 housing count of 43,367 (the sum of an estimated 10,192 residential units in 1989, the 28,304 units allowed by the Ewa Development Plan and the 4,871-unit Kapolei Village project). A household size of 3.03 was assumed. Although Ewa currently has relatively large households, it is believed that, as the region develops, Ewa's households will decrease in size to resemble characteristics in similar communities such as Central Oahu and East Honolulu.

2. **Significant increase in employment.**

   Public policies call for establishing job centers in Ewa which will ideally redirect traffic activity away from the Primary Urban Center. Market study projections indicate that job opportunities within the planning region are projected to increase about 600 percent over a twenty year period (Leventhal, 1986).

3. **Establishment of city-related mixed uses and secondary urban center in "western" Ewa.**

   Kapolei City, Ko Olina Phase 1 and the James Campbell Industrial Park, all situated in the western half of the Ewa Development Plan area, are major employment generators -- which essentially create the city-like environment in the "secondary urban center," as defined by the City and County of Honolulu General Plan. This urban environment would complement and support nearby residential communities which include the Kapolei Villages, Kapolei Knolls, Makakilo, and Honokai Hale/Nanakai Gardens.

4. **Intensification of residential uses in eastern Ewa.**

   The City and County of Honolulu General Plan designates the eastern half of Ewa, generally the area along Fort Weaver Road, as Ewa's urban-fringe and this area is intended primarily for residences. All other uses will be established to serve the nearby residents.

Table 5
Estimated Ewa Population Growth Independent of Makaiwa Hills

1989 Existing Residential Units (1)	10,192
Additional Residential Units Allowed in Development Plan (2)	33,175
Total Existing and Potential Residential Units	**43,367**

Estimated 2010 Resident Population (3)	131,402
1989 Residential Population (4)	39,338
Anticipated Increase in Residential Population Between 1989 and 2010	**92,064**

Percent Increase Between 1989 and 2010 Population	234.0%
Average Annual Growth Rate Between 1989 and 2010	5.9%

Notes:

(1) Based on estimate provided by the City Department of General Planning, Planning Information Branch in "1989 Population by Traffic Zones," dated June 28, 1990.

(2) Based on the following estimate of residential units:

Ewa Gentry	*5,300*
Ewa Marina	*4,791*
West Loch	*1,496*
Ko Olina Phases 1 and 2	*9,500*
Kapolei Town Center	*2,300*
Kapolei Knolls	*500*
Kapolei Village (not designated on the Ewa D.P., but is included as an approved project)	*4,871*
Makakilo	*3,817*
Other (assumption based on residentially-designated land located in Ewa Beach, Ewa Villages and Honouliuli that is not included in any specific development proposals)	*600*
Total	*33,175*

Source: Volume 2 of "Development Plan Status Review for Fiscal Year 1989" produced by the City Department of Planning, September 1989; and personal communication with Steve Young, City Department of General Planning)

(3) Based on household size of 3.03. Ewa currently has relatively large households. As the region develops, however, it is expected that household sizes will decrease to resemble characteristics in Central Oahu and East Honolulu.

(4) Based on estimate provided by the City Department of General Planning, Planning Information Branch in "1989 Population by Traffic Zones," dated June 28, 1990.

5. **Retention of military uses.**

   The NASBP and the IPP Military Family Housing will likely continue their operations.

6. **Land banking in eastern Ewa.**

   The State is working towards reserving over 2,000 acres in eastern Ewa for future uses.

4 PRELIMINARY COMMUNITY ISSUES ON MAKAIWA HILLS

This section explores potential community issues and concerns on Makaiwa Hills. Section 4.1 discusses issues and concerns independent of the proposed project. Section 4.2 identifies preliminary community issues on Makaiwa Hills.

Three sources of information were used in this analysis:

1. **Neighborhood Board minutes.**

   The Neighborhood Board system is a formal mechanism for citizen input to public entities regarding islandwide City policies, specific community problems and other matters, and proposed changes. The types of issues addressed by a Neighborhood Board and subsequent actions often reflect values and concerns of the constituent population.

   To understand the values, concerns and issues of Ewa residents, this study examined the minutes of the Ewa Neighborhood Board No. 23 over a three-year period, from July 1987 to October 1990. Section 4.1.1 discusses issues addressed by this Board.

2. **Community Advisory Committee on the Secondary Urban Center.** The Estate of James Campbell assembled this group comprising representatives of Ewa community organizations. This group provides community input into the Estate's planning process.

   In 1987, a series of community workshops were held to define community issues and needs for community services and facilities. The findings and recommendations were presented in Ewa Secondary Urban Center: Workshops on Community Facility Needs and Solutions (Phillips Brandt Reddick and Associates (Hawaii), Inc., 1987). Although this information is already three years old, it remains useful because it is a good indicator of community's expectations regarding the Second City. Section 4.1.2 summarizes this group's recommendations.

3. **Community Interviews.** Earthplan conducted interviews with community residents and organization leaders in the course of this study. These interviews were held to supplement information from printed sources of material regarding community needs and values, and, more importantly, to identify community issues and concerns relative to Makaiwa Hills. No attempt was made to assess the extent or "quantity" of project support or opposition.

   The selection of individuals was based on the following *cross-section* of potential interests:

   * Leaders of regional Ewa organizations, including the Neighborhood Board, and community and neighborhood organizations;

* Residents in nearby communities who are active in their community activities; and

* Residents and operators of nearby activities who live or work adjacent to the project site.

Thirty-two people were interviewed during this study and the list is presented in *Table 6.*

In general, interviewers asked people to provide input as individuals. In some cases, the interviewer asked the informants to further explain their organization's position, in addition to their own personal viewpoint. Informants were not asked to "take a position," nor were they asked to predict their organization's position if one were not yet taken.

Each person was informed that input would be summarized in the Social Impact Assessment and that individual conversations would remain confidential. The basic source of project information was the Makaiwa Hills: Development Plan Application and Environmental Assessment (Wanket, 1990).

4.1 COMMUNITY ISSUES INDEPENDENT OF THE PROPOSED PROJECT

4.1.1 Ewa Neighborhood Board Issues

Over the past three years, the Ewa Neighborhood Board No. 23 addressed the following types of problems:

1. **Problems typically associated with stable, active and predominantly residential communities. These included:**

   - controlling and minimizing crime,
   - improving the quality and facilities in the public education system,
   - improving roadway infrastructure and circulation,
   - monitoring and improving recreational facilities, and
   - improving the delivery of ambulance, police and fire protection services.

   The Ewa Neighborhood Board appeared to be very active in and aware of community affairs. As a whole, the Board maintained an ongoing working relationship with the Ewa Beach, Makakilo and Honokai Hale Community Associations. In fact, many of the Board members were active participants in these neighborhood groups.

Table 6
List of People Interviewed for this Study

Note: Those interviewed provided their perspectives on how the Makaiwa Hills project might affect the nearby and regional communities. They were not asked to represent the views of their organizations.

Name	Organization or Affiliation
Peter Akim	Makakilo resident adjacent to the project site
Dick Beamer	Chair of Transportation Committee of Ewa Neighborhood Board No. 23 President of Ewa Beach Community Association
Dave Brueck	Vice President and Acting President of the Palehua Community Association
Cheryl Bargamento	Chair of Health Committee of the Ewa Neighborhood Board No. 23
Tomiko Clark	Makakilo resident adjacent to the project site
Barbara Conrardy	Secretary of the Ewa Neighborhood Board No. 23 President of Palehua Vista Association Member of Ewa Beach Community Association
Francis Cummings	Makakilo resident adjacent to the project site
Ed Dunbar	Member of Ewa Neighborhood Board No. 23 Member of Ewa Beach Community Association
Mike Freitas	Vice President and recent president of Honokai Hale/ Nanakai Gardens Community Association
Wanda Gereben	Administrator of Camp Timberline
David Gilbert	Member of Ewa Neighborhood Board No. 23

Name	Organization or Affiliation
Paula Helfrich	Member of Ewa Neighborhood Board No. 23
Sterling Ing	President of Honokai Hale / Nanakai Gardens Community Association
Emogene Martin	Chair of Parks and Recreation Committee of the Ewa Neighborhood Board President of Friends for Ewa
John Meatoga	Member of Ewa Neighborhood Board No. 23
Kelly Miyahira	Vice Chair of the Ewa Neighborhood Board No. 23
Mary Miyashiro	Member of Ewa Neighborhood Board No. 23 Ewa Beach Community Association
Paris Mizumoto	Makakilo resident adjacent to the project site Board member of the Makakilo Youth League
Ronald Nishimoto	Makakilo resident adjacent to the project site
Captain Phil Nostrand	Detachment Commander of Palehua Solar Observatory
Glenn Oamilda	Member of Ewa Neighborhood Board No. 23 Ewa Beach Community Association President of West Oahu Employment Corporation
Calvin Ontai	Member of Ewa Neighborhood Board No. 23
Rodolfo Ramos	Treasurer of the Ewa Neighborhood Board No. 23
James Respicio	Member of Ewa Neighborhood Board No. 23
Jane Ross	Chair of Ewa Neighborhood Board No. 23 Corresponding Secretary of Honokai Hale/ Nanakai Gardens Community Association

Name	Organization or Affiliation
Ray Rosetti	General Manager of Waimanalo Gulch Landfill Pacific Regional Manager of Waste Management, Inc.
Dwight Smeigh	Makakilo resident adjacent to the project site
David Space	Makakilo resident adjacent to the project site Board member of Palehua Community Association
Bob Tong	Vice President of Sales and Marketing, Finance Realty
Richard Towill	Lessee of nearby Campbell Estate land
Ken Williams	Senior Project Manager of Ko Olina Resort
Roy Wickramaratna	Member of Ewa Neighborhood Board No. 23 President of Makakilo Community Association

This Neighborhood Board also worked closely with public officials in advocating community improvements.

2. **Potential effects of proposed developments.** This Neighborhood Board is unique among the other neighborhood boards in that Ewa is a community in constant transition. New communities and development proposals were discussed at virtually every meeting during this two-year period. Construction activities on previously vacant or agricultural land are evidence that the existing physical, social and economic environments will evolve into the secondary urban center. Hence, the awareness of, and expectations for, change exist among the Neighborhood Board members.

   Generally, this Neighborhood Board tended to support these developments, providing that (1) the proposal is consistent with the Kapolei Master Plan of The Estate of James Campbell and (2) the proposal addresses the necessary infrastructure and public service requirements. Within this three-year period, the Board supported or had no objections to the following projects:

   - Urban designation of 130 acres in Kapolei;
   - The 27-hole Golf Course by The Myers Company;
   - Kapolei Knolls;
   - Ewa Gentry;
   - 64-acre expansion of the James Campbell Industrial Park;
   - Puuloa Golf Course;
   - City's proposal to remove the vehicle shredder facility from the Ewa Development Plan Public Facilities Map;
   - Kapolei Town Center (with request to see overall plan);
   - Rezoning of 96 acres in Kapolei City to B-2;
   - Ko Olina Phase 2 (with stipulations regarding Kamokila Park relocation);
   - Preservation designation for Midden Beach; and
   - Continuing the use of Hawaii Raceway Park at the James Campbell Industrial Park until lease termination.

Issues and concerns within the last year are as follows:

Gang Violence -- The Board was very concerned about increased gang violence and drug abuse in schools and parks and at the shopping center.

Transportation and Traffic -- The Board was instrumental in new bus stops and more busses serving the Ewa area. Members monitored current needs for improved roadway facilities and continued to urge good planning measures in preparing for Ewa's growth. They supported a fixed rail system with a terminus at Waiawa and possible expansion to Ko Olina.

Height Changes -- The Board generally supported height increases at Kapolei and Makakilo, providing the new height limits are consistent with the FAA.

Concern Over Some Proposals -- While the Board continued to support proposed developments which were consistent with the Kapolei Master Plan, members raised concern over some proposals which may affect nearby residents. The Board was concerned about potential heavy industrial use at the proposed Kapolei Business-Industrial Park, as well as noise and light impacts of a proposed Ko Olina Tennis Center. The Board could not reach a majority in supporting or opposing a proposal to establish a temporary dirigible testing site at Makaiwa. Further, even though the Board supported the existing and temporary Hawaii Raceway Park, members encouraged that a permanent site be found outside the Ewa region.

4.1.2 The Secondary Urban Center Community Advisory Committee

The Estate of James Campbell assembled the Community Advisory Committee on the Secondary Urban Center. Comprising representatives of Ewa community organizations, this group provided community input into the Estate's planning process.

In 1987, a series of community workshops were held to define community issues and needs for community services and facilities. The workshops focussed discussions in:

* *governmental services*, including programs and facilities for transportation, police and fire protection, medical and emergency rescue, civil defense and governmental offices;
* *education*, including programs and facilities for child care, preschool, and secondary, higher and continuing education; and
* *recreation/culture/art*.

Although this information is already three years old, it remains useful because it indicates the community's expectations regarding the Second City. The following summarizes the recommendations of these efforts, as reported in Ewa Secondary Urban Center: Workshops on Community Facility Needs and Solutions (Phillips Brandt Reddick and Associates (Hawaii), Inc., 1987):

1. **Governmental Services.**

   Police protection: supported fully-operational police station in the Ewa (Kapolei) Town Center

   Health care facilities: recommended siting of emergency ambulance service to be reassessed in terms of future needs, and that this service be located near the proposed Ewa (Kapolei) Town Center

   Public transportation services: supported transit line extending to Ko Olina, recommended more evaluation of viable water transportation and recommended shuttle service linking main shopping areas and transit terminals

Secondary City Hall/auxiliary State offices: supported the location of a civic center in the Ewa (Kapolei) Town Center; recommended a secondary City Hall providing a full range of services and auxiliary state offices

Civil defense services: recommended that a civil defense communication center be located in the Ewa (Kapolei) Town Center to include emergency rescue services and a helipad

2. **Education.**

- recommended setting aside relatively level and "expandable" sites for all schools; move West Oahu College to the second city; locate high technology and adult education programs at the James Campbell Industrial Park; provide adequate space for resource teachers and the arts; schools should be within walking and biking distance from residences; provide water sports at West Beach (Ko Olina) marina; set aside sites for day care centers; provide adult education programs in high schools and colleges; provide sites for private schools; develop aquaculture facility at the Barbers Point Harbor

3. **Recreation/culture/art.**

- provide active recreation and cultural facilities at the planned Kapolei Regional Park; delete the proposed Makakilo District park; transfer Ewa Beach and Ewa proposed park funds to the Kapolei Regional Park; locate a central library and museum adjacent to the Kapolei Regional Park; develop a public golf course in Ewa

Where appropriate, these recommendations have been incorporated in plans for the Kapolei Town Center (Helber, Hastert & Kimura, Planners, 1988).

4.2 PRELIMINARY EWA ISSUES RELATED TO MAKAIWA HILLS

4.2.1 Description of Those Interviewed

The 32 people interviewed for this project represented a cross section of interests regarding Makaiwa Hills. All of those interviewed lived in the study area, or conducted business near the project site.

Those interviewed were asked to provide their perspectives on how the proposed project might affect the nearby uses and the regional community. They were not asked to represent the views of their organizations, although if the organization has taken a formal position, then they were asked to discuss these positions. Further, some of those interviewed were asked to provide information about their respective area of expertise, in addition to their perspective on project issues. The total does not equal 32 because some people belonged to more than one category. The following is a rough breakdown of these interests.

* Over 80 percent of those interviewed -- 27 out of 32 -- were residents. Twenty of the residents belonged to regional organizations, such as the Ewa Neighborhood Board, the Makakilo Community Association, and the Honokai Hale/Nanakai Gardens Community Association.

* Seventeen informants lived in Makakilo and Honokai Hale/Nanakai Gardens. Seven of these lived adjacent to the southeastern boundary of the project site. The others were either Ewa Neighborhood Board members, or members of community associations.

* Ewa Beach and Ewa residents accounted for ten of the interviews; all were Neighborhood Board members.

* The five non-resident interviewees operated a business near the project site.

The interviews were conducted for *issue identification*, and not to quantitatively assess support or opposition. Such quantitative information could be produced only through a poll or survey, neither of which were included in Earthplan's scope of work.

4.2.2 Summary of Issues and Concerns

As of this writing, project presentations have been made to community associations near the project site, but not to the Ewa Neighborhood Board. The Development Plan/Environmental Assessment for the project or Summary Sheet were mailed to some of those interviewed, including those who were officers in community organizations and those who own property adjacent to the project site.

Many of those interviewed knew about Makaiwa Hills from the printed material or the Ewa Master Plan, but were unaware of specific acreages or unit counts. In conducting interviews, the consultant provided information as included in the Development Plan/Environmental Assessment. In two instances, informants chose to withhold their reactions until a presentation was made to the Ewa Neighborhood Board.

This identification of issues is preliminary. As the study progresses, and as more people learn about specific aspects of Makaiwa Hills, the issues may change to reflect greater awareness of the project and changing community values.

Except for reactions to the project's housing component, there were no extremes in opinion to either development in Ewa or the Makaiwa Hills project. The proposed project generated neither overwhelming support nor strong opposition; instead Makaiwa Hills stimulated discussion primarily about Ewa development and secondarily about people's concerns regarding the site and project components.

The following summarizes reactions and opinions shared in the interview process:

1. **Moderation of Support/Acceptance of Ewa Development.**

   Ewa organizations, and presumably the constituents they represent, have historically supported the development of a second city. This support continues, but informants are exhibiting slightly more caution about growth than previously found in other studies.

   Most of those interviewed felt that Ewa development is generally good, but stressed that public facilities and services must keep pace with this development. Some expressed resignation at an inevitable future of an urban environment; they neither liked or disliked what was to come. A few felt overwhelmed by the pace of change; two people indicated that they planned to leave in a few years because of the increased population.

   The effect of Ewa development on property values was a concern. Although some appreciated higher property values, others feared that older residents would be unable to keep up with increased property taxes.

2. **Predominance of Regional Issues.**

   Most of the issues raised by those interviewed concerned the effects of Makaiwa Hills on the region, rather than on the immediate environs. Almost all of those interviewed wanted developers and public officials to make sure that regional infrastructure systems are improved at the same pace as development. Some stressed, however, that they did not necessarily hold private developers responsible for the infrastructure. Rather, they felt that the public sector, having advocated the second city concept, should be spearheading efforts to improve facilities. Further, informants were concerned that, even though much planning is going into the development of Kapolei, infrastructure improvement may end up being reactionary rather than pro-active.

   Well-planned adequate infrastructure systems were desired by most:

   * Informants questioned the adequacy of the existing water supply; some urged desalination while a few did not want to see valuable water used to keep golf courses green.

   * The capacity of Honouliuli Sewage Treatment Plant was a concern of many, and they wanted to see secondary treatment established before major growth occurs.

   * Traffic was the most frequent issue, and many felt that growth is already taking its toll. Wider roads and fixed transit were recommended.

* People were also concerned about whether the existing and planned public schools were adequate to meet the increased demand resulting from the project.

The other regional issue was housing. Most of those interviewed did not object to upscale and executive housing. They suspected that there is a market for such housing and that the project would only be built if it were an economically-feasible venture. There was also a feeling that the more affluent residents would help Ewa's economy and "round out" the social characteristics of the Ewa region. Those who had no objection to upscale housing generally did not mind locating the project's affordable requirements off-site.

Others wanted to see a more mixed community. They felt that there should not be any kind of exclusivity in Ewa. To them, the affordable units should be on-site, and that there should be more multi-family units.

3. **Site Specific and Non-Housing Project Components.**

The site specific issues were raised by residents of Honokai Hale/Nanakai Gardens and Makakilo, as well as by other users near the project site. Ewa Beach and Ewa Villages residents tended to deal with region-wide issues.

Residents and users makai of the project site were very concerned that the development of the project site may cause drainage problems for the lower areas. These informants also expressed apprehension that construction impacts of dust and noise would directly impact them because of prevailing tradewinds. Makakilo residents were not worried about construction.

Honokai Hale/Nanakai Gardens residents remembered that the on-site Makaiwa Gulch was previously proposed for a landfill. They felt that Makaiwa Hills is a much better alternative.

People who lived or operated an activity mauka of the project site were concerned about how the project might decrease their isolation.

The only reaction regarding the commercial component was favorable; nearby residents wanted the convenience of a new regional shopping center. A possible golf course received mixed reactions. Some felt it would improve the project site's frontage along Farrington Highway; others either did not see a need for the golf course or felt that it was a waste of water. There was also concern that the on-site school may end up being "exclusive" because of the upscale nature of the project.

4.2.3 Ewa Development In General

Ewa organizations, and presumably many of the constituents they represent, have supported the development of a Second City in Ewa for many years. As shown in Section 4.1.1, the Neighborhood Board expressed support for almost all of projects reviewed by its members. Over the past few months, however, the Neighborhood Board has been tempering its support for some projects with concerns about impacts on neighbors. There is also increasing concern about the adequacy of existing and planned infrastructure.

In the interviews for this project, most of the informants wanted to see Ewa developed as the secondary urban center. They cited job and housing opportunities as favorable elements, but mostly just anticipated the realization of a long-time vision. Compared to previous interviews for other Ewa projects, however, we found an increasingly-used caveat attached to support for Ewa development. Almost all of those who favored Kapolei stressed that public facilities and services must keep pace with this development. This is different from previous studies which indicated strong, and almost unconditional, support for the direction of Ewa's growth.

Those who did not favor major growth at Kapolei fell into two categories. First, there were those who were resigned to the urban environment envisioned in public policy. They felt that the forces for change were much bigger than them. Even though they preferred Ewa the way it is now, they were still willing to live in the new second city. They felt that certain benefits, such as increased convenience and property values, offset the loss of the existing lifestyle. Second, there were those who felt overwhelmed by the pace of change; two people indicated that they planned to leave in a few years because of the increased population.

Development's impact on property taxes was viewed as a "double-edged" sword. While many appreciated higher property values, there was also apprehension about the effect of increases property taxes on those with fixed incomes. The elderly would be especially burdened, and informants did not want to see older people forced out of their homes.

4.2.4 Regional Makaiwa Hills Issues

Almost all of those interviewed were more concerned about the regional and cumulative impacts of projects such as Makaiwa Hills, rather than site specific issues. This may be because, with Makaiwa Hills being the last of the Ewa Master Plan projects to begin seeking approvals, the existing residents are already experiencing some of the impacts of growth, such as increased traffic. Further, the project site is virtually unused by the public. With no homes, jobs or recreation value, Makaiwa Hills was little known by the community.

1. **Regional Infrastructure Systems.**

   Almost all of those interviewed wanted developers and public officials to make sure that regional infrastructure systems are improved at the same pace as development. Some stressed, however, that they did not necessarily hold private developers responsible for the infrastructure. Rather, they felt that the public sector, having advocated the second city concept, should be spearheading efforts to improve facilities. Further, informants were concerned that, even though much planning is going into the development of Kapolei, facility improvement may end up being reactionary rather than pro-active.

Traffic was the most frequent concern. Informants felt that growth was occurring with no major regional roadway improvement being constructed, and were afraid that improvements would not be made until there are major problems. With fixed transit being a long-term solution, those interviewed felt that road widening and a new North-South road were at least short- and mid-term solutions to traffic problems. They advocated that these be constructed now, rather than wait until the demand becomes unbearable. Some pointed out that there is already backup on Fort Weaver Road, with the addition of Ewa Gentry and West Loch homes.

Of less concern, but still frequent, were *water-related issues*. Informants were concerned that the existing water supply may be inadequate for future uses and did not want their own water supply diminished because of bad planning. Some people felt that desalination was a viable, though long-term, solution. A few did not want to have to compete with golf courses for their water supply.

The capacity of *Honouliuli Sewage Treatment Plant* was a concern of many, and they wanted to see secondary treatment established before major growth occurs. They were concerned that development is occurring without firm commitments to upgrade and expand the sewage facility.

People were also concerned about whether the existing and planned *public schools* were adequate to meet the increased demand resulting from the project.

2. **Housing.**

All of those interviewed were informed of or knew about the upscale nature of housing proposed in Makaiwa Hills. Most did not object to this type of housing in Ewa. They felt that the project would only be built if there were a sure market for it. These people also liked the idea of having a community of executives, retirees and second-home owners. They felt that these residents would contribute to the economy and help diversify the social characteristics of the region. Those who had no objection to upscale housing generally did not mind locating the project's affordable requirements off-site. They were satisfied that Makaiwa Hills would meet its requirements, and that there were other Ewa communities which would accommodate affordable housing.

- A few of these people who liked the upscale nature of Makaiwa Hills did not want to see a prevalence of affordable housing in Ewa. They preferred market housing for both philosophical and economic reasons.

  At the other extreme were those who felt that the public and private commitment to establishing affordable housing in Ewa should be applied to each individual project within its boundaries. They wanted each planned community to contain a mix of housing types and prices, with an emphasis on affordability. They felt that there should not be any kind of exclusivity in Ewa.

  Some people felt that, because there is no compelling public need for executive housing (unlike affordable housing), Makaiwa Hills should not inconvenience the community in any way. The project developer should have to pay for all infrastructure improvements, and should ensure that neighbors are not inconvenienced in any way.

4.2.5 Site-Specific Issues

Drainage impacts was a big concern for those who lived or operated a business makai of Farrington Highway. They cited instances of increased surface runoff during heavy rain. Runoff became severe for some whenever land clearing occurs during rainy months. These people wanted to make sure that drainage problems will not recur during construction or result from impervious surfaces created by development; they asked that the project drainage study be made available to the community.

Another issue raised by makai residents was *construction impacts*. These informants feared that Honokai Hale/Nanakai Gardens residents would experience increased dust and noise during construction, particularly because of prevailing tradewinds. Some asked if blasting would occur.

It was pointed out that Honokai Hale/Nanakai Gardens has been experiencing impacts due to nearby construction for many years. In the development of the Barbers Point Deep Draft Harbor, residents filed lawsuits because of damages to property and structure resulting from blasting. Later, with the construction of the Ko Olina marina and golf course, residents again experienced increased dust and noise. Because of the close working relationship with the Ko Olina developer, however, such impacts were monitored and mitigated. The developer hired a cleaning service to clean floor surfaces and draperies in individual homes not soiled by construction-related dirt; the service was available by request. Interviewees suggested that the Makaiwa Hills developer consider similar mitigation. Makakilo residents were not worried about construction.

As Section 5.3 discusses, the uses mauka of the project site either depend on or enjoy a large degree of *isolation*. Those interviewed felt that Makaiwa Hills would bring residences closer to them, thereby decreasing their isolation.

Generally, those interviewed did not volunteer many comments regarding the specific project components other than housing. The following summarizes their reaction to non-housing project components:

* Nearby residents liked the commercial component. They looked forward to having a new regional shopping center nearby, mostly because of the convenience. Jobs played a secondary role, presumably because Kapolei City and Ko Olina would be the main job generators.

* A few people, generally those who were opposed to an upscale community, were concerned about the Makaiwa Hills school. They did not want this school to end up "exclusive," in the sense that it would be attended only by affluent children.

* A possible golf course -- though not a project component at this time -- received mixed reactions. Some felt it would improve the project site's frontage along Farrington Highway; others either did not see a need for the golf course or felt that it was a waste of water.

5 POTENTIAL SOCIAL IMPACTS OF MAKAIWA HILLS

This section identifies potential social impacts related to the Makaiwa Hills. Section 5.1 describes project population impacts. The regional effects of Makaiwa Hills are described in Section 5.2, while Section 5.3 identifies project impacts on the nearby uses. Section 5.4 presents impacts on on-site uses. Impacts of public services and facilities are presented in Section 5.5.

5.1 POPULATION IMPACTS

Table 7 shows that Makaiwa Hills will increase the Ewa region population by an estimated 6,400 persons. When compared to the potential population allowed by current Development Plan designations, the project-related population is expected to be less than that already accommodated, as follows:

1. The project site already has 103 acres designated Low Density Apartment and 40 acres designated Residential
2. When deducting the amount of land which would be used for roadways, infrastructure and common areas (25 percent), there is a net acreage of 77 acres in Low Density Apartment and 30 acres in Residential.
3. Based on the densities allowed in the Special Provisions of the Ewa Development Plan, the project site has the potential for 2,318 low-density apartment units and 360 residential units, for a total of 2,678 units.
4. An average household size of 3.03 persons would result in a population of 8,100 persons, which is over 1,600 persons more than what the proposed Makaiwa Hills would generate. Ewa traditionally has large households. It is assumed that as the area is developed, Ewa's households will decrease in size because the population will evolve to be similar in characteristics as the islandwide population. The future Ewa region will likely resemble other regions such as Central Oahu and East Honolulu. Hence, an average household size of 3.03, which is smaller than the existing Ewa average, but the same as household sizes for Central Oahu and East Honolulu, is used to predict the future population of Ewa.

The current Low-Density Apartment and Residential designations were enacted by City Ordinances 86-75 and 89-141. These areas have already been accounted for in the potential population presented in *Table 5* of Section 3. Note that the land was incorporated in other developments, including the "West Beach Expansion" (Ordinance 86-75) and Kapolei City (Ordinance 89-141).

It is estimated that, with the projects already appropriately designated on the Ewa Development Plan Land Use Map, the 2010 Ewa population is projected to reach 131,400. With the Makaiwa Hills project, the estimated Ewa population for 2010 would decrease by about 1,600 persons to 129,800 persons. Makaiwa Hills is therefore within the 2010 population guidelines set forth by the City and County of Honolulu General Plan.

Table 7
Population Impacts of Makaiwa Hills

Potential On-Site Residential Population Currently Allowed on the Ewa Development Plan	
Number of Acres Designated Low-Density Apartment	103
Net Acreage for Low-Density Apartment (1)	77
Potential Number of Apartment Units (2)	2,318
Number of Acres Designated Residential	40
Net Acreage for Residential Uses (1)	30
Potential Number of Residential Units (3)	360
Total Number of Residential and Apartment Units Based on Current Development Plan Designations	2,678
Total Population Which Can Be Accommodated On-Site Based on Current Development Plan Designations (4)	8,113

Population Impacts of Makaiwa Hills	
Number of Proposed Residential Units	2,130
Project-Related Potential Residential Population (4)	6,454
Increase/(Decrease) of Population Compared to What Can Be Accommodated Under Current Designations	(1,659)

Notes:

(1) Based on subtracting 25% of land used for roads/infrastructure and common areas

(2) Based on 30 units/acre, as allowed by the Special Provisions of the Ewa Development Plan, Section 32-3.2(a)(4)(B)

(3) Based on 12 units/acre, as allowed by the Special Provisions of the Ewa Development Plan, Section 32-3.2(a)(4)(A)

(4) Based on average household size of 3.03. Although Ewa currently has higher-than-average household size, it is expected that the addition of different types of housing units, and the inclusion of new households will result in a region reflecting a cross-section of Oahu's households. It is expected that Ewa will resemble Central Oahu and East East Honolulu in terms of household sizes.

Proposed Mitigation

No mitigation is required, since the project is within population guidelines.

5.2 IMPACTS ON THE REGIONAL CHARACTER

5.2.1 Probable Non-Project Changes

Section 3 discusses how public policy intends that the Ewa region more than triple in population over the next twenty years. In the vicinity of the project site, the City of Kapolei is intended to be the nucleus of the secondary urban center. Ko Olina Phase 1 is under construction, and Ko Olina Phase 2 is undergoing location changes, but has the necessary designations. Sitework for the Kapolei Shopping Center has begun and Makakilo continues to grow with ongoing residential development.

By the time Makaiwa Hills is implemented, the existing community will therefore have been undergoing a gradual adaptation to this major influx of new people. Some of the changes which may have occurred prior to project implementation are as follows:

1. **Population and cultural diversification.**

   When compared to the islandwide community, the 1980 Ewa community tends to be slightly younger, and contain significantly higher proportions of Caucasians and Filipinos. Ewa had proportionally (1) fewer people born in Hawaii, (2) more people born in other parts of the United States, and (3) slightly less foreign-born residents. Residents of Ewa tended to be less educated than the islandwide community, and the mean family income was lower.

   Before the onset of Makaiwa Hills, the residential profile of the Ewa region will have begun to reflect more of a cross-section of the islandwide community. Residents of Honokai Hale/Nanakai Gardens will already have experienced a diversity of new residents from nearby Ko Olina Phase 1, Kapolei and Makakilo. Though many of these developments will offer affordable housing, many of the new residents will be part of the market housing segment and will therefore have incomes above the current median income level for the Ewa area.

   With these changes will come cultural diversity. Adaptation will begin with competition for jobs at the new resort and shopping center, shared use of new commercial areas, altered make-up of schools and community organizations and shared new recreation areas.

2. **Disruption of the slow-paced lifestyle.**

The initial impact of impending change is a change in the current slow-paced lifestyle which characterizes the residential communities of the Ewa region. The existing communities may experience difficulty in adjusting to the changes which are likely to develop. Some of these changes include (1) the potential increase in crime; (2) disturbance of community cohesion due to economic disparities; (3) crowding at recreational and commercial facilities; (4) increased traffic; and (5) transitional effects of new schools.

3. **Competition for public facilities and services.**

With the increased residential and de facto population will come increased competition for public facilities. New Ewa residents will attend the same churches and schools as existing residents; they will increase the need for police and fire protection; they will add cars to the streets. Even though new public facilities will be built and public services expanded, existing residents will nevertheless be aware of having to share these with more people.

4. **Shift in employment patterns and increased job competition.**

As Makaiwa Hills is implemented, the Ewa region will already have experienced an increased diversity in types of employment. Many current Ewa residents who are currently working outside Ewa will have jobs closer to home. Many unemployed and currently employed people working in other parts of Oahu will seek jobs in the City of Kapolei, nearby clubhouses at golf courses, day care centers, schools, new resort hotels and at the industrial park. The new residents of Ko Olina, Makakilo and Kapolei will also be competing for the same jobs. This period of adjustment to a new lifestyle will be difficult for many Hawaii-born residents who need jobs but lack training.

5. **Introduction of visitor industry to the Ewa region.**

By the time Makaiwa Hills is underway, the visitor industry will have been introduced to the Ewa region. Cultural diversification will increase as residents interact with non-Hawaii residents at Ko Olina and at restaurants and shopping malls. Also, many residents will have visited the restaurants and shops and some will be employees at these facilities.

5.2.2 Potential Project Impacts on Regional Character

1. Consistency with Growth Policies.

The City and County of Honolulu General Plan encourages the development within the secondary urban center at Kapolei to relieve developmental pressures in urban Honolulu. Ewa is targeted to meet housing needs not readily provided in the primary urban center. A major consideration in public policy is to redirect traffic currently flowing into Honolulu proper by providing alternative employment centers and residences outside of the existing urban core.

Part of the Campbell long-range master plan for Ewa, Makaiwa Hills is the last planned community to begin efforts in seeking land use approvals. Other planned communities either have secured their State and Development Plan approvals, or have had their initial phases approved. The proposed project is an integral part of public and private efforts to establish a secondary urban center in Kapolei. Makaiwa Hills addresses the island's housing need and will provide economic opportunities and employment at the proposed regional shopping mall.

Proposed Mitigation

No mitigation is recommended, since the project is consistent with public policies regarding growth in the secondary urban center.

2. Addition of Another Hillside Development.

Until recently, Ewa was characterized by pockets of military and residential communities separated by vast agricultural fields. The openness extends to the mountains, where Makakilo, the sole mauka community, was surrounded on three sides by hundreds of undeveloped acres of land.

This picture changes every day as construction machinery clears the land and replaces a portion of the plain's vastness with homes, streets, landscaped greenery and hotels. Even the mountains are already changing as Makakilo extends its community to the east and west.

Makaiwa Hills will join Makakilo as another hillside community. This means that, with the Makakilo expansion, the predominant open space character of the mountains will be transformed into an extension of the makai urban environment.

Makaiwa Hills is not expected to adversely affect the regional character, however. The project is not a high-density community, nor will it be continuous rows of houses forming a hillside grid. Rather, the proposed project is envisioned as pockets of well-designed townhouses and single-family homes punctuated by gulches and ravines. As pointed out earlier, almost a half of the project site is proposed for Preservation designation. Further, it is noted that, because of the site's topography, much of the upper portion of the project site will not be visible from makai communities or the freeway.

Proposed Mitigation

As long as the site's topography is incorporated into design and the project site does not undergo extensive grading and filling, it is expected that Makaiwa Hills would provide an attractive backdrop to the urbanized makai landscape. Hence, no mitigation other than sensitive planning is required.

3. An Upscale Community.

Makaiwa Hills is targeting executives, professionals, retirees and second home buyers. It is considered an upscale community, and Campbell Estate executives have likened it to Waialae Iki, an executive community overlooking the Waialae Country Club (Yamaguchi, 1990).

The project is part of an overall private and public effort to attract, house and employ people in the upper income range. With its marina orientation, Ewa Marina is expected to attract people with high incomes in both its residential component, visitor accommodations and health and fitness center. Likewise, Ko Olina's hotels and residences are already being sold with their high price tags. Finally, those projects with golf courses, including publicly-sponsored communities, feature executive homes with golf course frontage.

The proposed project is perhaps the only Ewa project being publicized as an upscale executive community. In the overall housing scheme for Ewa, Makaiwa Hills would provide housing choices for executives working at Kapolei City, thereby adding to locational and economic choices in the high-end housing market. Hence, Makaiwa Hills functions as an integral part of the Second City concept.

Whether or not Makaiwa Hills contributes to or causes social conflict because of its upscale nature is unknown at this time. For the existing and new Ewa residents, the upscale nature of Makaiwa Hills may not be a problem if the region is socially and economically integrated at the time of project implementation. Such integration requires several factors. There needs to be a wide range and locational mixing of housing types. Community organizations should be easily accessible for residents and there should be no apparent exclusionary groups, facilities or areas. People feel comfortable with socio-economic diversity if they believe they have physical, legal and some economic access to most facilities. They need to believe that they have -- or can attain -- the same ability as others to compete for jobs and public services.

Social disharmony can occur when a definable group feels excluded from a facility, area, service or otherwise resource they wish to access, and at this time, there is no way of knowing if Makaiwa Hills will foster or encourage a sense of exclusion. Specific rules which prohibit access would exacerbate tension between the "haves and have-nots." Further, an individual's anxiety during personal economic crisis is heightened when faced with evidence of "conspicuous consumption" (expensive cars, exclusive clubs, designer clothes, etc.) exhibited by the wealthy.

Conflict would also occur if, to house upper income families, Makaiwa Hills would displace a public use or resource, such as recreation. No on-site community uses exist, however, and the project will not eliminate an important public resource.

Proposed Mitigation

Public officials and private developers need to monitor the social development of the Ewa region, as well as the market for the proposed project. If conditions at the time of implementation signal potential disharmony or social conflict, then effort is needed to work with the future Ewa community to mitigate anticipated problems.

4. Location of Affordable Units.

It is expected that the developer of Makaiwa Hills will comply with affordable housing requirements. Options include on- or off-site affordable units, an in-lieu contribution, or a combination of these.

By itself, Makaiwa Hills would not have a negative social impact if the affordable units are located off-site. If there is a regional trend towards this option, however, then there is a potential for locating all of these off-site affordable units in one area -- either in Ewa or outside the region. This would lead to a socially-undesirable situation because it would physically segregate people of low or moderate incomes.

Likewise, if the project's affordable unit requirements are met on-site, it is recommended that the affordable units are interspersed with market units as much as possible. Again, it is important to avoid communities which are obviously the poor counterparts of the affluent neighborhoods.

Proposed Mitigation

The only way to avoid establishing economically homogeneous communities is to develop appropriate public policy on locating off-site affordable units. It is highly recommended that Ewa developers assist City and State officials in developing effective policies and implementation mechanisms.

5.3 IMPACTS ON NEARBY USES

5.3.1 Overview of Nearby Uses

1. North or Mauka of the Project Site

Three separate operations currently occur above the Makaiwa Hills project site, two of which are on lands owned by the Estate of James Campbell:

1. *Camp Timberline* sits on ten acres of Estate property above Makaiwa Hills and is accessible via roadways in Makakilo. Owned by the St. Andrews Priory School, Camp Timberline is an isolated mountain retreat with 120 beds, tent sites, a dining area and

gathering place, a swimming pool, basketball and volleyball court and hiking trails. Approximately 12,600 people use the facility annually, and they are from community groups, church organizations, and schools. Two families reside on-site year round. (Camp Timberline, n.d. and personal communication with Wanda Gereben, Administrator, Camp Timberline, November 6, 1990).

2. The *Palehua Solar Observatory* is one of the sole network of six facilities throughout the world which maintain a 24-hour watch of solar activity. The sun has a wide variety of effects and these facilities report certain solar activities, such as solar flares and associated radio bursts, within two minutes of occurrence. The only networked facility in Hawaii, the Palehua Solar Observatory has an optical telescope and a series of radio telescopes. The observatory is located on approximately five acres owned and operated by the U.S. Air Force (personal communication with Captain Phil Nostrand, Detachment Commander of the Palehua Solar Observatory, November 5, 1990).

3. The Estate maintains *17 "campsite leases"* above the camp and observatory. The ten-year leases were initiated in the 1940s and cover areas ranging from .16 to 15.8 acres. The twenty houses situated here are used as second homes and primary residences. A general caretaker lives on-site, and some of the lots contain caretaker cottages.

2. Makai of the Project Site

Farrington Highway separates Makaiwa Hills from *Honokai Hale and Nanakai Gardens*, two contiguous residential communities. These communities include 290 residential units and are across Farrington Highway. Nanakai Gardens is the older of the two, having been developed in the mid-1960s; that subdivision contains 130 single-family units. Honokai Hale contains 160 single-family units and was built in the early 1970s.

Further makai of the project are the Ko Olina Phases 1 and 2. Under construction, Phase 1 includes 5,200 residential units, 4,000 visitor units, a golf course, a small marina, four new sandy beaches, a Hawaiian cultural center, and other amenities. Phase 2 is currently seeking Urban designation in the State Land Use Map and re-configuration in the Ewa Development Plan. That phase includes 1,500 low-density apartments, 2,000 medium-density apartments, a golf course and support facilities, and a shopping center with retail-commercial development and a low-rise garden office complex.

3. East of the Project Site

Located east of the project site Gulch is *Makakilo*, a 23-year old residential community offering mid-priced, single family and multi-family housing, and support public and commercial facilities. Most of the 2,800 residential units (as of December 1989) are single-family units. Expansion plans include adding between 2,000 and 3,000 residential units over the next ten to 15 years. Also, a golf course is planned for the slopes of Puu Makakilo. The privately-owned and -operated *Palailai Sanitary Landfill* is located near the lower portions of the project site; the landfill is closed and is being monitored. Eventually, this area will be converted into a park.

4. West of the Project Site

The *Waimanalo Gulch Landfill* is in the gulch just west of the Makaiwa Hills project site. The public landfill accepts both ash from HPOWER, which is mono-filled, or stored in a separate area, and unburnable waste from all over Oahu. According to the private operator which is under contract with the City, the landfill has a 14-year remaining life, after which the land can be transformed into a park.

5.3.2 Impacts on Nearby Residential Uses

1. Honokai Hale/Nanakai Gardens

These communities are stable from a planning standpoint, in that no expansion and major changes are programmed. The anticipated changes in Honokai Hale/Nanakai Gardens -- *independent of Makaiwa Hills* -- will therefore be caused by external forces and are expected to be both physical and social in nature.

As property values increase, residents of these communities may take financial advantage of this appreciation for home improvements, or may choose to sell their units at these higher prices. An obvious change in the community will be larger units, as people add home improvements, or build new units. In fact, it was observed during the course of this study that some of the houses were already being improved or transformed. Unless the relatively small lots are consolidated, it is unlikely that much physical change will occur beyond that. There also appeared to be real estate activity, as evidenced by the for-sale signs in front lawns.

For those with fixed incomes, increased property taxes may be a hardship. In particular, the elderly, which census shows are numerous in the area, may have difficulty keeping up with tax payments. Their options may be to sell their houses and move, or bring in their family or renters to help them pay increased expenses. Either way, this situation with the elderly, as well as increased real estate activity, will lead to new people moving into Honokai Hale/Nanakai Gardens.

With Makaiwa Hills, Honokai Hale/Nanakai Gardens will be sandwiched by a makai upscale resort residential community and a mauka residential community characterized by executive homes. The project will therefore add to the situation of increased property values and corresponding property tax increases.

The proposed project will also alter the mountain backdrop by introducing pockets of townhouses and single-family homes punctuated by gulches and ravines. This means that the predominant open space character of the mountains will be transformed into an extension of the makai urban environment.

Makaiwa Hills may have drainage impacts on the communities located makai of Farrington Highway, and in the interviews conducted for this study, Honokai Hale/Nanakai Gardens residents expressed apprehensions about surface runoff.

Possible short-term impacts on Honokai Hale/Nanakai Gardens residents may arise from construction activities. Dust and noise may adversely affect makai neighbors, particularly because of the prevailing tradewinds.

Proposed Mitigation

There is no mitigation which can be undertaken by Makaiwa Hills to change the property value increase occurring in Honokai Hale/Nanakai Gardens. This is an impact which is already occurring due to the Ko Olina and Kapolei developments; this trend would continue even if Makaiwa Hills were not built.

Makaiwa Hills is not expected to adversely affect views of the mountain as seen by Honokai Hale/Nanakai Gardens residents. Almost half of the project site is proposed for Preservation designation, and, because of the site's topography, much of the project site will not be visible from makai communities or the freeway. Hence, no mitigation other than sensitive planning is required.

It is assumed that the engineering studies conducted in this Environmental Impact Statement process will recommend measures to avoid drainage impact.

The residents of Honokai Hale/Nanakai Gardens have been experiencing the effects of construction for many years, with the construction of the Barbers Point Deep Draft Harbor, Ko Olina and freeway improvements. Although adherence to public regulations may sufficiently avoid negative construction impacts, it is recommended that the developer of Makaiwa Hills meet with the residents to see what kinds of additional measures might be necessary to ensure minimal or no impact.

2. Makakilo

Unlike Honokai Hale/Nanakai Gardens, Makakilo's changes will be driven by both external and internal forces. The external forces which will change Makakilo are related to all of the development activities occurring makai of the freeway. The internal force for change is the master plan for Makakilo, as directed by Finance Realty. Both external and internal changes are already occurring.

The likely trend of increased property values, to which Makaiwa Hills will contribute, is the same for Makakilo as for Honokai Hale/Nanakai Gardens. As noted earlier, increased property value can be a positive change if one could capitalize on equity increase; it is a negative change if one could not keep up with corresponding increased property taxes.

The project is expected to have minimal construction impacts on Makakilo residents because of prevailing tradewinds.

The proposed regional shopping center would be conveniently located for Makakilo residents.

Proposed Mitigation

As with Honokai Hale/Nanakai Gardens, there is no mitigation which can be undertaken by Makaiwa Hills to change the property value increase occurring in Makakilo.

No mitigation is necessary to mitigate visual impacts.

Because no or minimal construction impacts are expected to affect Makakilo residents nearest the project site, no mitigation is recommended except for strict adherence to public regulations governing such activities.

5.3.3 Impacts on Ko Olina

Ko Olina's Phase 2 golf course will be the project component closest to Makaiwa Hills. Apartments, a commercial and office garden complex and public facilities would be the uses located around and makai of the golf course. Further makai are the resort, residential and other uses proposed in Ko Olina Phase 1. Makaiwa Hills is expected to have little or no impact on Ko Olina.

The two phases of Ko Olina, as well as other developments in Kapolei, include commercial uses. While the Makaiwa Hills shopping center may be yet another amenity for Ko Olina guests and residents, it would also introduce another competitive element.

The proposed project will also alter the mountain backdrop by transforming the predominant open space character of the mountains into an extension of the makai urban environment. Makaiwa Hills is not expected to have a negative impact on Ko Olina because Ko Olina has a distinct ocean orientation. Further, the project is expected to be an attractive alternative to its current natural state

Proposed Mitigation

Because Makaiwa Hills would not necessarily have a negative impact on Ko Olina's commercial uses, no mitigation is required. It is noted that the Makaiwa Hills shopping center will not be the only competitor to the commercial uses of Ko Olina. Within Ko Olina, there will be separate commercial areas in its Phases 1 and 2 which may compete with each other. The Kapolei Business-Industrial Park also has a commercial component, as does the City of Kapolei.

The project is not expected to negatively affect mauka views from Ko Olina and no mitigation is recommended.

5.3.4 Impacts on Other Uses

1. Camp Timberline, Palehua Solar Observatory and "Campsite" Leases

These three uses are located mauka of the project site and all share a need or desire for isolation. All of them may be affected by the proposed project because Makaiwa Hills would add to Makakilo's efforts in building houses in the uphills.

Camp Timberline may have visual access to a portion of the project site, and campers may be able to see homes. This decrease in isolation would not necessarily hurt their operation, however. First, the homes nearest the camp would be custom lot homes at extremely low density; hence, campers would not see rows of houses, but large homes separated by open space. Second, any kind of off-site camp activity is oriented to the mountains; the project would not therefore not displace camp activity. Finally, although isolation is desirable, it is not imperative and the camp could continue its operation.

The Palehua Solar Observatory and other similar facilities depend on isolation because of (1) the need for security and (2) the equipment's sensitivity to nearby radio waves, noise and dust. In discussions with the detachment commander for this facility, three possible project impacts were identified. Note, however, that these are very preliminary and further discussions are needed with the Air Force:

(1) Short term construction-related impacts may arise. Noise and dust may interfere with the operations of radio and optical telescopes; cane burning has already affected this equipment.

(2) A long-term impact is potential radio interference of nearby machinery. Occasionally, the operation of weed-eaters can disrupt radio operations; more residents in the area increase the potential for ham radios, walkie-talkies, and transmission equipment.

(3) Another long-term impact is on-site security, which may need to be increased because of the proximity to more people.

A desirable aspect of the "campsite" leases is the isolation. Residents and those who occasionally use their on-site second homes are drawn to the this mountain because, within minutes of urban Honolulu, they enjoy seclusion and scenic panorama amidst natural beauty. It is believed that Makaiwa Hills would have minimal impact on these sites because Camp Timberline and the Palehua Solar Observatory provide a buffer between the proposed project and these sites. Makaiwa Hills may slightly alter the environment of these homes and vacation homes by bringing large-lot residential development closer to these people. Nighttime quality may change due to the introduction of street and house lights, albeit far away. The effect of Makaiwa Hills on the daytime environment is expected to be minimal. The largest lots -- which may include acre-lots -- would be closest to the campsite leases, and houses and development may only be visible from the southernmost campsites.

Proposed Mitigation

Seclusion is part of the camp's selling point. To retain Camp Timberline's isolation, the Estate of James Campbell should establish a buffer of forested land between the camp and the uppermost houses. This would provide privacy to both project residents and campers.

The Air Force has been added to the list of consulted parties for the Environmental Impact Statement. Further study by the Air Force is needed to see how Makaiwa Hills might affect the observatory's operations and to recommend mitigation measures.

Minimal or no project impact is expected for the Estate campsite leases and thus no mitigation is required.

2. Waimanalo Gulch Landfill

Makaiwa Hills is not expected to impact landfill operations. Rather, the sanitary landfill may produce occasional short-term discomforts for residents living in the lower northwestern portion of the project. Bad smells may offend residents on days when there is a combination of large quantities of organic material (such as fish) and Kona winds in a northeasterly direction. The landfill would not cause long-term visual impacts, since exposed portions are covered at the end of each day. Because of the safety precautions undertaken by the private operator, such as lining to prevent gas escape, the landfill in not expected to threaten the health or well-being of nearby residents.

A long-term benefit is the potential use of the covered landfill as a park, which would not occur until the 14-year life expectancy is completed.

Proposed Mitigation

A possible mitigation to offset some of the short term impacts is project phasing. The areas nearest the landfill could be left as one of the last to develop, and construction could coincide with landfill closure.

5.4 IMPACTS ON ON-SITE USES

5.4.1 Impacts on Existing Uses

The Estate maintains two separate grazing leases at the Makaiwa Hills project site. On approximately 100 acres of flatlands along the H-1 Freeway, less than two dozen cattle and horses are grazed in a single-person operation under a month-to-month tenancy.

Historically, a portion of the project site was part of the 4,700-acre Tongg Ranch. The Estate is currently negotiating new 15-year leases with former sublessees of Tongg Ranch and the operation is expected to continue as Palehua

Ranch. Palehua Ranch will comprise three parcels, the largest of which will be operated as Rocker G. Livestock Company. Of the company's 3,800 leased acres, 1,800 are part of the Makaiwa Hills project site.

Rocker G. Livestock Company grazes about 200 mother cows and their calves on the ranch. Additional income is derived by allowing 400 to 500 head of cattle from other ranches to graze on its land from about December through May. The nine part-time jobs generated by the company's operation are equivalent to two full-time jobs.

Makaiwa Hills will not impact the 100-acre single-person operation, which will be phased out in favor of the planned nursery operations (see "Possible Interim Uses").

The proposed project will remove about 1,800 acres from the grazing operation of Rocker G. Livestock Company. Although this will not require a reduction in the number of its own herd, the project will cause the elimination of temporary grazing of cattle from other ranches. Other grazing lands to replace those which will be required for the Makaiwa Hills project are not available in the area. No employment changes are expected.

Hence, Makaiwa Hills will be instrumental in reducing company revenues derived from temporary grazing and will require that other ranches find alternatives to the Palehua Ranch.

Proposed Mitigation

No project-generated mitigation is needed for the 100-acre single-person operation, since no project impacts are anticipated.

Although Makaiwa Hills will not effect a reduction on in Rocker G. Livestock Company's employees or its herd, the project will cause a permanent reduction in acreage available to other ranches, as well as an undetermined loss in revenues. This impact is irreversible, and no mitigation can offset project impacts.

5.4.2 Impacts on Possible Interim Uses

Before Makaiwa Hills is developed, the Estate of James Campbell plans to develop two nurseries on the project site. On a portion of the flatlands now used for the single-person grazing operation, a nursery will be a grow-out area for ornamental trees to be used for Ewa projects. This nursery will continue operation until the property is developed and between 15 to 20 full-time jobs are expected to be generated.

A few acres in the southeast corner of the project site will be part of another 20-acre nursery. This nursery will provide plants and trees for the Estate's Ewa projects. At peak operation, the nursery will generate about 20 jobs. Like the other nursery, this one will continue until the proposed project is developed.

K. P. Harvest, a private company, is proposing to conduct flight testing of a helium motorized spherical dirigible. The "Skywalker" testing is part of the company's effort to obtain an Air Worthiness Certificate from the Federal Aviation Administration (FAA). The company would lease 50 acres between the 300 to 500-foot elevation from the Estate; only 10,000 square feet would be used with the remaining land serving as a safety buffer. Company officials are currently in discussion with the FAA to see if this testing would interfere with existing flight patterns.

Proposed Mitigation

The phase-out of these nurseries are planned by the Estate and the project itself is not the cause of termination. Further, almost half of the project site would be left in Preservation and could be used for a nursery if continued nursery operation is desired at the time of project implementation.

The project would not impact the Skywalker" testing since the project is short-term; no mitigation is necessary.

5.5 IMPACTS ON PUBLIC SERVICES AND FACILITIES

5.5.1 Police Protection

1. Ewa's Crime Statistics

In 1988, there were a total of 410,719 reported offenses on the island of Oahu. Approximately 12.3 percent were Part 1 offenses, which includes the violent crimes such as murder, forcible rape, robbery, and auto theft. Twenty one percent of the total reported offenses were Part 2 offenses, which partially include arson, fraud, vandalism, substance abuse and stolen goods. The bulk of these reported offenses, over two-thirds, were vehicular accidents and miscellaneous reports.

As part of District III, the Ewa region is in Beats 325 (the project site, Honokai Hale/Nanakai Gardens and Makakilo), 326 (Ewa Villages, Honouliuli and NASBP) and 327 (James Campbell Industrial Park, Ewa Beach and IPP Military Family Housing). An additional beat, 325A, was recently included.

With 82,359 reported offenses in 1988, District III accounted for 20 percent of the total islandwide reported offenses. The breakdown of the District III's reported offenses was similar to the islandwide proportions.

Overall, Beats 325, 326 and 327 accounted for 12.8 percent of the total District III reported offenses in 1988.

These beats had a lower proportion of the more violent Part 1 reported offenses, with 11.1 percent of the total reported offenses, but a higher proportion of Part 2 offenses with 22 percent of the total (Honolulu Police Department, not dated).

2. Existing and Proposed Police Facilities

District III, which extends from Red Hill to Kaena Point and Kipapa Ridge, is handled by the Pearl City Police Station.

Currently, there are three shifts of one police officer dispatched to each of the four beats in a 24-hour period; hence twelve beat officers operate in Ewa within a 24-hour period.

In terms of short-term plans, the Police Department is requesting funds for two officers per shift. Long-term plans include adding a new full-service station in Kapolei, with the establishment of Ewa and the Waianae Coast as a new district. This means that the District III would cover the area from Red Hill to Kunia Road, and the new district would extend from Kunia Road to Kaena Point. If this occurs, the Kapolei station would be the headquarters for five beats in Ewa and eight beats along the Waianae Coast (personal communication with Lieutenant Melvin Chastain, Administrative Lieutenant for District III, Pearl City Police Station, October 23, 1990).

In addition, two substations are proposed by the Police Department. One would be located in Ko Olina, near a proposed fire station. The other would be located near the proposed relocation site of the Ewa Beach Fire Station at Ewa Marina (personal communication with Kyle Nakasone, Research Analyst, Honolulu Police Department, November 20, 1990).

3. Project Impacts

Makaiwa Hills will increase the demand for police services in Ewa. The project demand is, however, part of the cumulative need anticipated by public officials. As discussed in the previous section, police officials have projected the future demand for services, based on the Ewa Master Plan, and have proposed facilities and increased staffing to meet this demand. Makaiwa Hills has been a part of the Ewa Master Plan and, as shown in Section 5.1, is within the anticipated population count.

Police officials have expressed the following concerns about the regional impacts of Makaiwa Hills. These concerns include (1) effects on traffic conditions and (2) the cumulative demand for police services (letter dated 13 November 1990 from Chester E. Hughes, Assistant Chief of Police, Support Services Bureau, Honolulu Police Department to William E. Wanket, Inc.).

Recommended Mitigation

As part of the Ewa Master Plan, Makaiwa Hills has been included in programs to upgrade police facilities and increase police officers. No additional mitigation beyond those already planned is necessary at this time.

A possible crime-deterring mitigation measure is on-site security and project design. Current project plans imply distinct pockets of residences. Visitors could be monitored by private security guards for each community. Further, the communities could be designed to limit major ingresses and egresses to reduce access possibilities.

Neighborhood watch programs are also effective in crime detection and deterrence. Finally, design measures, such as well-lit roads, sidewalks, and parking and common areas, would help eliminate crime opportunities.

5.5.2 Fire Protection

The project site is currently being serviced by the Makakilo Fire Station, which is an engine company staffed by five firefighters per shift. Back-up service is provided by the Ewa Beach (engine company), Nanakuli (engine and tanker company), Ewa Beach (engine company) and the Waipahu (engine and ladder company) Fire Stations.

Two new fire stations are planned for the immediate vicinity of the project site. Budget requests have been submitted for facilities at Ko Olina and the James Campbell Industrial Park. The Ko Olina Phase 1 facility would be an engine and ladder company, with twelve firefighters per shift. The James Campbell Industrial Park fire station is envisioned as a future battalion headquarters with an engine and ladder company; 15 firefighters would serve each shift. Other new facilities being planned for the Ewa area include the relocation of the Ewa Beach Fire Station to the Ewa Marina project, and a fire station at Ewa Villages. No time frame has been determined for these (personal communication with Battalion Chief Attilio Leonardi, Administrative Services, Honolulu Fire Department, October 25, 1990).

The project will increase the area's population over a larger area than currently planned, and will increase the need for fire protection services.

Some of the people familiar with the area pointed out that the current dryness of the project site is conducive to brush fires. Makaiwa Hills may reduce the potential for brush fires by introducing landscaped areas which would be watered and maintained throughout the year.

Recommended Mitigation

The project includes a one-acre site for a new fire station. Further discussion with Fire Department officials is needed to determine the exact site and scale of the new facility, as well as staffing requirements.

5.5.3 Educational Facilities

Makaiwa Hills is estimated to generate approximately 200 to 250 elementary school-aged children, 85 to 100 intermediate school students, and 125 to 150 high school aged students. These Department of Education estimates assume that the majority of homes will be for executives, retirees, professionals, and second home buyers.

The schools in the vicinity of Makaiwa Hills are Makakilo Elementary, Ilima Intermediate and Campbell High Schools. School officials predicted that these schools will be operating well beyond capacity at the time the project is constructed. Hence, the proposed on-site school is necessary to serve students living in Makaiwa Hills. Schools in the Kapolei Village area will probably serve the project residents during an interim period (letter dated 9 November 1990 from Charles Toguchi, Superintendent of the State Department of Education, to William E. Wanket).

Proposed Mitigation

The proposed school at Makaiwa Hills will mitigate project impacts on existing and off-site school facilities. Further, as suggested by the State Department of Education, the developer will donate the land for the school or pay a fair share of the costs to build additional classrooms to accommodate the enrollment growth.

5.5.4 Child Care

As Kapolei develops, the need for child care services within the region will increase as more and more people live and work in the Second City. Three sites in the area already have been committed for child care purposes. First, West Loch has a 5.3 acre site for a park-and-ride facility with a 30,000 square foot child care center. This is scheduled for implementation in Phase 2. Second, Ko Olina has one acre for child care and other public facilities. Third, Royal Kunia, which is just outside Ewa in Central Oahu, has similar provisions included in its master plan.

In addition, three potential child care centers are being explored in Kapolei. One site is located in the City of Kapolei, with the other two in Kapolei Villages.

Makaiwa Hills will increase the regional demand for child care services because of the (1) increase in residential population and (2) employment generated by the proposed regional shopping center. Currently, there is no rule of thumb in projecting child care needs and requirements for specific development proposals have been determined on a case-by-case basis.

Proposed Mitigation

The extent of the increase in demand for child care services generated by Makaiwa Hills is unknown at this time. Also undetermined is the degree to which proposed child care centers may meet this requirement.

Nevertheless, Makaiwa Hills should include a site for a child care facility, since a sheer increase in demand is anticipated. As with sites for other public facilities, this site would be dedicated to the City and County of Honolulu. The location and size of this site should be determined in conjunction with the City Office of Human Resources.

In addition, there are also employer-based options, including (1) major employer subsidy of on-site care; (2) pre-tax contributions to qualified employees; and (3) direct voucher provided by employers to employees who demonstrate their use of qualified child care facilities. These are very long-term options, in that they require the cooperation of and commitment by the actual owner and operator of the regional shopping center, neither of which are chosen at this time.

5.5.5 Medical and Emergency Facilities

Three hospitals are within reasonable travelling distance of the project site. The Kaiser Foundation Health Plan has a central hospital in Moanalua. The Pali Momi Medical Center is located near the Pearl Ridge Shopping Center, and the St. Francis Hospital-West is located in the Ewa Plains. In addition, the area contains numerous medical clinics and doctors' offices.

As Kapolei City progresses, additional medical facilities will be required to serve the increased population. The proposed project is expected to be adequately served by the existing and additional medical facilities.

Emergency services are provided by City ambulances located in Aiea. Further, the Waipahu Fire Station contains an ambulance unit which serves Pearl City, Waipahu, Ewa Beach, Makakilo and parts of Waianae. Also eight-hour service is provided to the Makakilo Fire Station by the Waipahu unit. Twenty-four hour ambulance service at the Makakilo Fire Station is currently in the planning stage. All of the new fire stations described in Section 5.3.2 will have an extra stall for ambulances if deemed necessary in the future.

Proposed Mitigation

No mitigation is needed at this time.

5.5.6 Recreation

The parks nearest the project site are those which serve Honokai Hale/Nanakai Gardens and Makakilo. These include:

* *Kamokila Park*, a 5.8 acre community park located just east of Honokai Hale/Nanakai Gardens;
* *Makakilo Community Park*, an 8.5-acre park located in the upper part of Makakilo; and
* *Mauka Lani Neighborhood Park* (4.4 acres) and *Makakilo Playground* (four acres), both of which are located near elementary schools serving the Makakilo community.

Currently undeveloped, the Kapolei Regional Park will add another recreational amenity to the area. Further, other developments with a residential component include parks in their development programs.

Makaiwa Hills is not expected to impact existing or planned parks of other communities. To serve its residential community, the project includes 16 acres for park use and will contain hundreds of acres of preservation land, some of which may be usable for passive recreation.

The City Department of Parks and Recreation has commented on the suitability and adequacy of the proposed park relative to Makaiwa Hills future residents. Park officials prefer a site which is (1) more conducive, in terms of topography, to active recreation facilities and (2) centrally located for the future residents (letter dated 7 November 1990 from Alvin K. C. Au, Acting Director of the City Department of Parks and Recreation, to William E. Wanket).

Proposed Mitigation

No mitigation regarding existing and proposed off-site parks is necessary since no impact is expected.

Regarding the suitability and adequacy of the proposed park relative to Makaiwa Hills future residents, further discussion between park and Estate officials is needed to properly site and design this park.

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Appendix E.

Environmental Noise Impact Assessment
Makaiwa Hills, Ewa, Oahu

Darby & Associates

D.L. ADAMS ASSOCIATES, LTD.
dba
DARBY
& ASSOCIATES
ACOUSTICAL CONSULTANTS

#90-31
December 12, 1990

William E. Wanket, Inc.
Pacific Tower, Suite 660
1001 Bishop Street
Honolulu, Hawaii 96813

Attention: Mr. William Wanket

**RE: ENVIRONMENTAL NOISE IMPACT ASSESSMENT
MAKAIWA HILLS, EWA, OAHU**

Dear Mr. Wanket:

In this report we present our findings on environmental noise aspects of the subject project.

1. SUMMARY OF FINDINGS

1.1 Apart from locations near Farrington Highway, most of the site is currently exposed to relatively low noise levels with existing daytime background (L90) levels of typically 40 dBA or less. Wind is usually the dominant noise source although aircraft movements and distant traffic are at times audible.

1.2 All but a small area near the mauka/Diamond Head corner of the site is exposed to a Day-Night Average Sound Level (Ldn) due to aircraft noise of less than 55 dBA. Thus, aircraft noise exposure is in clear compliance with the State Department of Transportation's Ldn 60 residential area limit.

1.3 Most of the site (apart from locations near Farrington Highway) is also subjected to overall noise exposure levels of less than Ldn 55, a clearly acceptable noise environment for residential, recreational and commercial purposes.

1.4 Some of the proposed residential areas near Farrington Highway will, however, be exposed to existing and future Ldn's of higher than the Department of Housing & Urban Development's 65 dBA limit for conventional construction. Possible noise mitigation measures include the use of sound barrier walls or landscaped earth berms (which must be high enough to clearly block line-of-sight to the highway traffic) and appropriate building orientation and design, such as:

*PALI PALMS PLAZA • 970 NO. KALAHEO AVENUE • SUITE A-311
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(1) Avoiding the use of multi-story homes in these areas, and orienting the buildings so that bedroom windows do not directly face Farrington Highway.

(2) Restricting the use of jalousie windows to non-critical areas, such as bathrooms, laundries, etc.

(3) Air-conditioning noise-sensitive areas, such as bedrooms, so that windows may be kept closed for noise reduction purposes.

(4) Providing additional sound absorptive treatment in bedrooms (carpets with padding, louvered closet doors, etc.).

1.5 The additional, project-generated traffic on Farrington Highway and other nearby roads should not cause any significant environmental noise impact.

1.6 Although not part of the currently-proposed development, the lower preservation areas may in the future be considered for development of a golf course. Provided that the club house and its associated facilities are suitably located (with respect to the nearest homes) and the appropriate control measures are incorporated in their design, and provided that ground maintenance equipment is adequately silenced and reasonable restrictions are placed on its hours of operation, use of a possible future golf course should not cause any significant environmental noise impact. Any noise impact from the additional road traffic generated by a future golf course could be assessed once the projected traffic data are available.

1.7 Noise exposure levels in the lower preservation areas adjacent to Farrington Highway (i.e., within about 300 ft) could be Ldn 60 to 65, or higher. Landscaped earth berms would reduce traffic noise in these areas and would also improve the noise environment in these parts for a future golf course.

1.8 The dominant noise source during construction activities will probably be earth moving equipment, such as bulldozers and diesel-powered trucks. Any noise impact from these operations on the existing Honokai Hale and Makakilo residential areas should, however, be relatively short-term.

1.9 Blasting, if required, could also have noise impacts. However, with the appropriate blast design techniques, the noise from blasting can be controlled within acceptable limits at the closest noise-sensitive areas.

1.10 Provided that the appropriate noise control measures are incorporated in the design, noise levels at the property lines of the proposed commercial regional mall, due to the operation of mechanical and electrical equipment, such as exhaust fans, emergency generators, and refrigeration and air conditioning equipment, will be in compliance with the appropriate Department of Health and Land Use Ordinance regulations.

1.11 Because of the distance (more than 1,000 ft) between the existing sugar cane fields makai of Farrington Highway and the closest proposed homes in the Makaiwa Hills development, noise from sugar cane activities should not have any significant impact on the proposed development.

2. PROJECT DESCRIPTION

The proposed 1915-acre Makaiwa Hills Development, indicated in Figure 1, comprises a mixture of residential, commercial and recreational areas. Although a substantial portion of the site will remain undeveloped and serve as open space, the lower preservation areas may in the future be considered for development of a golf course.

The site is bounded on its makai side by Farrington Highway. Apart from a military facility no longer in use, the site is bounded on its Waianae and mauka sides by largely undeveloped land. On its Diamond Head side are the Makakilo residential development and a quarry.

On the makai side of Farrington Highway (i.e., directly opposite the proposed development) are the Honokai Hale residential development, the Royal Ko Olina Golf Course and an area of sugar cane fields.

3. THE EXISTING ACOUSTICAL ENVIRONMENT

3.1 General - Ambient noise measurements were made at the project site on July 13, 1990. Noise levels were recorded over 10-minute sampling periods at locations A through E, shown in Figure 1, using a Larson Davis Laboratories Model 700 Sound Level Meter. The measurement locations are described below:

A. Between Waimanalo Gulch and Makaiwa Gulch, about 300 ft from the site of the former missile facility.

B. About 1/2 mile from the mauka/Diamond Head corner of the site and 600 ft from Palehua Road.

C. About 100 ft from Farrington Highway, close to the intersection of the new and old Farrington Highways.

D. Near the Board of Water Supply facility, about 1,000 ft from Farrington Highway.

E. Just mauka of the large water storage tanks, about 1,500 ft from Farrington Highway.

Long-term (24-hour) noise measurements were subsequently performed at the following additional site locations (also shown in Figure 1), at various times between September 6 and November 4, 1990:

F. Towards the Waianae/makai corner of the site (near the Ko Olina Interchange), about 250 ft from Farrington Highway.

G. Approximately half way along the makai boundary of the site, about 300 ft from Farrington Highway.

H. Near the mauka/Diamond Head corner of the site, about 120 ft from Palehua Road.

J. Near the makai/Diamond Head corner of the site, about 250 ft from Farrington Highway and 150 ft from Old Farrington Highway.

Further measurements were also made at selected loctions on August 13, September 7 and 9 and October 31, 1990, to assess the noise from aircraft operations associated with Naval Air Station Barbers Point (NASBP) and Honolulu International Airport (HIA).

Weather conditions during the measurements were generally clear, with daytime temperatures approaching 90^{o} and tradewinds at 10 to 20 mph.

3.2 Measurement Results - The noise measurement results, in terms of the Equivalent Continuous Noise Level (Leq), the minimum noise level (Lmin), the levels exceeded for 90%, 50%, 10% and 1% of the time (L90, L50, L10 and L1, respectively), and the maximum noise level (Lmax), are presented in Table 1 and summarized below. These statistical levels are commonly used descriptors of environmental noise; for example, the L1 level describes the near-maximum noise, while L90 is a good measure of the background noise level. Leq is an "energy-weighted" average noise level. (A brief description of acoustical terminology is presented in Appendix I.)

Location	Measured Noise Levels - dBA						
	Leq	Lmin	L90	L50	L10	L1	Lmax
A	47	37	39	45	51	54	56
B	48	38	40	45	52	58	59
C	62	44	54	59	66	72	76
D	51	42	46	50	54	57	62
E	43	37	39	41	45	53	58

Table 2 presents a summary of the single-event aircraft noise levels measured at Locations A, D, E, G and J.

Figures 2 through 7 show the hourly statistical noise levels measured over 24-hour periods at Locations F, G, H and J. Also shown are the Day-Night Average Sound Levels (Ldn's).

Apart from those areas near Farrington Highway, most of the site is currently exposed to relatively low noise levels. At Locations A, B and E, for example, the existing daytime background (L90) noise levels recorded during the short-term measurements were 40 dBA or less, typical of rural or semi-rural areas. Wind was usually the dominant noise source although aircraft movements and traffic were at times audible (particularly at locations closer to Farrington Highway).

The data presented in Table 2 confirm that most of the site is exposed to relatively little aircraft noise. At most locations the Lmax from trans-ocean and interisland jets was less than 60 dBA. Predictably, the highest aircraft noise levels were recorded at Location J, because of its proximity to the HIA flight arrival tracks (shown in Figure 8) and the NASBP touch-and-go tracks (shown in Figure 9). In fact, the dominant source of aircraft noise at Location J during the measurements on October 31, 1990 was a P-3 military aircraft performing touch-and-go operations.

It should be noted that, for noise abatement purposes (in areas closer to HIA), the flight arrival tracks shown in Figure 8 are not normally used during the evening and nighttime (i.e., between 7 pm and 7 am) unless special circumstances dictate otherwise.

3.3 <u>Estimated Noise Exposure Levels</u> - An extract from the NASBP/HIA noise contour map, presented in Figure 10, shows that all but a small area near the mauka/Diamond Head corner of the site is exposed to an Ldn due to aircraft noise of less than 55 dBA.

The short and long-term noise data recorded elsewhere confirm that, apart from areas near Farrington Highway, most of the site is also subjected to overall noise exposure levels of less than Ldn 55. For example, an Ldn of 49 dBA was recorded at Location H (which is quite close to Palehua Road) over two consecutive 24-hour periods.

The proposed residential areas closest to Farrington Highway will, however, be exposed to existing Ldn's due to traffic noise of around 60 dBA (near Location G) and to existing Ldn's upwards of 65 dBA (near Location F).

4. NOISE STANDARDS AND GUIDELINES

Land-use compatibility guidelines are commonly presented in terms of Ldn, a measure of noise exposure over a typical 24-hour period. It is essentially the Leq measured over 24 hours (after adding 10 dBA to the noise levels recorded between 10 pm and 7 am, to account for people's higher sensitivity to noise at night).

For example, the U.S. Environmental Protection Agency and the Department of Housing and Urban Development (HUD) specify that residential and other noise-sensitive developments can normally be constructed in areas subjected to noise exposure levels of up to Ldn 65, with no special noise control measures required in buildings of conventional construction (References 1 and 2). Sites exposed to Ldn's in the range of 65 to 75 dBA are considered normally unacceptable for residential development, with building approval subject to additional noise control measures. These criteria are generally consistent with the land use compatibility guidelines shown in Figure 11, obtained from Reference 3.

In Hawaii, the State Department of Transportation stipulates an aircraft noise exposure limit of Ldn 60 for residential buildings.

Note that for residential developments located within an Ldn 65 to 70 zone, HUD's site acceptability standards require the construction to provide a minimum of 5 dBA attenuation in addition to "attenuation provided by buildings as commonly constructed in the area, and requiring open windows for ventilation." A minimum of 10 dBA additional attenuation is required for residential projects exposed to an Ldn of 70 to 75 dBA.

HUD also has a design goal of Ldn 45 or less for the interior spaces of dwelling units.

On Oahu, State and County noise regulations may be enforced whenever noise emissions exceed specified levels and cause complaints from occupants of neighboring properties. However, the State Department of Health (DOH) and City and County of Honolulu Land Use Ordinance (LUO) noise regulations are expressed in terms of maximum allowable noise levels rather than a 24-hour noise exposure level, such as Ldn (see Figures 12 and 13).

The DOH regulations use A-weighted sound levels and state that the allowable noise levels shall not be exceeded for more than 10% of the time during any 20-minute period (Reference 5). The LUO regulations differ from those of the DOH in that they use octave band sound levels instead of A-weighted levels and no temporal factor is involved (Reference 6). In addition, the DOH also specifies maximum allowable noise levels for vehicles, including trucks (Reference 7).

5. POTENTIAL IMPACTS AND DESCRIPTION OF CONTROLS

5.1 Aircraft Noise - As noted earlier, most of the site is exposed to relatively little aircraft noise. All of the proposed residential areas will be subjected to Ldn's of less than 55 dBA due to aircraft operations associated with both NASBP and HIA. Thus, aircraft noise exposure is in clear compliance with the State Department of Transportation's Ldn 60 residential area limit.

Although at times audible, aircraft noise should not significantly impact the proposed development:

5.2 Traffic Noise - A traffic count was performed during the short-term measurement at Location C to permit calibration of the FHWA Traffic Noise Prediction Model. The FHWA traffic noise model was then used, in conjunction with projections of future (year 2010) traffic volumes, to estimate increases in noise levels due to project-generated traffic and general traffic growth.

Projections were made at the locations shown in Figure 14. The results, presented in Table 3, show that the project-generated traffic should cause noise level increases of 0.5 dBA or less along Farrington Highway on the Waianae side of Kalaeloa, and increases of 1.7 dBA or less on the Diamond Head side of Kalaeloa. These are not considered significant increases in terms of subjective response.

Any cumulative noise impact from future traffic (including that generated by the subject project and other projects in the leeward area) should also be relatively small. For example, the predicted increases in traffic noise in the next 20 years are around 3 dBA along Farrington Highway in the vicinity of the Honokai Hale residential development. Subjectively, 3 dBA corresponds to a small (just noticeable) increase in loudness.

As noted earlier, the proposed residential areas in the Makaiwa Hills project that are closest to Farrington Highway will be exposed to existing Ldn's due to traffic noise of around 60 dBA (near Location G) and to existing Ldn's upwards of 65 dBA (near Location F). With a predicted traffic noise increase of approximately 3 dBA in the next 20 years, these areas will be exposed to future Ldn's of between almost 65 and 70 dBA, i.e., exceeding HUD's Ldn 65 limit for conventional construction.

Possible noise mitigation measures include providing sound barriers next to the freeway (such as walls or landscaped earth berms, which must be high enough to clearly block line-of-sight to the freeway traffic), and appropriate building orientation and design, such as:

(1) Avoiding the use of multi-story homes in these areas, and orienting the buildings so that bedroom windows do not directly face Farrington Highway.

(2) Restricting the use of jalousie windows to non-critical areas, such as bathrooms, laundries, etc.

(3) Air-conditioning noise-sensitive areas, such as bedrooms, so that windows may be kept closed for noise reduction purposes.

(4) Providing additional sound absorptive treatment in bedrooms (carpets with padding, louvered closest doors, etc.), to reduce reverberant sound buildup.

Noise exposure levels in the lower preservation areas adjacent to Farrington Highway (i.e., within about 300 ft) could be Ldn 60 to 65, or higher. According to the guidelines presented in Figure 11, an Ldn in the range of 60 to 75 dBA is "marginally compatible" for recreation areas and golf courses. Landscaped earth berms would reduce traffic noise in these areas and also improve the noise environment for a future golf course.

5.3 <u>Golf Course Operations</u> - Although not part of the currently-proposed development, the lower preservation areas may in the future be considered for development of a golf course. Apart from the additional road traffic generated by such a facility, potential noise sources include the club house, the public address system and ground maintenance activities.

By suitably locating the club house (with respect to the nearest homes) and incorporating the appropriate control measures in the design, noise from sources at and near the club house, such as the kitchen, refrigeration and air conditioning equipment, exhaust fans, golf cart chargers, pumps and other stationary equipment, should be inaudible, or barely audible, at these closest homes. If live music and entertainment are planned inside the club house, provided that the building structure incorporates an adequate degree of "sound proofing," noise from these activities should also be inaudible at the closest homes. A public address system near the club house using state-of-the-art, "low level" directional loudspeakers, should have minimal impact on nearby residential areas.

Noise from equipment associated with ground maintenance activities, including lawn mowers and leaf blowers, could, at times, have an adverse impact on the proposed nearby homes. However, noisy equipment is also incompatible with, and disruptive to, golf play. Provided that all equipment powered by internal combustion engines has adequate exhaust mufflers, and schedules are developed so that the noisier maintenance operations do not occur near residences before 7 am, the noise from ground maintenance operations should not cause "unreasonable" or "excessive" noise as defined in Reference 5.

Any noise impact from the additional road traffic generated by a future golf course could be assessed once the projected traffic data are available.

5.4 <u>Construction Noise</u> - Development of the project site will involve demolition, excavation, grading and the construction of infrastructure and buildings. The various construction phases of a development project may generate significant amounts of noise; the actual amounts are dependent upon the methods employed during each stage of the process. Typical construction equipment noise ranges in dBA are shown in Figure 15. Earthmoving equipment, such as bulldozers and diesel-powered trucks, will probably be the loudest equipment used during construction.

Any noise impact from these operations on the existing Honokai Hale and Makakilo residential areas should, however, be relatively short-term.

In cases where construction noise exceeds, or is expected to exceed, the DOH's "allowable" property line limits, a permit must be obtained from the DOH to allow the operation of vehicles, construction equipment, power tools, etc. which emit noise levels in excess of the "allowable" limits. Required permit conditions for construction activities are:

> "No permit shall allow construction activities creating excessive noise...before 7:00 am and after 6:00 pm of the same day."

> "No permit shall allow construction activities which emit noise in excess of ninety-five dB(A)...except between 9:00 am and 5:30 pm of the same day."

> "No permit shall allow construction activities which exceed the allowable noise levels on Sundays and on... [certain] holidays. Activities exceeding ninety-five dB(A) shall [also] be prohibited on Saturdays."

In addition, construction equipment and on-site vehicles or devices requiring an exhaust of gas or air must be equipped with mufflers. Also, construction vehicles using traffic-ways must satisfy the DOH's vehicular noise requirements.

Blasting, if required, could also have noise impacts. However, blasting at construction sites near populated areas is usually accomplished by using numerous small charges detonated with small time delays. Blast mats can also be used to assist in directing the explosive energy into the rock, control flying debris and muffle the noise. Thus, with the appropriate blast design techniques, the noise from blasting can be controlled within acceptable limits at the closest noise-sensitive areas.

5.5 Commercial Regional Mall - Approximately 156 acres have been set aside in the southeastern portion of the Makaiwa Hills property for development as a commercial regional mall, the mauka side of which will be partially bordered by proposed residential areas and a school.

The noise from mechanical and electrical equipment associated with the proposed commercial development, including refrigeration and air conditioning equipment, exhaust fans, emergency generators, etc., will be reduced to acceptable levels at these adjacent noise-sensitive areas (i.e., in compliance with the appropriate DOH and LUO property line limits) and within the development itself, provided that the appropriate noise control measures are incorporated in the design.

The required noise control measures may include the following:

(1) Partial or complete acoustical enclosures for supermarket refrigeration equipment.

(2) Sound attenuators on building and garage exhaust fans.

(3) Inlet and discharge silencers on cooling towers.

(4) Acoustical louvers or silencers at mechanical and electrical equipment room air intake and discharge openings.

(5) Appropriate selection of vibration isolation mounts; mechanical and electrical equipment room wall, floor and ceiling constructions; acoustical linings; etc.

5.5 <u>Sugar Cane Activities</u> - Although relatively infrequent, operations such as land preparation, harvesting, etc., are characterized by periods of intense activity with equipment operating 24 hours per day. However, because the distances involved (the existing sugar canefields makai of Farrington Highway are at least 1,000 feet from the closest proposed homes) noise from sugar cane activities should not have any significant impact on the proposed development.

This completes our assessment of environmental noise aspects of the proposed Makaiwa Hills development. Please call if you have any questions on the above, or if you require any further information at this stage.

Sincerely,

John C. Shearer

JCS/ld.2rp

Encl.

REFERENCES:

1. *HUD Environmental Criteria and Standards*, 24 CFR Part 51, Federal Register, Volume 44, No. 135, July 12, 1979; amended 49 FR 880, January 6, 1984.

2. *Toward a National Strategy for Noise Control*, U.S. Environmental Protection Agency, April 1977.

3. Appendix to American National Standard ANSI 53.23-1980, *Sound Level Descriptors for Determination of Compatible Land Use.*

4. *FHWA Highway Traffic Noise Prediction Model*, FHWA - RD - 77 - 108; U.S. Department of Transportation, December 1978.

5. *Chapter 43 - Community Noise Control for Oahu*, Department of Health, State of Hawaii, Administrative Rules, Title 11, 1981.

6. *Section 3.11, Noise Regulations*, Land Use Ordinance, City and County of Honolulu, October 22, 1986.

7. *Chapter 42 - Vehicular Noise Control for Oahu*, Department of Health, State of Hawaii, Administrative Rules, Title 11, November 6, 1981.

TABLE 1

NOISE DATA RECORDED AT FIVE LOCATIONS AT THE SITE OF THE PROPOSED MAKAIWA HILLS DEVELOPMENT ON FRIDAY, JULY 13, 1990

*Location	Time	Measured Noise Levels - dBA							Dominant Noise Sources
		Leq	Lmin	L90	L50	L10	L1	Lmax	
A	11:50 - 12 noon	47	37	39	45	51	54	56	Wind, distant helicopter movements, distant aircraft
B	12:46 - 12:56 pm	48	38	40	45	52	58	59	Wind, one light aircraft movement, distant helicopter movements
C	1:40 - 1:50 pm	62	44	54	59	66	72	76	Traffic on Farrington Highway
D	2:30 - 2:40 pm	51	42	46	50	54	57	62	Distant traffic, wind, aircraft movements, birds, distant helicopter movements
E	2:30 - 2:40 pm	43	37	39	41	45	53	58	Wind, aircraft movements

* See Figure 1

TABLE 2

SUMMARY OF SINGLE-EVENT AIRCRAFT NOISE LEVELS

RECORDED AT SELECTED LOCATIONS

Measurement Location	Date	Time	Aircraft Type	Lmax (dBA)	*SEL (dBA)	Associated Airport
A	7/13/90	11:50 am	DC-10	55	--	HIA
D	"	2:05 pm	B-737	58	--	"
"	"	2:10	DC-10	56	--	"
"	"	2:12	DC-10	57	66	"
E	"	2:29	DC-9	59	68	"
"	"	2:30	DC-9	63	73	"
"	"	2:45	Four F-18's	68	81	"
G	9/7/90	4:21 pm	B-737	52	64	"
"	"	4:24	G.A.	50	61	"
"	"	4:26	Helicopter	64	72	NA
"	"	4:27	Helicopter	67	78	NA
"	"	4:29	G.A.	65	76	HIA
"	"	4:42	B-747	60	71	"
"	"	4:49	C-5	59	71	"
G	9/9/90	2:28 pm	B-737	56	62	"
"	"	2:29	DC-10	56	64	"
"	"	2:31	DC-10	58	67	"
"	"	2:34	DC-10	50	--	"
"	"	2:50	DC-9	<50	--	"
"	"	2:53	DC-10	56	68	"
"	"	2:55	DC-10	51	63	"
"	"	2:57	DC-9	50	--	"
"	"	2:58	DC-9	53	66	"
"	"	3:02	L-1011	49	59	"
"	"	3:04	B-747	51	66	"
"	"	3:09	DH-7	54	65	"
"	"	3:18	DC-10	56	67	"

* SEL is the Sound Exposure Level, a commonly-used aircraft noise metric. It is the Equivalent Continuous Level (Leq) of noise from the aircraft movement, normalized to 1 second.

TABLE 2

SUMMARY OF SINGLE-EVENT AIRCRAFT NOISE LEVELS

RECORDED AT SELECTED LOCATIONS

(CONTINUED)

Measurement Location	Date	Time	Aircraft Type	Lmax (dBA)	*SEL (dBA)	Associated Airport
J	10/31/90	3:57 pm	P-3	71	79	NASBP
"	"	3:59	KC-135	73	83	"
"	"	4:01	DC-10 & P-3	77	86	NASBP & HIA
"	"	4:03	DC-10	65	74	HIA
"	"	4:05	L-1011 & P-3	68	80	NASBP & HIA
"	"	4:08	F-18	71	81	HIA
"	"	4:10	B-737	<60	--	"
"	"	4:12	L-1011	66	79	"
"	"	4:17	P-3	75	82	NASBP
"	"	4:20	P-3	65	76	"
"	"	4:22	DC-10	65	78	HIA
"	"	4:24	L-1011 & P-3	70	81	NASBP & HIA
"	"	4:28	P-3	65	76	NASBP
"	"	4:31	P-3	65	75	"
"	"	4:36	P-3	62	73	"
"	"	4:38	DC-10	64	71	HIA
"	"	4:39	P-3	73	83	NASBP
"	"	4:40	P-3	68	77	"

* SEL is the Sound Exposure Level, a commonly-used aircraft noise metric. It is the Equivalent Continuous Level (Leq) of noise from the aircraft movement, normalized to 1 second.

TABLE 3

EXISTING AND FUTURE (2010) TRAFFIC NOISE LEVELS
AT SELECTED LOCATIONS

Condition	Locations (see Figure 14)											
	1	2	3	4	5	6	7	8	9	10	11	12
Existing a.m. Peak	76.2	74.6	74.6	74.3	74.4	74.4	--	--	--	--	66.4	74.7
Future (year 2010) a.m. Peak Without Project	79.5	77.0	77.0	76.9	76.9	76.3	--	65.5	--	--	68.9	77.2
Future a.m. Peak With Project	79.6	77.4	77.3	77.2	77.2	76.5	55.3	65.5	60.1	62.3	70.6	77.5
Increase in Future a.m. Peak due to Project	0.1	0.4	0.3	0.3	0.3	0.2	--	0.0	--	--	1.7	0.3
Increase in a.m. Peak due to Project and Future Traffic Growth	3.4	2.8	2.7	2.9	2.8	2.1	--	--	--	--	4.2	2.8
Existing p.m. Peak	76.5	73.5	73.5	73.3	73.3	73.3	--	--	--	--	64.4	72.8
Future (year 2010) p.m. Peak Without Project	79.2	76.3	76.3	76.2	76.2	75.2	--	67.0	--	--	66.5	75.8
Future p.m. Peak With Project	79.7	76.7	76.4	76.4	76.4	75.3	57.0	67.0	64.0	64.0	67.9	76.5
Increase in Future p.m. Peak due to Project	0.5	0.4	0.1	0.2	0.2	0.1	--	0.0	--	--	1.4	0.7
Increase in p.m. Peak due to Project and Future Traffic Growth	3.2	3.2	2.9	3.1	3.1	2.0	--	--	--	--	3.5	3.7

Note: Noise levels are Equivalent Continuous Noise Levels in dBA, at arbitrary 100 ft reference distance.

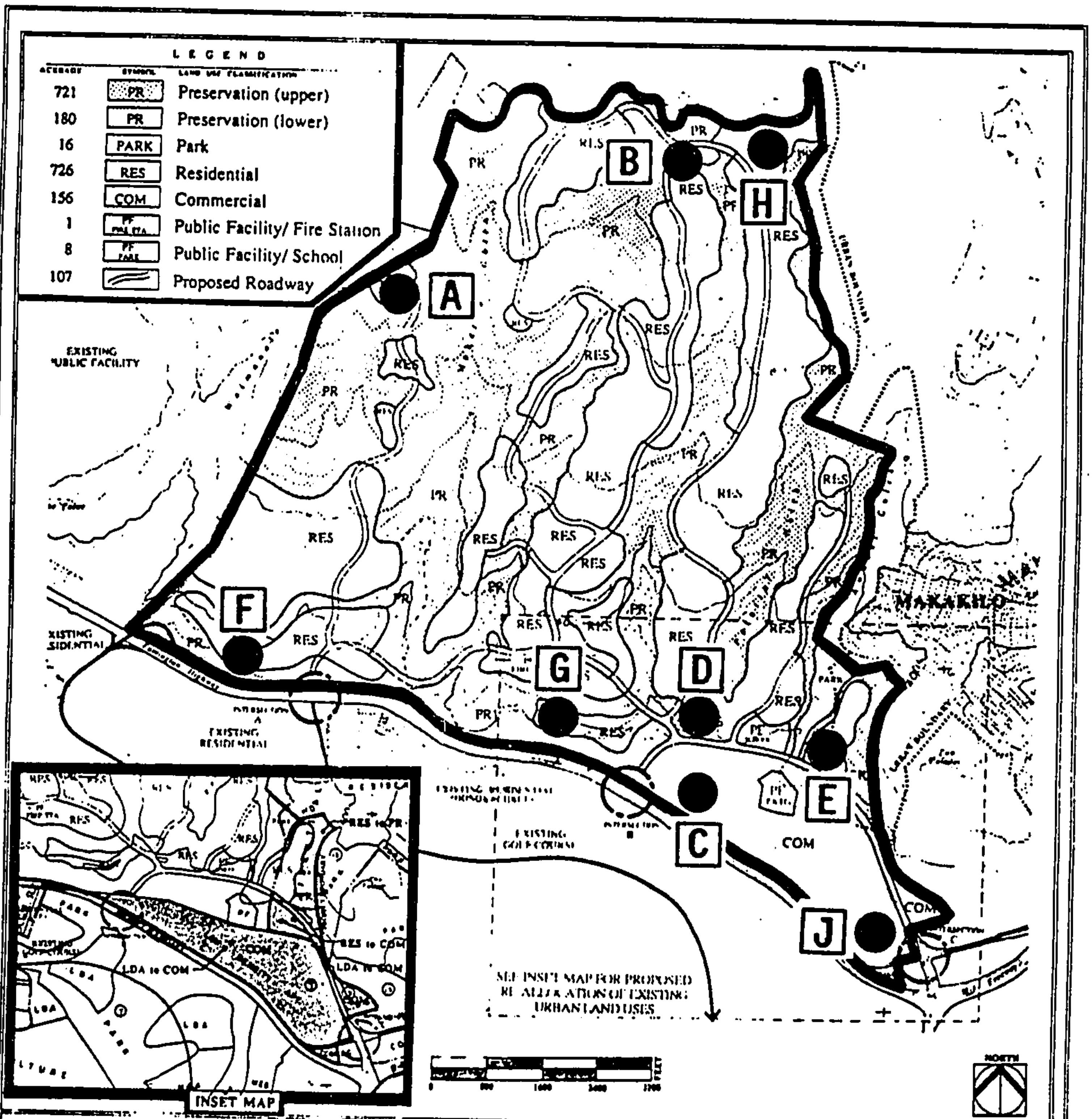

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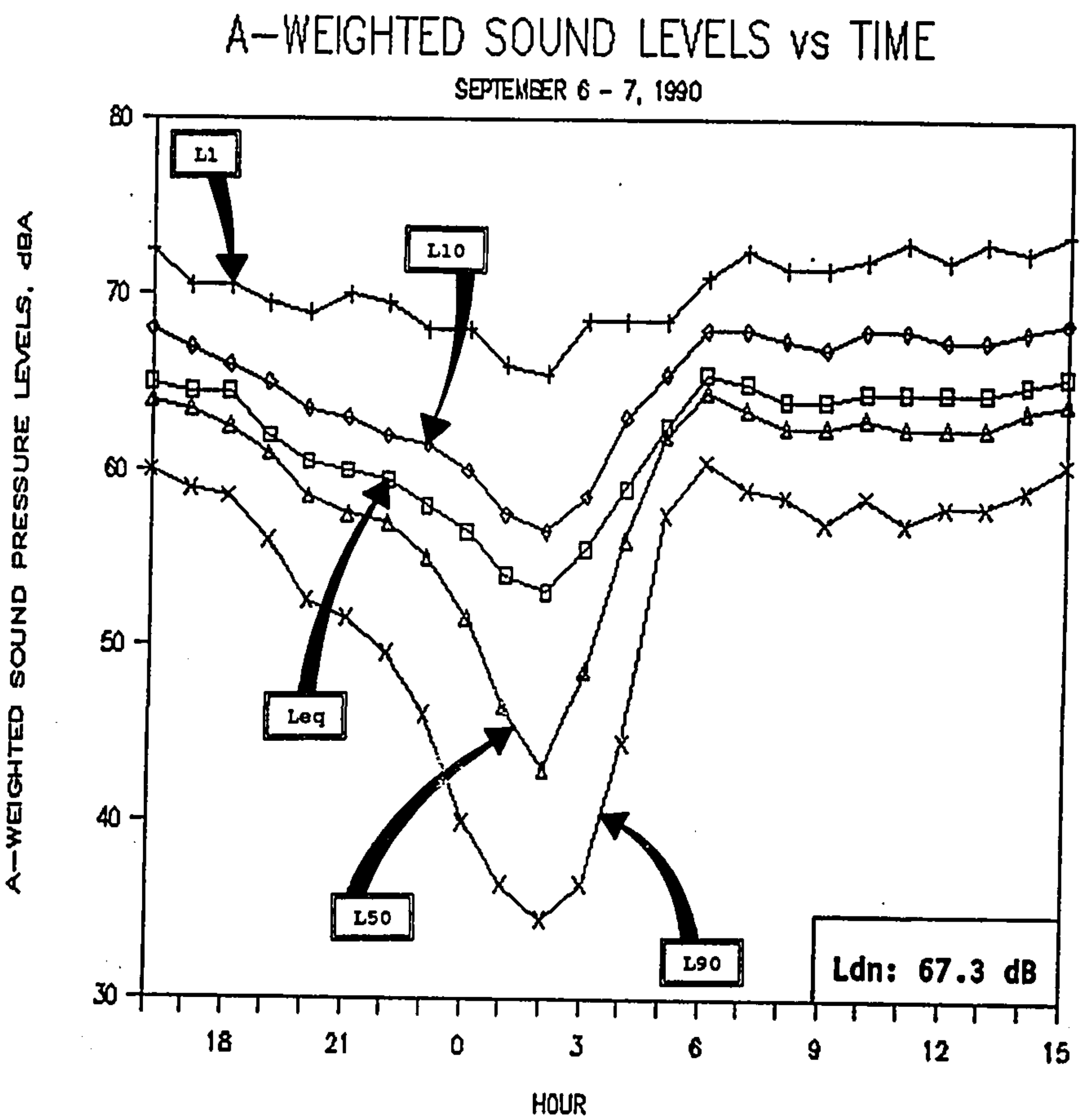
FIGURE 1 SITE PLAN SHOWING NOISE MEASUREMENT POSITIONS



POSITION F

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FIGURE 2 STATISTICAL NOISE LEVELS MEASURED AT LOCATION F OVER A 24-HOUR PERIOD COMMENCING AT 4 PM ON 9/6/90

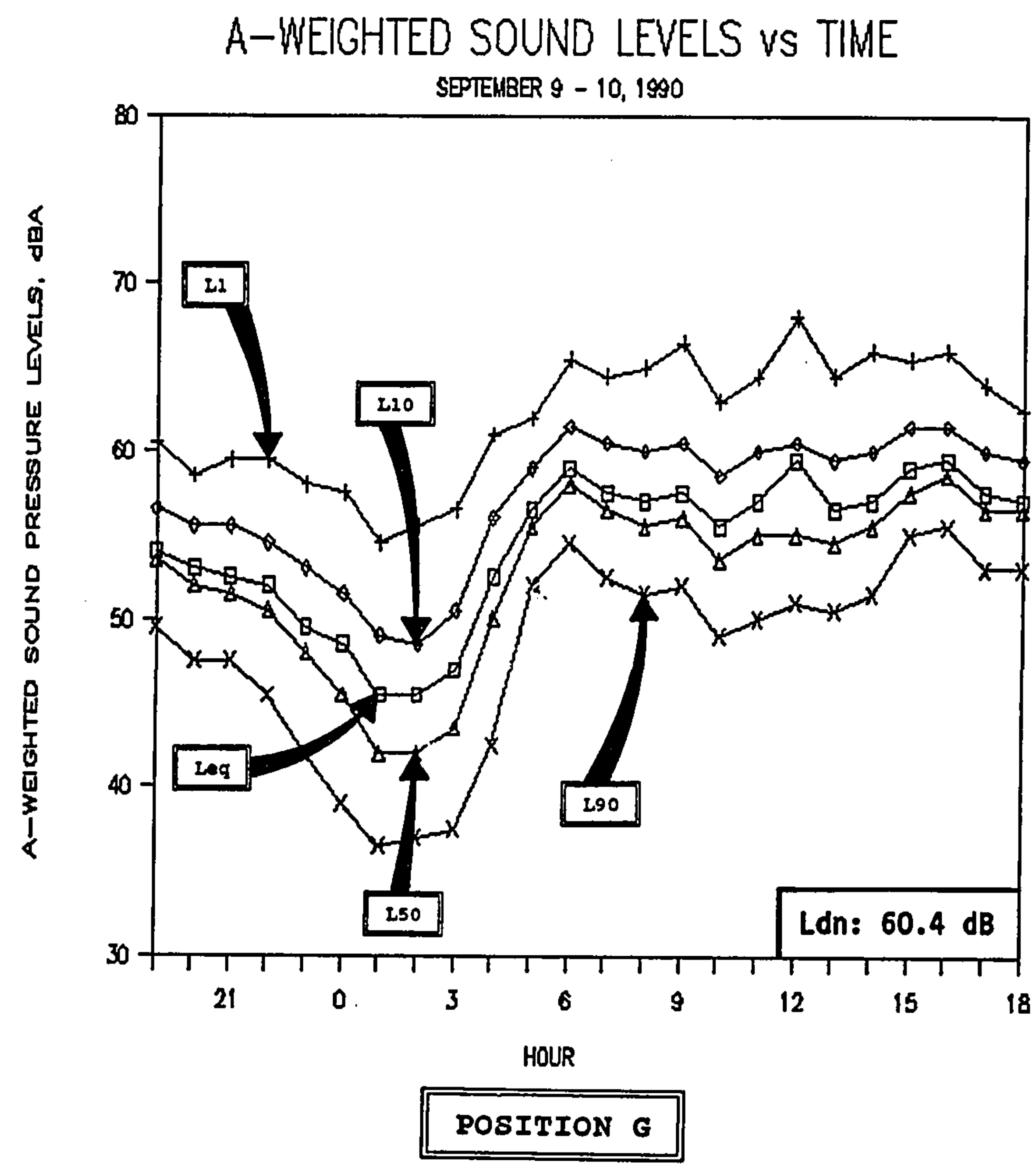

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FIGURE 3 STATISTICAL NOISE LEVELS MEASURED AT LOCATION G OVER A 24-HOUR PERIOD COMMENCING AT 7 PM ON 9/9/90

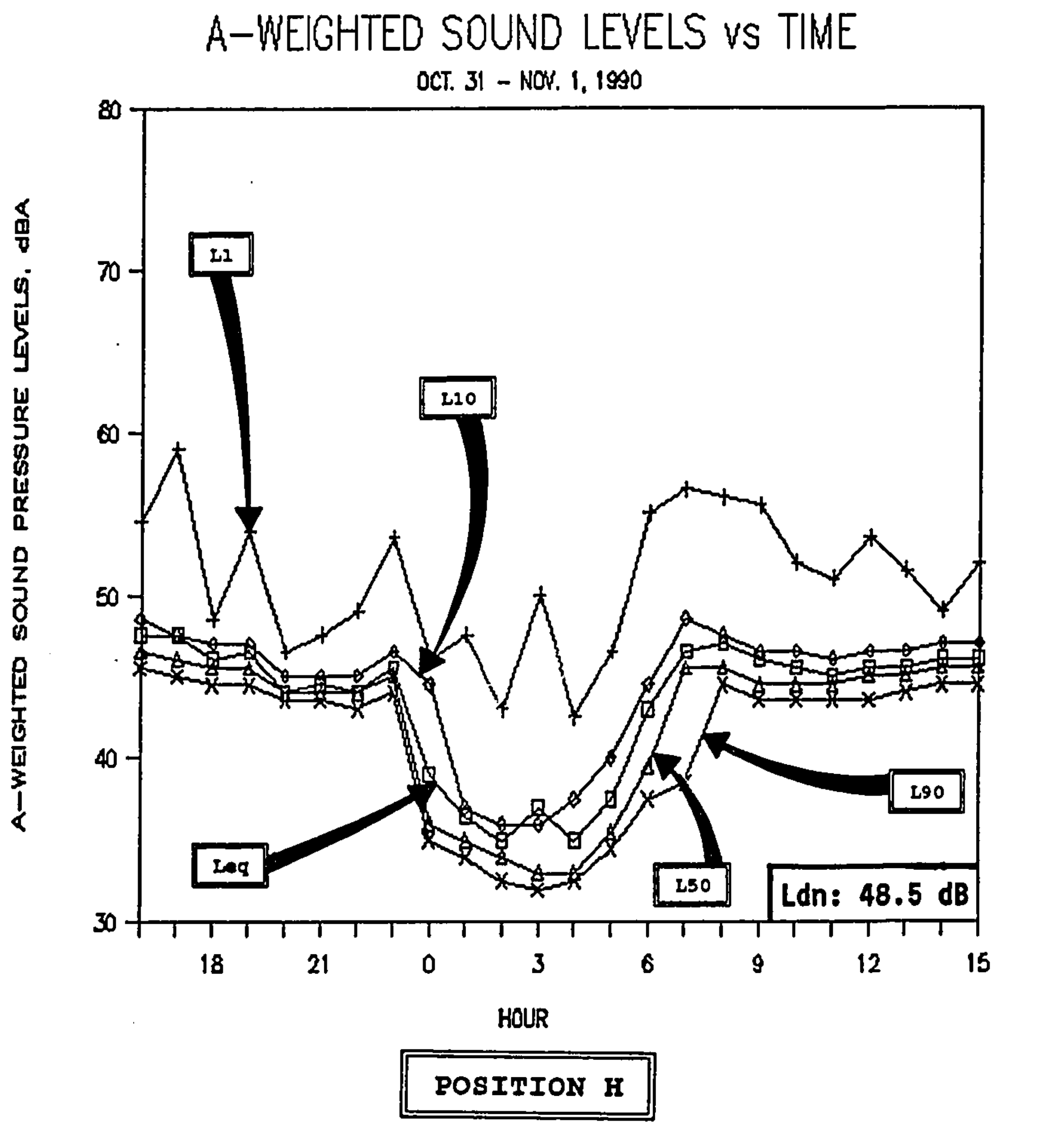

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FIGURE 4 STATISTICAL NOISE LEVELS MEASURED AT LOCATION H OVER A 24-HOUR PERIOD COMMENCING AT 4 PM ON 10/31/90

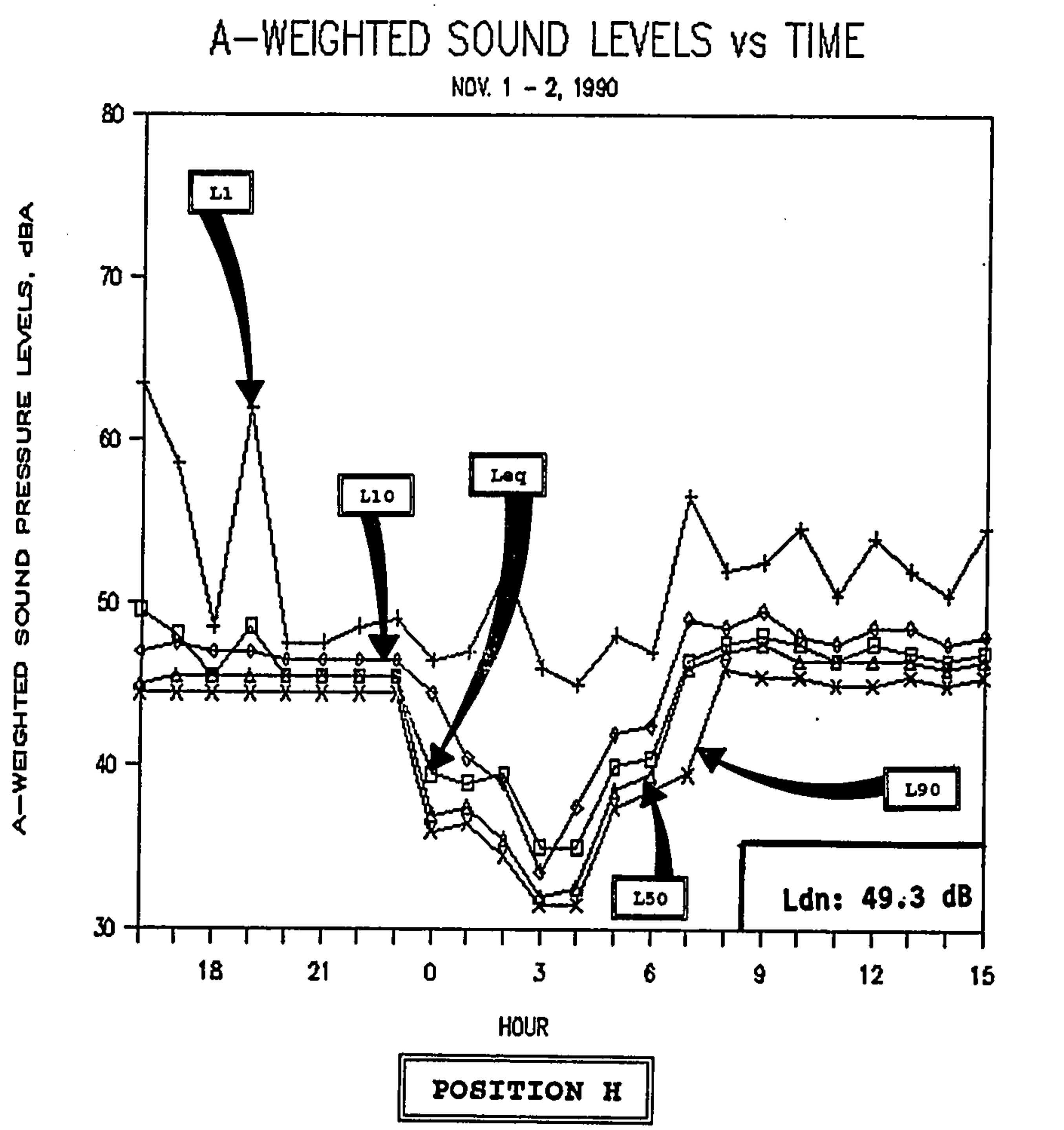

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FIGURE 5 STATISTICAL NOISE LEVELS MEASURED AT LOCATION H OVER A 24-HOUR PERIOD COMMENCING AT 4 PM ON 10/1/90

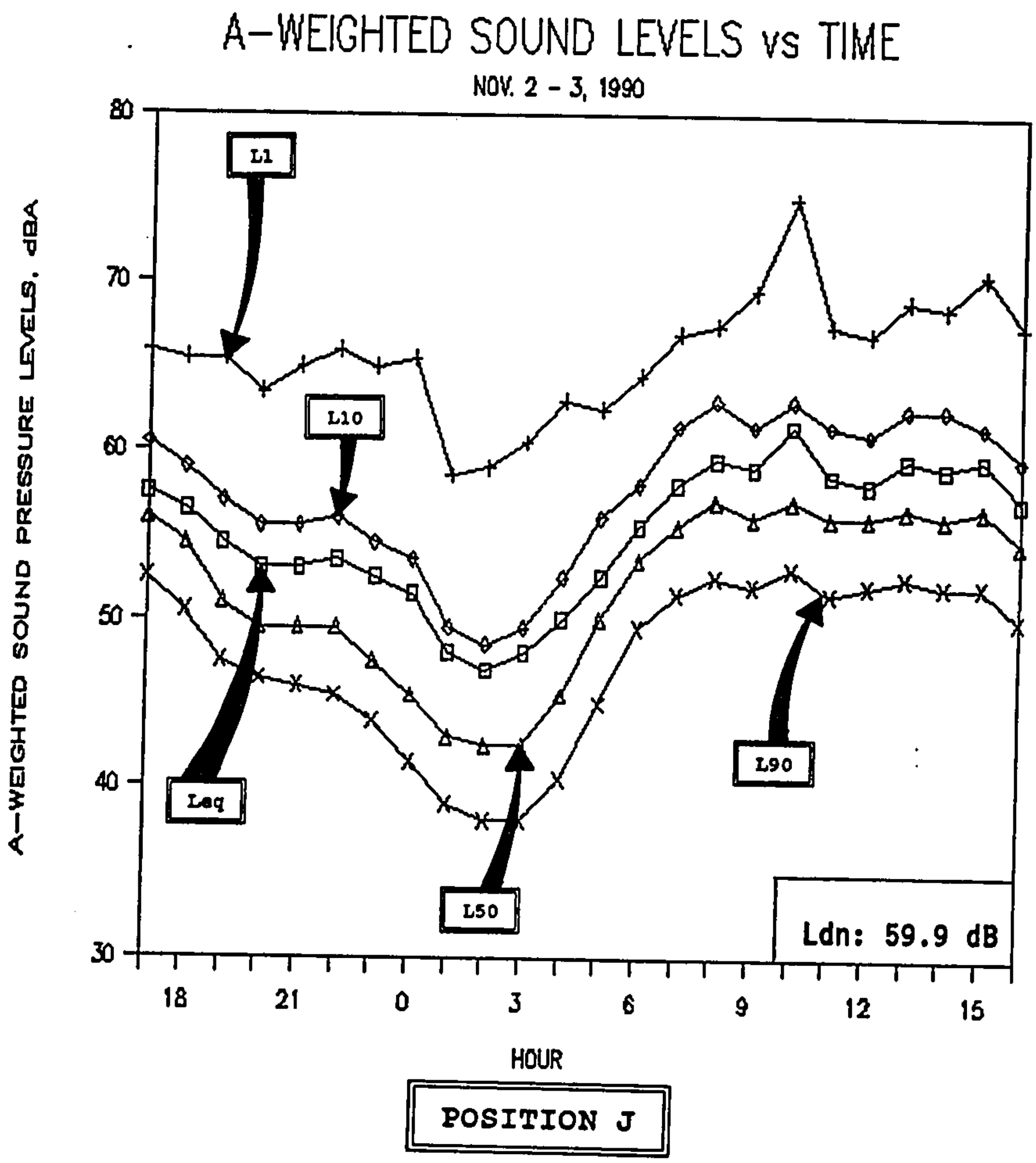

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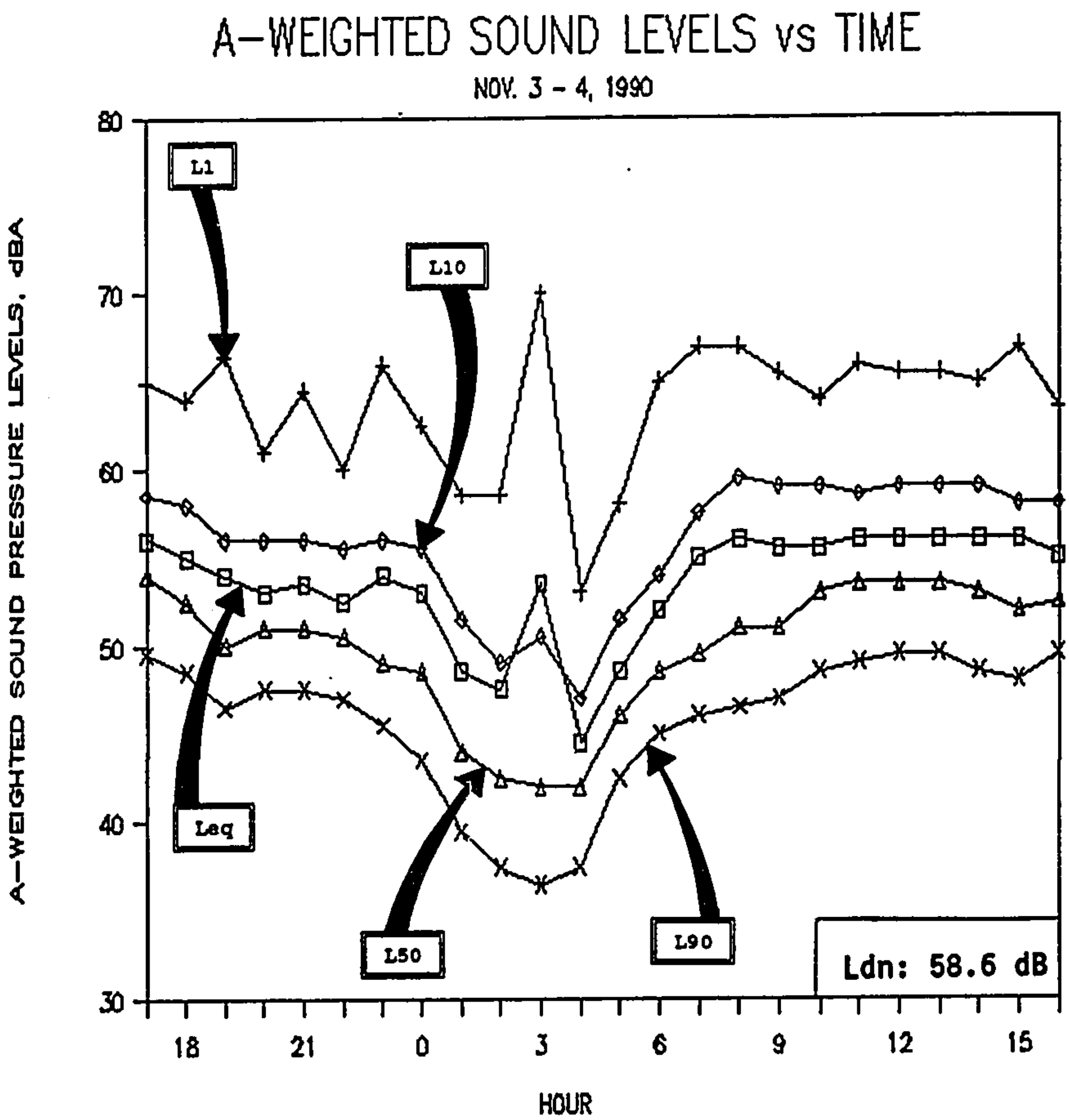
FIGURE 6 STATISTICAL NOISE LEVELS MEASURED AT LOCATION J OVER A 24-HOUR PERIOD COMMENCING AT 5 PM ON 11/2/90



POSITION J

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FIGURE 7 STATISTICAL NOISE LEVELS MEASURED AT LOCATION J OVER A 24-HOUR PERIOD COMMENCING AT 5 PM ON 11/3/90

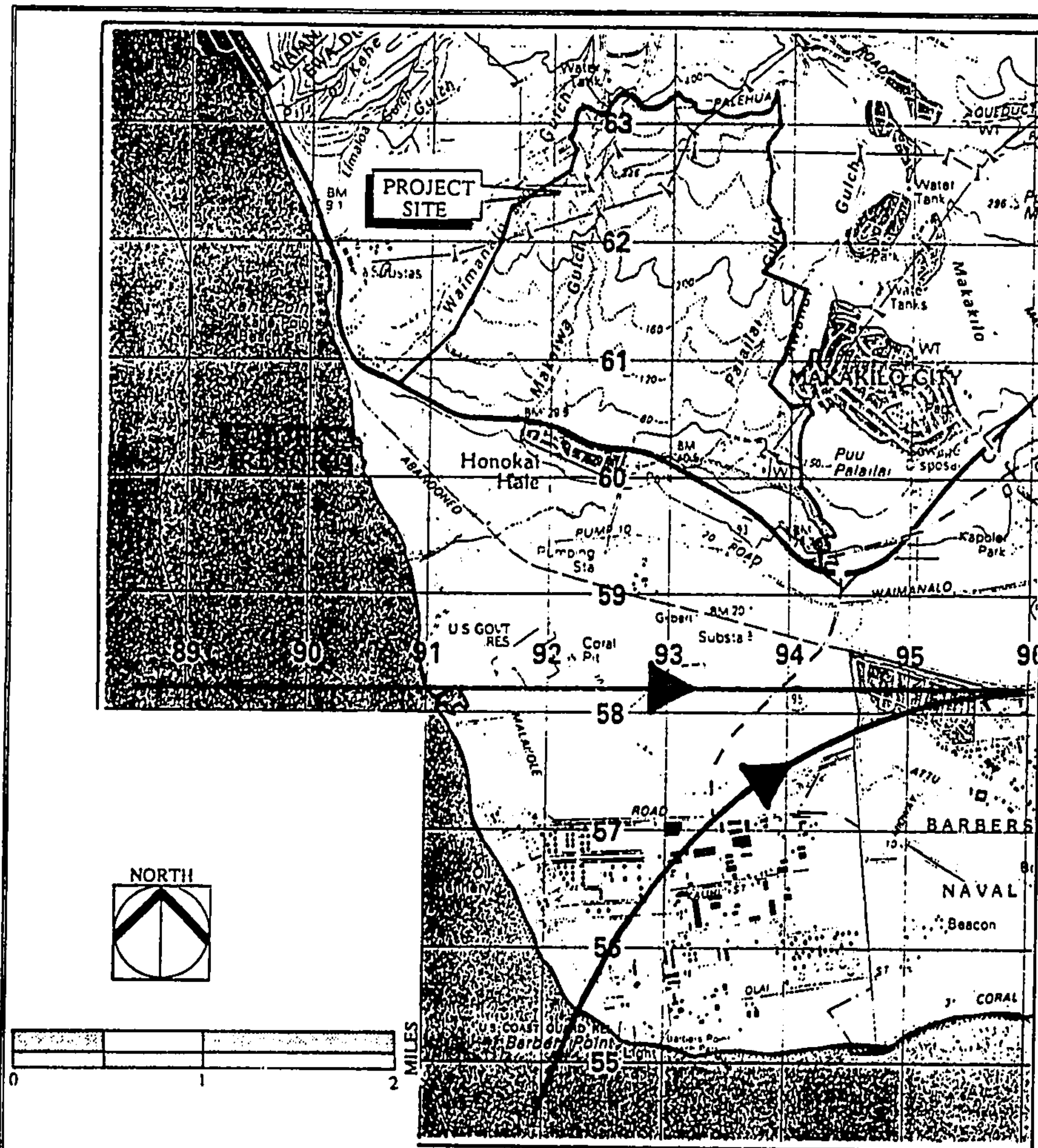

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FIGURE 8 SITE LOCATION IN RELATION TO CLOSEST HONOLULU INTERNATIONAL AIRPORT FLIGHT ARRIVAL TRACKS

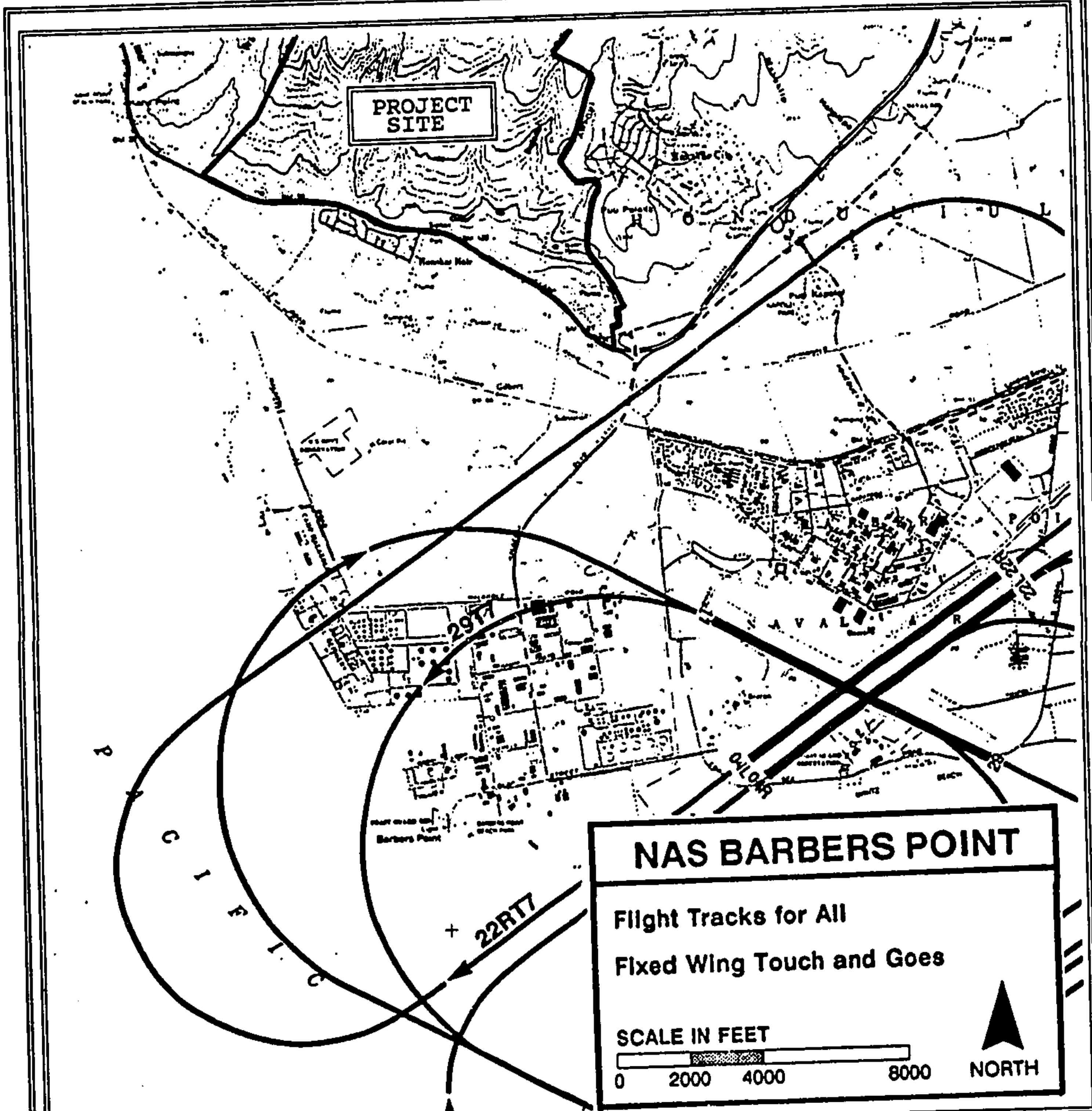

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FIGURE 9 SITE LOCATION IN RELATION TO NAS BARBERS POINT "TOUCH AND GO" FLIGHT TRACKS

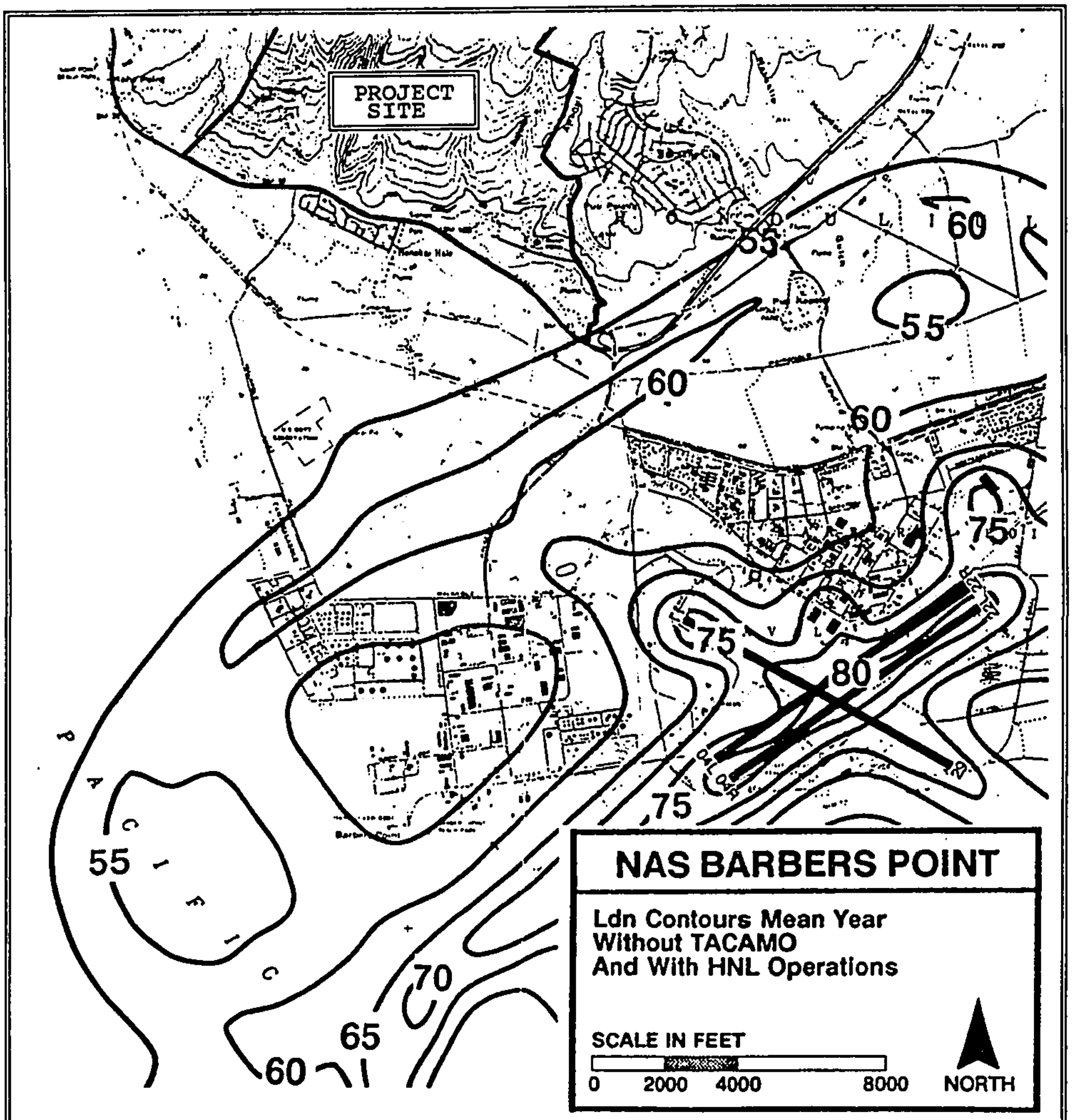

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FIGURE 10 NAS BARBERS POINT AND HONOLULU INTERNATIONAL AIRPORT "MEAN YEAR" LDN CONTOURS (FROM NASBP AICUZ REPORT)

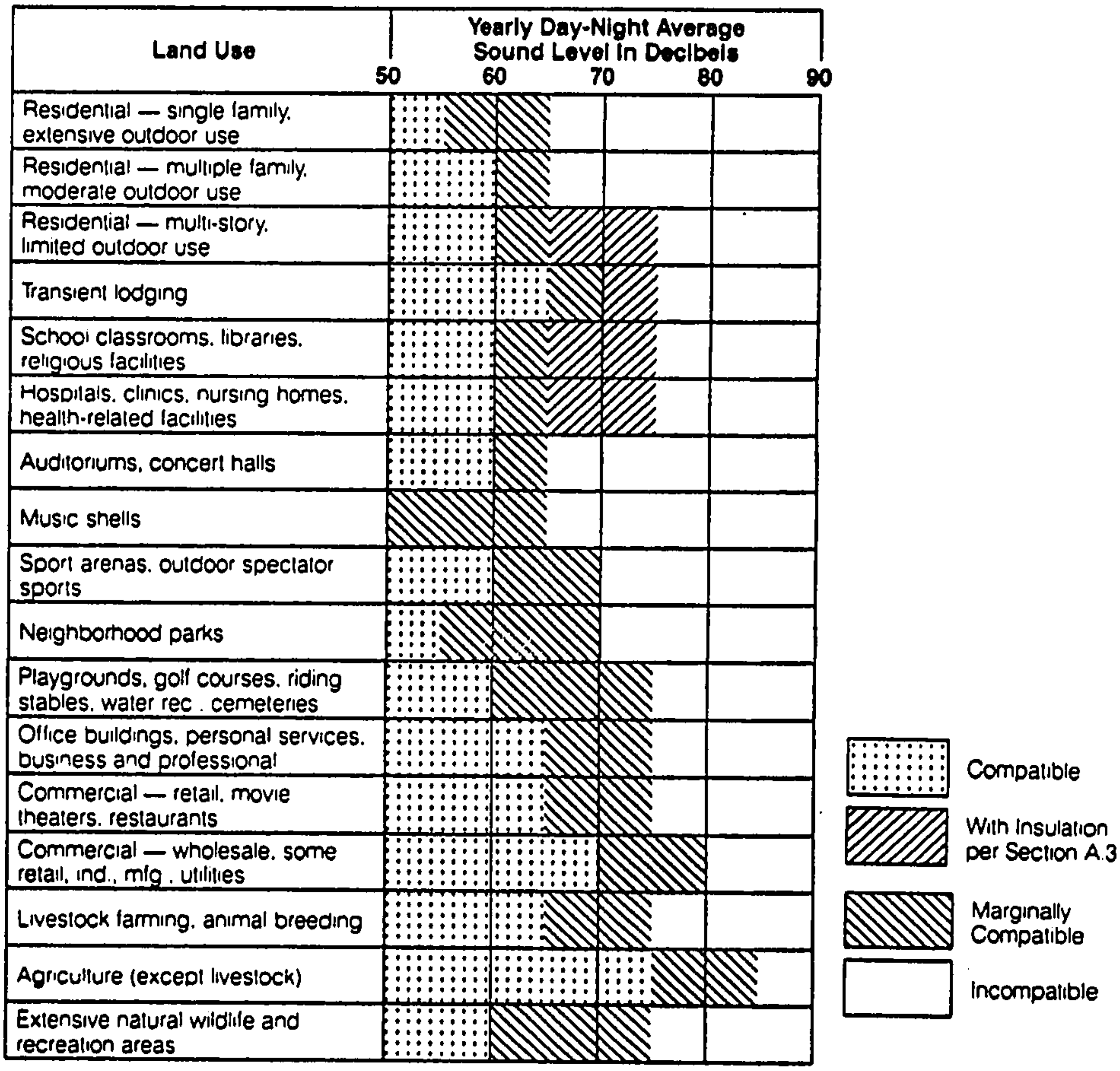

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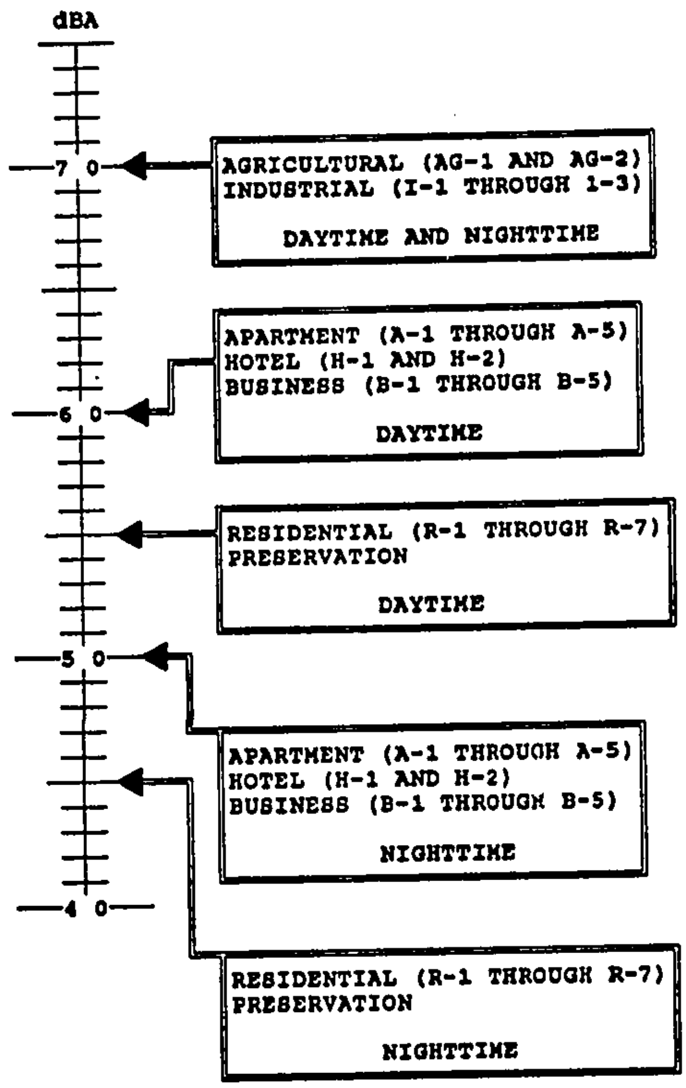
FIGURE 11 LAND USE COMPATIBILITY FOR BUILDINGS AS COMMONLY CONSTRUCTED (FROM REFERENCE 3)



Daytime: 7 am - 10 pm
Nighttime: 10 pm - 7 am

Note: The regulations state that the "allowable" noise levels shall not be exceeded for more than 10% of the time within any 20-minute period.

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FIGURE 12 DEPARTMENT OF HEALTH PROPERTY LINE NOISE LIMITS FOR VARIOUS ZONING DISTRICTS

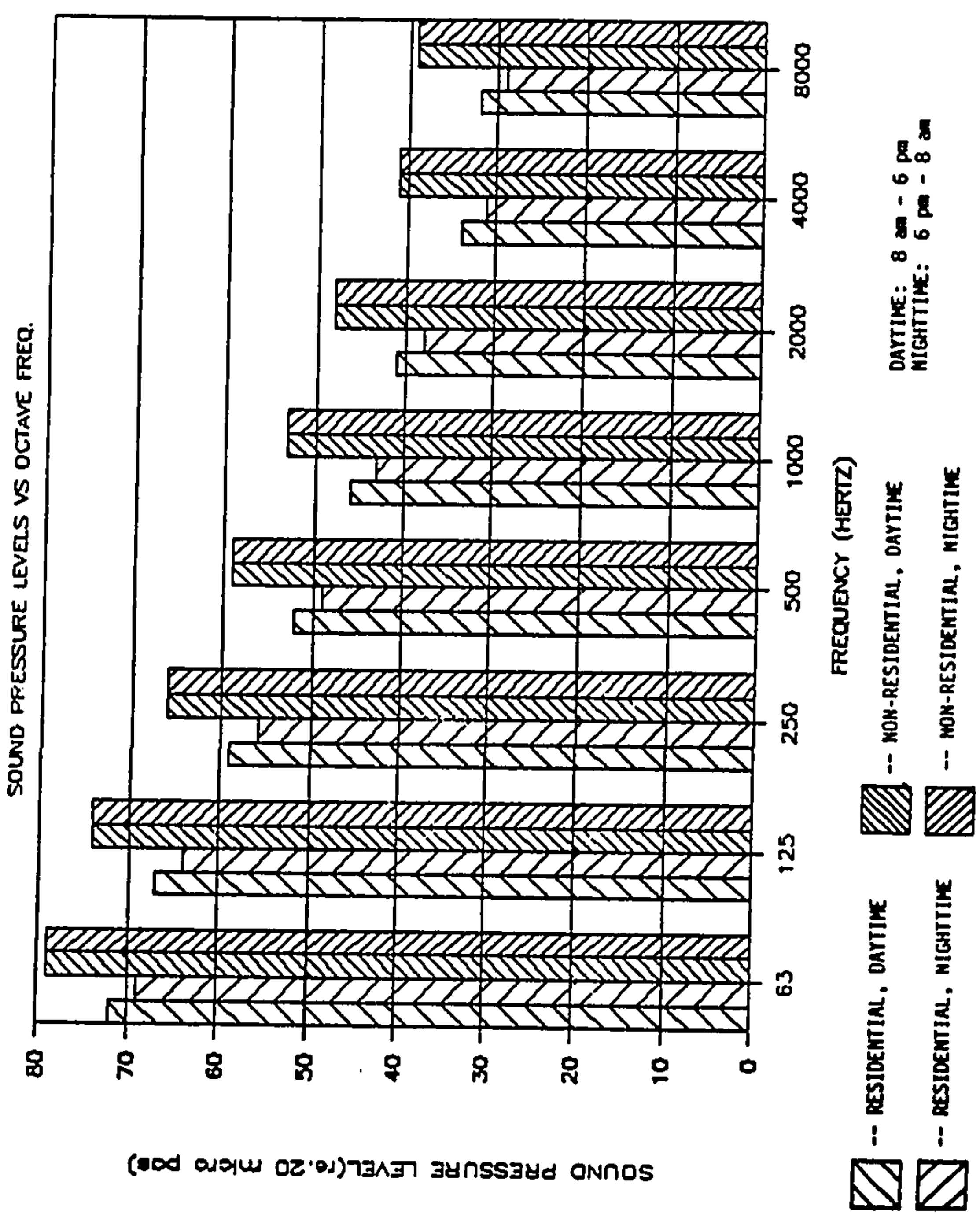

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FIGURE 13 MAXIMUM ALLOWABLE OCTABE BAND NOISE LEVELS (FROM CITY & COUNTY OF HONOLULU LAND USE ORDINANCE)

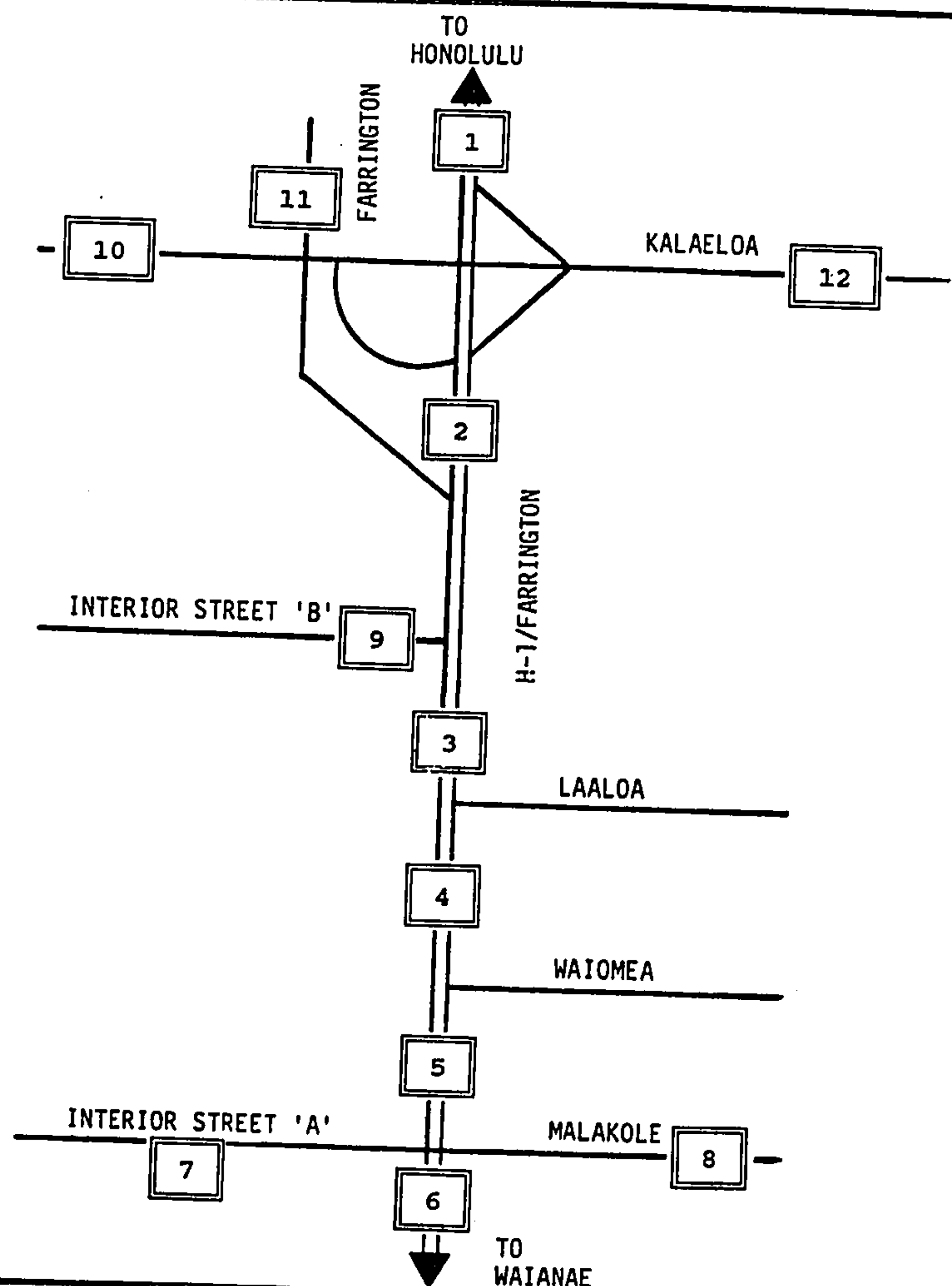

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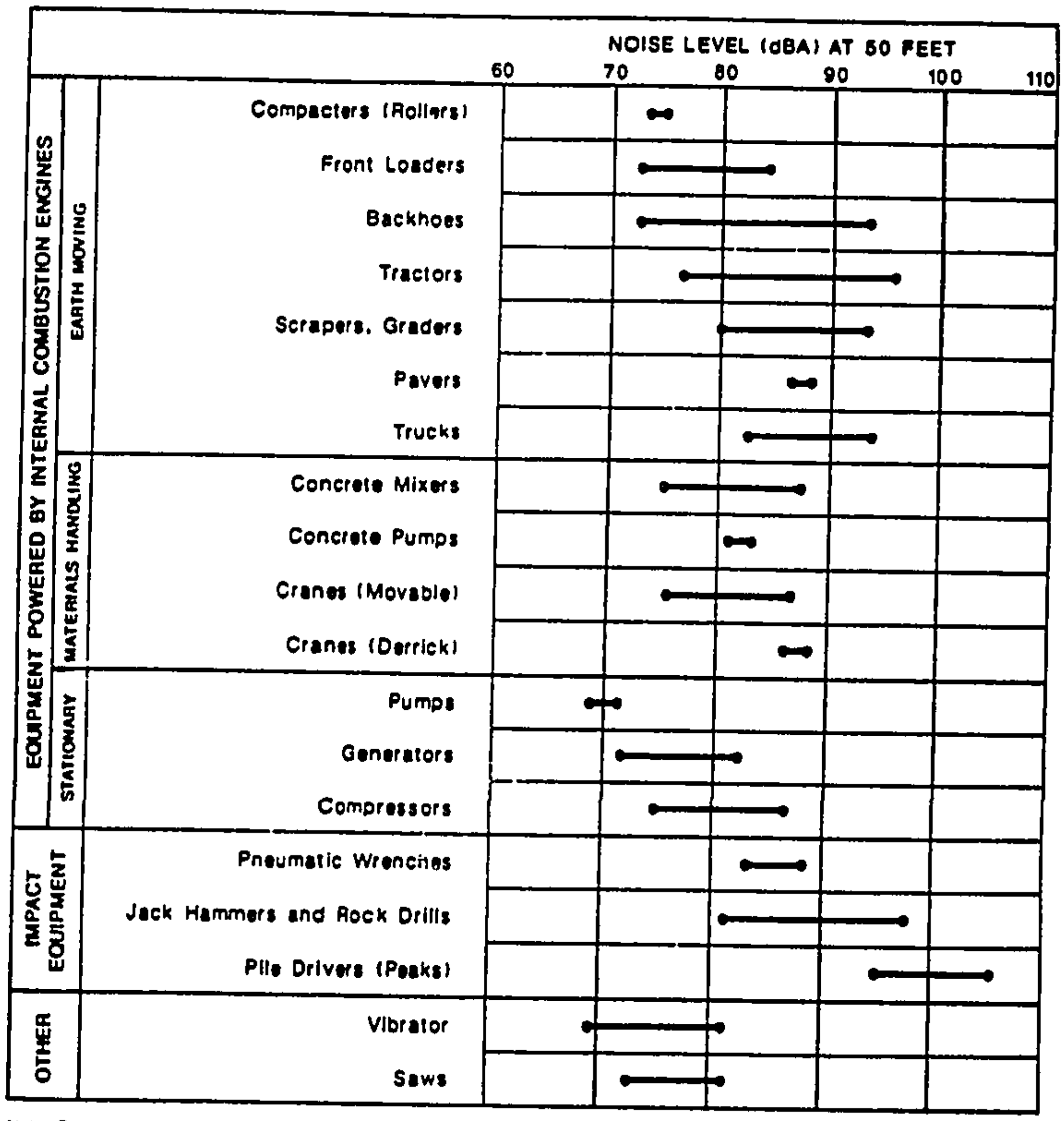
FIGURE 14 LOCATIONS USED FOR TRAFFIC NOISE ASSESSMENTS (SEE TABLE 3)



Note: Based on Limited Available Data Samples

SOURCE: U.S. ENVIRONMENTAL PROTECTION AGENCY
1972

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FIGURE 15

TYPICAL CONSTRUCTION NOISE LEVELS @ 50' DISTANCE

APPENDIX I

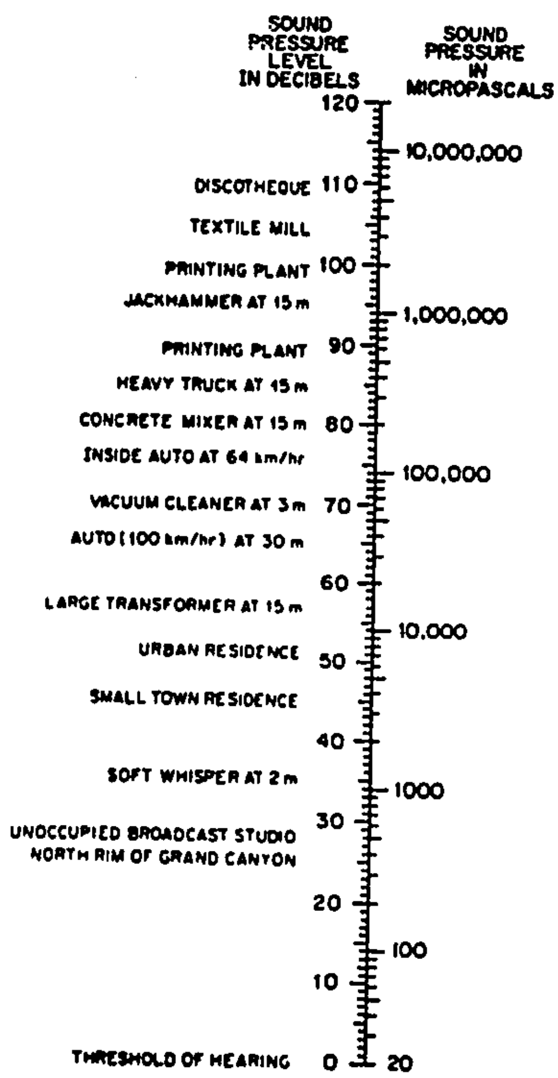
ACOUSTICAL TERMINOLOGY

Sound (Noise) Level

Sound or noise consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. It is measured using precision instruments known as sound level meters, in terms of decibels, abbreviated dB. Sound Level, or Sound Pressure Level, is defined as:

$$SPL = 20 \log (P/Pref) \text{ dB}$$

where P is the sound pressure fluctuation (above or below atmospheric pressure) and Pref is 20 micropascals, which is approximately the lowest sound pressure that can be detected by the human ear. So if P is 20 micropascals, SPL = 0 dB, if P is 200 micropascals, SPL = 20 dB, and so on. The chart below indicates the relation between sound pressure and sound pressure level, and also shows typical dBA levels of various sources of noise.



When two sound levels are combined, the result is the logarithmic sum. For example, two sound levels of 50 dB produce a combined level of 53 dB, not 100 dB; two sounds of 40 and 50 dB produce a combined level of 50.4 dB.

dBA

Sound level, or noise level, is usually expressed in terms of dBA which is measured using the "A-weighting" filter incorporated in sound level meters. This is an electronic filter having a similar frequency response to the human ear, which is most sensitive to sounds in the range 1000 to 4000 Hz, and less sensitive to lower and higher frequencies. The level of a sound in dBA is a good measure of the loudness of that sound, and so different sounds having the same dBA level sound about equally as loud.

A change of 1 or 2 dBA in the level of a sound is difficult for most people to detect, but a 3 to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness.

Statistical Sound (Noise) Levels

Sounds that vary in level over time, like road traffic noise and most community noise, are commonly described in terms of Lx, where L is the noise level exceeded for x% of a given measurement period, and/or Leq, the Equivalent Continuous Noise Level. For example, L1 is the noise level exceeded for 1% of the time, L10 the noise exceeded for 10% of the time, and so on. Leq is defined as the steady sound level that contains the same amount of acoustical energy as the given time-varying sound.

Figure A-1 illustrates the relationship between selected statistical sound levels.

Day-Night Average Sound Level (Ldn)

Ldn is essentially the Equivalent Continuous Noise Level measured over a 24-hour period. However, in calculating the Day-Night Average Sound Level, 10 dBA is added to the noise levels recorded between 10 pm and 7 am to account for people's higher sensitivity to noise at night. Figure A-2 shows typical Ldn levels in outdoor locations.

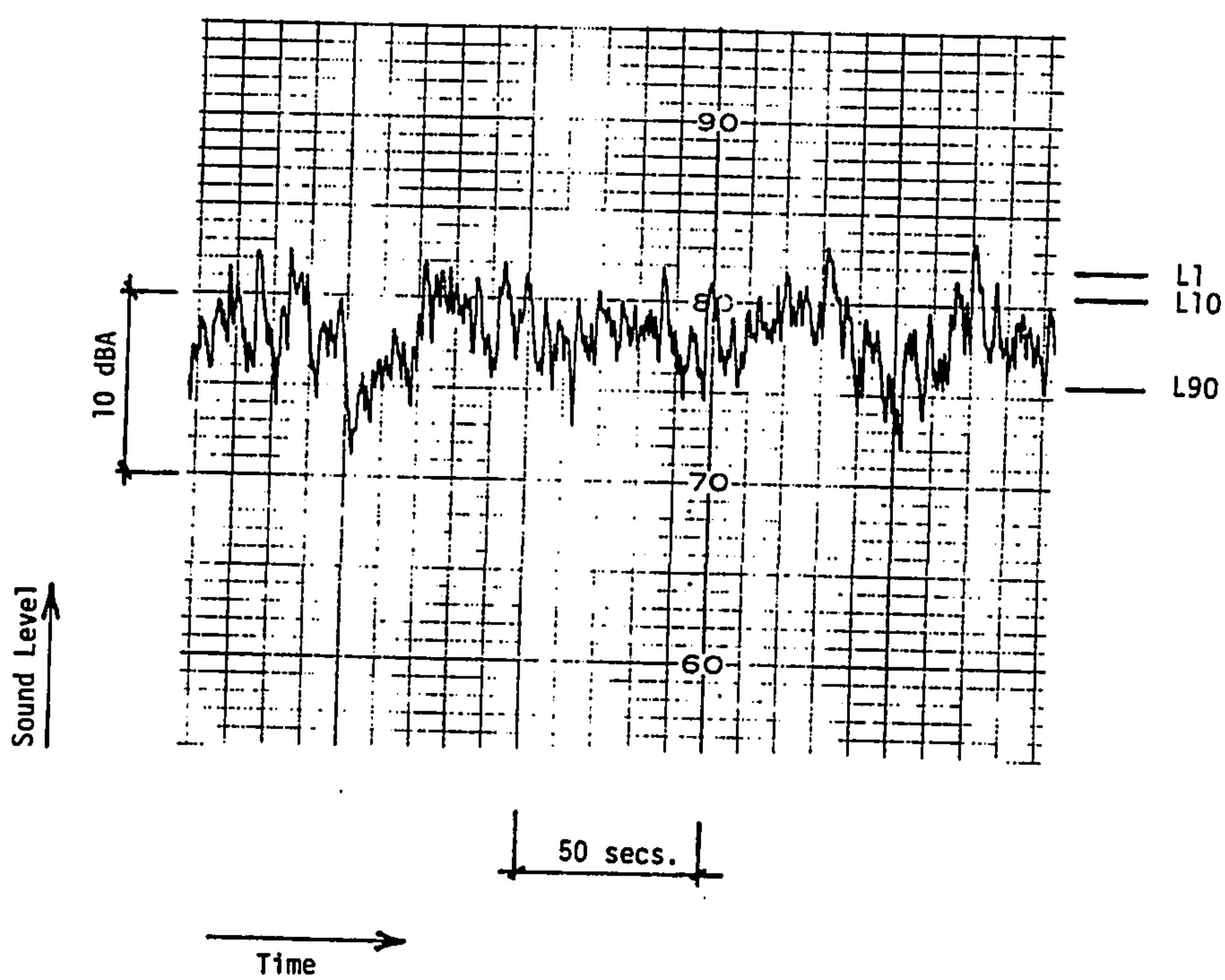


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FIGURE A-1 USE OF STATISTICAL SOUND LEVEL DESCRIPTORS FOR TIME-VARYING SOUND

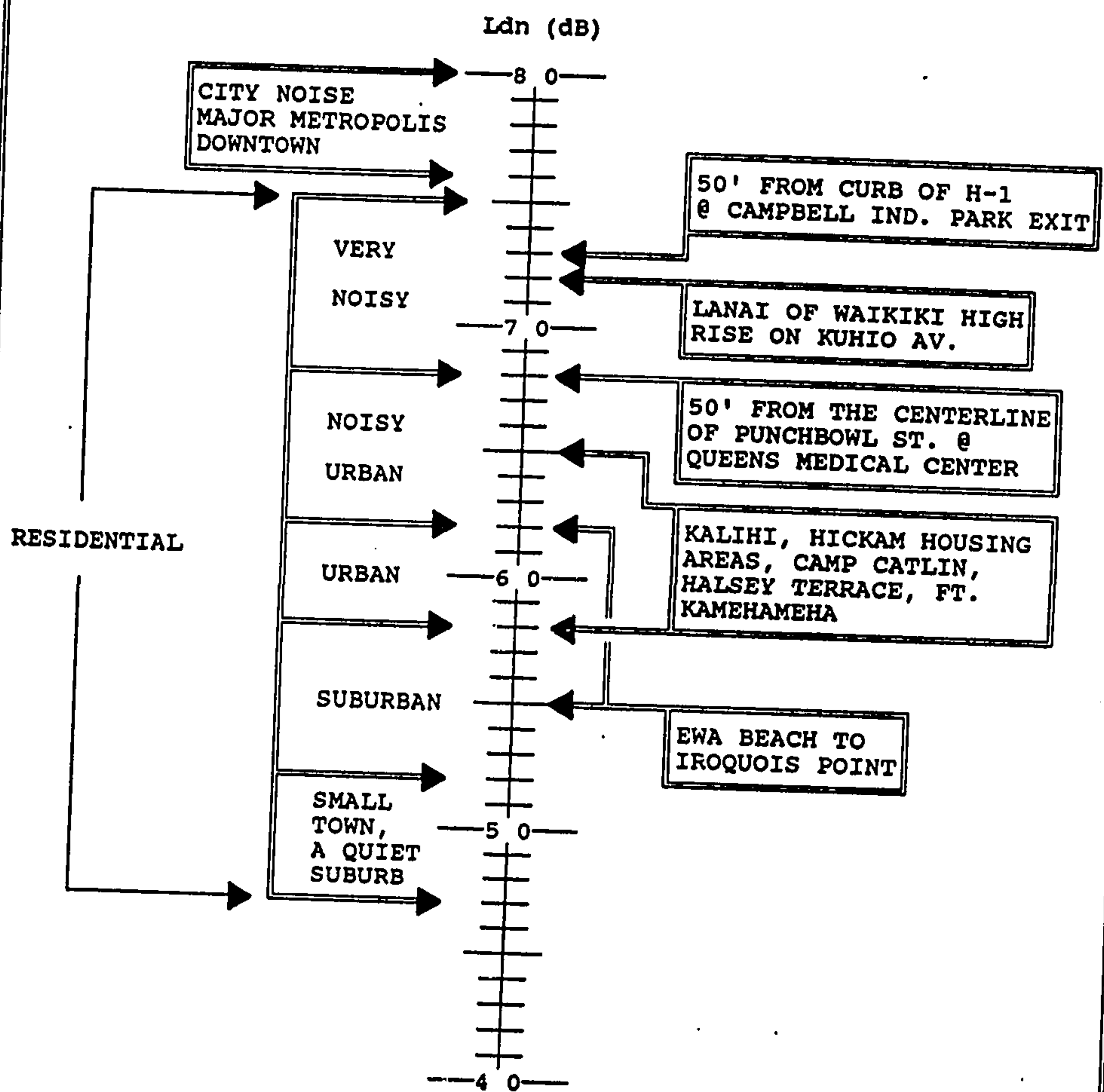

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FIGURE A-2 TYPICAL LDN LEVELS IN OUTDOOR LOCATIONS

APPENDIX II

RESUMES OF

RONALD A. DARBY

AND

JOHN C. SHEARER

PROFESSIONAL BIOGRAPHY
RONALD A. DARBY

EDUCATION
Master of Science in Engineering, Catholic University, Washington D.C.
Bachelor of Science in Mechanical Engineering, Pennsylvania State University
Graduate studies include courses at the University of Maryland and the University of Hawaii and the completion of the required course work for Doctor of Engineering at Catholic University.

REGISTRATION
Registered Professional Engineer:
Hawaii
Maryland

PROFESSIONAL AFFILIATIONS
Acoustical Society of America
National Council of Acoustical Consultants Consulting Engineers Council of Hawaii
National Society of Professional Engineers

EXPERIENCE
Mr. Darby founded Darby & Associates (formerly Ronald A. Darby & Associates and Darby-Ebisu & Associates, Inc.) in 1970. Mr. Darby has performed airport, community and industrial noise exposure measurements, evaluations and studies in the Hawaiian Islands, Guam and mainland U.S.A. He has been responsible for architectural and mechanical equipment noise control efforts for new and existing building projects in the Pacific Basin, Mainland U.S.A. and Japan.

Mr. Darby was a research scientist at LTV Research Center, Hawaiian Division from 1967 and 1970. He was involved in all phases of deep ocean underwater acoustic measurement exercises, planning, data collection, data processing (analog and digital), analysis and reporting. Typical results were long range sound transmission loss values, ambient noise levels and source levels. Mr. Darby developed a unique method to measure radiated noise levels of submarines using aircraft. He also served as member of Tactical Analysis Group for Commander, Anti-submarine Warfare Forces, Pacific at Pearl Harbor.

Other relevant work experience includes his responsibilities as a research mechanical engineer at the Marine Engineering Laboratory, Annapolis, Maryland (Now NSRDC) from 1960 to 1967. In this position, he was technical secretary of the "Submarine Noise Measurement Panel", Committee of Undersea Warfare, National Academy of Science for one and a half years. Significant accomplishments include the development of a practical technique for predicting radiated noise from ship's machinery and the development of laboratory techniques and special transducers for measuring structural noise transmission from machines. Mr. Darby also created technological forecasts and cost effectiveness studies on machinery noise and devised practical experiments to evaluate machinery noise quieting devices, i.e., isolation mounts, flexible hoses, sound enclosures, etc.

PROFESSIONAL BIOGRAPHY
JOHN C. SHEARER

EDUCATION
Master of Science in Engineering Acoustics, University of Southampton, U.K.
Bachelor of Engineering in Mechanical Engineering, University of Adelaide, Australia

PROFESSIONAL AFFILIATIONS
National Association of Acoustical Consultants
Australian Acoustical Society
Institution of Engineers (Australia)

EXPERIENCE
Mr. Shearer joined Darby & Associates, Kailua, Hawaii, as senior consultant in 1989. Prior to this, he was senior consultant at Richard Heggie Associates Pty. Ltd. in Sydney, Australia from 1988 to 1989. His responsibilities included environmental noise impact assessments for proposed hotels, commercial and industrial developments, architectural acoustics and mechanical noise control for high rise office buildings, hotels and television studios.

Mr. Shearer was senior consultant at Wilson, Ihrig & Associates, Inc. in Oakland, California from 1985 to 1988. He was involved in assessing the noise and vibration impact of new rapid transit systems throughout the U.S. and in assessing the community noise impact of helicopter operations. Other responsibilities included analysis of existing and projected noise levels at proposed residential developments potentially impacted by aircraft noise, prediction of the environmental noise impact of proposed motor sport raceways, analysis of building sound isolation requirements and the design of acoustic enclosures for pumps, compressors, etc.

As director at Shearer-Gardner Pty. Ltd. in Adelaide, Australia from 1977 to 1984, Mr. Shearer was involved in a wide range of projects in environmental noise assessments and control, industrial noise control and architectural acoustics. Also, Mr. Shearer served as branch manager at Vipac and Partners Pty. Ltd. in Adelaide, Australia from 1975 to 1977, where his consulting responsibilities included environmental and industrial noise control and architectural acoustics.

Appendix F.

Air Quality Impact Report Makaiwa Hills

J. W. Morrow

AIR QUALITY IMPACT REPORT

MAKAIWA HILLS

January 14, 1991

PREPARED FOR

William E. Wanket, Inc.

AND

The Estate of James Campbell

PREPARED BY

J. W. Morrow
Environmental Management Consultant
563 Paulele Street
Kailua, Hawaii 96734

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1. INTRODUCTION

The Estate of James Campbell is proposing to develop a planned community, to be called Makaiwa Hills, on approximately 1,915 acres of land on the slopes of the Waianae Mountain Range in the Ewa District of Oahu (Figure 1). The project will consist of approximately 2,130 residential units on approximately 726 acres and a regional shopping center on approximately 156 acres. Other anticipated facilities include an elementary school, fire station, park, and other recreational uses. In the future, a golf course may also be developed on the lower portion of the property, but no firm plans exist at this time.

The property ranges in elevation from 50 to 1300 feet above mean sea level (MSL) and is predominantly grass covered with scattered trees and shrubs (Figure 2). It is transected by three major and three minor north-south gulches. Tongg Ranch currently uses much of the site for grazing of cattle and horses.

The purpose of this report is to assess the air quality impact of the proposed development. The project can be considered an "indirect source" of air pollution as defined in the federal Clean Air Act [1] since it will attract mobile sources of air pollution, i.e., motor vehicles. Thus, much of the focus of this analysis is on the project's ability to generate traffic and the resultant impact on air quality. Air quality impact was evaluated for existing (1990) and future (2010) conditions.

The following direct and indirect impacts have also been addressed:

- offsite impacts due to electrical generation
- refuse disposal at a resource recovery facility
- pesticides use at the golf course
- onsite and offsite construction impacts

2. AIR QUALITY STANDARDS

A summary of State of Hawaii and national ambient air quality standards is presented in Table 1 [2,3]. Note that Hawaii's standards are not divided into primary and secondary standards as are the Federal standards.

Primary standards are intended to protect public health with an adequate margin of safety while secondary standards are intended to protect public welfare through the prevention of damage to soils, water, vegetation, man-made materials, animals, wildlife, visibility, climate, and economic values [4].

Some of Hawaii's standards are clearly more stringent than their Federal counterparts but, like their Federal counterparts, may be exceeded once per year. It should also be noted that in April, 1986, the Governor signed amendments to Chapter 59 (Ambient Air Quality Standards) making the State's standards for particulate matter and sulfur dioxide the same as national standards. In the case of particulate matter, however, this uniformity did not last long. On July 1, 1987, the EPA revised the Federal particulate standard to apply only to particles 10 microns or less in diameter (PM-10) [5], leaving the State once again with standards different than the Federal ones.

In the case of the automotive pollutants [carbon monoxide (CO), oxides of nitrogen (NOx), and photochemical oxidants (Ox)], there are only primary standards. Until 1983, there was also a hydrocarbons standard which was based on the precursor role hydrocarbons play in the formation of photochemical oxidants rather than any unique toxicological effect they had at ambient levels. The hydrocarbons standard was formally eliminated in January, 1983 [6].

The U.S. Environmental Protection Agency (EPA) is mandated by Congress to periodically review and re-evaluate the Federal standards in light of new research findings [7]. The last review resulted in the relaxation of the oxidant standard from 160 to 235 micrograms/cubic meter (ug/m3) [8]. The carbon monoxide (CO), particulate matter, sulfur dioxide (SO2), and nitrogen dioxide (NO2) standards have been reviewed, but no new standards were proposed.

Finally, the State of Hawaii also has fugitive dust regulations for particulate matter (PM) emanating from construction activities [9]. There simply can be no visible emissions from fugitive dust sources.

3. EXISTING AIR QUALITY

3.1 General. The State Department of Health maintains a network of air monitoring stations around the state to gather data on the following regulated pollutants:

- total suspended particulates (TSP)
- particulate matter <10 microns (PM-10)
- sulfur dioxide (SO2)
- carbon monoxide (CO)

- ozone (O3)
- lead (Pb)

In the case of TSP, PM-10, and SO2, measurements are made on a 24-hour basis to correspond with the averaging period specified in the standards. Samples are collected once every six days in accordance with U.S. Environmental Protection Agency (EPA) guidelines. Carbon monoxide and ozone, however, are measured on a continuous basis due to their short-term (1-hour) standards. Lead concentrations are determined from the TSP samples which are sent to an EPA laboratory for analysis. Note that the lead standard is a quarterly average.

The nearest Department of Health (DOH) air monitoring site is the Barbers Point station located at the Campbell Industrial Park, some 2 miles south of the project. The DOH also monitors air quality at its downtown Honolulu building some 16 miles east of the project site.

3.2 Department of Health Monitoring Sites. Recent data from the Barbers Point and Honolulu stations are summarized in Tables 2 - 5. The data indicate that total suspended particulate (TSP) and sulfur dioxide (SO2) standards are being met. In fact, much of the time sulfur dioxide concentrations are below the detectable limit of the measurement method being employed. Carbon monoxide (CO) levels are also below State standards most of the time with only occasional exceedances.

Photochemical oxidants are secondary pollutants formed in the atmosphere largely as a result of anthropogenic emissions of hydrocarbons and oxides of nitrogen. Since there are no ambient standards for hydrocarbons, there is no monitoring. In the case of NO2, the State ceased routine monitoring in 1976. As indicated by federal and state standards, ozone is monitored at Sand Island as a surrogate for photochemical oxidants. Recent monitoring data from that station indicate that the state's 1-hour standard is being met over 99% of the time.

As noted above, the State also has been having particulate samples analyzed for lead content, and Table 5 summarizes ambient lead levels over the past 20 years. Generally, airborne lead levels have declined as expected due to the federal program for gradual phaseout of leaded gasoline. Particulate lead accumulated over the years in roadside soils and plants, however, will remain indefinitely in the area and provide inhalation exposure whenever dust is re-entrained in the air as a result of scouring winds or mechanical disturbance due to vehicular motion.

3.3 Onsite Carbon Monoxide Sampling. In conjunction with this study, air sampling was conducted at the following two sites along Farrington Highway and H-1 Freeway during December 1990.

- Farrington Highway at the Proposed Intersection "A" (makai side)

- Kunia Road at H-1 Freeway (East of Palailai Interchange)

In each case, the actual sampling site was within 10 meters of the road edge and on the south (makai) side due to the winds prevailing at the time. A continuous carbon monoxide (CO) instrument was set up and operated during the a.m. and p.m. peak traffic hours based on the results of the traffic impact study [10]. An anemometer and vane were installed to record onsite surface winds. A simultaneous manual count of traffic was also performed. The variability of each of the parameters measured during the peak hours is clearly seen in Figures 3 - 6.

A summary of the average values is presented in Table 6. Onsite surface winds on December 3 were generally northeasterly during both the a.m. and p.m. peak hours with mean wind speed about 2 m/sec. Atmospheric stability was neutral in the morning and slightly to moderately unstable during the afternoon. Traffic counts were comparable to those reported by the traffic consultant. CO concentrations were comparable with the computer-predicted concentrations discussed in Section 6 when the increased actual wind speed is accounted for.

4. CLIMATE & METEOROLOGY

4.1 Temperature & Rainfall. The National Climatic Data Center in its 1982 annual summary for Honolulu notes that:

> "Hawaii's equable temperatures are associated with the small seasonal variation in the amount of energy received from the sun and the tempering effect of the surrounding ocean. The range of temperature averages only 7 degrees between the warmest months (August and September) and the coolest months (January and February) and about 12 degrees between day and night. Daily maximums run from the high 70's in winter to the mid-80's in summer, and daily minimums from the mid-60's to the low 70's. However, the Honolulu Airport area has recorded as high as 93 degrees and as low as 53" [11].

Rainfall in the project area ranges from about 20 inches per year at the lower elevations to 30 inches per year at the top of the property [13,14]. In accordance with Thornwaite's scheme for climatic classification [14], the area thus ranges from semiarid steppe to subhumid grassland.

4.2 Surface Winds. Meteorological records were reviewed from the Honolulu International Airport and Hickam Air Force Base (AFB). It is quite evident that northeast tradewinds predominate during much of the year (Table 7). A closer examination of the data, however, indicates that low velocities (less than 10 mph) occur frequently and that the "normal" northeasterly tradewinds tend to breakdown in the Fall giving way to more light, variable wind conditions through the Winter and on into early Spring. It is during these times that Honolulu generally experiences elevated pollutant levels. This seasonal difference in wind conditions can be seen clearly in Figures 7 and 8.

Of particular interest from an air pollution standpoint were the stability wind roses prepared for the period January 1955 to December 1968 at Hickam Air Force Base [15]. These data indicated that stable conditions, i.e., Pasquill-Gifford stability categories E and F [16], occur about 28% of the time. It is under such conditions that the greatest potential for air pollutant buildup from groundlevel sources exists.

5. HIGHWAYS AND TRAFFIC

As noted previously the principal access road to the project site is Farrington Highway which exists as a 4-lane divided highway in the project area. Operating speeds along this segment are in the 40 - 45 mph range. East of the project Farrington Highway runs into the H-1 Freeway at the Palāilai Interchange. West of the project, it becomes an undivided 4-lane roadway.

The traffic study provided by Pacific Planning & Engineering, Inc. [10] focused on this segment of Farrington Highway from the project's western boundary to the Palailai Interchange. Traffic data from that study indicated a.m. and p.m. peak hours in the 6:30 - 7:30 a.m. and 3:15 - 4:15 p.m. range, respectively. Traffic counts made in conjunction with the air sampling conducted for this project were generally consistent with those data.

Projections for future traffic volumes in the vicinity of the two proposed new access roads to the project as well as east of Palailai Interchange were taken from the Pacific Planning & Engineering, Inc. report. Photographs of the existing conditions at those intersections are presented in Figure 9.

6. MOBILE SOURCE IMPACT

6.1 Emission Factors. Automotive emission factors for carbon monoxide (CO) were generated for calendar years 1990 and 2010 using the Mobile Source Emissions Model (MOBILE-3) [17]. To localize emission factors as much as possible, the August, 1988 age distribution for the City & County of Honolulu [18] was input in lieu of the national statistics normally used.

6.2 Microscale Analysis. Analyses such as this generally involve estimation of concentrations of non-reactive pollutants. This is due to the complexity of modeling pollutants which undergo chemical reactions in the atmosphere and are subject to the effects of numerous physical and chemical factors which affect reaction rates and products. For projects involving motor vehicles as the principal air air pollution source, carbon monoxide is normally selected for modeling because it has a relatively long half-life in the atmosphere (about 1 month) [19], and it comprises the largest fraction of automotive emissions.

In this instance, a microscale screening analysis was performed for the Farrington Highway - Intersection "A", Farrington Highway - Intersection "B" and H-1 Freeway east of Palailai Interchange segments. The updated version of an EPA guideline model CALINE-4 [20,21] was employed with an array of receptors spaced at distances of 10 - 30 meters from the road edge. Because of the growing level of urbanization and traffic in the area, a background CO concentration of 1.0 milligram per cubic meter (mg/m3) was assumed.

Worst case meteorological conditions were selected for the a.m. and p.m. peak traffic hours. A wind speed of 1 meter per second, an acute wind/road angle, and neutral stability (Pasquill-Gifford Class "D") [16], were all selected to maximize concentration estimates in the vicinity of the intersections. Review of the traffic data and preliminary modeling indicated that northwesterly winds were most likely to produce the maximum CO concentrations near the intersections under study; thus, this wind direction was input for the modeling.

Maximum one-hour carbon monoxide (CO) concentrations were then computed for the peak traffic hours. The analyses were performed for existing conditions (1990) and future conditions (2010) both with and without the proposed project. The results are summarized in Figures 10 - 12.

7. OFF-SITE STATIONARY SOURCE IMPACT

7.1 Electrical Generation. Based on an average HECO residential customer's consumption of 600 kilowatt-hours/month (kwhr/mo), an annual electrical demand of 15.5 million kilowatt hours is estimated for the project. Lacking any details at this time on the electrical demand of commercial and public facilities, it is assumed that those facilities will have an equivalent total demand, thereby giving a grand total of 31 million kwhr/yr.

This demand will obviously necessitate the generation of electricity by power plants. Currently, most of Oahu's electrical energy is generated at Hawaiian Electric Company's (HECO) Kahe Generating Station located within a mile and visible from the higher elevations of the project site (Figures 1 and 13). This is currently a six-unit, approximately 650-megawatt facility firing low-sulfur fuel oil. A seventh 150-megawatt unit was proposed by HECO [22], but two out-of-state companies proposed and are now building a gas turbine and coal-fired power plant at Campbell Industrial Park to sell power to the utility [24]. For the purposes of this analysis, low sulfur (0.5%) fuel oil-firing was assumed. Estimates of annual emissions were computed based on EPA emission factors and the fuel required to meet a 31 million Kwhr demand. The results are presented in Table 8.

As pointed out by HECO, computer modeling has shown that the maximum groundlevel concentration of stack gas pollutants occur within the boundaries of the Makaiwa Hills project [25]. Fortunately, under current operating conditions, these maximum concentrations have not been predicted nor measured to exceed state or federal air quality standards. Furthermore, since the project is east-northeast of the power plant, it is <u>upwind</u>, in terms of the prevailing trade winds, most of the time; thus, impacts would be infrequent. While emissions are barely visible during normal operations, periodic maintenance does result in visible plumes from the stacks. This may give rise to public complaint from future residents of the area. Given the expected increase in Oahu's population and concomitant increase in electrical demand, however, it is likely that additional generating units will eventually be added to the Kahe facility thereby increasing possible impact on Makaiwa residents.

7.2 <u>Solid Waste Disposal</u>. The refuse generated by the residents of the 2,130 new homes as well as the commercial establishments and public facilities in Makaiwa Hills will require disposal. Historically, about 80% of Oahu's refuse was being landfilled with the remaining 20% being burned at the Waipahu Incinerator [26]. With the recent opening of the City's new resource recovery facility (HPOWER) at Campbell Industrial Park, most refuse will be pre-processed and burned leaving less mass to be landfilled. This facility was originally designed to handle most of Oahu's domestic refuse (1,800 tons/day). Estimates of annual emissions attributable to the combustion of Makaiwa Hills refuse at HPOWER are included in Table 8.

The City's newest landfill, Waimanalo Gulch, is immediately adjacent to Makaiwa Hills along Farrington Highway (Figure 13). While a properly run sanitary landfill should not significantly affect air quality, there are at times visible fugitive dust emissions, and the operation does generate additional truck traffic in the area. Under the predominant northeast tradewinds, landfill-related emissions would be carried away from the project site. Only during the less frequent southerly (kona) winds might emissions affect future Makaiwa Hills residents.

8. OTHER LONG-TERM IMPACTS

8.1 Agricultural Burning. Burning of sugar cane fields prior to harvest is a long-standing practice in Hawaii's sugar industry. Unfortunately, however, as urbanization closes in around agricultural operations, it is inevitable that complaints about air pollution will arise. Cane fires result in the emission of particulates, carbon monoxide, and trace amounts of other organics. This was most recently demonstrated in an EPA study of cane burning on Maui [27]. Concentrations of particulates can reach high levels within about one mile of the fires [28]. A complete quantitative characterization of cane smoke, however, has yet to be performed. Fortunately, fires are generally infrequent and only last about 20 - 30 minutes.

In the specific case of Makaiwa Hills, most nearby cane fields have already been designated for urban use and thus field burning would appear to have been eliminated as an issue. There are, however, relatively large tracts of land east, i.e., upwind, of the project which are still designated for agricultural use, and thus there may still be some field burning impacts. Given the distance between source and receptor, however, such impacts should not be excessive, and ambient air quality standards would still be met. In the future, these remaining fields, already almost surrounded by urban uses, may also succomb to urban pressure and be removed from agriculture.

8.2 Campbell Industrial Park.

8.2.1 Criteria Pollutants. The industrial sources at Campbell Industrial Park obviously affect air quality in the Ewa area. The maximum concentrations of total suspended particulate matter (TSP), inhalable particulate matter (PM-10), and sulfur dioxide, however, are in compliance with existing federal and state air quality standards. Neither monitoring nor computer modeling show violations of the current standards. Historically, there has been a problem meeting the State's TSP standard, and even with adoption of the less stringent federal standards, this may continue to be a problem as levels in the past have on occasion even exceeded those standards. As noted in Section 2, the state and federal particulate standards are once again different and while recent monitoring data indicate that the federal PM-10 standard is being met, the state TSP standard continues to be threatened.

SO2 standards are being gradually approached as new sources come in and existing sources expand. The completion of the City's resource recovery facility and the future completion of a gas turbine and coal-fired power plant as well as other as yet unidentified sources in the industrial park will all contribute additional increments of regulated and unregulated pollutants to the Ewa air. The responsible government agencies will have to watch the situation closely to insure that standards continue to be met.

The 2-mile, normally upwind location of Makaiwa Hills suggests little or no impact from the industrial park. Given the park's size and potential growth, however, one can anticipate some impact under southerly wind conditions.

8.2.2 Toxic Air Pollutant Emissions. The U.S. Environmental Protection Agency's 1987 Toxic Release Inventory [29] data were reviewed and those air emissions from existing Campbell Industrial Park facilities were compiled into Table 9. It is evident that there are quite a number of chemicals with varying toxicities being released although their quantities are not nearly as great as the "criteria" pollutants, e.g., sulfur dioxide, carbon monoxide, etc., which are emitted in thousands of tons per year (Table 10).

Lacking any information on the specific time frame over which these emissions occur, it is virtually impossible to determine their impact on local air quality. Release of 120 tons of ammonia over a 24-hour period, for example, has a substantially greater effect on air quality than 120 tons released incrementally over a full year, i.e., 8,760 hours. Thus, while it is good to be aware of these emissions, their effects cannot be thoroughly evaluated.

8.3 Pesticide Use. As noted in the Introduction, no golf course is currently planned for this project; however, one may be added in the future. If it comes to pass, then some use of pesticides is likely. Pesticides are routinely required at golf courses in order to maintain fairways and greens. Typical pesticide use at a 27-hole golf course was obtained from another report prepared for this project [30].

The herbicides MSMA, glyphosate, metribuzin, and bensulide all have relatively low mammalian toxicities with oral LD_{50} values on the order of hundreds or thousands of milligrams active agent per kilogram body weight (mg/kg) [31, 32]. MSMA and metribuzin have OSHA air standards of 0.5 mg/m3 and 5 mg/m3, respectively [31]. These are 8-hour time-weighted averages.

The insecticide chlorpyrifos is a moderately toxic organophosphate which can affect the normal functioning of mammalian nervous systems through its inhibition of the enzyme cholinesterase. It has oral LD_{50} values in the range of 60 - 82 mg/kg. The OSHA standard for airborne concentrations of chlorpyrifos is 0.2 mg/m3 as an 8-hour average [32].

The fungicides metalaxyl and chlorothalonil have relatively low acute toxicities with oral LD_{50} values in the hundreds and thousands of mg/kg [32]. Chlorothalonil, however, has also demonstrated some carcinogenic potential in animals [32].

If properly used in accordance with label instructions, all of the aforementioned chemicals should present no hazard to the properties or owners of properties adjoining the proposed golf course. In fact, the greatest risk in using such chemicals is generally to the users themselves if they do not strictly follow label instructions. This is because the user may come in contact with the concentrated product while nearby properties and people may only be exposed to the greatly diluted and dispersed application solution.

The potential for significant airborne concentrations of these chemicals is relatively slight when one considers the dilution factor in application solutions plus the coarse spray that is normally used to assure adequate coverage in the desired area and avoidance of drift. Should a user improperly apply these chemicals under wind conditions which would contribute to drift, then there would be an increased possibility of downwind exposure of property and people. In order to assess the possible impact of such an event on people, a dispersion modeling analysis was performed for each of the chemicals. The results of this modeling are summarized in Table 11.

9. CONSTRUCTION IMPACT

The principal source of short-term air quality impact will be construction activity. Construction vehicle activity will increase automotive pollutant concentrations along the principal access roads as well as in the vicinity of the project site itself. During off-peak hours, the additional construction vehicle traffic should not exceed road capacities although the presence of large trucks can reduce a roadway's capacity as well as lower average travel speeds thereby contributing to additional air pollution emissions.

The site preparation and earth moving will create particulate emissions as will building and on-site road construction. Construction vehicles movement on unpaved on-site roads will also generate particulate emissions. EPA studies on fugitive dust emissions from construction sites indicate that about 1.2 tons/acre per month of activity may be expected under conditions of medium activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50 [33].

Since a significant fraction of the onsite soils were clays and silty clays, in all probability having silt contents equal to or greater than the 30% cited above, and the computed P/E Indices for the area were 24 - 39 implying drier conditions than in the EPA case, it may be assumed that there is a potential for fugitive dust problems.

In addition to the onsite impacts attributable to construction activity, there will also be offsite impacts due to the operation of concrete batching plants needed for construction. Since it is also too early to identify specific facilities that will be providing the concrete, the discussion of air quality impacts is necessarily generic.

Design and operating features of a typical concrete batching plant were obtained for this analysis. This plant (Rex Transit Mix Batch Plant, Model LO GO 5) [34], is a portable unit capable of producing up to 100 cubic yards of concrete per hour.

Assuming 8 hours/day operation and published EPA emission factors [33] for both direct plant emissions and fugitive dust emissions, estimates of worst case ambient impact were derived using the PTPLU screening model [35]. Ninety percent control of particulate emissions from the plant itself and 60% control of fugitive dust emissions from the process were assumed. One-hour concentration estimates were adjusted to 8-hour averages using an EPA-recommended factor [36] and then to 24-hour averages based on a weighted averaging technique. The worst case concentration of total suspended particulates (TSP) was thus estimated to be 105 micrograms/cubic meter (ug/m3) due to the plant operation.

Since it is not known where exactly the plant(s) will be located and thus what the background concentration of TSP will be, it is somewhat difficult to predict cumulative concentrations for comparison with standards. However, if the batch plant's 105 ug/m3 were assumed to be all < 10 microns and were added to the second highest 24-hour PM-10 concentration (42 ug/m3) from the 1989 DOH Barbers Point data, the sum would still comply with the federal 24-hour standard of 150 ug/m3.

10. DISCUSSION

10.1 Microscale Analysis. The 1-hour "worst case" concentration estimates at the proposed Intersections "A" and "B" along Farrington Highway and along the H-1 Freeway east of the Palailai Interchange (Figures 10, 11 and 12) indicate compliance with federal and state 1-hour CO standards under both current and projected peak traffic conditions. The general trend is towards increasing CO levels despite the effect of lower new vehicle emissions resulting from the federal motor vehicle emissions control program. The difference between the "with" and "without" project scenarios is in the range of 3 - 7% with the "with project" scenario showing the higher CO levels during peak hours.

Compliance with the federal and state 8-hour standards can also be inferred from the fact that the predicted 1-hour maxima are all below the State's 8-hour standard of 5 mg/m3.

10.2 Stationary Source Impacts. The emissions estimates for electrical generation and solid waste disposal may be compared to the 1980 county emissions inventory in Table 10 in order to provide some perspective on their significance. The project's contribution to county emissions appears to be less than 0.4%.

10.3 Other Long-Term Impacts. As noted in Section 8, there will be at times exposure to the smoke from agricultural field burning. Until urbanization entirely replaces sugar cane cultivation in the Ewa District, this will result in some human exposure and complaints about cane fire smoke. The State Department of Health and federal EPA have indicated that they are continuing efforts to better characterize the exposure and potential health effects [37]. Depending on the results of those efforts, the smoke exposure may be reduced or eliminated before cane cultivation ceases in Ewa.

In the case of industrial air pollution sources at Campbell Industrial Park, the likelihood of those sources significantly affecting Makaiwa Hills seems rather low given the distance (about 2 miles) and low frequency of winds which would carry source emissions toward the development. A screening of historical wind data from Barbers Point Naval Air Station indicated that winds heading from the industrial park towards Makaiwa Hills occurred about 5% of the time.

The estimated downwind pesticide concentrations presented in Table 11 indicate the level of human exposure possible under adverse conditions of high wind speed and proximity to the source. Downwind pesticide concentration estimates were low (microgram quantities versus the miligram quantities in toxic effects studies) and of short duration (5 - 10 minutes per acre treated upwind). Because of the number of variables, e.g., nozzle pressure, spray height, spray volumes, wind speed, etc, these estimates have an error factor of 2 to 3. True concentrations could be up to 3 times greater or 1/3 as much. In either case, the concentrations and duration of exposure suggest low risk. Only in the case of a carcinogen might there be some basis for questioning the "acceptability" of the concentration.

10.4 Short-Term Impact. Since as noted in Section 9, there is a potential for fugitive dust due to the dry climate and fine soils, it will be important for adequate dust control measures to be employed during the construction period. Dust control could be accomplished through frequent watering of unpaved roads and areas of exposed soil. The EPA estimates that twice daily watering can reduce fugitive dust emissions by as much as 50%. The soonest possible landscaping of completed areas will also help. Use of dust screens may be necessary when excavation and other construction activities occurr in close proximity to existing dwellings.

11. CONCLUSIONS AND MITIGATION.

11.1 Conclusions. Based on the foregoing analysis, the following conclusions may be drawn:

- Traffic generated by the proposed project will contribute to reduced air quality along the major roadways serving the area. State and federal air quality standards will be met.
- Electrical demand and solid waste disposal resulting from the project will cause an increase in county emissions amounting to less than 0.4% of the latest available county emissions inventory.
- Project residents may at times be affected by emissions from the surrounding environment, specifically:
  * agricultural field burning which should decline as urbanization replaces agriculture in Ewa;
  * Campbell Industrial Park which has a low probabiity to due prevailing wind directions; and
  * pesticide use which should be minimal if label instructions are complied with.
- Construction activities will have a short-term impact on local air quality due to the additional construction vehicle activity and fugitive dust from construction activities.

11.2 Mitigation

11.2.1 Motor vehicle activity: The types of measures that could help reduce the predicted traffic-related adverse impacts include:

- additional highway improvements to increase capacity
- development and use of a mass transit system

- increased bus service to the project area
- encouragement of car-pooling
- limited parking facilities to encourage use of public transportation
- development of employment opportunities near Makaiwa Hills
- implementation of an inspection/maintenance (I/M) program to reduce individual motor vehicle emissions

While many of these measures would have to be initiated by government, the project developer can encourage such initiatives as well as implement those measures within his own capability.

11.2.2 Electrical generation: Measures that will reduce offsite emissions at electrical power plants and save energy include the following recommendations of the State Department of Business, Economic Development and Tourism:

- east/west orientation of streets for the long dimensions of houses to minimize heat gains in the morning and afternoon.
- adequate system of walkways and bikeways to encourage walking and bicycling between home, school, park and commercial areas.
- selection and placement of landscape materials to provide shading for minimization of heat gains in the morning and afternoon.
- maximize shading of paved areas by trees, awnings, trellises, roofing or houses.
- provide enclosed yards where clotheslines can be used.
- use drought-resistant plants for landscaping to reduce energy use associated with irrigation.
- install operable windows and orient opening towards prevailing winds.
- install eves (minimum 30 inches), louvers, trellises, or shade screen to shade windows, especially on west, south, and east sides.
- include attics ventilated by devices such as louvers at or near the roof ridge.

- include radiant barriers in attics.
- use light colored finishes on roofs and walls.
- install heat pump water heaters, or
- install solar water heaters or provide for future installation by pre-plumbing and pre-wiring.
- install the most energy efficient appliances.
- install ceiling fans or provide for future installation by pre-wiring.
- install time switches to high-usage applications or equipment such as electric water heaters.
- install fluorescent lights with high efficiency ballasts.

Additionally, future residents of Makaiwa Hills should be advised prior to purchase that their property may be impacted by emissions from the Kahe Generating Station during periods of northwesterly winds even though the plant will be in full compliance with state and federal air pollution control rules. Futhermore, they should be advised that visible emissions occur during routine maintenance and that stacks, transmission lines, and other appurtenant facilities may be visible from their property. Finally, they should be advised that due to future population growth, the plant may be expanded to meet the increased electrical demand of that population.

11.2.3 Solid waste disposal: The following measures will help reduce emissions resulting from burning of solid wastes:

- provide a recycling program for the project
- provide a composting facility for the project

Future residents of the western portion of the project should also be advised prior to purchase that their property is near a municipal sanitary landfill which at times generates visible dust and truck traffic.]

11.2.4 Pesticide use: The following measures will help reduce any possible air quality impacts associated with pesticide use:

- full compliance with label use instructions
- use of integrated pest control measures
- minimize pesticide use

- maximize use of non-chemical pest control measures
- use of low-toxicity/nonpersistent chemicals

11.2.5 Construction impacts: The following measures will help reduce the short-term impacts associated with construction activities:

- compliance with state/county dust control requirements
- covers for open trucks transporting dusty materials
- frequent watering of exposed soil areas
- soonest possible landscaping of exposed soil areas
- concrete and asphalt plants in compliance with DOH permits

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TABLES

TABLE 1

SUMMARY OF STATE OF HAWAII AND FEDERAL
AMBIENT AIR QUALITY STANDARDS

POLLUTANT	SAMPLING PERIOD	FEDERAL STANDARDS PRIMARY	SECONDARY	STATE STANDARDS
1. Total Suspended Particulate Matter (TSP)	Annual Geometric Mean	--	--	60
(micrograms per cubic meter)	Maximum Average in Any 24 Hours	--	--	150
2. PM-10	Annual	50	50	--
(micrograms per cubic meter	Maximum Average in Any 24 Hours	150	150	--
3. Sulfur Dioxide (SO2)	Annual Arithmetic Mean	80	--	80
(micrograms per cubic meter)	Maximum Average in Any 24 Hours	365	--	365
	Maximum Average in Any 3 Hours		1,300	1,300
4. Nitrogen Dioxide (NO2) (micrograms per cubic meter)	Annual Arithmetic Mean	100		70
5. Carbon Monoxide (CO)	Maximum Average in Any 8 Hours	10		5
(milligrams per cubic meter)	Maximum Average in Any 1 Hour	40		10
6. Ozone (O3) (micrograms per cubic meter)	Maximum Average in Any 1 Hour	235		100
7. Lead (Pb) (micrograms per cubic meter)	Maximum Average in Any Calendar Quarter	1.5		1.5

TABLE 2

AIR MONITORING DATA
BARBERS POINT, OAHU
1974-89

	PARTICULATES*			SO_2			NO_2		
YEAR	RANGE	MEAN	>AQS	RANGE	MEAN	>AQS	RANGE	MEAN	>AQS
1974	23-132	47	1	<5-10	<5	0	<20-40	25	0
1975	13-137	52	1	<5-11	<5	0	< 5-25	11	0
1976	12-101	40	1	<5-7	<5	0	< 5-29	14	0
1977	25-134	54	1	<5-18	<5	0	------	--	-
1978	22-127	48	1	<5-40	<5	0	------	--	-
1979	23-223	76	10	<5-27	<5	0	------	--	-
1980	29-158	53	2	<5-10	<5	0	------	--	-
1981	26-188	51	2	<5-40	<5	0	------	--	-
1982	15- 63	41	0	<5-12	<5	0	------	--	-
1983	28-193	--	2	<5-95	--	1	------	--	-
1984	17-112	50	1	<5-<5	<5	0	------	--	-
1985*	24-138	57	3	<5-25	<5	0	------	--	-
1986*	7-66	26	0	<5-10	<5	0	------	--	-
1987*	10-40	22	0	<5-13	<5	0	------	--	-
1988*	10-48	24	0	<5-19	<5	0	------	--	-
1989*	10-44	25	0	<5-20	<5	0	------	--	-

NOTES:
1. Particulates = 1974-84, total suspended particulates (TSP) 1985-89, particulate matter <10 microns (PM-10)
2. SO2 = sulfur dioxide
3. NO2 = nitrogen dioxide
4. >AQS = number of violations of state air quality standard
5. All concentrations are in micrograms per cubic meter of air.
6. Sampling station was moved from Barbers Point Lighthouse to the Chevron Refinery site due to salt spray from the ocean on 17 March 1972.
7. The samplers were elevated to a rooftop on 7 August 1979.
8. Source: State Department of Health

TABLE 3

SUMMARY OF AEROMETRIC DATA COLLECTED
AT THE DEPARTMENT OF HEALTH BUILDING

1978 - 1987

TOTAL SUSPENDED PARTICULATES	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
(24-hr values, ug/m3)										
Period of sampling (mos.):	12	12	12	8	12	12	12	12	12	12
Number of samples:	60	8	61	35	55	56	60	59	57	53
Range of values:	14-53	22-62	23-103	23-75	11-42	14-58	11-48	10-48	11-61	14-59
Mean of values:	29	32	37	40	29	26	25	24	25	25
Number of times State AQS exceeded:	0	0	1	0	0	0	0	0	0	0
SULFUR DIOXIDE										
(24-hr values, ug/m3)										
Period of sampling (mos.):	12	12	12	8	12	12	12	12	12	12
Number of samples:	61	57	58	38	50	56	58	53	57	54
Range of values:	<5-44	<5-42	<5-60	<5-44	<5-38	<5-16	<5-<5	<5-<5	<5-6	<5-11
Mean of values:	18	22	18	19	11	<5	<5	<5	<5	<5
Number of times State AQS exceeded:	0	0	0	0	0	0	0	0	0	0
PHOTOCHEMICAL OXIDANTS										
(Daily 1-hr maxima, ug/m3)										
Period of sampling (mos.):	10	12	11	12	12	12	12	12	12	12
Number of samples:	284	337	295	314	335	348	296	341	348	342
Range of values:	10-84	10-80	10-84	10-104	0-151	0-123	0-104	8-198	10-88	4-84
Mean of values:	33	39	38	37	32	46	44	43	39	38
Number of times State AQS exceeded:	0	0	0	1	2	2	1	3	0	0

TABLE 4

SUMMARY OF AEROMETRIC DATA COLLECTED
AT THE DEPARTMENT OF HEALTH BUILDING

1971 - 1987

NITROGEN DIOXIDE (24-hr values)	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980-87
Period of sampling (mos.):	10	12	12	12	12	3	n.d.	n.d.	n.d.	n.d.
Number of samples:	83	113	99	90	91	22				
Range of values:	<20-159	<20-236	<20-95	<20-95	16-70	12-63				
Mean of values:	56	56	46	37	33	35				
Number of times State AQS exceeded:	1	2	0	0	0	0				

CARBON MONOXIDE (Daily 1-hr maxima)	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Period of sampling (mos.):	12	8	n.d.	n.d.	n.d.	6	12	12	12	12
Number of samples:	365	208				169	318	342	348	345
Range of values:	0-20.7	0-17.3	Station moved to Kaimuki			0-8.6	0.6-10.9	0.0-10.4	0.2-13.5	0.3-11.1
Arithmetic mean of daily maximum values:	3.1	3.0				2.4	2.4	1.5	2.2	1.7
Number of days State AQS exceeded:	19	10	10			0	1	1	3	1

TABLE 5

LEAD MONITORING DATA
HONOLULU, OAHU
1970-89

AVERAGE CONCENTRATION
(micrograms/cubic meter)

YEAR	1st QUARTER	2nd QUARTER	3rd QUARTER	4th QUARTER
1970	0.78	0.81	0.65	0.92
1971	1.65	0.63	0.65	1.05
1972	--	0.75	0.65	0.48
1973	0.52	0.52	0.72	0.55
1974	0.84	0.61	0.70	0.92
1975	0.65	0.81	0.59	1.05
1976	0.91	0.65	0.99	1.00
1977	0.89	0.59	0.48	0.80
1978	--	--	--	0.72
1979	0.39	0.25	0.26	0.42
1980	0.41	0.23	0.21	0.20
1981	0.25	--	--	--
1982	0.21	0.16	0.09	0.21
1983	n/a	n/a	n/a	n/a
1984	0.3	0.2	0.2	0.3
1985	0.1	0.03	0.02	0.1
1986	0.1	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.01
1989	0.0	0.02	0.01	n/a

Source: Department of Health

TABLE 6

ONSITE CARBON MONOXIDE SAMPLING RESULTS
FARRINGTON HIGHWAY AND H-1 FREEWAY
DECEMBER 1990

Date	Day of Week	Time	Location	Side	CO mg/m3	Onsite Weather WD deg [s.d.]	WS m/s
03 Dec 90	Mon	6:30 - 7:30 am	Farrington @ Intersection "A"	South	2.3	44 [12]	1.7
03 Dec 90	Mon	3:15 - 4:15 pm	Farrington @ Intersection "A"	South	1.9	43 [16]	1.9
18 Dec 90	Tue	6:30 - 7:30 am	H-1 Freeway @ Palailai	South	1.3	345 [30]	2.5
17 Dec 90	Mon	3:30 - 4:30 pm	H-1 Freeway @ Palailai	South	2.3	15 [23]	1.6

TABLE 7

ANNUAL FREQUENCY DISTRIBUTION OF WIND SPEED AND DIRECTION HONOLULU INTERNATIONAL AIRPORT

Direction	Wind Speed (Kts) 0 - 3	4 - 7	8 - 12	13 - 18	19 - 24	>24	TOTAL
N	0.0149	0.0261	0.0075	0.0020	0.0002	0.0000	0.0506
NNE	0.0114	0.0219	0.0106	0.0046	0.0005	0.0000	0.0490
NE	0.0114	0.0449	0.0829	0.0853	0.0204	0.0018	0.2466
ENE	0.0088	0.0637	0.1559	0.1209	0.0224	0.0014	0.3731
E	0.0039	0.0179	0.0329	0.0210	0.0023	0.0001	0.0782
ESE	0.0021	0.0056	0.0050	0.0015	0.0003	0.0001	0.0146
SE	0.0021	0.0059	0.0091	0.0049	0.0006	0.0002	0.0228
SSE	0.0023	0.0074	0.0123	0.0038	0.0008	0.0002	0.0268
S	0.0025	0.0104	0.0127	0.0033	0.0005	0.0003	0.0296
SSW	0.0011	0.0041	0.0053	0.0017	0.0003	0.0000	0.0125
SW	0.0007	0.0031	0.0058	0.0022	0.0003	0.0001	0.0122
WSW	0.0006	0.0017	0.0031	0.0022	0.0005	0.0001	0.0082
W	0.0019	0.0030	0.0021	0.0009	0.0002	0.0001	0.0082
WNW	0.0027	0.0051	0.0012	0.0003	0.0001	0.0000	0.0094
NW	0.0084	0.0153	0.0031	0.0008	0.0003	0.0000	0.0279
NNW	0.0087	0.0166	0.0041	0.0012	0.0002	0.0000	0.0308
TOTAL:	0.0835	0.2527	0.3534	0.2567	0.0496	0.0043	1.0002

TABLE 8

Estimates of Annual Emissions Due to
Electrical Generation and Solid Waste Disposal
Makaiwa Hills
2010

	Emissions (T/Yr)	
Pollutant	Electrical Generation	Solid Waste Disposal
Nitrogen oxides	112.9	12.9
Sulfur oxides	85.0	2.6
Particulate Matter	8.6	1.1
Carbon monoxide	5.4	11.4
Volatile Organics	1.1	0.7

TABLE 9

TOXIC EMISSIONS INVENTORY
CAMPBELL INDUSTRIAL PARK
EWA, OAHU
1987

CHEMICAL NAME	EMISSIONS (LB/YR)	FACILITY
1,1,1-Trichloroethane	75,240	Reynolds Metals Company
1,2,4-Trimethylbenzene	500	Chevron U.S.A. Inc.
	18,500	Chevron U.S.A. Inc.
	9,400	Hawaiian Independent Refinery
1,2-Dibromoethane	500	Chevron U.S.A. Inc.
1,2-Dichloroethane	500	Chevron U.S.A. Inc.
1,3-Butadiene	500	Chevron U.S.A. Inc.
1,3-Dichloropropylene	1,000	Chevron U.S.A. Inc.
Aluminum Oxide	150,250	Chevron U.S.A. Inc.
Ammonia	360	Hawaiian Cement
	242,900	Chevron U.S.A. Inc.
Benzene	3,100	Hawaiian Independent Refinery
	22,000	Hawaiian Independent Refinery
Chlorine	18,100	Chevron U.S.A. Inc.
Cyclohexane	500	Chevron U.S.A. Inc.
	24,000	Chevron U.S.A. Inc.
Ethylbenzene	8,900	Hawaiian Independent Refinery
	11,200	Chevron U.S.A. Inc.
Ethylene	5,000	Hawaiian Independent Refinery
Glycol Ethers	3,050	Chevron U.S.A. Inc.
Lead	61,445	Reynolds Metals Company
Methanol	500	Chevron U.S.A. Inc.
Methyl Tert-Butyl Ether	500	Chevron U.S.A. Inc.
N-Butyl Alcohol	4,200	Hawaiian Independent Refinery
Naphthalene	120,650	Reynolds Metals Company
	6,700	Chevron U.S.A. Inc.
Propylene	250	Hawaiian Independent Refinery
	33,750	Chevron U.S.A. Inc.
Sulfuric Acid	250	Hawaiian Independent Refinery
	14,250	Chevron U.S.A. Inc.
Toluene	250	Brewer Chemical Corporation
	40,000	Chevron U.S.A. Inc.
Xylene (Mixed Isomers)	57,000	Hawaiian Independent Refinery
M-Xylene	50,000	Hawaiian Independent Refinery
O-Xylene	34,000	Chevron U.S.A. Inc.
P-Xylene	20,800	Chevron U.S.A. Inc.
	8,800	Chevron U.S.A. Inc.

SOURCE: U.S. Environmental Protection Agency

TABLE 10

1980 EMISSIONS INVENTORY
CITY & COUNTY OF HONOLULU

SOURCE CATEGORY	EMISSIONS (Tons/Year) PM	SOx	NOx	CO	HC
Steam Electric Power Plants	2092	36,736	12,455	1,065	184
Gas Utilities	14	0	199	0	0
Fuel Combustion in Agricultural Industry	1088	579	358	0	31
Refinery Industry	622	7,096	2,149	266	2,584
Petroleum Storage	0	0	0	0	1,261
Metallurgical Industries	28	96	40	0	0
Mineral Products Industry	6,884	1,883	597	0	31
Municipal Incineration	42	145	2,029	0	184
Motor Vehicles	1,413	1,014	17,270	239,198	22,853
Construction, Farm and Industrial Vehicles	184	193	2,507	3,729	338
Aircraft	382	145	1,751	5,594	1,476
Vessels	42	386	438	533	123
Agricultural Field Burning	1,399	0	0	15,982	1,692
TOTAL:	14,191	48,274	39,792	266,367	30,758

SOURCE: State Department of Health

TABLE 11

ESTIMATES OF DOWNWIND PESTICIDE CONCENTRATIONS

Product	Active Agent Concentration (ug/m3)
MSMA	10
Bensulide	63
Trimec	5
Metribuzin	4
Glyphosate	8
Chlorpyrifos	5
Metalaxyl	7
Chlorothalonil	42

Conditions:		
	Windspeed:	4.5 m/sec
	Stability category:	D (neutral)
	Downwind distance:	100 m
	Exposure duration:	5 - 10 minutes
	Treated area:	1 acre
	Application height:	0.5 m
	Active agent drift:	0.4%

FIGURES

FIGURE 1

PROJECT LOCATION

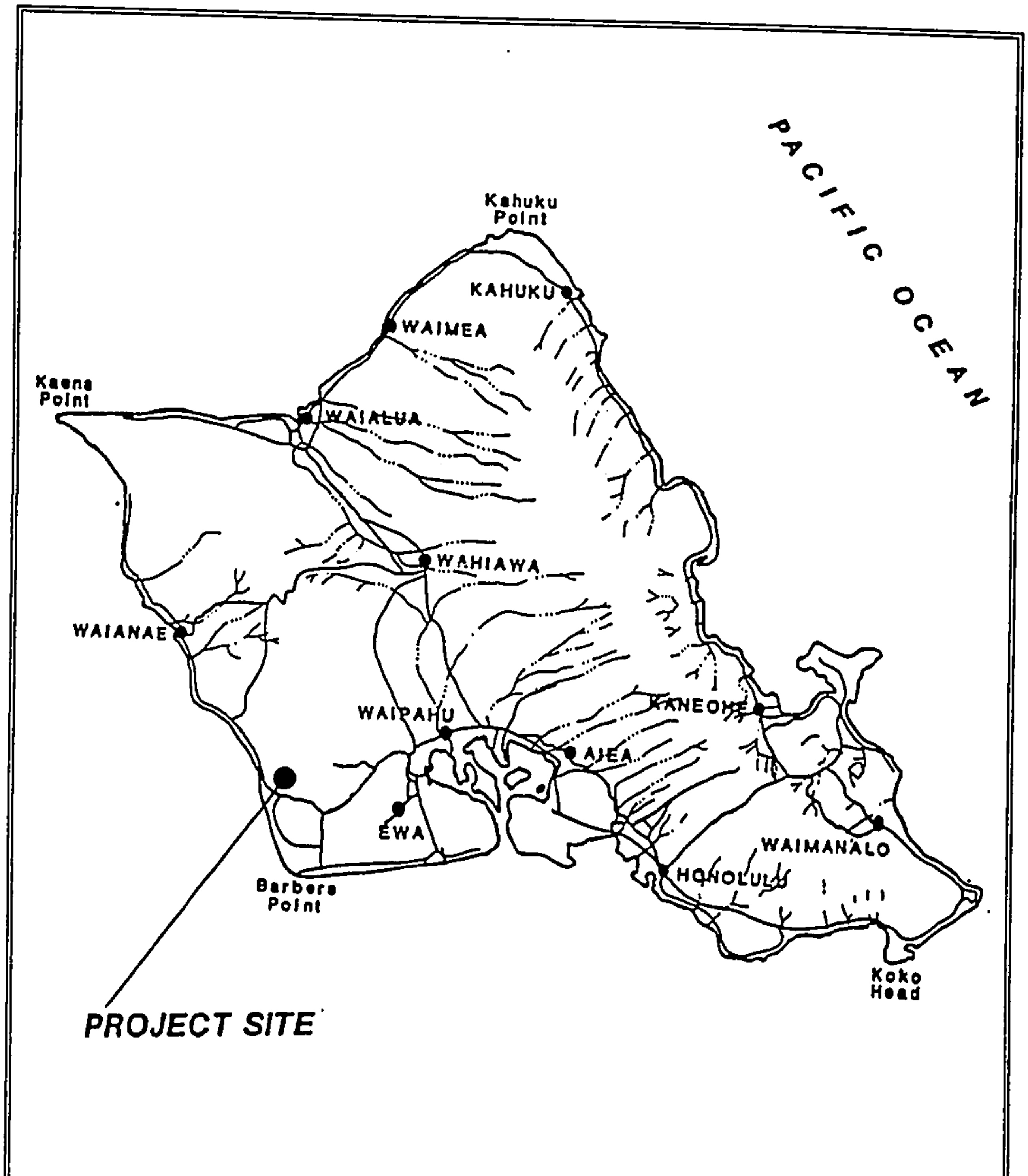


FIGURE 3

A.M. PEAK HOUR CONDITIONS
FARRINGTON HIGHWAY IN THE VICINITY OF
THE PROPOSED INTERSECTION "A"
DECEMBER 3, 1990

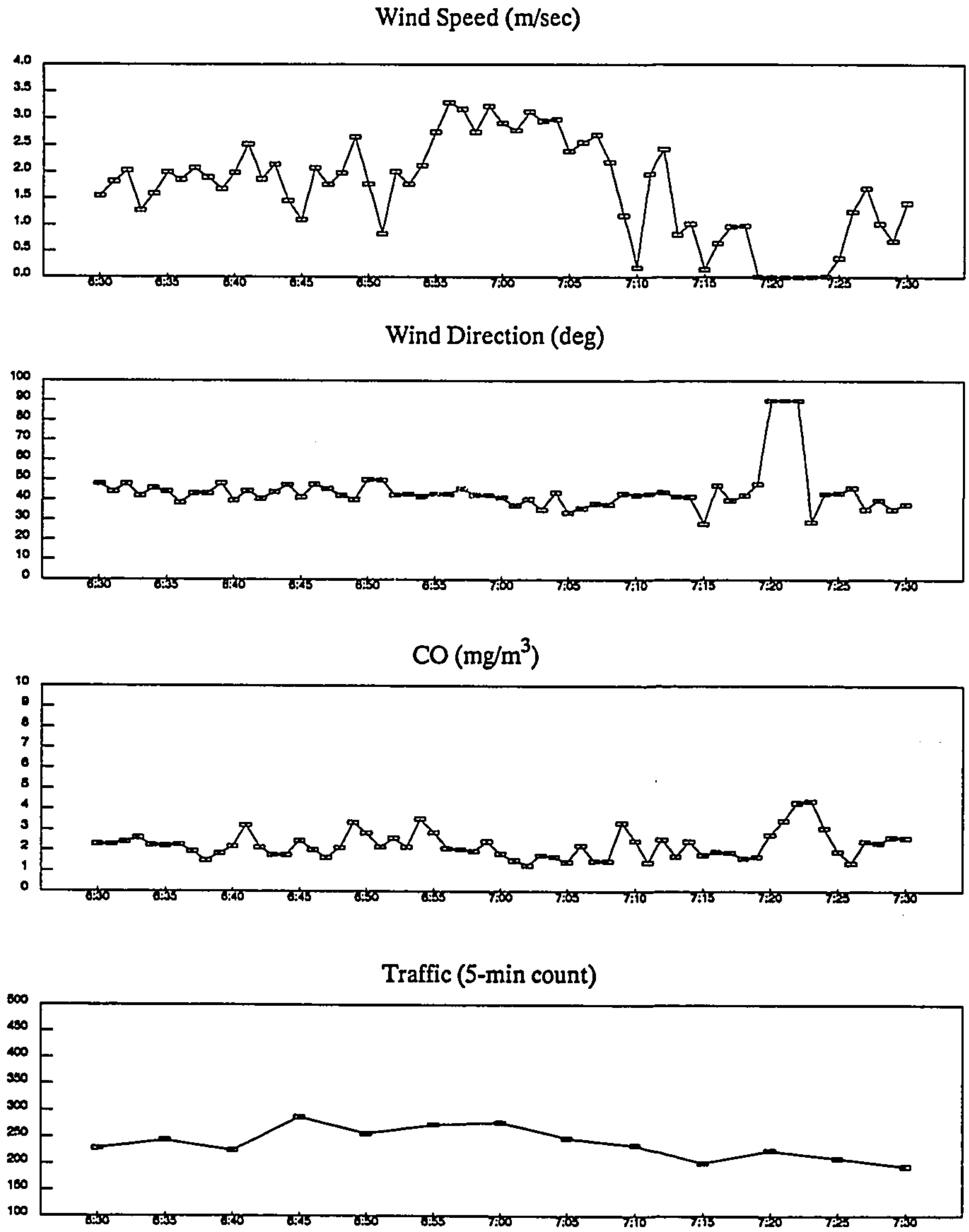
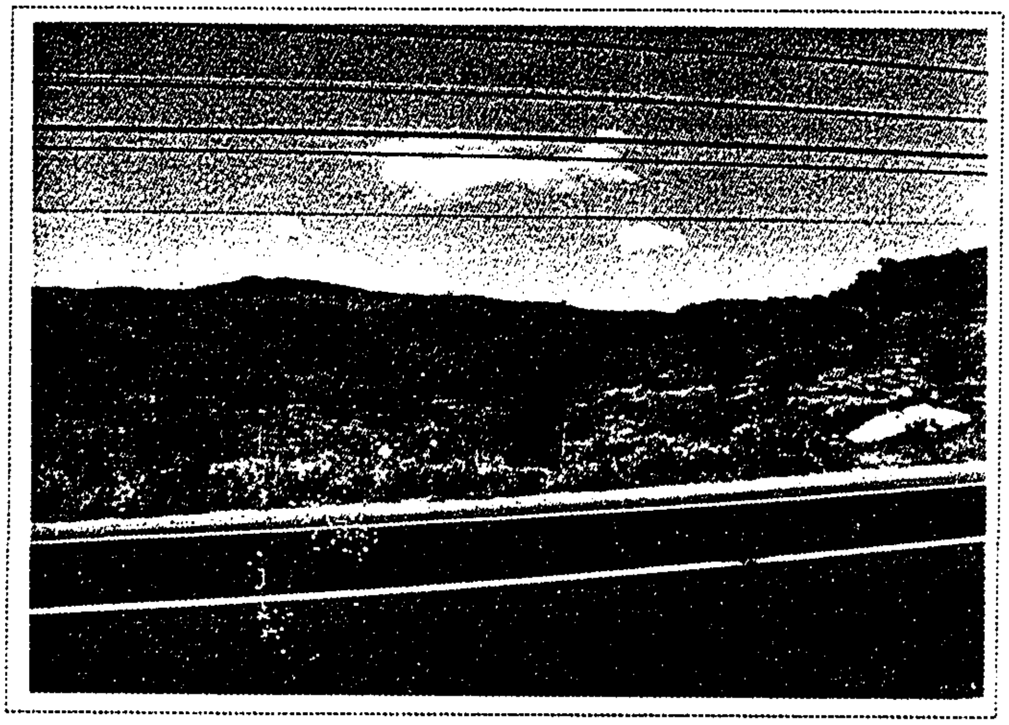


FIGURE 2

EXISTING SITE CONDITIONS
DECEMBER 1990

West End of
Property
Facing Northeast



East End of
Property
Facing Northwest

FIGURE 4

P.M. PEAK HOUR CONDITIONS
FARRINGTON HIGHWAY IN THE VICINITY OF
THE PROPOSED INTERSECTION "A"
DECEMBER 3, 1990

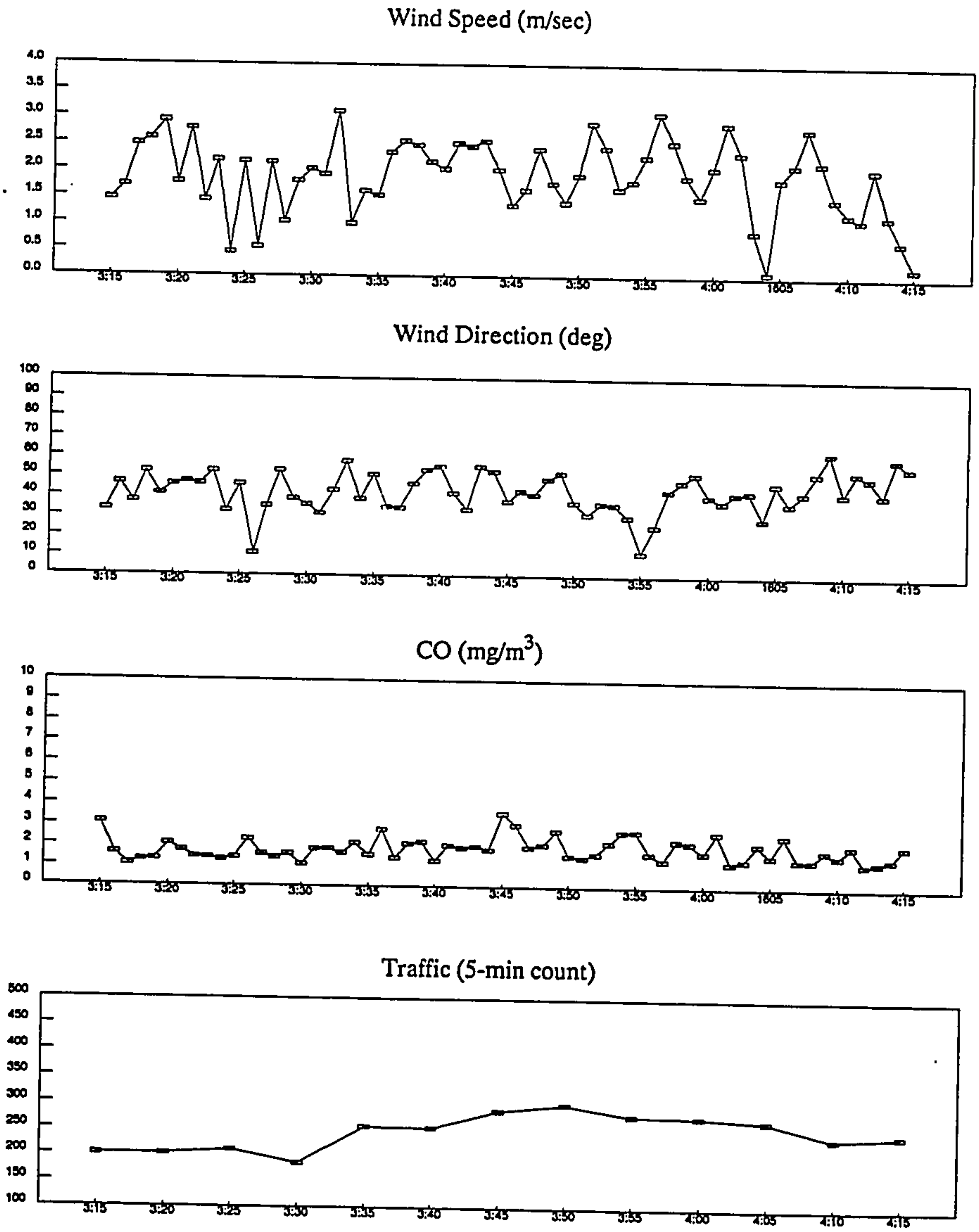


FIGURE 5

**A.M. PEAK HOUR CONDITIONS
H-1 FREEWAY EAST OF PALAILAI INTERCHANGE
DECEMBER 18, 1990**

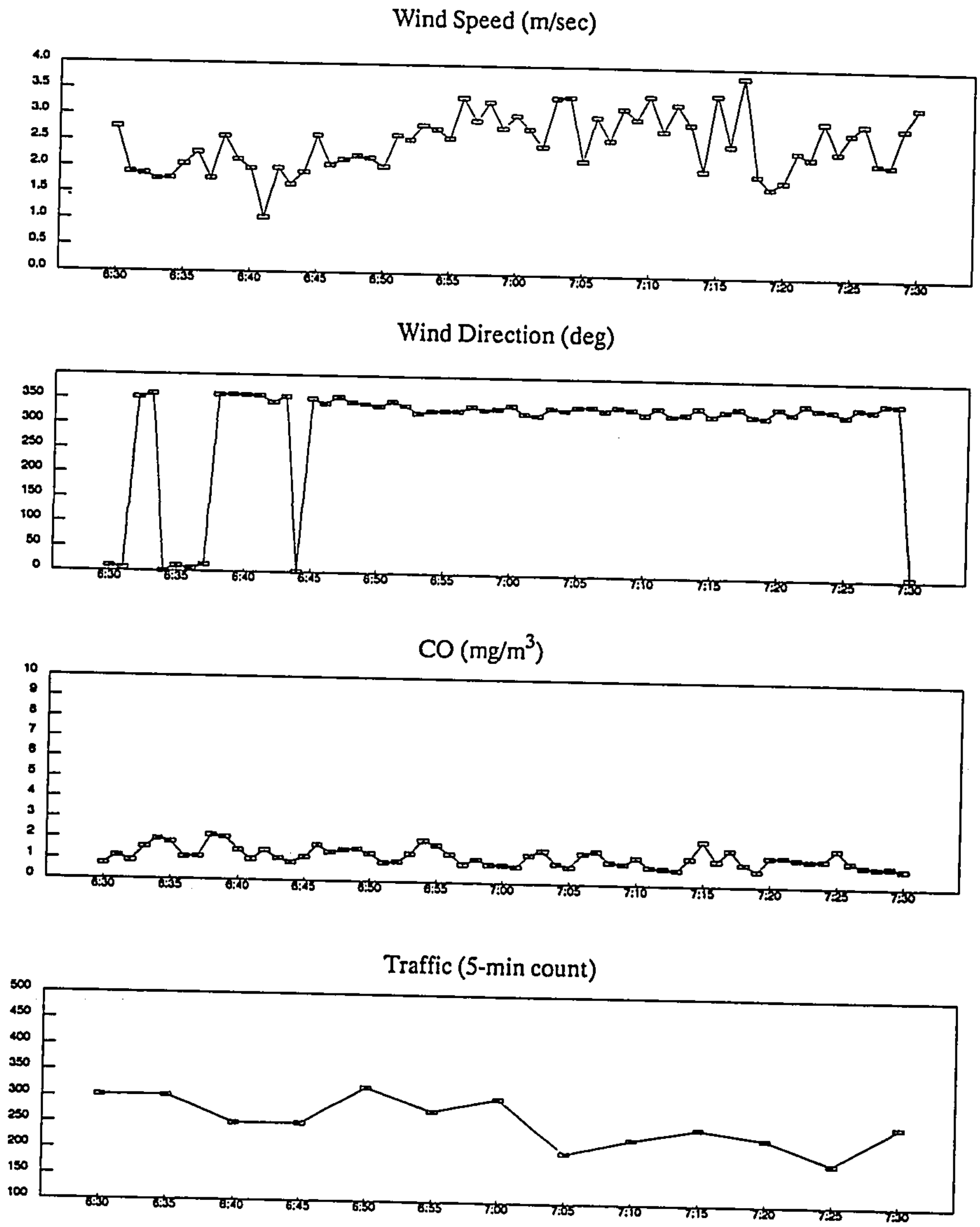


FIGURE 6

P.M. PEAK HOUR CONDITIONS
H-1 FREEWAY EAST OF PALAILAI INTERCHANGE
DECEMBER 17, 1990

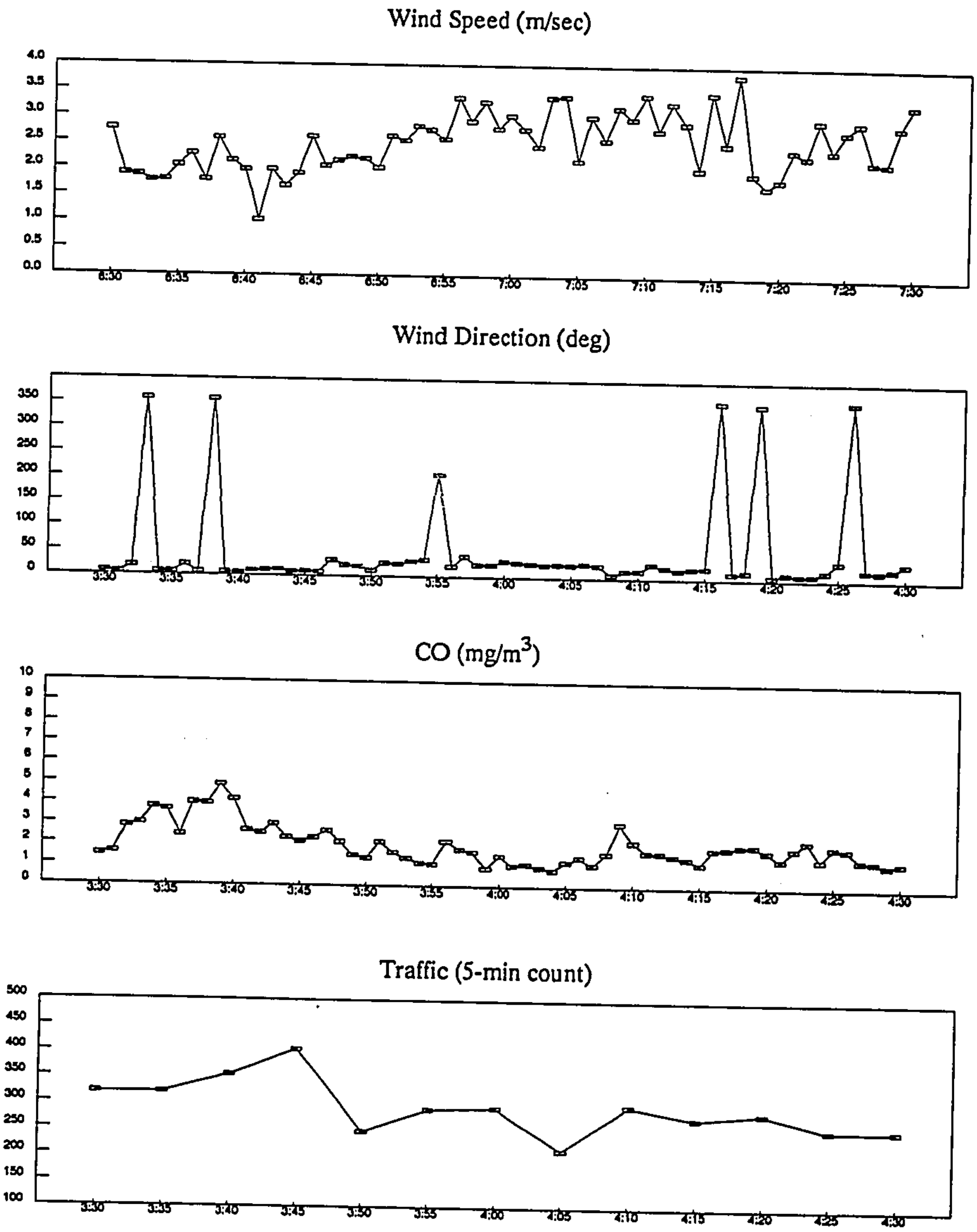
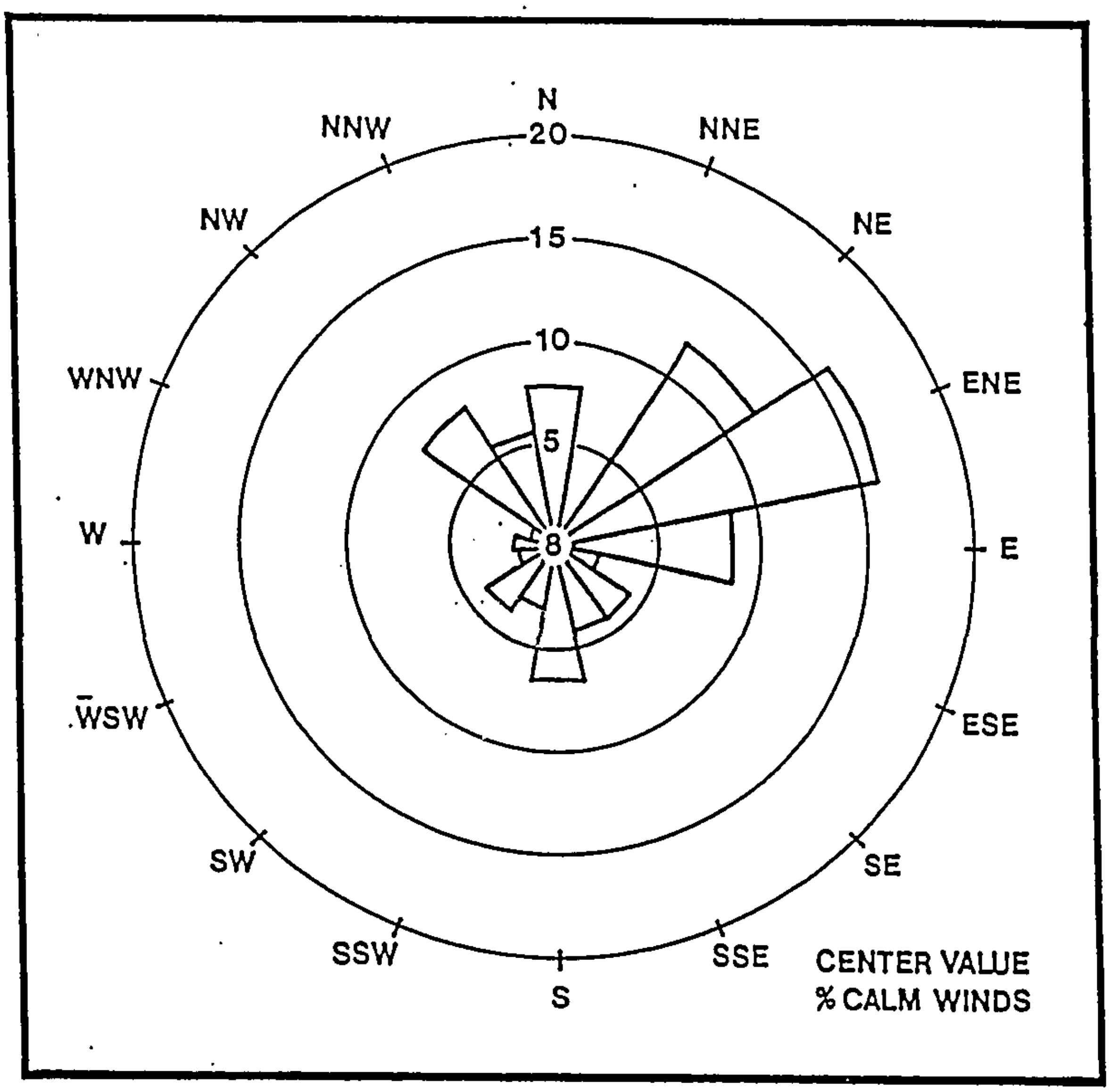


FIGURE 7

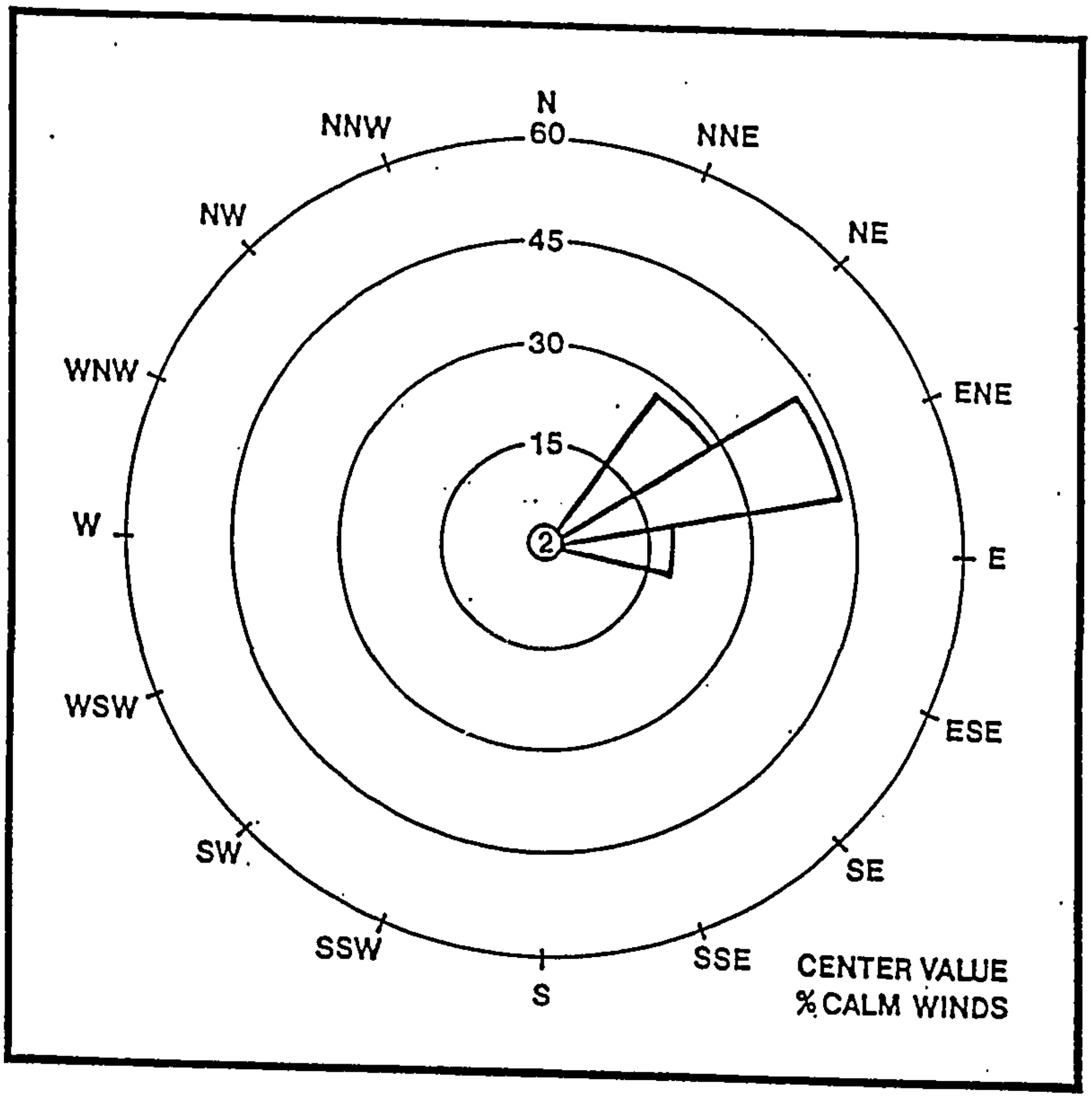
JANUARY WINDROSE
HONOLULU INTERNATIONAL AIRPORT



SOURCE: National Weather Service (1940-67)

FIGURE 8

AUGUST WINDROSE
HONOLULU INTERNATIONAL AIRPORT

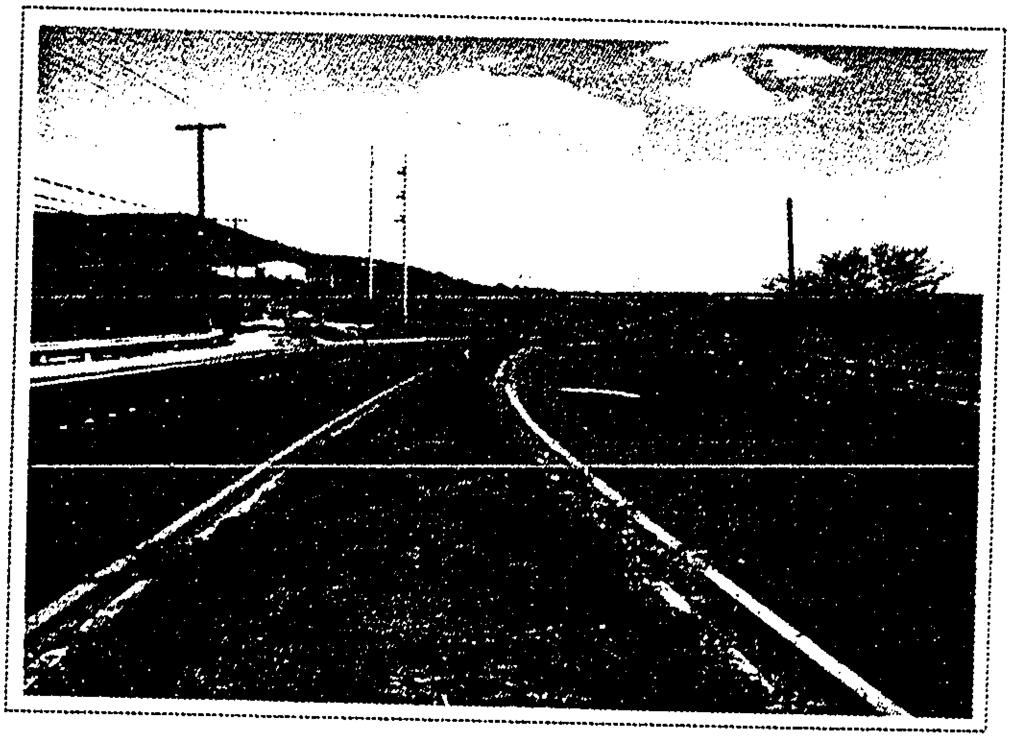


SOURCE: National Weather Service (1940-67)

FIGURE 9

FARRINGTON HIGHWAY IN THE VICINITY OF THE PROPOSED INTERSECTIONS "A" AND "B" DECEMBER 1990

Vicinity of Intersection "A" (facing southeast)

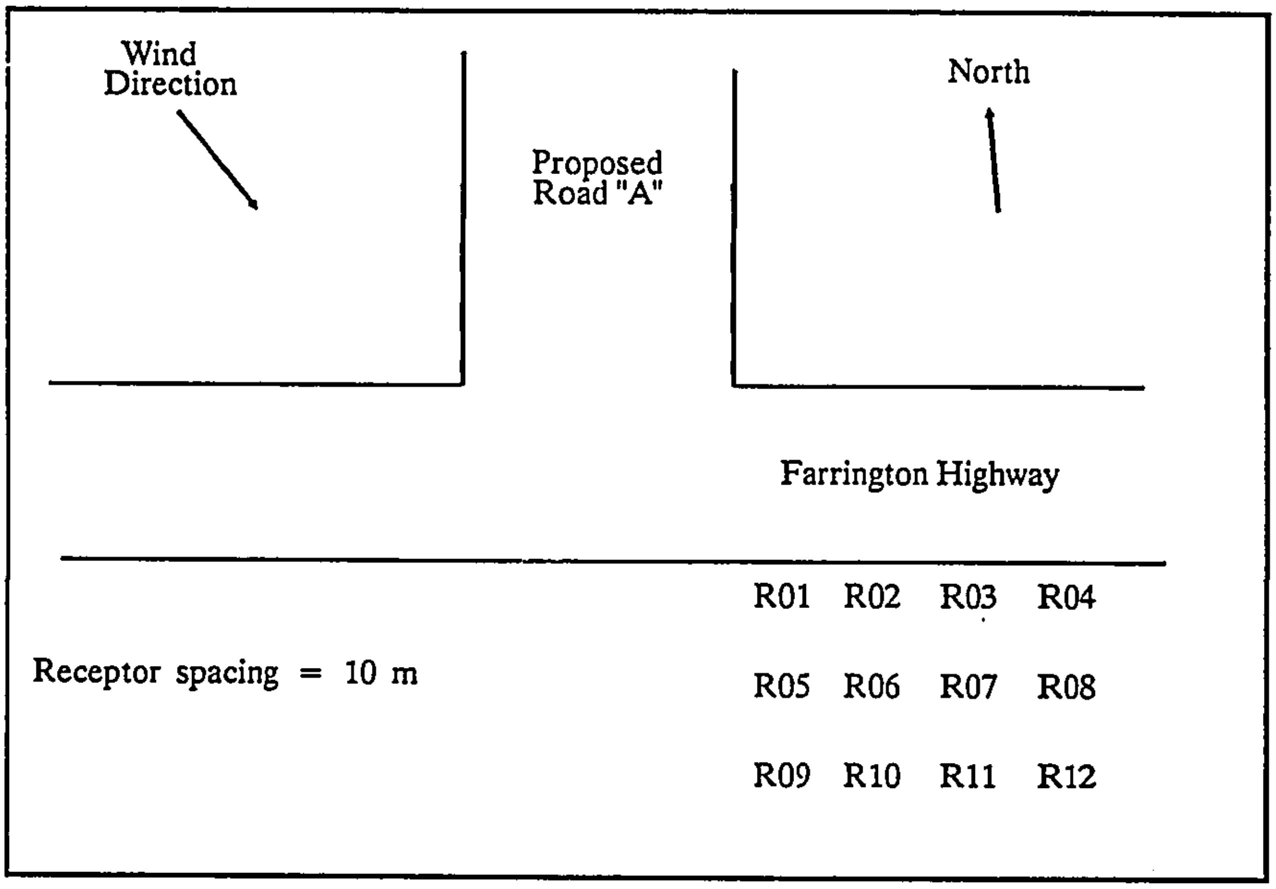


Vicinity of Intersection "B" (facing southeast)

FIGURE 10

ESTIMATES OF MAXIMUM 1-HOUR CARBON MONOXIDE CONCENTRATIONS

Farrington Highway at Proposed Intersection "A"
Peak Traffic Hours
1990 - 2010



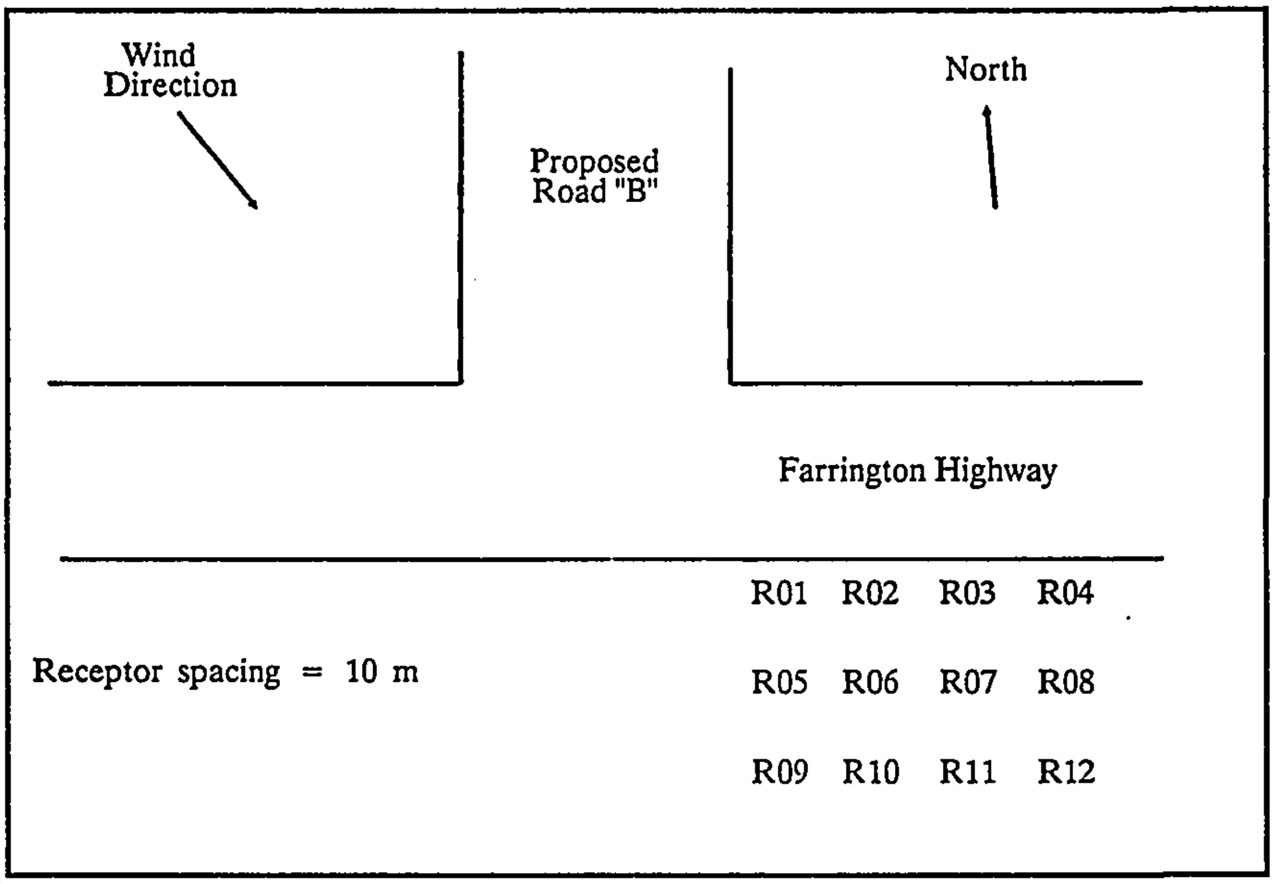
Concentration (mg/m^3)

Receptor	A.M. 1990	A.M. 2010 w/o	A.M. 2010 w/proj	P.M. 1990	P.M. 2010 w/o	P.M. 2010 w/proj
R01	3.6	4.4	4.7	3.4	4.7	4.8
R02	3.6	4.3	4.6	3.4	4.4	4.6
R03	3.6	4.2	4.4	3.4	4.3	4.6
R04	3.6	4.1	4.4	3.4	4.2	4.4
R05	3.0	3.9	4.0	2.8	4.0	4.1
R06	3.0	3.6	3.8	2.8	3.6	3.8
R07	3.0	3.5	3.6	2.8	3.5	3.6
R08	3.0	3.4	3.6	2.8	3.4	3.5
R09	2.6	3.5	3.6	2.4	3.6	3.6
R10	2.6	3.3	3.4	2.5	3.3	3.4
R11	2.6	3.2	3.3	2.5	3.1	3.2
R12	2.6	3.1	3.2	2.5	3.0	3.1

FIGURE 11

ESTIMATES OF MAXIMUM 1-HOUR CARBON MONOXIDE CONCENTRATIONS

Farrington Highway at Proposed Intersection "B"
Peak Traffic Hours
1990 - 2010



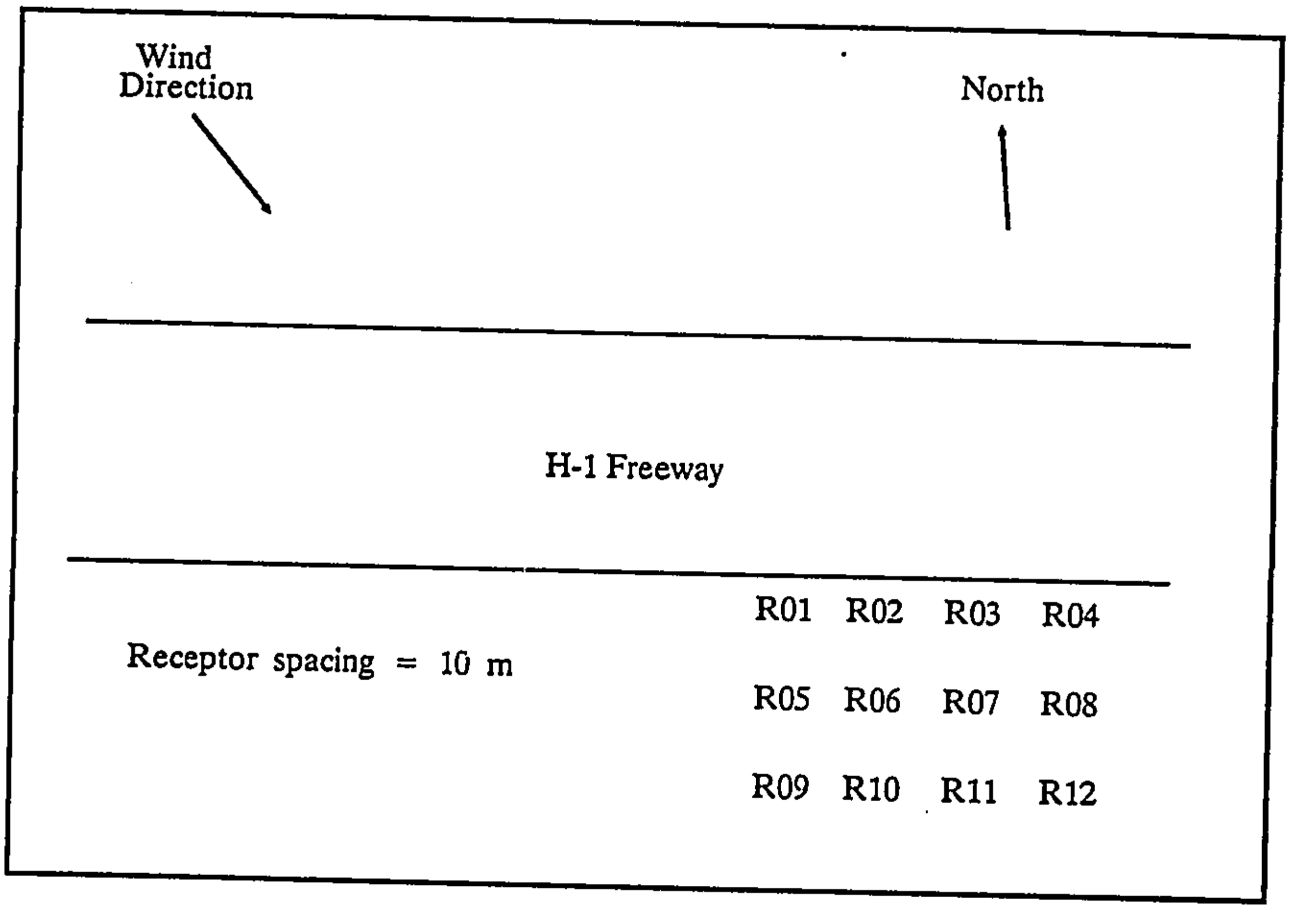
Concentration (mg/m^3)

Receptor	A.M. 1990	A.M. 2010 w/o	A.M. 2010 w/proj	P.M. 1990	P.M. 2010 w/o	P.M. 2010 w/proj
R01	3.6	4.1	4.2	3.5	4.3	4.6
R02	3.6	4.1	4.2	3.5	4.3	4.8
R03	3.6	4.1	4.2	3.5	4.3	4.9
R04	3.8	4.1	4.2	3.5	4.3	4.9
R05	3.1	3.3	3.4	2.8	3.4	3.5
R06	3.1	3.3	3.4	2.8	3.4	3.5
R07	3.1	3.3	3.4	2.8	3.4	3.6
R08	3.1	3.3	3.4	2.8	3.4	3.8
R09	2.6	2.8	3.0	2.5	2.8	3.0
R10	2.6	2.8	3.0	2.5	2.8	3.0
R11	2.6	2.8	3.0	2.5	2.8	3.1
R12	2.6	2.8	3.0	2.5	2.8	3.1

FIGURE 12

ESTIMATES OF MAXIMUM 1-HOUR CARBON MONOXIDE CONCENTRATIONS

H-1 Freeway East of Palailai Interchange
Peak Traffic Hours
1990 - 2010



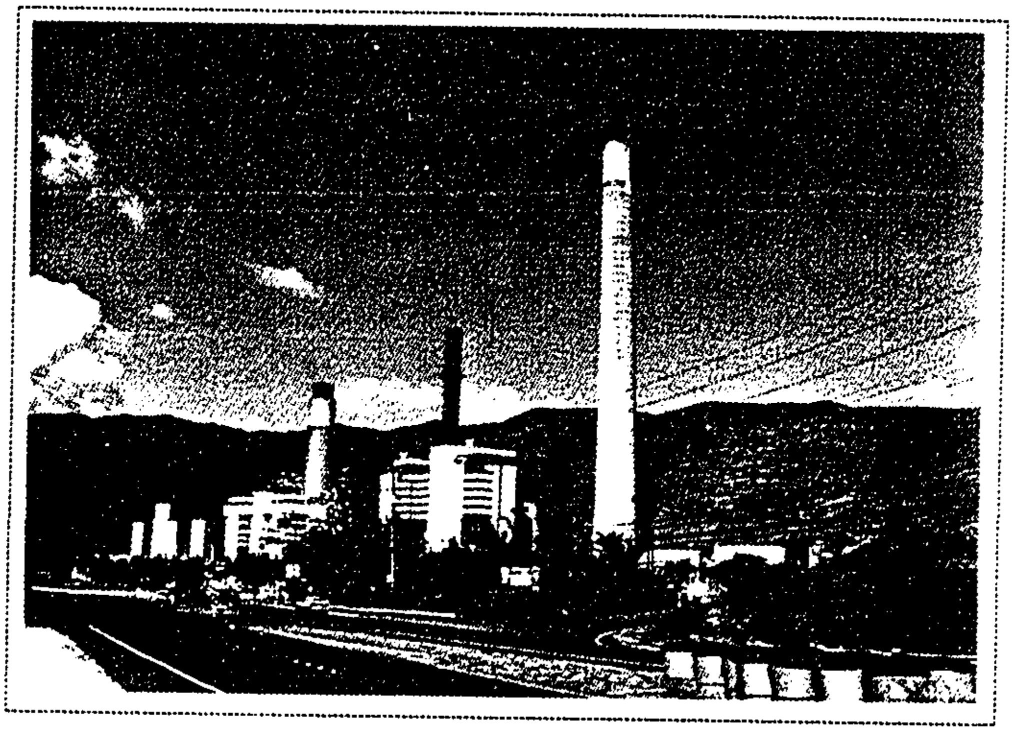
Concentration (mg/m^3)

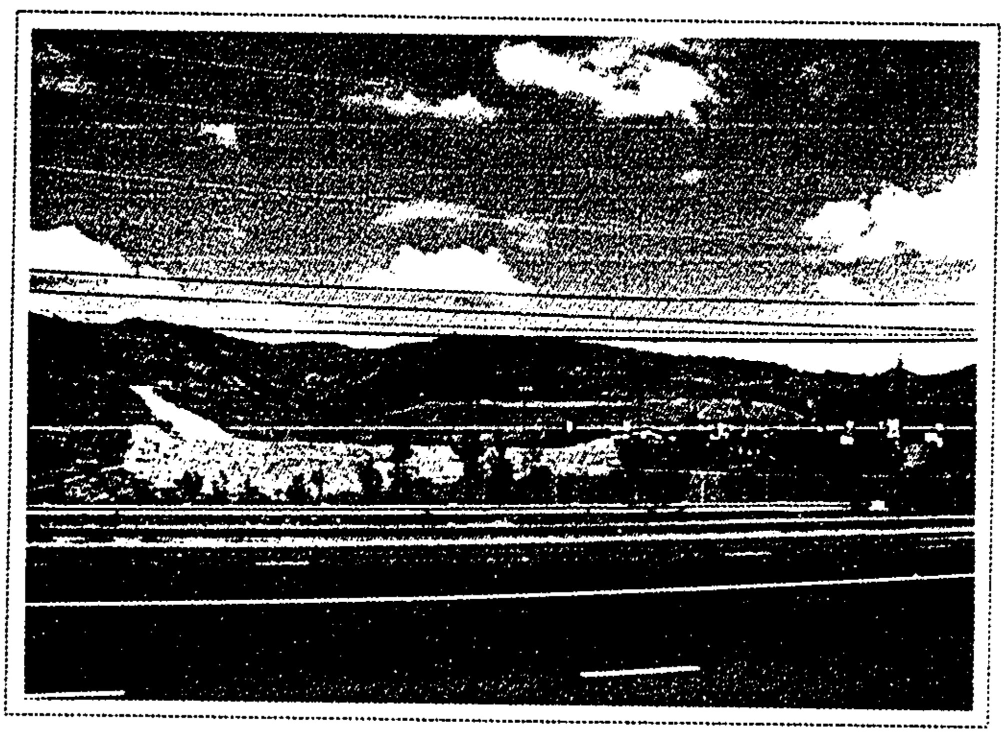
Receptor	A.M. 1990	A.M. 2010 w/o	A.M. 2010 w/proj	P.M. 1990	P.M. 2010 w/o	P.M. 2010 w/proj
R01	4.2	5.6	5.7	4.1	4.9	5.4
R02	4.2	5.6	5.7	4.1	4.9	5.4
R03	4.2	5.6	5.7	4.1	4.9	5.4
R04	4.2	5.6	5.7	4.1	4.9	5.4
R05	3.4	4.3	4.4	3.3	3.9	4.2
R06	3.4	4.3	4.4	3.3	3.9	4.2
R07	3.4	4.3	4.4	3.3	3.9	4.2
R08	3.4	4.3	4.4	3.3	3.9	4.2
R09	3.1	3.6	3.8	2.8	3.3	3.5
R10	3.1	3.8	3.8	2.8	3.3	3.5
R11	3.1	3.8	3.8	2.8	3.3	3.5
R12	3.1	3.8	3.8	2.8	3.3	3.5

FIGURE 13

OFF-SITE STATIONARY SOURCES
DECEMBER 1990

Kahe Generating Station (Hawaiian Electric Company)





Waimanalo Gulch Sanitary Landfill (C&C Honolulu)

PROFESSIONAL QUALIFICATIONS

James W. Morrow, M.S.

Environmental Management Consultant

DATE OF BIRTH:	January 25, 1945	
EDUCATION:	B.S. (cum laude) Biochemistry June, 1966	University of New Hampshire Durham, New Hampshire
	M.S. Public Health August, 1973	University of Hawaii Honolulu, Hawaii
LANGUAGE TRAINING:	Vietnamese (3 years) - University of Hawaii Cambodian (2 years) - University of Hawaii Thai (2 years) - University of Hawaii German (1 year) - University of New Hampshire	
HONORS, SCHOLARSHIPS:	East-West Center Grantee, 1971-73 National Science Foundation Undergraduate Research Program, 1964-66 New York State Regents Scholarship, 1962	
MILITARY TRAINING:	ROTC Distinguished Military Graduate, 1966 US Army Chemical School Basic Officer's Course, 1967 Chemical Officer's Advanced Course, 1980 Radiological Safety Course, 1985 Command & General Staff College, 1986 (with honors)	
MILITARY ASSIGNMENTS:	Assistant Corps Chemical Officer (HQ IX Corps) Radiological Protection Officer (HQ IX Corps) Instructor, Nuclear-Biological-Chemical Defense Current Rank: Lieutenant Colonel	
PRESENT POSITION(S):	Environmental Management Consultant 1974 to present	
	Director, Environmental Health American Lung Association of Hawaii August, 1973 to present	
	Clinical Faculty (currently Associate Professor of Public Health) School of Public Health, University of Hawaii-Manoa 1978 to present	

CONTINUING EDUCATION

Course Title & Sponsoring Institution	Year
"Design & Current Status of Dry Scrubbing Systems" Air Pollution Control Association New York, New York	1987
Lethal Chemical Agent Decontamination Training US Army Chemical School Ft. McClellan, Alabama	1987
M8A1 Automatic Chemical Agent Alarm Certification Course Schofield Barracks, Hawaii	1986
Radiological Safety Course US Army Chemical School Ft. McClellan, Alabama	1984
"Principles & Practice of Air Pollution Control" (EPA Course No. 452) Honolulu, Hawaii	1982
"EPA Disperson Models" Air Pollution Control Association New Orleans, Louisiana	1982
"Dispersion Modeling of Complex Sources" Air Pollution Control Association Philadelphia, Pennsylvania	1981
"Control Equipment for Particulate Emissions "Industrial Ventilation Systems" "Airborne Radioactive Emissions" "Thermal Processing of Hazardous Organic Wastes" Air Pollution Control Association Montreal, Canada	1980
"Coastal Zone Meteorology and Air Quality Problems" Air Pollution Control Association Cincinatti, Ohio	1979
"Pesticide Protection for Health Personnel" EPA and University of Miami Medical School Honolulu, Hawaii	1977
"Principles of Industrial Toxicology" Wayne State University Detroit, Michigan	1977

RESEARCH

American Lung Association of Hawaii, 1973-74. Study of the unique short term air pollution episode occurring annually in Honolulu due to extreme use of fireworks at New Years.

University of Hawaii, School of Public Health, 1972-73. Study of the character, problems and solutions of wastewater treatment at a ready mix concrete plant.

University of New Hampshire, Department of Biochemistry, 1965-66. Study of cell wall constituents of selected Lactobacilli and means of separating and identifying those constituents.

University of New Hampshire, Department of Chemistry, 1964. Development of gas chromatographic method for separating and identifying polyamines from biological samples.

MEMBERSHIP IN HONORARY/PROFESSIONAL SOCIETIES

Air Pollution Control Association
American Public Health Association
National Association of Environmental Professionals
American Industrial Hygiene Association (Hawaii Section)
Hawaii Public Health Association
Alpha Chi Sigma (professional chemistry)
Sigma Xi
Phi Sigma (honorary biological sciences)
Phi Kappa Phi (academic honors)
Alpha Epsilon Delta (honorary pre-medical)
Alpha Zeta (honorary agricultural science)

PUBLICATIONS

Morrow, J. W., D. Thomas and H. Burkard. "H2S Monitoring in the Vicinity of Hawaii's First Geothermal Well," Paper No. 95-105B, Air Pollution Control Association Annual Meeting (1988)

Flachsbart, P. G. and J. W. Morrow. "Development of Hawaii's H2S Standards and Geothermal Regulations," Paper No. 87-104.5, Air Pollution Control Association Annual Meeting (1987)

Bach, W., A. Daniels, L. Dickinson, F. Hertlein, J. Morrow, S. Margolis, and V. Dinh. "Fireworks Pollution and Health," Intern. J. Environmental Studies, 7: 183-192 (1975)

Burbank, N. C. and J. W. Morrow. "Wastewater and Wastewater Treatment at a Ready Mix Concrete Plant, "Proceedings, 28th Annual Purdue Industrial Waste Conference (1973)

Ikawa, M., J. Morrow and S. Harney. "Paper Chromatographic System for the Identification of Glycerol in Bacterial Cell Walls," J. Bact., 92: 812-814 (1966)

Appendix G.

Visual Assessment for Makaiwa Hills

Michael S. Chu

VISUAL ASSESSMENT FOR MAKAIWA HILLS

prepared by: MICHAEL S. CHU
prepared for: THE ESTATE OF JAMES CAMPBELL
DECEMBER 1990

TABLE OF CONTENTS

VISUAL ASSESSMENT

prepared by: MICHAEL S. CHU, LAND ARCHITECT

1. Purpose of Assessment

1.1 Purpose

The purpose of this assessment is to evaluate the proposed 1915 acre Makaiwa Hills development with regards to potential impact upon existing scenic resources and the overall scenic quality of the area.

This assessment is based on site inspections of the project site as well as a review of existing public policies and objectives regarding public scenic resources as seen from important public roadways and from other public viewing points such as parks and schools.

The proposed Makaiwa Hills land use plan is illustrated in Figure No. 5, Proposed Ewa Development Plan Land Use Amendment. As a land use map, the plan does not contain specific site details such as building locations and other design features. These design features will be developed at later stages in the planning process. This view assessment therefore focuses primarily on the broad visual implications of the proposed project and attempts to identify, at this early stage, the primary impacts and possible mitigative measures that may be considered in the following site design stages of the project. Further investigation into potential view impacts may be appropriate and may such time.

1.2 Background

The Ewa District, traditionally known for its rural/agricultural character, has been undergoing a steady transformation towards an urban environment. Early nodes of urbanization include the development of the Honokai Hale subdivision along the makai side of the highway; the residential development of Makakilo which lies east of the Makaiwa Hills project site; and the Campbell Industrial Park. Adoption of the revised General Plan for the City and County of Honolulu in 1982 further established the Ewa Plain as the preferred area for urban growth (secondary urban center[1]) on the island of Oahu. The completion of the H-1 freeway and the emergence of the resort development

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1 Objective C, Physical Development and Urban Design, General Plan of the City and County of Honolulu, 1982

at Ko Olina, the Barbers Point Harbor, Kapolei City and Kaoplei Villages are recent examples of urban expansion occurring in Ewa and indicate the magnitude of growth set in place by the General Plan.

Through these developments, the visual character of the Ewa District has not remained static. The cumulative effect of urban expansion over the past decade(s) has already dramatically altered the landscape, and attempts to assess view impacts in accordance with a rural/ agricultural imagery fails to comprehend the broader scope and recent developments occurring in the Ewa District.

Inherent to the urbanization of the Ewa District are several underlying visual/ scenic considerations that may deserve serious consideration. The thrust of this assessment therefore attempts to identify and assess these features so that these visual/ scenic qualities may be integrated, preserved or enhanced in responding to the policies/ objectives of the General Plan and Ewa Development Plan.

2. Existing Conditions

2.1 Project Location

Makaiwa Hills is a large, contiguous area containing 1915 acres of land consisting of TMK: 9-1-15: 5, 11& 17; 9-1-16: 9 (por.); and 9-2-03: 2 (por.). It is located at the western portion of the Ewa District. The site fronts over 2 miles of the H-1 Freeway/Farrington Highway between the Campbell Industrial Park off-ramp and the Ko Olina overpass. The project site extend mauka 1.75 miles from the freeway to Palehua Road (private unpaved road). The western edge of the project area is bordered by the Waimanalo Gulch. The Makakilo community boarders the site to the east.

Other landmarks include the smaller Honokai Hale residential subdivision and the Ko Olina Resort which lie directly opposite the project site on the makai side of the highway.

2.2 Physiography

The Ewa District consist of 2 major physiographic features. The first is the Ewa Plain and the Makakilo Slightly Dissected Upland[2]. The Ewa Plain is a large area of low

[2] Physiographic Divisions, Atlas of Hawaii, 1983

relief and covers the entire low land area of the Ewa District. It contains few natural land features of visual prominance. Its natural shoreline is a fairly regular uncliffed sedimentary coast. The Makakilo Slightly Dissected Upland are rolling "foothills" which descend from the Waianae Cliff and Valley formation (Waianae Mountains). These foothills are cut by widely spaced erosional gullies. These two land types intersect at approximately the 100 foot elevation.

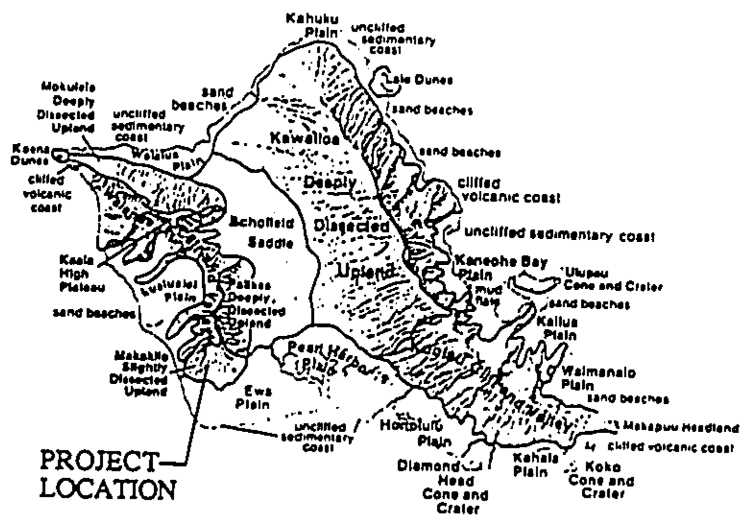


EXHIBIT: PHYSIOGRAPHY OF THE ISLAND OF OAHU
SOURCE: ALTAS OF HAWAII

The foothills of the Makaiwa Hills project site are moderately rich in its physiographic character. It contains 5 ridgelines separated by several moderately eroded gulches and tributary gullies. These ridges and gulches/ gullies descend from the upper reaches of the foothills and extend through the Makaiwa Hills site down to an elevation of approximately 100 to 150 feet where they disperse into the Ewa Plain. The ridges and gulches within the project site are distinctly different from the steep and deeply eroded ridges which characterize the Waianae Mountains, and appear to have a "rolling" profile as opposed to the "sharp edges" of the Waianae Mountains.

The Makaiwa Hills project site slopes at a generally consistent incline of approximately 10- 15% with steeper slopes up to 50% occurring in the gulches. A small level portion of the site (approximately 156 acres), once used for sugar cane cultivation, is located at the southeastern corner of the property near the existing Campbell Industrial Park off-ramp. This area is more akin to the low lying Ewa Plain area as opposed to the upland characteristics which prevails through most of the project site. It is also distinguishable from the upper slopes by its soil type (see Figure Nos. 8 &9) and contains several large water tanks.

Two of the ridges are fairly regular in slope and breadth, and extend the full mauka/makai length of the site. The other ridges lines are irregular and form a series of terraced plateaus. The ridges are vegetated with grasses and low lying shrubs although scattered stands of naturalized trees can be found, usually at the upper elevations.

Three major gulches run through the project site. They include Makaiwa Gulch, Palailai Gulch and Awainui Gulch, plus three other unnamed tributary gullies. The bottom of the gulches tend to be heavily vegetated with thickets of kiawe and hale-koa trees. Numerous exposed surface boulders are scattered throughout the project site. Rainfall however is generally light and coupled with the grazing usage of the land, the site is not noted for its heavy vegetated growth.

A fourth gulch (Waimanalo Gulch) is located adjacent to the western boundary, outside of the project site. It is currently used as a burial site for ash material generated by the H-Power plant which operates at the nearby Campbell Industrial Park.

Puu Palalai lies outside the lower eastern boundary of project area. Other dormant cones are located mauka of the project site within the Nanakuli Forest Reserve. Other than the ridges and gulches mentioned above, there are no other significant natural land forms and/or landmarks within the project site.

As one would expected, the relationship of the foothills perched above the low lying plain provides for commanding views from many locations within the project site.

2.3 Manmade Features

The most prominent manmade features are two parallel 100 ft. wide easements crossing the mid and upper portion of the project site. Large overhead electrical transmission lines originating at the Kahe Power Plant are located within these easements. Abutting the northwestern corner of the project area is a former military missile site which has since been removed, however remnants of this facility to include mounds, abandoned structures and a paved roadway can be found just beyond the project boundaries (see Figure No. 13, Site Photo K). Two large water storage tank are located near the southeastern corner of the site.

Palehua Road is a narrow unpaved roadway along the northern boundary of the site and is accessible from the Makakilo development. Mauna Kapu Community Site, a private camp site, is located north of Palehua Road and is outside the project site. The entire project area is uninhabited.

The project site is east of the Hawaiian Electric Company's Kahe Generating Station. From certain upper portions of the project site, the tip of the 450 ft. exhaust chimney is visible (see Figure No. 11, Site Photo A & B). Two other chimneys are also located at the Kahe facility but are not visible from the project site.

According to Hawaiian Electric Co., periodic maintenance of the facility results in a visible plume emanating from the stack. According to discussions with HECO[3], steam is used to cleanse the boilers and stacks of accumulated soot. This occurs 2 to 3 times per day for a duration of 60 to 90 minutes. The extent of visibility of the plume varies based on the amount of accumulated soot and wind conditions. The exhaust eminating from the chimneys are within Federal and State environmental standards.

> The subject property is near Hawaiian Electric Company's Kahe Generating Station. Stacks, transmission lines, and other appurtent facilities may be visible from the property and during Kona wind conditions, combustion gases from the facility may impinge upon the property. Existing units (stacks) are permitted under applicable Federal and State environmental regulations. Permit application for future unit additions will comply with applicable environmental regulations in effect at that time.[4]

2.4 Visual Framework

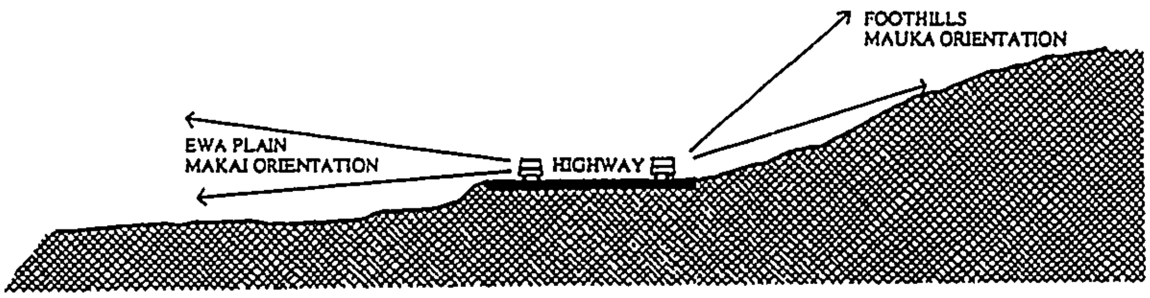
The visual framework of the Ewa District consist of the major physiographic features of the district and the viewing experience as seen from the roadway. Primary elements of the visual framework are:

a) The low lying Ewa Plain
b) The foothills (Makakilo Slightly Dissected Upland)
c) View from the primary roadway (H-1 Freeway and Farrington Highway)

The main feature of the Ewa District is the visual relationship between the Ewa Plain and the foothills. The significance of this visual relationship is heightened by the

3 Verbal conversation with Mita Okada, HECO, 16 Jan. 1991
4 Hawaiian Electric Co. Inc., Wiliam A. Bonnet, Manager, Environmental Department, Dec. 17, 1990

alignment of the H-1 Freeway/ Farrington Highway along the intersecting seam of these two land features. This juxtaposition establishing a mauka- makai orientation for the highway traveller with the slopes of the foothills extending mauka and the open space of the plain extending makai. The result of this relationship is that the open space character of the Ewa District can be seen and enjoyed from almost all segments of the highway.



EXHIBT: TYPICAL MAUKA/MAKAI
CROSS SECTION AT HIGHWAY

The makai views from the highway provide a broad and expansive views of the Ewa Plain. It overlooking many acres of open area and extends past the shoreline to the horizon. Even with the distant industrial forms of Campbell Industrial Park within the makai viewing plane, the sense of open space and expansiveness of the Ewa Plain is not adversely reduced.

The mauka views from the highway are equally significant, providing close-up views into the descending foothills which contrast the open and low lying imagery on the makai side.

Other visual/ scenic characteristics include the shoreline. The shoreline area is uncliffed and does not contain any sharp or distinctive features that are of regional significance. The horizon line is partially visible from portions of the highway and from the foothills, the shoreline itself is usually hidden by shoreline vegetation or buildings. The visual significance of the shoreline is best appreciated laterally (standing at the shoreline) or as a distant view object from the foothills. Similarly, distant mauka views from the shoreline areas are not highly vivid or memorable.

Views from the slopes of the foothills and particularly the Makaiwa Hills project area are extremely desirable. Perched above the Ewa Plain, these views are panoramic and unobstructed. They command sightlines across the entire southern shoreline of Oahu, extending as far as Diamond Head (see Figure No. 13, Site Photos K,L, M &N). Of particular visual interest are; (1) the Barbers Point Harbor and the lagoons at the Ko Olina resort which have introduced visual variation to an otherwise regular shoreline; and (2) the extensive landscape coverage which blankets the Ko Olina area. Similar views can be seen from the slopes of the Makakilo community.

2.5 Visual Effect, Examples

Given the basic visual framework of the Ewa District, past and recent examples of urbanization can be studied to determine the sensitivity and types of visual impacts that may result. The following summations are provided:

Urbanization within the Plain

Some examples of urbanization within the Ewa Plain include the Campbell Industrial Park and the Ko Olina resort developments. The Campbell Industrial Park development has resulted in a low profile of building mass along the shoreline area. The extensive landscaping within the industrial park softens and mitigates the overall building forms, particularly from within the park but do not mask the overall bulk from highway or upland viewing areas. Rather it is the great viewing distance and the vastness of the plain that dwarfs the building forms.

As no major buildings have yet been erected at the Ko Olina development, the primary visual effect is the extensive landscape treatment that has occurred on the site. Blanketed in green grass and dotted with palms and trees, it underscores the vastness of the Ewa Plain and dramatizes the transition away from the rural/ agricultural imagery. The relationship of the highway and the Ko Olina site provides a good example of public view penetration into the open space amenities of a site.

Urbanization within the Foothills

The Makakilo community is an example of urbanization within the foothills. The effect of this type of urbanization is illustrated in Figure No. , Site Photos I &J. These site photos illustrate the visual effect of residential subdivisions and structures in an upland condition. The visual effect is considered insignificant based on the relatively low building heights (25 ft., LUO) and the softening of roof lines by the maturing street trees and other landscape plantings on individual lots. Non-development within the the gulches and within 300+ feet (approx.) of the highway also reduces visual impact and keeps the foreground along the highway in open space.

Urbanization and Treatment Along the Highway
The Honokai Hale subdivision is an example of urbanization along the highway. This may be considered a "worst case" example. The necessity of a wall along the edge of the highway results in a "corridor condition" along one side of the highway, making the enhancement of the mauka/ makai visual relationship irretrievable at this highway segment.

3. Proposed Action

The Makaiwa Hills project seeks to urbanize approximately 1915 acre for the purpose of developing approximately 2130 residential dwelling units, 156 acres of commercial facilities, plus necessary public facilities such as parks, schools, fire station and roadways.

Except for small portions currently designated as Urban, the project site is within the State Land Use Agriculture boundary. Therefore a State Land Use Boundary amendment, followed by a Development Plan amendment and zoning will be necessary to achieve the development of the project as proposed.

Specific development proposals are as follows:

Commercial, 156 acres
Approximately 156 acres located towards the southeastern corner of the project site is proposed for commercial use. A regional shopping center is envisioned at this location, and will link the project with the urban core of Kapolei City. Ewa DP height guidelines for commercial uses is 60 feet.

Residential, 726 acres
2130 residential units are proposed and will consist of both multi-family and single family units. The multi-family units will be located near the lower portions of the site

close to the commercial area. The single family units will be located at the middle and upper portions of the site and will follow the ridgelines to the upper elevations.

Preservation, 901 acres

Approximately 47% of the overall project area is proposed to remain in open space through a Preservation land use designation. This will include the 5 gulches that cut through the project site (Upper Preservation, 721 acres) plus and additional 180 acres which parallel the highway between the existing Ko Olina overpass and the proposed instersection A near Honokai Hale. Waimanalo Gulch which is outside the project site is currently designated with a Public Facility (PF) land use.

As a planning option, the applicant distinguishes the lower preservation area (approximately 180 acres) as a potential golf course site. As a separate and future consideration, this scenario would establish an 18 hole course parallel to the freeway to include a club house, parking, and other maintenance related structures (see section 5 for further discussion).

Public Facilities and Roadways

Public/quasi-public development in support of the overall Makaiwa Hills development includes a 1 acre site for a fire station, 8 acre site for a public school, and a 16 acre site for a public park.

Approximately 107 acres of the total project site will be used to develop the proposed public roadway system. Roads shall be developed in conformance to City and County subdivision standards. The proposed roadways will cross the gulches in several locations, requiring bridges and/or other retaining systems.

In addition to improvements to the existing intersection at the Campbell Industrial Park off ramp, two additional intersections are proposed to link the Makaiwa Hills project with the existing freeway system (see Figure No. 5).

Summary of Land Uses

Acres	Land Use
721	Preservation (upper)
180	Preservation (lower)
16	Park
726	Residential
156	Commercial
1	Public Facility/ Fire Station
8	Public Facility/ School
107	Proposed Roadway

1915 ac. total
2130 dwelling units

4. Applicable Policies & Objectives

State and County policies regarding public views and scenic resources are as follows:

4.1 *Hawaii State Plan*, Chapter 226, HRS

The Hawaii State Plan, enacted by the Legislature of the State of Hawaii, identifies the goals, objectives, policies and priorities for the State of Hawaii. Section 226-12 of the plan addresses the State's objectives and policies regarding scenic resources.

Sec. 226-12 Objectives and policies for the physical environment- scenic, natural beauty, and historic resources.

(a) Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawaii's scenic assets, natural beauty, and multi-cultural/historic resources.

(b) To achieve the scenic, natural beauty, and historic resource objective, it shall be the policy of this State to:

(3) Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features.

(5) Encourage the design of developments and activities that complement the natural beauty of the islands.

Relationship

The State's policies of "promoting the preservation of views and vistas" and of "complementing the natural beauty of the islands" would not be violated by the development of the Makaiwa Hills project. The project site has not been found to be a prominent nor significant scenic/natural beauty resource element in either State or County documents. Public viewing points are not presently located on the project site. Retention of gulches/ gullies in a Preservation land use would minimize disruption to the visual character of the foothills. Public enjoyment of views overlooking the Ewa Plain would become possible through the development of publicly assessible roads within the Makaiwa Hills project site.

4.2 General Plan, City and County of Honolulu

The General Plan contains long range objective statements aimed at perpetuating public general welfare and prosperity, as well as broad policy statements necessary to facilitate the attainment of the objectives. Objectives and policies pertaining to visual and scenic concerns are embodied in the following sections of the General Plan:

<u>Natural Environment</u>

Objective B

To preserve and enhance the natural monuments and scenic views of Oahu for the benefit of both residents and visitors.

Policy 2- Protect Oahu's scenic views, especially those seem from highly developed and heavily travelled areas.

Policy 3- Locate roads, highways, and other public facilities and utilities in areas where they will be least likely obstruct important views of the mountains and the sea.

<u>Physical Development and Urban Design</u>

Objective D- To create and maintain attractive, meaningful, and stimulating environments throughout Oahu.

Policy 4- Require the consideration of urban design principles in all development projects.

Policy 7- Promote public and private programs to beautify the urban and rural environmentals.

Relationship

In addition to meeting GP policies and objective regarding the development of the secondary urban center, the Makaiwa Hills project may advance certain Natural Beauty and Urban Design objectives by; (1) placing and intergrating large portions of the project site in a Preservation land use; (2) and by developing a landscape treatment along the highway that unifies the scenic attributes of the district with the highway driving experience.

4.3 Development Plans, Common Provisions

The DP Common Provisions for all districts provide general policies regarding the treatment of views and scenic resources. Under Section 312-1.4 the following statements are provided:

(1) Public Views

Public views include views along streets and highways, mauka-makai view corridors, panoramic and significant landmark views from public places, views of natural features, heritage resources, and other landmarks, and view corridors between significant landmarks.

Such public views shall be protected by appropriate building heights, setbacks, design and siting controls established in the CZC (LUO). These controls shall be determined by the particular needs of each view and applied to public streets and to both public and private structures.

The design and siting of all structures shall reflect the need to maintain and enhance available views of significant landmarks. No development shall be permitted that will block important public views.

Wherever possible, overhead utility wires and poles that significantly obstruct views shall be relocated or placed underground.

> Relationship
>
> The Common Provisions establish the overall policies regarding protection and /or maintainance of significant views, landmarks, natural features etc. Further articulation is contained in the Special Provisions of each individual District. The regulatory controls (such as the LUO) provide the specific site and design standards (such as heights and setbacks).

4.4 Ewa Development Plan, Special Provisions

The Special Provisions of the Ewa DP amplify the general policies stated in the Common Provisions. The Special Provisions provide specific urban design controls by way of open space, public views and height controls.

(1) Open Space

The visibility, preservation, enhancement and accessibility of open space areas as defined in Sections 32-1.4 of the development plan special provisions shall be given high priority in the design of adjacent and nearby developments in Ewa, and particularly along the shoreline at West Beach.

(2) Public Views

In order to promote pleasing and attractive living environments in existing and new neighborhoods, mauka and makai views, and views of central Honolulu shall be protected whenever possible.

(3) Height Controls

The general height limits of structures in Ewa shall be as follows:

• Preservation	25 ft.
• Agriculture	25 ft.
• Residential	25 ft.
• Low Density Apt.	30 ft.
• Med. Density Apt.	
West Beach Special Area	150 ft.
all others	60 ft.
• Commercial	
West Beach Special Area major shopping complex	150 ft.
all others	60 ft.
• Industrial	60 ft.
• Resort	150 ft.

Relationship

The project's relationship to the Ewa DP Special Provisions is embodied in the proposed Makaiwa Hills land use plan. "Visibility, protection, enhancement and public accessibility" of open space would result through the retention of all gulches in a Preservation land use designation. Views of the open space (gulches) would be available to the general public via the development of a public roadway system. Access to the Makaiwa Hills roadway system would also result in the establishment of many new high quality viewing points which are not currently available to the public.

5. Potential Visual Impacts & Mitigative Measures

5.1 Short Term Visual Impacts

The visual effect of the proposed development will have a short term effect by way of necessary site grading, construction forms and activities, etc. Such effects are considered temporary and may be substantially minimized by breaking the project into phases which are incrementally constructed over the course of several years. Conversely, the duration of impacts will occur over a longer period of time.

5.2 Long Term Visual Impacts

Possible visual impacts may result from the following:

- The 726 acres of residential land use within the foothills
- The 156 acre commercial land use at the lower southeast portion of the project site
- The construction of bridges between the gulches
- The treatment along the mauka side of the highway
- Combustion gases may be visible and may impinge upon the project site from the Hawaiian Electric Kahe Generating Station

Discussion and mitigation of each potential impact are as follows:

Residential Land Use- Upon development, a subdivision pattern would be permanently etched into the terrain of the foothills. This effect however may not be overly adverse or significant to existing public views or the visual quality of the environment. Using the Makakilo development as an example, the upslope views from the highway and the shoreline demonstrate low visual impact from residential development in the foothills. The residential scale structures do not dominate the overall integrity of the foothills. Other mitigating factors considered in reaching this conclusion include the following:

a) Retention of the gulches/ gullies in a preservation land use

The proposed Upper Preservation area (gulches/ gullies) consist of approximately 721 acres, nearly equaling the 726 acres of propose residential land use and separates the proposed residential areas into several pockets of development. The favorable balance between residential and non-developed areas coupled with the configuration of the gulches/ gullies insure that a monolithic hillside subdivision would not occur.

b) Setback of residential land uses from the highway

The "worst case" example (Honokai Hale) of a residential subdivision abutting the highway would not occur as the Makaiwa Hills project places all residential land uses a minimum of 300+ feet from the mauka edge of the highway. The setback area is described as Lower Preservation.

c) LUO standards for residential zones

The LUO allows a maximum of 50% lot coverage on any residential lot. This standard coupled with the Upper Preservation land use would significantly reduces overall visual impact.

d) Subdivision rules and regulations

Street tree planting will be required for any subdivision application. The installation of street trees will merge with the building and roof forms and will further soften/ mask visual impacts.

f) Private design covenants

Private design covenants may be applied to the residential development to include restrictive building heights, view corridors, roof lines, building colors and materials, landscaping, etc. These design details would have a cumulative and positive effect in minimizing view impacts.

g) Underground utilities

Placement of utilities would eliminate the potential of visual unsightliness associated with overhead utilities.

Commercial Development- Unlike the sloping foothills, the proposed 156 acre commercial land use area is fairly level and immediately adjacent/ visible from the highway. DP guidelines recommend a 60 ft. building height for this area. It is very likely that commercial development (or any development) in this area will be highly visible from the highway. Consideration of the visual implications associated with this proposal include:

a) Existing DP land use designation

The proposed 156 acre commercial area is currently designated by the Ewa DP map as LDA (Low Density Apartment) with a small portion designated as residential. Developed under its present LDA designation, a buffer to shelter the residential units from the traffic along the highway may be necessary and would perpetuate the undesirable "corridor condition". Redesignation to a commercial land use would be mitigative as potential commercial uses would not be as adversely effected by adjacent traffic impacts (i.e. noise).

In addition to view considerations, the 156 acres lie in the wind shadow of Puu Palalai, blocking normal northeast tradewinds. Residential living conditions would suffer from the absence of cooling breezes.

b) Topography

The subject 156 acres abuts a steep portion of the foothills (see Figure No. , Site Photo E). DP Guidelines for a 60 foot building height would be below the elevation of the cliffs and the commercial structures would not be silhouetted against an open skyline.

c) Site plan

Opportunities for configuring a viable regional commercial area within the 156 acre site are numerous. Use of setbacks, building design standards, landscaping, etc. may be applied during zoning and other permitting processes to assess the appropriateness of site design.

Bridges between the gulches- An undetermined number of bridges connecting the descending ridgelines will be required to link the proposed roadway system. The bridges may be fairly massive structures and may adversely effect the visual quality of the open space system as implied with the preservation designation. Conversely, roadways and bridges may be instrumental in enhancing the visual appearance of the project. Design consideration/ mitigation may include the following:

a) Bridge design

Development of design standards may be used to establish a thematic imagery for the proposed roadways and bridges. Reduction in the overall size of the bridges may be achieved by establishing the roadway elevations below the ridgelines.

b) Landscaping

Landscaping techniques may be used as a secondary measure for reducing potential visual impact of bridges. Natural vegetation disturbed through grading for foundations should be replaced in kind.

Treatment along the mauka side of the highway- Treatment along the entire 2 mile frontage of the project site may significantly effect the visual/ scenic character of the District. Investigations into the existing conditions of the Ewa District (see sections 2, Physiographic, Visual Framework an Visual Sensitivity) emphasize the highway treatment as a major factor in establishing the newly emerging visual character of the district. Left unchecked and with no specific set of urban design guidance, piecemeal treatment along the highway frontage may adversely affect the long term development of the district and may fail to adequately meet the urbanization policies of "enhancement and promoting pleasing and attractive living environments[5]". Efforts to fulfil these policies may be met through the following:

a) Comprehensive design concept for the highway frontage

Inclusion of a comprehensive design concept for the highway frontage to include both the mauka and the makai sides of the road. The establishment of the design concept should take into account opportunities to develop a continuous scenic highway corridor through the Ewa District in concert with State DOT Highways and private land owners responsibilities.

b) Underground overhead utilites

All overhead utilities along the highway should be placed underground in conformance with DP guidelines.

5 Ewa Development Plan, Special Provisions, Specific Urban Design Considerations

Combustion gases from the Hawaiian Electric Kahe Generating Station- The occurence of exhaust plumage eminating from the HECO facility is not a visual impact resulting from the Makaiwa Hills project but instead it is an existing condition that is independent of the project site. Conflict and concern however may occur as a result of residential development in visual proximity to the plumage.

According to Hawaiian Electric Co. Inc., "air dispersion computer modeling has shown maximum ground level concentrations of stack gas pollutants ocurring within the project site. Model concentrations are within Federal and State air quality standards established for these pollutants and air quality monitoring stations have confirmed the conservative nature of the model concentrations, i.e. measured concentrations are less than predicted by the model.[6]"

Discussion and Mitigative Measures

As the concentration of pollutants are within Federal and State standards, disclosure of this occurrence and of future expansion of the Kahe station should be made to prospective purchasers/ residents of the Makaiwa Hills project.

5.3 Lower Preservation Alternatives (180 acres)

The proposed Land Use Plan (Figure 5) indicates 2 options for the "Lower Preservation" area (180 acres). Presently, this area is in a "natural" state consisting of undisturbed coastal scrub vegetation (Hale Koa, Kiawe, grasses) along the mauka side of the highway.

Option 1, Maintain Existing Character

Description- Option 1 would keep the lower 180 acres in its present natural condition (See Figure No. 5, Lower Preservation). This would effect approximately 1.3 miles of highway frontage between the Ko Olina overpass and intersection B and would extend mauka into the project site a minimum of 300+ feet. This Lower Preservation zone would link with the Upper Preservation zone (gulches and gullies) resulting in a continuous network of natural open space paralleling the mauka side of the highway and extending inland through the reaches of the gulches/ gullies. Under option 1, the directives of the Ewa DP Special Provision requirement to retain "visibility" and "preserve" open space

6 Hawaiian Electric Co. Inc., William A. Bonnet, Manager, Environmental Department, Dec. 17, 1990

areas would be literally accommodated, however the "enhancement" of such open space would be minimal.

Discussion and Mitigative Measures

This scenario would be consistent with the present day character of the Ewa District and would represent minimal change to the visual character along approximately 1.3 miles of the highway.

It would not however yield any increase nor public accessibility to the 180 acres of open space. Periodic brush fires, susceptibility to litter and other negative effects may be anticipated under this scenario. In view of recent highway frontage improvements that have been emerging along both the mauka and makai sides of the highway and in anticipation of other developments occurring within the district, the 180 acres left in it present natural condition may become an isolated oddity or eyesore.

Mitigative measure under this scenario may consist of undergrounding of existing overhead utilities, continued highway shoulder maintenance as performed by the Department of Transportation, Highways Division as well as the formulation of maintenance practices instituted by the landowner for areas beyond the right-of-way.

Option 2, Golf Course Development

Option 2 proposes to develop the lower 180 acres into a golf course. Under the golf course scenario, most of the natural landscape would be removed and replaced with an ornamental landscape and irrigation system. The irrigation system would spur on vegetative growth in a manner not currently sustainable by the natural rainfall of the area.

Although foreign to the present conditions of the site, this alternative would echo the landscape character on the opposite side of the highway (Ko Olina) and would also be visually compatible with the emerging landscape treatment occurring along portions of the mauka side of the highway. The result would be a visually symmetrical/balanced treatment along the both the sides of the highway. Under this scenario, maintenance, and overall enhancement/ beautification along the highway would be possible. Opportunities to visually unifying major segments of the highway within the district with a comprehensive landscape treatment would fulfill several GP and DP objectives.

Ancillary structures to include maintenance buildings, a golf club house and parking may be expected as part of Option 2.

Discussion and Mitigative Measure

Option 2 represents a significant alteration to the existing visual character of the highway frontage. It would not increase the overall quantity of open space as proposed by the project's land use plan. It would however increase accessibility and useage of the open space in a golf/ receational manner, and may be an improvement to the visual quality of the area.

Potential for adverse effects may result through the establishment of a inappropriate landscape buffer along the highway frontage, designed to restrict viewing penetration into the foothills/ preservation areas and creating a "corridor condition" along the highway. Other visual impacts may result from placement of ancillary golf course structures too close to the highway.

Mitigative measures may be applied to insure landscape design/ visual unity between overall highway frontage and the golf course treatment. Blockage of mauka view penetration and the "corridor effect" by way of formalized screening should be avoided. Efforts to appropriately intergrate the golf course into the visual framework of the district parrallel the recommendations previously discussed in section 5.2 (Treatment along the mauka side of the highway, p.14).

Other design mitigation may include substantial building setbacks from the highway and height controls for all golf course related structures.

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PLANNING • LANDSCAPE ARCHITECTURE • URBAN DESIGN

MAKAIWA HILLS
RECREATION USES WITHIN THE PROPOSED PRESERVATION AREAS

The Makaiwa Hills project proposes to amend approximately 901 acres of Agriculture to a Preservation land use designation. For planning purposes, the 901 acres are distinguished as Lower Preservation (consisting of 180 acres in the lower portion of the site) and Upper Preservation (721 acres at the mid and upper portions of the site).

Lower Preservation	180 acres
Upper Preservation	721 acres
total:	901 acres

In proposing 47% of the total project site for a Preservation designation, it is anticipated that a significant open space network will be established within the interior and fringes of the project site, and will enhance both the urban design and visual characteristic of the development.

The appropriate zoning designation for the 901 acres would be P-2, General Preservation. The intent of this zoning designation is to manage major open space and recreation lands. and to provide for outdoor space for the public's use and enjoyment.

In evaluating the site opportunities, certain recreational uses within the proposed Preservation areas may be considered without jeopardizing the basic open space values. Intergration of recreation uses would be consistent with certain General Plan Objectives and Policies to include:

Culture and Recreation
Objective D
To provide a wide range of recreational facilities and services that are readily available to all residents of Oahu.

Policy 1: Develop and maintain community based parks to meet the needs of the different communities on Oahu.

Policy 2: Develop and maintain a system of regional and specialized recreation facilities.

Policy 4: Encourage public and private botanic and zoological parks on Oahu to foster an awareness and appreciation of the natural environment.

Policy 10: Encourage the private provision of recreation and leisure-time facilities and services.

Due to the topographic conditions and proximity to the highway, the Lower Preservation area may be particularly suited for active or semi-active recreational activity. In addition to the golf course option, other recreation activities may include a variety of outdoor recreation

[illegible] HOTEL STREET SUITE [illegible] • HONOLULU HAWAII [illegible] • TELEPHONE [illegible]

facilities such as community clubhouses, swimming pools, recreational courts, botanic or zoological gardens, equestrian center, or playfields.

Recreation uses such as nature or riding trails may extend into the gulches (Upper Preservation area) and beyond to establish a network of trails and scenic lookouts throughout the foothills.

In a dispersed or clustered arrangement, it is feasible for certain recreation uses and facilities (special accessories) to be strategically located within the 901 acres of Preservation with minimal adverse impact upon the integrity of the open space. Other general benefits include increased public use and access into the area, and greater flexibility in controlling and managing the acreage.

Prepared By

MICHAEL S. CHU ASLA

*****

MICHAEL S CHU
LAND ARCHITECT
PLANNING • LANDSCAPE ARCHITECTURE • URBAN DESIGN

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Professional Services
Land Use Planning
Landscape Architecture
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Education
B.S. California State Polytechnic University, Pomona, 1977, Landscape Architecture
University of Hawaii, Urban and Regional Planning
Iolani School, 1967

Professional Practice
Michael S. Chu, Land Architect, 1982 to present
Phillips Brandt Reddick, Hawaii 1978-82
EDAW Inc. 1977-78
Tongg Assoc. 1973-75

Registration
State of Hawaii, Board of Registration, Professional Landscape Architect, 5348
State of Hawaii, Board of Registration, Realtor Associate, RS-36803

Professional & Community Affiliations
American Planning Association, Member
American Society of Landscape Architects, Member
American Institute of Architects, Professional Affiliate
Hawaii Architect Magazine
The American Land Resource Association, Charter Member
Honolulu Chamber of Commerce, Member
DLU Design Advisory Committee, Member

Background

Michael S. Chu, Land Architect is a professional consulting firm specializing in land use planning, landscape architecture and urban design. The firm was founded in 1982 and is located in downtown Honolulu. The firm is often engaged by governmental agencies, private land owners, developers or other consultants to provide technical planning and/or design services. These services include land use analysis, site planning and landscape architectural design, environmental studies and permit processing.

As a sole propiertorship, the firm maintains a wide network of professional colleagues in related fields and often draws upon this network when undertaking multi-disciplinary projects. This flexibility has enabled the firm to successfully engage in larger and complex projects with a team of subconsultants specifically selected to meet the needs and work products of a particular project. In other instances, the firm works independently or participates as a subconsultant to others and is capable of contributing land use and site planning expertise, technical report writing, design graphics, and landscape architectural design services.

The services of the firm are particularly strengthened with its broad experience and familiarity with governmental objectives as they relate to land use planning and design. Most recently the firm was the prime consultant and author of the Coastal View Study for the City and County of Honolulu, Hawaii County and Kauai County and also authored the Statewide Planning for Private Marina Facilities for the State Department of Transportation, Harbors Division.

Since 1985 Michael S. Chu has served as a member of the DLU Design Advisory Committee. He has also served as a member of the DLU technical review committee for the BMX-4 zoning district of the Land Use Ordinance.

Prior to establishing the firm, Michael S. Chu was a planner and landscape architect with the nationally recoginized firm of EDAW Inc., as well as the local firms of PBR Hawaii and Tongg Assoc. While at PBR he held the position of managing director of its Hawaii office and was project manager for several large multi-disciplinary projects to include the subjects of urban design, public housing and resort planning. His professional experience includes planning and design work throughout Hawaii, as well as Guam, Tahiti and Japan.

Description of Projects

Old Koloa Town, Kauai
The firm was responsible for planning and the development of a landscape architectural master plan for the renovation and revitalization of Koloa Town. Prepared for Koloa Town Associates and Spencer Mason Architects.

Russian Fort Elizabeth, Kauai
The project consisted on preparing an overall master plan and phase I construction documents for the historic restoration of the Russian Fort Elizabeth at Waimea, Kauai. *Performed for the State of Hawaii,* Department of Land and Natural Resources.

Oahu Coastal View Study
This landmark study was completed in 1987 and consisted of a detailed inventory of coastal scenic resources on Oahu and the formulation of design guidelines applicable to the SMA and Coastal Zone Management program. Performed for the City and County of Honolulu, Department of Land Utilization.

Since the completion of the study, the firm was commissioned to conduct similar islandwide Coastal View Studies by the Hawaii County Planning Department (1988) and the Kauai County Planning Department (1989).

Kapolei Villages, Oahu
Involvement in Kapolei Villages consisted of revising the 830 acre residential master plan and providing further design and design graphics to illustrate the overall development concept. Performed for the State of Hawaii, Housing and Finance Development Corp. and Towill Corp.

Architectural Compatibility Study, Oahu
This urban design project consisted of organizing and structuring a variety of independent projects into an overall and thematic development master plan for Hickam Air Force Base. Performed for the U.S. Air Force and Aotani and Assoc.

Servco Commercial Center, Oahu
The services of the firm was utilized to prepare the owner's development requirements, preparation of a detailed development master plan and to process assorted governmental permits for Servco's newly acquired 14.5 acres of waterfront industrial land at Sand Island. Performed for Servco Pacific, Inc. and Aotani and Assoc.

Hotel Street Transit Mall, Oahu
The firm participated in the planning and design of the Hotel Street Transit Mall by providing design guidance regarding historic features, street signage, bus shelters, light standards and sidewalks within the Chinatown historic district. Performed for the Department of Transportation Services, City and County of Honolulu and Parsons Brinkerhoff, Quade and Douglas.

Kalakaua Center
The firm was retained to provide complete landscape architectural design and permit processing services for the renovation of the "Mitsukoshi building" located in the Waikiki Special District. Performed for Mutual of New York (MONY), Graham Murata and Russell, and the CJS Group Architects.

Hawaii State Library, Oahu
The firm was the project landscape architect for the renovation of the Hawaii State Library locate within the Capital District on Honolulu. Performed for the Department of Accounting and General Services, State of Hawaii and Aotani and Assoc.

EWA by Gentry, Soda Creek, Increment 2 & 3, Oahu
The firm was retained to prepare the cluster development application for increments 2 and 3 of the EWA by Gentry development consisting of over 600 residential units and community support facilities. Services included the landscape design and the preparation of all material for the submittal and application of permits. Other services include participation in the rezoning application of the overall 700 acre development. Prepared for the Gentry Companies.

Pentagram Restaurant Projects
The firm provides exclusive landscape architectural services for all development and renovation of Burger King and El Pollo Loco restaurants in Hawaii and Guam . Work has included landscape development and/or renovation of over 20 restaurants since 1985. Performed for the Pentagram Corp.

Statewide Planning for Marina Facilities
The firm was retained as the prime consultant to provide a statewide study and recommendations for expediting the development of recreational marina facilities. Performed for the State of Hawaii, Department of Transportation, Harbors Division.

Honolulu Waterfront Master Plan, Oahu
The firm served as the landscape architectural subconsultant (to R.M. Towill/ Helber Hastert Kimura, a joint venture) in preparing the overall redevelopment master plan for the 1500 acre Honolulu waterfront area. Performed for the State of Hawaii, Office of State Planning.

Kewalo Basin Park, Oahu
The firm served as prime landscape architect for the park design at the triangle peninsula located at Kewalo Basin. The park development is the first increment of the "lei of green" concept envisioned by the Honolulu Waterfront Master Plan. Performed for the State of Hawaii, Hawaii Community Development Authority.

Kuilima Golf Club House
The firm was commissioned to design the landscaping for the Kuilima Golf Club House located on the north shore of Oahu. The landscape design included extensive planting, detailed grading and site design ammenities. Performed for the Kuilima Development Company and Geoffrey Paterson and Assoc.

Permits and Land Use Amendments
The firm often provides consultation and assistance in the preparation of Development Plan and zoning amendments, as well as processing other regulatory permits. Prominent clients include William E. Wanket, the Estate of James Campbell, Servco Pacific, Duncan Macnaughon, and Goodsill Anderson Quinn & Stifel.

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Appendix H.

Makaiwa Hills: Impact on Agriculture

Decision Analysts Hawaii, Inc.

MAKAIWA HILLS: Impact on Agriculture

PREPARED FOR:

The Estate of James Campbell

PREPARED BY:

Decision Analysts Hawaii, Inc.

November 1990

CONTENTS

TABLES

EXECUTIVE SUMMARY

The proposed Makaiwa Hills project to be developed by The Estate of James Campbell is a planned community which will be located on the slopes of the Waianae Mountain Range, west of Makakilo in Ewa, Oahu. The project will require approximately 1,915 acres of land, of which about 1,875 acres are in the State Agricultural District. The impact of this project on agriculture is summarized below.

QUALITY OF THE SITE FOR CROP PRODUCTION

Of the approximately 1,915 acres proposed for development, about 100 acres of the flatlands along the H-1 Freeway in the southeast portion of the project consist of good soils and favorable terrain for commercial crop production. These lands were once planted in sugarcane, but were fallowed in the early 1980s because of difficult access problems after the H-1 Freeway was built, relatively low yields, rocky soils on much of the land, and the long hauling distance to the mill.

The remaining lands are poorly suited for growing crops because the soils are rocky, the slopes are steep, and/or low-cost water is not available.

IMPACT ON EXISTING AND PLANNED AGRICULTURE OPERATIONS

Pasture Operations on the Flatlands

The approximately 100 acres of flatlands along the H-1 Freeway which were once used for growing sugarcane are now a pasture for grazing less than two dozen cattle and horses. This is a single-person operation under a month-to-month tenancy. This operation will be reduced in area in favor of a nursery operation, and eventually will be eliminated when the Makaiwa Hills project is developed.

Given the small scale of this operation and the availability of pasture and grazing lands elsewhere in the State (but not in the immediate area), mitigation measures for the loss of pasture lands are not recommended.

Planned Nursery on the Flatlands

On a portion of the flatlands now used for grazing, Campbell Estate plans to develop a nursery which will be a "grow-out" area for ornamental trees destined for its projects in Ewa. This will be an interim endeavor which will expand gradually at the expense of pasture operations on the property, and continue in operation until the property is developed. The nursery is expected to provide about 15 to 20 jobs at peak operation.

A second nursery is planned by Campbell Estate on about 20 acres of lands, a few acres of which will lie within the southeast corner of the project site. This nursery will also provide plants and trees for the Estate's projects in Ewa, and will be an interim endeavor until the property is developed. This second nursery is expected to provide about 20 jobs at peak operation.

After the nurseries are closed, other nurseries in Hawaii will supply the demand for plants and trees. Nurseries require relatively little land, and generally are economically healthy. Consequently, the proposed development is not expected to adversely affect the growth of the nursery industry, and mitigating measures are not recommended.

Grazing Operations in the Foothills

With the exception of the flatlands, the remainder of the project site is part of a 3,800-acre ranch operated as Rocker G. Livestock Company. The company grazes about 200 mother cows and their calves on the ranch. The small size of this year-round operation reflects the low carrying capacity of the land which is due to low rainfall, rocky soils, and the presence of gulches and very steep slopes on much of the land. The ranch derives additional income by allowing 400 to 500 head of cattle from off-island ranches to graze on its ranchland from about December through May, with the number of cattle and the duration of grazing depending on rainfall and the resulting growth of grass. Employment provided by the Rocker G. Livestock Company consists of 9 part-time jobs which are the equivalent of 2 full-time jobs.

At full development of the Makaiwa Hills project around the year 2010, about 1,800 acres will be removed from the grazing operation of the Rocker G. Livestock Company, with no replacement lands available in the immediate area. This removal of land from the ranch will *not* require a reduction in the number of its own herd which the company grazes on the property. However, it is expected that this reduction of grazing acreage will eliminate the temporary grazing of cattle from other ranches, thereby reducing revenues and profits to the company. Alternatives for these other ranches are to (1) graze their cattle on their own ranches for a longer period (if possible) before sending them to the Oahu feed lot, (2) send their cattle to other ranches that have excess carrying capacity, and/or (3) send their cattle to the feed lot at a younger age. Employment provided by the Rocker G. Livestock Company is expected to remain unchanged.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

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At full development of the Makaiwa Hills project around the year 2010, about 1,800 acres will be removed from the grazing operation of the Rocker G. Livestock Company, with no replacement lands available in the immediate area. This removal of land from the ranch will *not* require a reduction in the number of its own herd which the company grazes on the property. However, it is expected that this reduction of grazing acreage will eliminate the temporary grazing of cattle from other ranches, thereby reducing revenues and profits to the company. Alternatives for these other ranches are to (1) graze their cattle on their own ranches for a longer period (if possible) before sending them to the Oahu feed lot, (2) send their cattle to other ranches that have excess carrying capacity, and/or (3) send their cattle to the feed lot at a younger age. Employment provided by the Rocker G. Livestock Company is expected to remain unchanged.

From a Statewide perspective, this loss of grazing land is very small—less than 0.2 percent of Hawaii's supply of pasture and grazing land. Furthermore, the Makaiwa Hills project is not expected to adversely affect the growth of Hawaii's cattle industry because land is not the limiting factor. The supply of pasture and grazing land in Hawaii is very large, encompassing an area over twice that of the entire land area of Oahu. Furthermore, the supply of pasture and grazing land is increasing as land is being released from plantation agriculture. Since about 1970, however, the cattle population in Hawaii has been declining slowly. This suggests that other ranches in the State could increase their herd sizes to compensate for the loss in beef production, if any, which may result from the loss of grazing land due to the Makaiwa Hills project.

In view of the relatively small impact of the Makaiwa Hills project on the cattle industry and on employment, and the availability of pasture and grazing lands elsewhere in the State (but not in the immediate area), mitigation measures for the loss of grazing lands are not recommended.

IMPACT ON THE GROWTH OF DIVERSIFIED AGRICULTURE

The development of Makaiwa Hills constitutes a commitment to urban use of about 100 acres of agricultural land suitable for growing crops. However, this commitment will not limit the growth of diversified agriculture Statewide since ample agricultural lands have been and continue to be freed from plantation agriculture. Since 1968, about 90,000 acres of Hawaii's agricultural land have been freed from sugar and pineapple production. Most of this land is fallow, in pasture, or in some other low-value land-holding operation. In addition, the plantations have announced plans to withdraw an additional 27,500 acres from sugar and pineapple production.

This past and scheduled release of land from plantation agriculture is enormous. For comparison, the total amount of land remaining in plantation agriculture on Oahu (two sugar plantations and two pineapple plantations) amounts to about 37,000 acres. For truck crops, less than 7,000 acres are required throughout the State to supply the entire Hawaii market.

As the above indicates, the limiting factor to the growth of diversified agriculture is not the *land supply,* but rather the *market demand* for those crops that can be *grown profitably* in Hawaii. Affecting about 100 acres of good agricultural land, the proposed Makaiwa Hills project involves far too little land to affect this conclusion, and will therefore not affect adversely the Statewide growth of diversified agriculture. Mitigating measures are not recommended.

GROUNDS MAINTENANCE

At full development, the Makaiwa Hills project will provide over 70 jobs involved with grounds maintenance throughout the project, including a golf course (if built), yards, and other landscaped areas. These will be outdoor jobs similar to certain jobs in the agriculture industry, and which require similar skills and training.

CONSISTENCY WITH STATE AND COUNTY PLANS

Since the Makaiwa Hills project will not affect any sugar or pineapple operations, it will not conflict with the thrust of the plantation-agriculture portions of the *Hawaii State Plan, the State Agriculture Functional Plan*, and the *General Plan of the City and County of Honolulu*. This thrust in all three plans calls for preserving the economic viability of plantation agriculture.

To a limited extent—particularly with respect to the small local impact on the cattle industry but not on the Statewide impact on the cattle industry, nor on the Statewide impact on diversified agriculture, nor on the addition of a significant number of grounds-maintenance jobs —the proposed project conflicts with the thrust of the diversified-agriculture portion of the State and County plans. This thrust calls for promoting the growth of diversified agriculture and for assuring the availability of an adequate supply of agriculturally suitable lands and water.

In addition, a portion of the project will be potentially inconsistent with the lower-level State agricultural *guidelines* which call for Agricultural Lands of Importance to be protected from development. However, this portion of the project which causes the conflict is consistent with the County Development Plan which designates urban development of the approximately 100 acres of good agricultural land. Furthermore, this plan is consistent with the broader State and County policy of directing housing and commercial development to Ewa—a policy which requires the urban development of agricultural land.

It should be noted that the State Department of Agriculture has advocated the development of homes in the foothills of the Waianae Mountains rather than on the high-quality agricultural lands on the plains below. Makaiwa Hills is consistent with this position.

MAKAIWA HILLS:
IMPACT ON AGRICULTURE

The proposed Makaiwa Hills project to be developed by The Estate of James Campbell is a planned community which will be located on the slopes of the Waianae Mountain Range, west of Makakilo in Ewa, Oahu. The project will consist of about 2,130 residential units, a regional shopping mall, considerable open space, public facilities, and possibly a golf course. The project will require approximately 1,915 acres of land, of which about 1,875 acres are in the State Agricultural District. The impact of this project on agriculture is discussed in this report.

AGRONOMICAL CONDITIONS

Soil Types and Agricultural Uses[1]

The affected acreage consists of fourteen soil types:

EaB	Ewa silty clay loam, 0 to 3 percent
EwC	Ewa stony silty clay, 6 to 12 percent
HLMG	Helemano silty clay, 30 to 90 percent slopes
HxA	Honouliuli clay, 0 to 2 percent slopes
HxB	Honouliuli clay, 2 to 6 percent slopes
LPE	Lualualei extremely stony clay, 3 to 35 percent slopes
LvB	Lualualei stony clay, 2 to 6 percent slopes
MBL	Mahana-Badland complex
McC2	Mahana silty clay loam, 6 to 12 percent slopes, eroded
McD2	Mahana silty clay loam, 12 to 20 percent slopes, eroded
McE2	Mahana silty clay loam, 20 to 35 percent slopes, eroded
MuC	Molokai silty clay loam, 7 to 15 percent slopes
rRK	Rock land
rSY	Stony steep land

For each soil type, Table 1 shows the approximate acreage, possible agricultural uses, and two soil ratings (explained below). About two-thirds of the project area consists of steep stony land (soil type rSY), which is unsuited for agriculture. Slightly less than 9 percent of the project area is suitable for crops or pasture operations, while another 22 percent of the project is suitable for pasture operations only. Most of the area suitable for crops is located on the flatlands in the southeast corner of the property along the H-1 Freeway.

Soil Ratings

The soils in the project area have been rated in terms of four classification systems commonly used in Hawaii: (1) Land Capability Grouping, (2) Agricultural Lands of Importance to the State of Hawaii, (3) Overall Productivity Rating, and (4) Land Evaluation and Site Assessment System. These classification systems are discussed below.

(1) *Land Capability Grouping by the United States Department of Agriculture Soil Conservation Service (SCS).*

This classification system rates soils according to eight levels, ranging from the highest classification level, I, to the lowest level, VIII. Assuming that the land is irrigated, about 1.5 percent of the project area has the highest land capability rating of **I**, which indicates that the soils have few limitations that restrict their agricultural use. About 2.7 percent of the area has a capability rating of **IIe**, which indicates that the soils have moderate limitations which reduce the choice of plants or which require moderate conservation practices. The subclassification "e" indicates that the limitation is due to erosion. About 3.9 percent of the area is rated **IIIe**, which indicates that the soils have severe limitations which reduce the choice of plants, require special conservation practices, or both. About 0.2 percent of the area is rated **IVe**, which indicates that the soils have very severe limitations which reduce the choice of plants, require very careful management, or both. About 3 percent of the area has a mixed rating of **IVe and VIIIe**. The VIII rating indicates that the soils and landforms have limitations which preclude their use for commercial plant production. About 0.8 percent of the area is rated **VIe**, which indicates that the soils have severe limitations which make them generally unsuitable for cultivation but are suitable for pasture operations. About 8.2 percent of the area is rated **VIIe**, which indicates that the soils have very severe limitations which make them unsuitable for cultivation but are suitable for pasture operations. About 79.7 percent of the area is rated **VIIs**, which indicates that the soils have very severe limitations which make them unsuitable for cultivation but suitable for pasture operations. The subclassification "s" indicates that the limitation is due to stoniness.

Table 1.— MAKAIWA HILLS:
SOIL TYPES, AGRICULTURAL USES, AND LESA AND SCS RATINGS

Soil Type	Acreage	Percent	Agricultural Uses	SCS Rating[1]	LESA Rating
EaB	17	0.9	Sugarcane, truck crops, and pasture	IIe	85
EwC	5	0.3	Pasture	IIIe	77
HLMG	157	8.2	Pasture	VIIe	n.r.
HxA	28	1.5	Sugarcane, truck crops, and pasture	I	87
HxB	35	1.8	Sugarcane, truck crops, and pasture	IIe	85
LPE	160	8.4	Pasture	VIIs	18
LvB	20	1.0	Sugarcane, truck crops, and pasture	IIIe	68
MBL	57	3.0	Pasture	IVe/ VIIIe	24
McC2	36	1.9	Sugarcane, pineapple, and pasture	IIIe	67
McD2	3	0.2	Sugarcane, pineapple, and pasture	IVe	64
McE2	15	0.8	Pineapple and pasture	VIe	53
MuC	14	0.7	Sugarcane, pineapple, and pasture	IIIe	81
rRK	49	2.5	Pasture	VIIs	n.r.
rSY	1,317	68.8	None	VIIs	n.r.
Former reservoir	2	0.1			
TOTAL	1,915	100.0			

n.r.: not rated.

1. Assuming all soils are irrigated except HLMG, LPE, MBL,rRK and rRS which are not irrigated.

Sources:

U.S. Department of Agriculture, Soil Conservation Service, *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii,* August 1972.

State of Hawaii Land Evaluation and Site Assessment Commission, *A Report on the State of Hawaii Land Evaluation and Site Assessment System,* Legislative Reference Bureau, February 1986.

(2) *Agricultural Lands of Importance in the State of Hawaii (ALISH), by the SCS, University of Hawaii (UH) College of Tropical Agriculture and Human Resources, and the State of Hawaii, Department of Agriculture.*

This system classifies lands into three categories: (a) "prime" agricultural land which is land that is best-suited for the production of crops because of its ability to sustain high yields with relatively little input and with the least damage to the environment; (b) "unique" agricultural land which is non-prime agricultural land that is currently used for the production of specific high-value crops; and (c) "other" agricultural land which is non-prime and non-unique agricultural land that is of importance to the production of crops. About 6 percent of the land in the project area is rated as "**prime**" agricultural land, and the remaining land is unrated.

(3) *Overall Productivity Rating, by the UH Land Study Bureau (LSB).*

This classification rates soils according to five levels, with "A" representing the class of highest productivity and "E" the lowest. About 0.4 percent of the land has soils rated "A," about 5.2 percent is rated "B," about 0.5 percent is rated "C," about 12.6 percent is rated "D," and 81.2 percent is rated "E."

(4) *Proposed Land Evaluation and Site Assessment (LESA) System, by the State of Hawaii Land Evaluation and Site Assessment Commission*

Based on soil quality, locational attributes, improvements, nearby activities, and land-use plans, the proposed LESA classification system would designate a sufficient amount of the better agricultural lands to meet projected agricultural goals. Such designated land would be termed "important agricultural lands" (IAL), which would include all lands on Oahu having a LESA rating of 66 or higher, out of a possible total of 100. If the LESA classification approach were applied to the proposed site, about 8 percent would be termed **IAL** (see Table 1). However, the designation could be changed based on a change in nearby activities and a change in County land-use plans. Also, the designation could be changed if an overriding public benefit were demonstrated.

These soil-rating systems suggest that about 6 to 8 percent of the project site is comprised of good soils. Most of the good soils are located at the lower elevations in the southeast corner of the property along the H-1 Freeway.

Climatic Conditions[2]

The project site is in an area which receives considerable sunshine and low rainfall of 20 to 30 inches per year.

Terrain

The project site ranges in elevation from approximately 50 feet to 1,300 feet with three major and three minor gulches transecting the project site. Slopes range from 2 to 50 percent, with flatlands located in the southeast portion of the project along the H-1 Freeway where most of the better soils are located.

Water Availability

About 100 acres of the flatlands were once irrigated by Oahu Sugar Co., Ltd.; a flume remains on the property, although wooden sections have deteriorated. Currently, both potable and non-potable water are available on the flatlands from existing water pipes. Also, groundwater flows under the property. High pumping costs preclude crop production on most of the higher elevation lands.

Summary

Of the approximately 1,915 acres proposed for development, *about 100 acres of the flatlands along the H-1 Freeway in the southeast portion of the project consist of good soils and favorable terrain for crop productions. However, the soils are somewhat rocky.*

The remaining lands are poorly suited for crops because the soils are rocky, the slopes are steep, and/or low-cost water is not available.

STATE AND COUNTY LAND-USE CLASSIFICATIONS

About 1,875 acres of the project site are located within the State Agricultural District. The remaining 40 acres are classified "Urban." Most of the "Urban" land is located on the eastern side of project on the lower slopes of the Waianae Mountain Range near Makakilo City, with an additional small area being used for the Ko Olina Resort interchange.

The larger "Urban" area is zoned by the City and County of Honolulu as "R-5 Residential." The level lands in the southeast corner of the project which have good soils plus the small area for the Ko Olina Resort interchange—an area of about 96 acres—are zoned "AG-1, Restricted Agriculture." The remaining lands, about 1,779 acres which encompasses the hillside, are zoned "AG-2, General Agriculture."

The City and County Development Plan for the area designates about 1,772 acres of the hillside "Agriculture" and the above-mentioned 40 acres near Makakilo as "Residential." In addition, *about 103 acres located on the flatlands in the southeast corner of the project along the H-1 Freeway are designated as "Low-Density Apartment;" these are the lands which are best-suited for crop production.*

FORMER SUGARCANE OPERATIONS

Approximately 100 acres of the subject property were once cultivated in sugarcane by Oahu Sugar Co., Ltd. on fields located on the flatlands in the southeast portion of the project along the H-1 Freeway—these are the above-mentioned lands which are best-suited for crop production. However, the fields were fallowed in the early 1980s, primarily because of difficult access problems after the H-1 Freeway was built, but also because of relatively low yields, rocky soils on much of the land, and the long hauling distance to the mill.

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Pasture Operations on the Flatlands

The approximately 100 acres of flatlands along the H-1 Freeway which were once used for growing sugarcane are now a pasture for grazing less than two dozen cattle and horses. This is a single-person operation under a month-to-month tenancy.

This operation will be reduced in area in favor of a nursery operation, and eventually will be eliminated when the Makaiwa Hills project is developed.

Given the small scale of this operation in terms of acreage, the number of livestock, and employment and, as discussed in a following section, the availability of pasture and grazing lands elsewhere in the State (but not in the immediate area), mitigation measures for the loss of pasture lands are not recommended.

Planned Nursery Operations on the Flatlands

On a portion of the flatlands now used for grazing, Campbell Estate plans to develop a nursery which will be a grow-out area for ornamental trees destined for its projects in Ewa. This will be an interim endeavor which will expand gradually at the expense of the pasture operations, and continue in operation until the property is developed. The nursery is expected to provide about 15 to 20 jobs at peak operation.

A second nursery is planned by Campbell Estate on about 20 acres of lands, a few acres of which will lie within the southeast corner of the project site. This nursery will also provide plants and trees for the Estate's projects in Ewa, and will be an interim endeavor until the property is developed. This second nursery is expected to provide about 20 jobs at peak operation.

After the nurseries are closed, other nurseries in Hawaii will supply the demand for plants and trees. Nurseries require relatively little land, and generally are economically healthy. Consequently, the proposed development is not expected to adversely affect the growth of the nursery industry, and mitigating measures are not recommended.

Grazing Operations in the Foothills

Historically, the foothills in the area have been used for grazing operations as part of the 4,700-acre Tongg Ranch. Under new 15-year leases to the former sublessees of Tongg Ranch, the operation will continue as Palehua Ranch which will consist of three parcels, the largest of which will be operated as Rocker G. Livestock Company. Its 3,800 acres include about 1,800 acres which will eventually be developed as part of Makaiwa Hills. The ranch includes good grazing lands as well as gulch lands.

The Rocker G. Livestock Company grazes about 200 mother cows and their calves on the ranch. The herd consists of cross Brahman stock, which is well adapted to the heat and rough country found in the area. In the winter months, the cattle graze at the higher elevations on green guinea grass; in the summer months, they graze at the lower elevations on dry buffalo grass. This grazing on dry grass in the summer months reduces the risk of brush fires on the property. The small size of this year-round operation reflects the low carrying capacity of the land which is due to low rainfall, rocky soils, and the presence of gulches and very steep slopes on much of the land.

The Rocker G. Livestock Company derives additional income by allowing 400 to 500 head of cattle from other ranches to graze on its ranch land from about December through May, with the number of cattle and the duration of grazing depending on rainfall and the resulting growth of grass. This is primarily a stocker operation whereby young steers and heifers form off-island ranches are grazed before being sent to the feed lot at Campbell Industrial Park. Cattle from other ranches may also be grazed if these ranches experience low rainfall and a resulting insufficient grass-growth to feed their herd.

Employment provided by the Rocker G. Livestock Company consists of 9 part-time jobs which are the equivalent of 2 full-time jobs.

At full development of the Makaiwa Hills project around the year 2010, about 1,800 acres will be removed from the grazing operation of the Rocker G. Livestock Company. This removal of land from the ranch will *not* require a reduction in the number of its own herd which the company grazes on the property. However, the owner of the company expects that the removal of land will eliminate the temporary grazing of cattle from other ranches, thereby reducing revenues and profits to the company. Alternatives for these other ranches are to (1) graze their cattle on their own ranches for a longer period (if possible) before sending them to the Oahu feed lot, (2) send their cattle to other ranches that have excess carrying capacity, and/or (3) send their cattle to the feed lot at a younger age. Employment provided by the Rocker G. Livestock Company is expected to remain unchanged.

Other grazing lands to replace those which will be required for the Makaiwa Hills project are not available in the area. However, it should be noted that the supply of pasture and grazing land in Hawaii is very large, an estimated 765,450 acres in 1983, most of which is located on the Big Island.[3] For comparison, this is over twice the entire land area of Oahu (381,632 acres).[4] The Makaiwa Hills project will have a relatively small impact on the supply of grazing land in the State in that the supply will decrease by less than 0.2 percent.

Furthermore, the supply of pasture and grazing land is increasing as land is being released from plantation agriculture, with much of this land being placed in grazing operations (see the next section). In contrast, the number of cattle in Hawaii has been declining slowly since about 1970.[5] This combination of a large and increasing supply of pasture and grazing land combined with decreasing number of cattle indicates that land is not the limiting factor to the growth of the cattle industry. It further suggests that other ranches in the State could increase their herd sizes to compensate for the loss in beef production, if any, which may result from the loss of grazing land due to the Makaiwa Hills project.

In view of the relatively small impact of the Makaiwa Hills project on the cattle industry and on employment, the availability of pasture and grazing lands elsewhere in the State (but not in the immediate area), mitigation measures for the loss of grazing lands are not recommended.

IMPACT ON THE GROWTH OF DIVERSIFIED AGRICULTURE

The development of the Makaiwa Hills constitutes a commitment of about 1,915 acres of agricultural land to a non-agricultural use, of which about 100 acres are suitable for growing crops. This commitment of land raises the question of whether the Makaiwa Hills will affect adversely the growth of diversified agriculture—either immediately or over the long term. Before addressing this question, *potential crops* and the *availability of land for diversified agriculture* are discussed below.

Potential Diversified-Agriculture Crops

Given the relatively sunny conditions, the soils, and other agronomical conditions in Ewa, crops suited for Ewa include: avocados, Chinese bananas, snap beans, bittermelon, sweet corn, cucumbers, daikon, long eggplant, round eggplant, semi-head lettuce, limes, dry onions, green onions, Chinese peas, sweet peppers, potatoes, sweet potatoes, pumpkins, radishes, Italian squash, oriental squash, tomatoes, watermelon, seed crops, forage crops, flowers, and potted foliage.

Assuming that the Hawaii demand for these crops exceeds that which is already supplied by producers elsewhere in the State, it is uncertain which of these crops would be profitable given the high land rents which prevail in the Ewa area.

Availability of Land for Diversified Agriculture

The amount of land available for diversified agriculture has been increasing for over two decades because land has been and continues to be released from plantation agriculture at a rate faster than it has been absorbed by other activities. Since 1968, about 90,000 acres of Hawaii's agricultural land have been freed from sugar and pineapple production: about 62,700 acres of land freed from sugar production (about 15,200 acres on Oahu and 47,500 on the Neighbor Islands), and about 27,300 acres freed from pineapple production (about 6,600 acres on Oahu and 20,700 on the Neighbor Islands).[6-8] Most of this land is fallow, in pasture, or in some other low-value land-holding operation.

In addition, Hamakua Sugar Co., Inc. has announced that it will sell 8,000 acres of land on the Big Island in order to reduce its debt; Ka'u Agribusiness Co., Inc. has announced that it will contract operations by 4,200 acres; McBryde Sugar Co., Ltd. is converting 5,000 acres of its sugarcane land to diversified agriculture; The Lihue Plantation Co., Ltd. has announced plans to contract operations by over 3,300 acres; and Dole Pineapple has announced plans to phase out its 7,000-acre pineapple operation on Lanai. Furthermore, a portion of the sugarcane land is in a "holding pattern" awaiting the discovery of profitable replacement activities; this land forms part of the supply of agricultural land available to profitable diversified-agriculture crops.

This past and scheduled release of land from plantation agriculture is enormous. For comparison, the total amount of land remaining in plantation agriculture on Oahu (two sugar plantations and two pineapple plantations) amounts to about 37,300 acres.[9] For truck crops, less than 7,000 acres are required throughout the State to supply the entire Hawaii market.[10]

Impact of the Makaiwa Hills Project on the Growth of Diversified Agriculture

As the discussion above indicates, the limiting factor to the growth of diversified agriculture is not the *land supply*, but rather the *market demand* for those crops that can be *grown profitably* in Hawaii. Affecting about 100 acres of good agricultural land, the proposed Makaiwa Hills involves far too little land to affect this conclusion, and will therefore not affect adversely the Statewide growth of diversified agriculture. Mitigating measures are not recommended.

GROUNDS MAINTENANCE

At full development, the Makaiwa Hills project will provide over 70 jobs involved with grounds maintenance throughout the project, including a golf course (if built), yards, and other landscaped areas. These will be outdoor jobs involved with cultivating grasses and plants, applying fertilizers and chemicals, maintaining irrigation systems, etc. Most of these outdoor jobs are similar to certain jobs in the agriculture industry, and require similar skills and training.

CONSISTENCY WITH STATE AND COUNTY PLANS

Since the Makaiwa Hills project will not affect any sugar or pineapple operations, it will not conflict with the thrust of the plantation-agriculture portions of the *Hawaii State Plan, the State Agriculture Functional Plan,* and the *General Plan of the City and County of Honolulu.* This thrust in all three plans calls for preserving the economic viability of plantation agriculture.

To a limited extent—particularly with respect to the small local impact on the cattle industry but not on the Statewide impact on the cattle industry, nor on the Statewide impact on diversified agriculture, nor on the addition of a significant number of grounds-maintenance jobs—the proposed project conflicts with the thrust of the diversified-agriculture portion of the State and County plans. This thrust calls for promoting the growth of diversified agriculture and for assuring the availability of an adequate supply of agriculturally suitable lands and water.

In addition, a portion of the project will be potentially inconsistent with the lower-level State agricultural *guidelines* which call for Agricultural Lands of Importance to be protected from development. However, this portion of the project which causes the conflict is consistent with the County Development Plan which designates urban development of the approximately 100 acres of good agricultural land. Furthermore, this plan is consistent with the broader State and County policy of directing housing and commercial development to Ewa—a policy which requires the urban development of agricultural land.

It should be noted that the State Department of Agriculture has advocated the development of homes in the foothills of the Waianae Mountains rather than on the high-quality agricultural lands on the plains below. Makaiwa Hills is consistent with this position.

ORGANIZATIONS CONTACTED

The Estate of James Campbell
Rocker G. Livestock Company
State of Hawaii Department of Agriculture.
University of Hawaii College of Tropical Agriculture and Human Resources.

Table 2.-- **SELECTED STATE AND COUNTY OBJECTIVES, POLICIES, AND GUIDELINES RELATED TO AGRICULTURAL LANDS**

HAWAII STATE PLAN (Chapter 226, Hawaii Revised Statutes, as amended):

Section 226-7 Objectives and policies for the economy--agriculture.

(a) Planning for the State's economy with regard to agriculture shall be directed towards achievement of the following objectives:

(1) Continued viability in Hawaii's sugar and pineapple industries.

(2) Continued growth and development of diversified agriculture throughout the State.

(b) To achieve the agricultural objectives, it shall be the policy of the State to:

(6) Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs.

Section 226-103 Economic priority guidelines.

(c) Priority guidelines to promote the continued viability of the sugar and pineapple industries:

(1) Provide adequate agricultural lands to support the economic viability of the sugar and pineapple industries.

(d) Priority guidelines to promote the growth and development of diversified agriculture and aquaculture:

(1) Identify, conserve, and protect agricultural and aquacultural lands of importance and initiate affirmative and comprehensive programs to promote economically productive agricultural and aquacultural uses of such lands.

Section 226-104 Population growth and land resources priority guidelines.

(b) Priority guidelines for regional growth distribution and land resource utilization:

(2) Make available marginal or non-essential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district.

Table 2.-- **SELECTED STATE AND COUNTY OBJECTIVES, POLICIES, AND GUIDELINES RELATED TO AGRICULTURAL LANDS**
(continued)

STATE AGRICULTURAL FUNCTIONAL PLAN (June 1985)
(Functional plans are guidelines for implementing the State Plan, and are not adopted by the State Legislature.)

B. Objective: Achievement of Productive Agricultural Use of Lands Most Suitable and Needed for Agriculture.

(5) Policy: Provide greater protection to agricultural lands in accordance with the Hawaii State Constitution.

(c) Implementing Action: Identify important agricultural lands to promote diversified agriculture, increased agricultural self-sufficiency, and assure the availability of agriculturally suitable lands.

(d) Implementing Action: Until standards and criteria to conserve and protect important agricultural lands are enacted by the Legislature, important agricultural lands should be classified in the State Agricultural District and zoned for agricultural use, except where, by the preponderance of the evidence presented, injustice or inequity will result or overriding public interest exists to provide such lands for other objectives of the Hawaii State plan.

CITY AND COUNTY OF HONOLULU
GENERAL PLAN, Objectives and Policies (Resolution No. 87-211)

Economic Activity

Objective C. To maintain the viability of agriculture on Oahu.

Policy 4. Provide sufficient agricultural land in Ewa, Central Oahu, and the North Shore to encourage the continuation of sugar and pineapple as viable industries.

Policy 5. Maintain agricultural land along the Windward, North Shore, and Waianae coasts for truck farming, flower growing, aquaculture, livestock production, and other types of diversified agriculture.

REFERENCES

[1] U.S. Department of Agriculture, Soil Conservation Service in cooperation with The University of Hawaii Agricultural Experiment Station, *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai,* State of Hawaii, Washington, D.C., August 1972.

[2] Department of Geography, University of Hawaii, *Atlas of Hawaii, Second Edition,* University Press, 1983.

[3] *A Report on the State of Hawaii Land Evaluation and Site Assessment System*, February 1986, p. 14.

[4] Department of Business and Economic Development, *The State of Hawaii Data Book, 1989*, November 1989, p. 129.

[5] Hawaii Agricultural Statistics Service, *Statistics of Hawaiian Agriculture: 1989*, September 1990, p. 74

[6] Hawaiian Sugar Planters' Association, *Hawaiian Sugar Manual 1988.*

[7] Hawaii Agricultural Statistics Service, *Statistics of Hawaiian Agriculture 1987.*

[8] Robert C. Schmitt, *Historical Statistics of Hawaii.*

[9] Derived from Hawaii Agricultural Statistics Service, *Statistics of Hawaiian Agriculture, 1989*, September 1990, p. 11.

[10] Derived from Hawaii Agricultural Statistics Service, *Statistics of Hawaiian Agriculture, 1988*, with adjustments to harvested acreage to reflect multiple harvest per year, as appropriate.

Appendix I.

Makaiwa Hills: Employment Impact and Labor Availability

Decision Analysts Hawaii, Inc.

MAKAIWA HILLS:
Employment Impact and Labor Availability

CONTENTS

TABLES

EXECUTIVE SUMMARY

The Makaiwa Hills project proposed for development by The Estate of James Campbell will provide about 2,130 up-scale single-family homes and townhouses in a premium location for executives, professionals, retirees, and owners of second homes. In addition, 600,000 square feet or more of commercial space will be provided in a regional mall which will serve residents of Ewa and of other nearby areas. The development may include a golf course.

EXISTING AGRICULTURE OPERATIONS

Approximately 100 acres of flatlands along the H-1 Freeway are now a pasture for grazing a small number of livestock. This operation, which is under a month-to-month tenancy, will be reduced in area and eventually will be eliminated when the Makaiwa Hills project is developed. The tenant and sole operator holds a full-time job elsewhere in the area.

The remainder of the project site forms part of a 3,800-acre ranch operated as Rocker G. Livestock Company. Grazing operations on this ranch provide about 9 part-time jobs which are the equivalent of 2 full-time jobs. At full development of the Makaiwa Hills project around the year 2010, about 1,800 acres will be removed from the grazing operation. However, employment provided by the ranch is expected to remain unchanged.

Given the negligible impact on employment, mitigating measures are not recommended.

Table ES-1. **MAKAIWA HILLS: IMPACT ON EMPLOYMENT**

Item	Jobs
Construction Phase	
Direct Construction Employment	average of 630
Indirect Employment Supported by Construction Activity	average of over 1,000
TOTAL Construction-Related Employment	average of over 1,600
Full Operation	
On-site Employment:	
Commercial Activity	1,800
Golf Course (if built)	65
Maintenance of Homes	over 100
Total Onsite Employment	nearly 2,000
Indirect Employment Supported by On-site Activities	about 1,000
Off-site Employment Supported by Expenditures of Residents of Makaiwa Hills	about 2,000
Hawaii Government Employment Supported by Tax Revenues Derived from Makaiwa Hills Residents and Businesses	over 500
TOTAL Employment Supported by Makaiwa Hills	over 5,500

Decision Analysts Hawaii, Inc.
November 1990

EMPLOYMENT DURING THE CONSTRUCTION PHASE

The number of construction workers required to build the on-site and off-site infrastructure, homes, commercial space, and other facilities planned for Makaiwa Hills is estimated to average about 630 jobs. However, the level of employment will fluctuate greatly during the construction period, depending upon what phase of construction the project is in. Salaries for construction workers will range from about $20,000 to over $100,000 annually, and are estimated to average about $40,000 annually.

In addition to the direct employment of construction workers, it is estimated that indirect employment supported by the construction activities will average over 1,000 jobs. These jobs will be located throughout Honolulu.

It is anticipated that the construction workers will commute to the Makaiwa Hills site from throughout the island, as is the case with other construction projects on Oahu. Over time, however, an increasing number of construction workers are likely to come from the Ewa area, given the high level of on-going construction activity throughout Ewa and the increasing numbers of homes being built in the Ewa District. In addition, a large number of construction workers will commute from Waianae since this community has a disproportionately large number of construction workers.

Mitigating measures in the form of expanded training programs to increase the number of construction workers appears unwarranted since construction activity on Oahu appears to be shifting from a prolonged "boom" period to one of slower growth.

EMPLOYMENT AT FULL OPERATION

After the Makaiwa Hills project is completed, employment at full operation is projected to reach nearly 2,000 jobs. This projection includes 1,800 jobs associated with the regional mall, about 65 jobs generated by the golf course (if it is built), and over 100 jobs to maintain or refurbish the homes.

Salaries for the new jobs are expected to range from a low of about $10,000 annually for entry-level positions to over $100,000 for upper-management positions, with the average expected to exceed $20,000 per year.

Indirect employment supported by on-site commercial activities will number about 1,000 jobs. In addition, consumption expenditures by residents of the Makaiwa Hills project will support about 2,000 jobs. Also, State and County tax revenues derived from residents and businesses within the project will support over 500 government jobs. These indirect jobs will be located throughout Honolulu.

It is expected that most of the employees who will hold jobs at Makaiwa Hills will be residents of communities in the Ewa and Waianae areas and, to a lesser extent, of nearby communities in Central Oahu. In particular, it is anticipated that the new and growing communities in Ewa will house an additional 43,000 workers by the year 2010.

With regard to education and vocational training, various organizations on Oahu provide appropriate programs. In addition, many employers at Makaiwa Hills, including major department stores, are expected to provide in-house and/or on-the-job training of newly hired employees.

For residents of West Oahu, supplemental education and training programs are available through the assistance of the non-profit West Oahu Employment Corporation (WOEC). In cooperation with other organizations, the WOEC is helping to improve the qualifications of residents for a variety of employment opportunities, ranging from entry-level positions to management positions. The WOEC accomplishes this by promoting vocational training and educational opportunities, and by offering job placement services. The WOEC sponsors English and math tutorial programs at various West Oahu schools, and provides scholarships to young people from West Oahu who are entering vocational or business-related programs.

Campbell Estate will "mitigate" employment impacts by paying its fair share to support the programs sponsored by this organization.

EMPLOYMENT BENEFITS PROVIDED BY MAKAIWA HILLS

As discussed above, the Makaiwa Hills project will provide or support a considerable number of direct and indirect jobs, and will thereby provide household income to the workers who hold these jobs. However, if the

Makaiwa Hills project were not to be built, most of these jobs would still be generated inasmuch as most of the potential residents would live elsewhere on Oahu, and would generate à similar number and variety of jobs through their consumption expenditures and tax payments. Also, residents in the area would travel to commercial areas elsewhere on Oahu to shop.

The primary employment benefit of the Makaiwa Hills project will result from the fact that the jobs are located near the City of Kapolei so that the project will contribute to State, County, and private plans to develop Ewa as a well-balanced "Second City" which provides not only homes, but also jobs and shopping opportunities. This contrast with the alternative of developing Ewa primarily as a suburb from which residents commute to jobs outside the area. Thus, the jobs to be provided by the Makaiwa Hills project will result in less commuter traffic to downtown Honolulu than would otherwise be the case. In addition, the Makaiwa Hills project will provide employment and income to residents of the Waianae district which, historically, has been an area of high unemployment and low incomes.

Makaiwa Hills:

Employment Impact and Labor Availability

The Makaiwa Hills project proposed for development by The Estate of James Campbell will contain up-scale homes, considerable commercial space, public facilities, and a possible golf course. The impact of this project on employment, the anticipated source of the workers, and the benefits of this employment are discussed in this report. The impact of the project on employment is summarized in Table ES-1 of the Executive Summary.

Project Description

The project will provide approximately 2,130 upscale homes in premium locations which will offer dramatic ocean views and which will be surrounded by a considerable amount of open space. Custom homes on large lots, semi-custom homes, and upscale standard homes and townhouses will be available. Measured in 1990 dollars, prices are expected to range from $400,000 for the smaller townhouses to over $1 million for the semi-custom single-family homes, with the large lots for custom homes ranging in price from $400,000 to $750,000. The purpose of providing these homes is to attract executives, professionals, and "decision-makers" to the newly developing Kapolei community. Other buyers will include retirees and those purchasing second homes.

The development will also include a commercial regional mall of 600,000 square feet or more which will include at least two major department stores, a variety of clothing stores, gift and speciality shops, and restaurants. Designed to serve residents throughout Ewa and other nearby communities, this mall will contribute to the success of the "Second City" at Kapolei, by (1) serving as a catalyst for further commercial development, (2) adding to a "critical mass" which will make the area a more attractive place to live, (3) establishing regional name recognition to Kapolei, and (4) providing a focus to the emerging community.

EXISTING AGRICULTURE OPERATIONS

Approximately 100 acres of flatlands along the H-1 Freeway are now a pasture for grazing less than two dozen cattle and horses. This operation, which is under a month-to-month tenancy, will be reduced in area and eventually will be eliminated when the Makaiwa Hills project is developed. The tenant and sole operator holds a full-time job elsewhere in the area.

The remainder of the project site forms part of a 3,800-acre ranch operated as Rocker G. Livestock Company. Grazing operations on this ranch provide about 9 part-time jobs which are the equivalent of 2 full-time jobs. At full development of the Makaiwa Hills project around the year 2010, about 1,800 acres will be removed from the grazing operation of the Rocker G. Livestock Company. However, employment provided by the ranch is expected to remain unchanged.[1]

Given the negligible impact on employment, mitigating measures are not recommended.

CONSTRUCTION PHASE

Employment During the Construction Phase

Construction employment required to build the on-site and off-site infrastructure, homes, commercial space, and other facilities planned for Makaiwa Hills is estimated to average about 630 workers. This figure is based on an estimated 4 man-years of effort per home, one man-year of effort for each 2,000 square feet of commercial space, and a 14-year construction period. However, the level of employment will fluctuate greatly during the construction period, depending upon what phase of construction the project is in.

Construction jobs will include supervisors, heavy-equipment operators, cement workers, carpenters, plumbers, electricians, roofers, glass and window installers, cabinet makers, carpet and tile layers, painters, interior decorators, landscapers, etc. These jobs will range over a variety of skill and pay levels, including entry-level, semi-skilled, skilled, and management positions.

Salaries for construction workers will range from about $20,000 annually to over $100,000, and are estimated to average about $40,000 per year.[2]

Construction-Related Employment

In addition to the construction employment, other employment directly related to developing and marketing the project will include planners, architects, civil engineers, draftsmen, advertising specialists, sales agents, loan officers, appraisers, escrow agents, attorneys, government inspectors, etc.

Further employment will be provided by companies which supply goods and services to support the construction activities, including suppliers of cement, lumber, roofing materials, steel, plumbing equipment, electrical equipment, hardware supplies, lights, flooring, wall coverings, shipping services, trucking services, equipment repair, etc.

Also, the consumption expenditures and taxes paid by construction workers and other related workers will generate additional public and private jobs involved in providing goods and services.

Based on employment multipliers derived by the State, it is estimated that the "indirect" employment related to construction activity will average over 1,000 jobs. These jobs will be located throughout Honolulu.

Source of Construction Workers

It is anticipated that construction workers will commute to the Makaiwa Hills site from throughout the island, as is the case with other construction projects on Oahu. Over time, however, an increasing number of construction workers are likely to come from the Ewa area, given the the high level of on-going construction activity throughout Ewa and the increasing numbers of homes being built in the Ewa district. In addition, a large number of construction workers will commute from Waianae since this community has a disproportionately large number of construction workers: in 1980, 12.6 percent of the workers in the Waianae district were construction workers as compared to 6.6 percent for all of Oahu.[3]

Job-Training Programs

Job training for construction workers consists of formal training programs, apprenticeship programs, and on-the-job training. Mitigating measures in the form of expanded training programs to increase the number of construction workers appears unwarranted since construction activity on Oahu appears to be shifting from a prolonged "boom" period to one of slower growth.

FULL DEVELOPMENT

Employment at Full Operation

After the Makaiwa Hills project is completed, employment at full operation is projected to reach nearly 2,000 jobs. This projection includes 1,800 jobs associated with the regional mall, estimated at 3 jobs per 1,000 square feet of commercial space; about 65 jobs generated by the golf course (if it is built); and over 100 jobs to maintain and refurbish the homes, estimated at one job per 20 homes.

The jobs associated with the regional mall will include leasing agents, store managers, buyers, display specialists, salespersons, waiters and waitresses, cooks, cashiers, bookkeepers, accountants, trainers, security guards, gardeners, janitors, etc. Jobs provided by the golf course (if it is built) will include a golf professional, groundskeepers, mechanics, clubhouse staff, and restaurant staff. Although most of the jobs maintaining homes will be for gardeners and house cleaners, additional jobs will be provided for periodic upkeep of homes (painters, tree trimmers, roofers, etc.), as well as home redecorating and remodeling (interior decorators, carpet and tile layers, architects, construction workers, etc.). These jobs will range over a variety of skills and pay levels, including entry-level, semi-skilled, skilled, and management positions.

Salaries for the new jobs are expected to range from a low of about $10,000 annually for the entry-level positions to over $100,000 for upper-management positions, with the average expected to exceed $20,000 per year.

Indirect Jobs

Additional employment will be provided by companies which supply goods and services in support of the regional mall, the golf course (if it is built), and maintenance, upkeep and refurbishing of the homes. Also, the consumption expenditures by those who work at the Makaiwa Hills project will generate additional public and private jobs involved in providing goods and services. Based on State employment multipliers, this "indirect" employment will number about 1,000 jobs.

Similarly, consumption expenditures by residents who live at the Makaiwa Hills project will support considerable employment: about 2,000 jobs. This is based on estimated consumption expenditures of $138.5 million in Hawaii[4], one job generated per $60,000 in consumption expenditure, less 15 percent of the resulting employment to avoid double-counting of the jobs in Makaiwa Hills.

Also, State and County tax revenues derived from residents and businesses in the Makaiwa Hills project will support over 500 government jobs, based on estimated tax revenues of $46.4 million, about one-half of this amount being spent on salaries, with the average salary being about $40,000 per government worker, including benefits.[4]

These indirect jobs will be located throughout Honolulu.

Source of Operating Workers

It is expected that most of the employees who will hold jobs in the Makaiwa Hills project will be residents of communities in the Ewa and Waianae areas and, to a lesser extent, of nearby communities in Central Oahu. In particular, the new and growing communities in Ewa are projected to house an additional 28,500 families by the year 2010.[5] At an average of 1.5 workers per family, the additional homes in the area will house an additional 43,000 workers.

Job-Training Programs

Major department stores and other commercial establishments generally require a high-school education, and provide in-house training for newly-hired employees. However, most mid-management and upper-management positions require at least some business-oriented college education.

If the golf course is developed, vocational training or a college education will be required for about twenty jobs. A high-school education supplemented by on-the-job training will be required for the other jobs.

Most of the workers who will take care of the routine upkeep of the homes (gardeners and house cleaners) develop their skills through on-the-job training. Those who perform periodic upkeep of the homes (painters, roofers, etc.), home redecorating, and home remodeling are part of the previously discussed construction industry.

In addition to the standard education and vocational-training programs offered by various organizations on Oahu, and in-house or on-the-job training to be offered by employers, supplemental education and training is available through assistance of the non-profit West Oahu Employment Corporation (WOEC). The overall mission of this organization, which was established in 1987, is "...to facilitate the entry of leeward Oahu residents into jobs newly created by the development on the Ewa Plains, the Makakilo Hillside and the Waianae Coast ..." In cooperation with other organizations, the WOEC is helping to improve the employment qualifications of West Oahu residents for a variety of employment opportunities, ranging from entry-level positions to management positions. The WOEC accomplishes this by promoting vocational training and educational opportunities, and by offering job placement services. The WOEC sponsors English and math tutorial programs at various West Oahu schools, and provides scholarships to young people from West Oahu who are entering vocational or business-related programs. Funding is provided by private organizations and the State which provides a matching grant.

Campbell Estate, which is represented on the board of the WOEC, will "mitigate" employment impacts by participating in the funding of this organization.

EMPLOYMENT BENEFITS PROVIDED BY MAKAIWA HILLS

As discussed above, the Makaiwa Hills project will provide or support a considerable number of direct and indirect jobs, and will thereby provide household income to the workers who hold these jobs. However, if the Makaiwa Hills project were not to be built, most of these jobs would still be generated inasmuch as most of the potential residents would live elsewhere on Oahu, and would generate a similar number and variety of jobs through their consumption expenditures and tax payments. Also, residents in the area would travel to commercial areas elsewhere on Oahu to shop.

The primary employment benefit of the Makaiwa Hills project will result from the fact that the jobs are located near the City of Kapolei so that the project will contribute to State, County, and private plans to develop Ewa as a well-balanced "Second City" which provides not only homes, but also jobs and shopping opportunities. This contrast with the alternative of developing Ewa primarily as a suburb from which residents commute to jobs outside the area. Thus, the jobs to be provided by the Makaiwa Hills project will result in less commuter traffic to downtown Honolulu than would otherwise be the case. In addition, the Makaiwa Hills project will provide employment and income to residents of the Waianae district which, historically, has been an area of high unemployment and low incomes.

ORGANIZATIONS CONTACTED

The Estate of James Campbell
Liberty House
West Oahu Employment Corporation

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Appendix J.

Makaiwa Hills: Impact on State and County Finances

Decision Analysts Hawaii, Inc.

MAKAIWA HILLS:
Impact on State and County Finances

PREPARED FOR:

The Estate of James Campbell

PREPARED BY:

Decision Analysts Hawaii, Inc.

November 1990

CONTENTS

TABLES

FIGURE

EXECUTIVE SUMMARY

The proposed Makaiwa Hills project to be developed by The Estate of James Campbell will provide about 2,130 up-scale single-family homes and townhouses in a premium location for the executive, professional, retiree, and second-home markets. In addition, 600,000 square feet or more of commercial space will be provided in a regional mall which will serve residents in Ewa and other nearby areas. The development will also include considerable open space, an elementary school, a fire station, and may include a golf course. In addition, the developer will provide park, road, water, drainage, and sewer improvements.

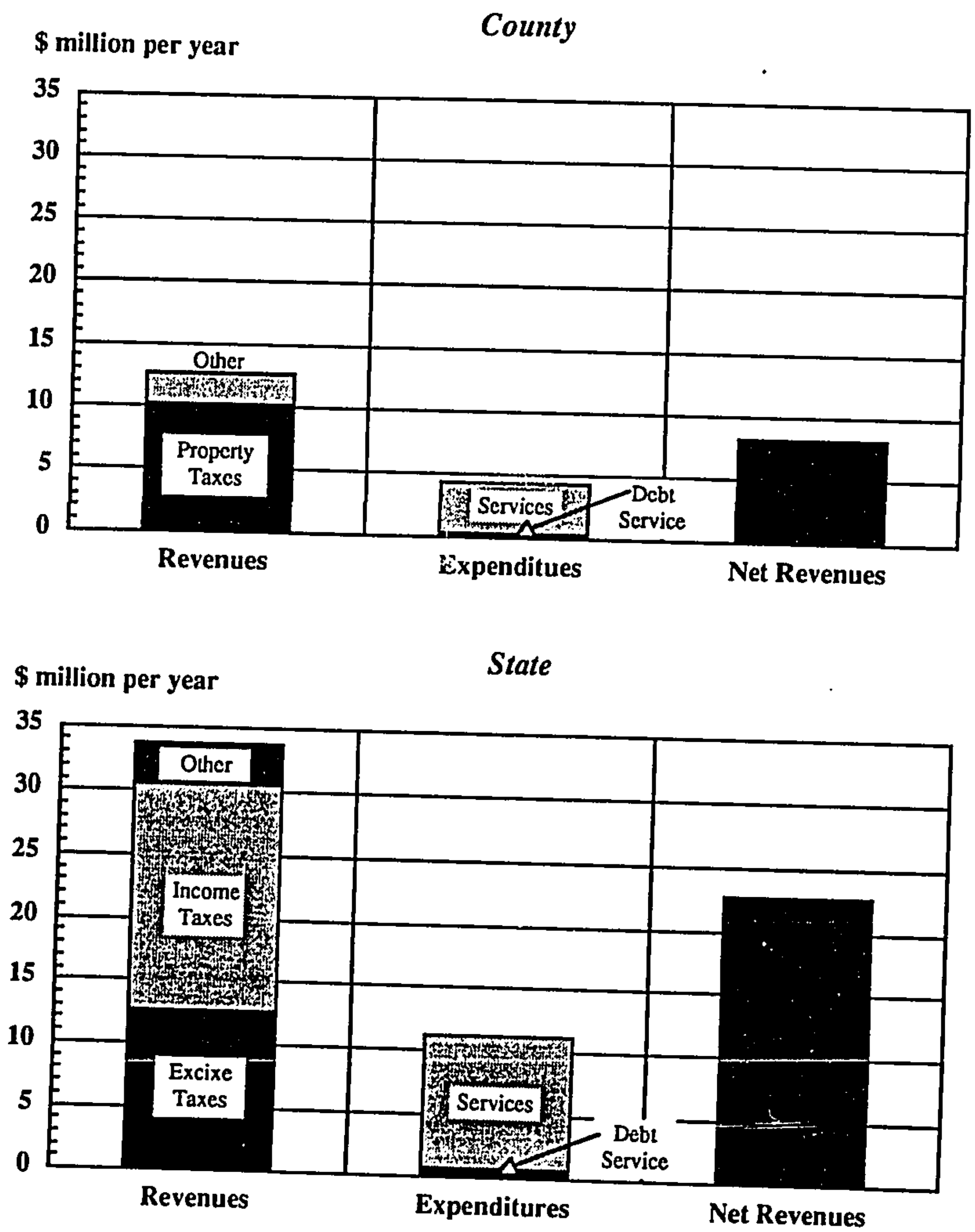
State and County revenues which will be derived from this project are expected to be substantial, and sufficient to allow government to easily afford the capital improvements and services required to accommodate the project. The revenues are expected to be sufficient to: (1) finance police-station, fire-station, wastewater-treatment, and school improvements; (2) provide the same level of per-unit services as are provided currently to island residents; and (3) serve additional community needs with the remaining net revenues.

Rollback taxes to the County because of withdrawing the land from agriculture will be about $3.1 million, which is nearly the same as the estimated $3.2 million in County improvements required to support the project. At project completion, County revenues derived from the Makaiwa Hills project are projected to be $12.6 million per year, while expenditures to support the project are expected to be $4.4 million (including debt service on police-station, fire-station, and wastewater-treatment improvements), for a net of $8.2 million per year (see Figure ES-1). This compares with less than $20,000 per year currently derived from property taxes on the property. All dollar amounts are expressed in 1990 dollars.

For the State, revenues generated by construction activity are estimated to reach $84.4 million. This sum far exceeds the $8.5 million projected expenditure by the State for required improvements. Upon completion of the project, State revenues derived from the Makaiwa Hills project are projected to be about $33.8 million per year, and expenditures required to support the project are estimated to be about $11.1 million per year (including debt service on school improvements), for a net income to the State of about $22.7 million per year. Currently, the State derives negligible tax revenues from activities on the property.

In summary, the Makaiwa Hills project will strengthen State and County finances by providing substantial net income. In view of this finding, mitigating measures are not recommended.

Table ES-1. MAKAIWA HILLS: IMPACT ON STATE AND COUNTY REVENUES AND EXPENDITURES



MAKAIWA HILLS:
IMPACT ON STATE AND COUNTY FINANCES

INTRODUCTION

The proposed Makaiwa Hills project to be developed by The Estate of James Campbell will contain up-scale single-family homes and townhouses in a premium location, considerable commercial space, considerable open space, public facilities, and possibly a golf course. The impact of this project on State of Hawaii and City & County of Honolulu revenues and expenditures is summarized in this report.

The estimates of government revenue which will be derived from residents and commercial activities within the project include taxes (property, excise, income, and other taxes), user charges and fees, earnings, and all other sources of revenues. Government expenditures required to support the project cover capital improvements, debt service on these improvements, and all government services normally provided to residents (police, fire, waste disposal, transportation, health, education, general government, etc.). All values are expressed in 1990 dollars.

PROJECT DESCRIPTION AND ASSUMPTIONS

The proposed Makaiwa Hills project will encompass an area of approximately 1,915 acres for homes, a regional mall, open space, a park, interior roads, public facilities (school, park, and fire station), and possibly a golf course (see Table 1). Approximately 2,130 up-scale homes will be provided in a premium locations which will offer dramatic ocean views and which will be surrounded by considerable open space within the project. Large-lot custom homes, semi-custom homes, and up-scale standard homes and townhouses will be available. Measured in 1990 dollars, prices are expected to range from $400,000 for the smaller townhouses to over $1 million for the semi-custom single-family homes, with lots for custom homes ranging in price from $400,000 to $750,000. The purpose of providing these homes is to attract executives, professionals, and "decision makers" to the newly developing Kapolei community. Other buyers will include retirees and those purchasing second homes.

The development will also include a commercial regional mall of 600,000 square feet or more which will include at least two major department stores, a variety of clothing stores, gift and speciality shops, and restaurants. Serving residents throughout Ewa and other nearby communities, this mall will contribute to the success of the "Second City" at Kapolei by (1) serving as a catalyst for further commercial development, (2) adding to a "critical mass" which will make the area a more attractive place to live, (3) establishing regional name recognition to Kapolei, and (4) providing a focus to the emerging community.

In addition, the developer will provide park, road, water, drainage, and sewer improvements.

Construction is projected to continue for over 10 years, with total construction costs expected to exceed $1.5 billion. This figure includes onsite and offsite improvements, homes, and buildings, but excludes the value of the land, interest costs, sales commissions, and profits to builders. Construction employment and total construction payroll will average about 630 jobs and $25 million per year, respectively. However, these figures will fluctuate greatly from one year to the next, depending upon the phase of construction.

When the project is fully developed, it is expected that Makaiwa Hills will house nearly 6,500 people.

The property-tax base for Makaiwa Hills is projected to exceed $2.1 billion. This is based on home prices ranging from $400,000 to nearly $2 million, with an average value of about $950,000. For the analysis, it is assumed that all families within the project will be eligible for a home-owner tax exemption; if homes are rented, this would eliminate the exemption and increase the property tax base accordingly. Commercial space is expected to be valued at $250 per square foot, while the golf course is expected to have a value of $20 million.

Consistent with the high home prices, family incomes are expected to be high—ranging from about $70,000 per year to over $250,000 per year—with an average of about $130,000 per year. It is expected that most home buyers will be trading up from existing homes which have experienced considerable appreciation in value, thereby allowing these home buyers to pay substantial down payments—typically about half of the value of the home. For those unable or unwilling to pay such a substantial down payment, their family incomes must be correspondingly higher in order to qualify for mortgages. Based on the average family income, total household income for residents within the project is projected to exceed $275 million per year.

Total consumption expenditures in Hawaii by the residents of Makaiwa Hills are estimated at $136 million per year, based on a conservative estimate of 50 percent of household income.

Retail sales are estimated to exceed $150 million per year, based on commercial sales of $250 per square foot and $75 per round for golfing and related purchases.

On-site employment is projected to be nearly 2,000 jobs, most of which will be generated by commercial activity within the regional mall. Additional employment will be provided by the golf course (if it is built) and maintenance of homes within the project. Total payroll for these jobs is projected to be nearly $40 million per year.

REVENUES

Table 2 shows taxes and other government revenues which will be generated by the Makaiwa Hills project. For the County, an estimated $3.1 million in "rollback" taxes will become due when the property is developed. For land which has been assessed and taxed at its agricultural value but which is developed, this tax recovers 10 years of back property taxes based on the difference between taxes computed on the market assessment and the agricultural assessment, plus a penalty of 10 percent.

At full development, County revenues from Makaiwa Hills are expected to reach $12.6 million per year, with $10.2 million of this being derived from property taxes. The remaining $2.4 million per year derives from a variety of sources related to population. These revenues, which are estimated at $372 per resident based on a detailed analysis of City & County finances, include taxes, licenses and fees for fuel, motor vehicles, bicycles, animals, sewers, water, public transportation, etc. Federal grants to the County for capital improvements are excluded from the estimate of County tax revenues. This compares with less than $20,000 per year currently derived from property taxes on the property.

For the State, construction activity is estimated to generate a total of $84.4 million in tax revenues, or about $6 million per year during the 14-year construction period. This estimate includes excise and conveyance taxes, but excludes corporate and individual income taxes.

At full development, the increase in State tax revenues is expected to be $33.8 million per year, with the largest revenues being derived from excise taxes of $12.6 million per year and income taxes of $18 million per year. The remaining $3.2 million per year in State revenues derives from a variety of sources related to population. These revenues, which are estimated at $494 per resident based on detailed analysis of State finances, include: general excise tax license, corporate income tax, inheritance and estate taxes, liquor permits and taxes, public service company taxes and fees, tobacco tax, insurance premium tax, franchise tax, conveyance tax, licenses and fees, fines, forfeits, penalties, rentals, charges for services, fuel taxes, vehicle registration fees, and other revenues. Income taxes received from on-site employees are excluded from the estimate of State revenues, since government expenditures to provide services to these employees is also excluded. Federal grants for capital improvements are also excluded. Currently, the State derives negligible tax revenues from activities on the property.

The combined State and County revenues during full operations is expected to total $46.4 million per year.

EXPENDITURES

Estimates for State and County expenditures required to support the Makaiwa Hills project are given in Table 3.

Capital Improvements

Most of the major improvements will be financed and/or provided by the developer. This will include park improvements, interior and exterior roads, water developments and a distribution system, drainage, collector sewers and trunks, etc. The only major capital improvements required by the County to support the project are a proportional share of police and fire stations, and expansion of the Honouliuli Waste Water Treatment Plant. The share of the capital cost for these items assignable to the Makaiwa Hills project is $3.2 million; assuming a 7-percent, 20-year bond, the debt service on this amount will be about $300,000 per year.

For the State, the major capital improvements required to support the project will be school improvements at an estimated cost of $8.5 million. The annual debt service on this sum will be about $800,000.

Services

The estimate for State and County expenditures on the services needed to support the residents of the proposed Makaiwa Hills project at full development are $14.5 million per year, with $4.1 million of this being allocated to the County and $10.4 million to the State. For the County, annual expenditures are estimated at $635 per resident. For the State, annual expenditures are estimated at $1,607 per resident.

State and County expenditures on services are expected to provide approximately the same level of per-unit services to residents as is currently the case, or possibly more, given economies of scale (e.g., a 10-percent increase in population is likely to require an increase in general government of much less than 10 percent). The expenditures cover general government, public safety, health, sanitation, education, culture and recreation, water, highways and streets, public transportation, economic development, housing, etc.

SUMMARY

The net impact on State and County finances of the proposed Makaiwa Hills project is summarized in Table 4. For the County, rollback taxes due to the withdrawal of the land from agriculture will be about $3.1 million, which is nearly the same as the estimated $3.2 million in County improvements required to support the project. At project completion, revenues to the County are expected to exceed expenditures by $8.2 million per year if debt service is included.

For the State, revenues generated by construction activity are estimated to generate $84.4 million. This sum greatly exceeds the estimated $8.5 million which is required for State-financed school improvements. Upon completion of the project, State revenues are expected to exceed expenditures by about $22.7 million per year if debt service is included.

The resulting combined fiscal impact on the State and County is that revenues are expected to exceed expenditures by an estimated $30.9 million per year upon completion of the Makaiwa Hills project if debt service is included.

To summarize the previous discussion and the results of Tables 2 through 4, the proposed Makaiwa Hills project will strengthen State and County finances by providing substantial income. Annual revenues which will be derived from this project are expected to be substantial, and sufficient to allow the State and County to easily afford the capital improvements and services required to accommodate the project. The revenues are expected to be sufficient to: (1) finance police-station, fire-station, wastewater-treatment, and school improvements; (2) provide the same level of per-unit services as are provided currently to island residents; and (3) serve additional community needs with the remaining net revenues. Other major improvements will be financed and/or provided by the developer.

In view of these findings, mitigating measures are not recommended.

ORGANIZATIONS CONTACTED

The Estate of James Campbell
The State of Hawaii Department of Education
City and County of Honolulu Department of Public Works
City and County of Honolulu Police Department
City and County of Honolulu Fire Department

Table 1.— MAKAIWA HILLS, IMPACT ON STATE AND COUNTY FINANCES: ASSUMPTIONS [1]
[In 1990 dollars.]

Item	Amount	
NEW DEVELOPMENT		
Land Area:		
Homes	726	acres
Commercial Regional Mall	156	"
Upper Preservation	721	"
Lower Preservation	180	
Public Facilities	25	"
Roads	107	"
Total	1,915	acres
Housing	2,130	homes
Commercial Space	600,000	sq. ft.
CONSTRUCTION ACTIVITY		
Duration of Construction	14	years
Construction Cost (70 percent of Total Assessed Value from below, excluding adjustment for Owner Exemption)	$ 1,514	million
Average Construction Employment (4 jobs per home, 1 job per 2,000 sf of commercial space)	630	jobs
Average Payroll ($40,000 per job)	$ 25.2	million per year
RESIDENTS (3.03 people per home)	6,454	people
INCREASED PROPERTY TAX BASE		
Homes (average value of $950,000 per home)	$ 2,023.5	million
Less Owner Exemption ($20,000 per home)	-42.6	"
Assessed Value of Homes	$ 1,980.9	million
Commercial Space ($200 per sq. ft.)	120.0	"
Golf Course	20.0	"
Total Assessed Property Value	$ 2,120.9	million
HOUSEHOLD INCOME (an average of $130,000 per family)	$ 276.9	million per year
CONSUMPTION EXPENDITURES (50 percent of Household Income)	$ 138.5	million per year

Table 1.— MAKAIWA HILLS, IMPACT ON STATE AND COUNTY FINANCES: ASSUMPTIONS [1] (continued)

Item	Amount	
ON-SITE RETAIL SALES		
Retail Sales ($250 per sq. ft. of Commercial Space)	$ 150.0	million per year
Golf (150 rounds per day at $75 per round)	4.1	"
Total Retail Sales	$ 154.1	million per year
OPERATING EMPLOYMENT AND PAYROLL		
Commercial Space (3 jobs per 1,000 sq. ft.)	1,800	jobs
Golf Course	65	"
Home maintenance (1 job per 20 homes)	107	"
Total Employment	1,972	jobs
Payroll ($20,000 per job)	$ 39.4	million per year

1. The assumptions are those of the consultant based on market and other studies for the project, and on information from comparable projects and from the DBED "Data Book, 1989."

Table 2.— MAKAIWA HILLS, IMPACT ON STATE AND COUNTY FINANCES: REVENUES [1]
[In 1990 dollars.]

Item	Amount	
COUNTY		
Rollback Taxes [2]	$ 3.1	million
Full Development:		
Property Taxes:		
Homes ($4.85 per $1,000) [3]	$ 9.6	million per year
Commercial ($9.45 per $1,000 assessed value)	0.6	"
Golf Course ($9.45 per $1,000 assessed value)	0.1	"
Total Property Tax Revenues	$ 10.2	million per year
Other Revenues ($372 per resident) [4]	2.4	"
Total County Revenues	$ 12.6	million per year
STATE		
Taxes on Construction Activity (with pyramiding, 5.5% excise tax on Construction Cost, and 0.05% convenience tax on Total Assessed Value, excluding Owner Exemption)	$ 84.4	million
Full Development:		
Excise Taxes:		
Residents (with pyramiding, 5.5% of Consumption Expenditures)	$ 7.6	million per year
Less 15% to avoid double counting	-1.1	"
On-site Businesses (4% of Total Retail Sales)	6.2	"
Total Excise Taxes	$ 12.6	million per year
Income Taxes (6.5 percent of Household Income) [5]	18.0	"
Other Revenues ($494 per resident) [6]	3.2	"
Total State Revenues	$ 33.8	million per year
TOTAL STATE AND COUNTY REVENUES (Excluding County Rollback Taxes and State Taxes on Construction Activity)	$ 46.4	million per year

Table 2.— MAKAIWA HILLS, IMPACT ON STATE AND COUNTY FINANCES: REVENUES (continued)

1. Estimated by consultant, unless otherwise noted.
2. Estimated by The Estate of James Campbell.
3. Based on a rate per $1,000 of $4.70 for land and $4.95 for improvements, and an allocation of value of one-third to the land and two-thirds to the improvements.
4. Includes all General Fund revenues other than property taxes, but excludes taxes paid by visitors. The multiplier is derived from "The Executive Program and Budget, Fiscal Year 1990" for fiscal year 1987/88, and is adjusted for inflation.
5. Based on incomes of $75,000 to $100,000, DBED, "Data Book: 1989," p. 263.
6. Includes all General Fund revenues other than excise and personal income taxes, but excludes taxes paid by visitors. The multiplier is derived from "State of Hawaii Comprehensive Annual Financial Report for the Fiscal Year Ended June 30, 1988," and is adjusted for inflation.

Table 3.— MAKAIWA HILLS, IMPACT ON STATE AND COUNTY FINANCES: EXPENDITURES
[In 1990 dollars.]

Item	Amount	
MAJOR CAPITAL IMPROVEMENTS		
County:		
Parks (paid by developer)	$ --	million
Police Station [1,2]	0.1	"
Fire Station [3]	0.6	"
Interior Roads (paid by developer)	--	"
Exterior Roads (fair share paid by developer)	--	"
Water Wells, Mains, Pumps, and Storage Tanks (fair share paid by developer)	--	"
Drainage (paid by developer)	--	"
Collector Sewers and Trunks (paid by developer)	--	"
Wastewater Treatment Plant Expansion [4]	2.5	"
Solid Waste Disposal (privately financed via user charges)	--	"
Total County Capital Improvements	$ 3.2	million
County Annual Debt Service (7%, 20-year bond)	$ 0.3	million per year
State:		
School Improvements [5]	$ 8.5	million
Freeway and Road Improvements (fair share paid by developer)	--	"
Total State Capital Improvements	$ 8.5	million
State Annual Debt Service	$ 0.8	million per year
Total State and County Annual Debt Service	$ 1.1	million per year
SERVICES, FULL DEVELOPMENT		
County ($635 per resident) [6]	$ 4.1	million per year
State ($1,607 per resident) [7]	10.4	"
Total State and County Services	$ 14.5	million per year

1. Proportional share of a new $2 million police station at Kapolei.
2. The projected resident and visitor population increase is 93,640 people.
3. Proportional share of four new $2 million fire stations in the Ewa area.
4. Proportional share of a $25 million 13-mgd expansion of the Honouliuli Wastewater Treatment Plant. Makaiwa Hills will generate 1.3 mgd of wastewater.
5. Based on 40 students per 100 homes, 25 students per classroom, and $250,000 per classroom and associated improvements. The land will be provided by the developer.
6. Derived from "The Executive Program and Budget, Fiscal Year 1990" for fiscal year 1987/88, and adjusted for inflation.
7. Derived from "State of Hawaii Comprehensive Annual Financial Report for the Fiscal Year Ended June 30, 1988," and adjusted for inflation.

Table 4.— MAKAIWA HILLS, IMPACT ON STATE AND COUNTY FINANCES: SUMMARY
[In 1990 dollars.]

Item	Amount	
COUNTY, Full Development:		
Rollback Taxes	$ 3.1	million
Full Development:		
Revenues	$ 12.6	million per year
Expenditures:		
Debt Service	$ 0.3	million per year
Services	4.1	million per year
Total County Expenditures	$ 4.4	million per year
Net County Revenues	$ 8.2	million per year
STATE:		
Taxes on Construction Activity	$ 84.4	million
Full Development:		
Revenues	$ 33.8	million per year
Expenditures:		
Debt Service	$ 0.8	million per year
Services	10.4	million per year
Total State Expenditures	$ 11.1	million per year
Net State Revenues	$ 22.7	million per year
STATE AND COUNTY, Full Development:		
Revenues	$ 46.4	million per year
Expenditures	15.5	million per year
Net State and County Revenues	$ 30.9	million per year

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August 1989

AREAS OF EXPERTISE

Economic Analysis: Economic development, input-output and other economic models, economic impacts, and evaluation of complex resource allocation problems.

Financial Analysis: Evaluation, feasibility, planning, comparative costs, funding sources, and financial impacts.

Market Analysis: Market potential, prices, marketing and price strategies.

Demographic Analysis: Population and housing forecasts and impacts.

Analytical Techniques: Systems analysis, mathematical modeling of complex relationships, decision analysis under uncertainty, analysis of multivariable/dynamic/probabilistic systems, statistical analysis, simulation, and linear programming and other optimization techniques.

Strategic/Policy Planning: Strategic plan development and implementation, project and research team management, and preparation of planning reports, position papers, and analyses.

Selected Fields of Specialty: Economic development (tourism, agriculture, energy, etc.), feasibility analysis, land and housing economics, valuations, and impact analysis (economic, financial, and demographics).

This strong multidisciplinary foundation enables successful analysis of complex problems and decisions.

EDUCATION

Ph.D. 1971: Stanford University, Engineering-Economic Systems
M.S. 1966: Stanford University, Engineering-Economic Systems
B.S. 1965: University of California, Santa Barbara, Electrical Engineering, unofficial liberal arts minor.

PROFESSIONAL EXPERIENCE

1980- President, Decision Analysts Hawaii, Inc.
1971 - 1980 Economic/Financial Consultant
1970 - 1973 Assistant Prof., University of Hawaii, Information Sciences
- 1970 Various part-time and summer jobs.

ACADEMIC HONORS

Various honors and honor societies; fellowships from the National Science Foundation, Ford Foundation, and Wheeler Foundation; various elected offices.

AFFILIATIONS

Adjunct Professor, University of Hawaii, Department of Regional and Urban Planning (1989 -).
Hawaii Economic Association (1978 –).
International Agricultural Development Service of Washington, D.C. (Rockefeller Foundation affiliate), registered consultant (1981 –).
Chamber of Commerce, Land & Water Use Planning Committee (1983 –).
American Bar Association, registered expert witness (1983 –).
American Planning Association, Public Issues Committee (1984 –).
American Arbitration Assoc., Commercial Panel of Arbitrators (1984 –).
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Appendix K.

Environmental Assessment of Fertilizer, Herbicide and Pesticide Use on the Proposed Makaiwa Hills Golf Course

Charles L. Murdoch, Ph. D., & Richard E. Green, Ph.D.

ENVIRONMENTAL ASSESSMENT

OF

FERTILIZER, HERBICIDE AND PESTICIDE USE

ON THE PROPOSED

MAKAIWA HILLS GOLF COURSE

A REPORT TO

William E. Wanket, Inc.
Land Use Consultant

September 20, 1990

PREPARED BY

Charles L. Murdoch, Ph. D

Richard E. Green, Ph. D.

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EXECUTIVE SUMMARY

Overview and Conclusions

This report addresses the potential environmental impact of fertilizer and pesticide application on the Makaiwa Hills Golf Course. The entire Makaiwa Hills project area is 1915 acres, of which only 180 acres will be occupied by an 18-hole golf course. The golf course is tentatively located adjacent to the southwest boundary along Farrington Highway, in the area labelled, "Preservation (lower)" on the development plan map shown in Appendix A. The golf course will require application of fertilizers to supply essential nutrients to turfgrasses and ornamental plants, and pesticides to control their associated weed, disease, and insect pests. The assessment provided in the report focuses principally on the potential for applied chemicals to move in surface runoff and to groundwater. Key elements of the analysis are (1) calculation of quantities of applied chemicals (pesticides and fertilizer nutrients) which are likely to be used throughout the year, (2) compilation of soil, geologic and climatic information which will aid in the assessment of chemical movement, (3) estimation of water balance from rainfall, irrigation and evapotranspiration, (4) compilation of pesticide properties which may be of environmental significance, and (5) computation of the Attenuation Factor for pesticides used on golf courses, using properties of the chemicals and soil properties, in order to estimate the likelihood of chemical movement to groundwater. Additionally, the potential for pesticide transport in the air and potential for negative impact on birds in the area are addressed briefly in the appendices. The toxicity and environmental behavior of pesticides which are likely to be used are considered in the analysis, as are soil, topographic and climatic factors which may impact on fertilizer and pesticide movement.

About 65% of the area is Stony Steep Land (slopes of 40-70%) in which about 50 to 90% of the surface consists of boulders and stones deposited by water and gravity on the side of slopes of drainageways. The remaining 40% is Lualualei extremely stony clay with slopes of 3 to 35%. This soil is principally in lower elevation areas of the site, but also extends up draws and around lower slopes of hills. Both land types have a Capability Classification of VIIs, indicating severe limitations for agricultural use due to stoniness and/or undesirable texture.

The Makaiwa Hills area, on the leeward coast of Oahu, is relatively arid. Mean annual rainfall is approximately 20 to 30 inches and varies from about 4.2 inches in January to about 0.3 inches in July. Mean pan evaporation is approximately 95 inches annually and varies from almost 10 inches in July and August to about 6 inches in December and January (Figures 1 and 2). There is an evaporation deficit of approximately 70 inches annually and there are no months when rainfall equals pan evaporation. Thus with careful irrigation, recharge of groundwater will be minimal.

The water requirement of plants is site-specific and is related to a number of weather factors, including the temperature, amount of sunlight, relative humidity, and amount of wind. The water requirement of specific plants varies also. Irrigation requirements of plants can be calculated from pan evaporation (PE) and rainfall (R) data. The water use requirement of warm-season turfgrasses has been found to be approximately 50% of pan evaporation. Adding 10% to account for inefficient irrigation, irrigation requirement can be calculated as (0.6 PE) - R. The irrigation requirement for warm-season turfgrasses was calculated for the Makaiwa Hills site, assuming 150 acres of the golf course will be irrigated. Based on these data, average monthly irrigation requirements range from zero in January to over 20 million gallons in June, July and August (Figure 3). The total annual irrigation requirement for the Makaiwa Hills area averages approximately 146 million gallons. This is considerably less than the commonly cited one million gallons per day (mgd) required for golf courses in Hawaii and the 0.9 mgd average of 11 golf courses surveyed in 1989. Thus irrigating by water use requirements of the turfgrass would not only result in less likelihood of chemical leaching, but also result in large savings of water compared to current practices.

Nitrogen is the only nutrient element in fertilizers applied to golf courses which is a potential contaminant of waters. A total of about 15 tons N would be applied each year to the golf course. Although this site is not prone to groundwater contamination by fertilizer nitrogen due to the low natural water recharge, the potential exists for nitrate leaching during the winter months when rainfall is high. A slow-release fertilizer or small amounts of soluble nitrogen applied through the irrigation system (fertigation) during low-rainfall months only is recommended. Water budgeting should be based on actual rainfall and pan evaporation or on a computer controlled irrigation system which programs water application from calculations of water use by means of weather sensing components. These careful management practices will result in reduced loss of nitrogen from the site by both leaching and runoff.

Pesticides applied to golf courses are approved by the EPA for such use and are unlikely to have an adverse impact on the environment. Groundwater contamination is of greatest concern at this site since the aquifer is a source of potable water. The pesticides used in largest quantity (MSMA, bensulide, glyphosate and chlortohalonil) are all highly sorbed on soil organic matter and are, therefore, not mobile. The more mobile pesticides are generally used in small quantities or are seldom used. Metribuzin, a herbicide, is the only mobile pesticide applied at a rate of over 75 pounds per year on the entire area. It is not considered a hazard to either surface or ground water as it is of low mammalian toxicity, has a high Health Advisory Level (HAL) for drinking water and is relatively non-persistent (half-life of 30 days or less) in the soil.

Considering the limited use of pesticides which have the potential to leach below the root zone and the high HAL for nitrate, significant contamination of the aquifer by chemical use on a golf course seems unlikely. However, this site is dominated by shallow, rocky soils which provide less retardation of pesticide leaching than normal agricultural soils. Thus the shallow-soil areas of the golf course will require importation of soil to provide adequate protection against pesticide leaching. One foot of soil having at least 1% organic carbon should be adequate when proper management is exercised in both irrigation and chemical use. Thus we do not anticipate an adverse effect of fertilizers and pesticides on groundwater quality if sufficient topsoil is provided and proper management is exercised in both irrigation and chemical use.

Although the areas with slopes exceeding 10% are likely to produce runoff from major winter storms, the runoff produced from treated golf course areas will be a small fraction of the total runoff reaching major drainage channels. Thus possible contamination of runoff waters by nitrate and pesticides from treated areas will be mitigated by dilution with runoff waters from higher elevations outside the golf course. The existence of 10 separate, defined drainage areas which terminate at Farrington Highway suggests that the runoff is highly dispersed along the highway, in addition to the dilution from off-site runoff. These factors suggest no adverse impact of chemical use on the receiving shoreline waters south of Kahe Point. Careful management of irrigation and chemicals during the winter months will further reduce the likelihood of any adverse effect of agricultural chemicals on runoff waters.

The chemicals applied in golf course management pose little hazard for birds or wildlife. Fertilizers are relatively non-toxic unless ingested in large amounts. With the exception of chlorpyrifos, the pesticides are of low toxicity to birds. Chlorpyrifos has a low solubility in water, is highly sorbed, and degrades rapidly; thus its use does not threaten either water quality or birds.

There will be no significant impact on air quality from application of pesticides in golf course management provided that appropriate application techniques are used. The spray equipment used in golf course maintenance is ground-operated. Nozzle heights are typically less than two feet. Low spray pressures and coarse nozzle openings result in relatively large droplet sizes which are not highly subject to drift.

Recommended Practices to Mitigate Impacts on Water Quality

1. Irrigation management is critical to the conclusions reached above. For this reason we recommend that a weather station including a rain gauge and a U. S. Weather Bureau class A evaporation pan be used to measure evaporation and rainfall. Irrigation amounts and scheduling can then be determined from water use rates of the turfgrass. Alternately, a computer controlled irrigation system with weather sensing instruments can be used to automatically compute water use rates and determine irrigation amounts and schedules.

2. Where grading is necessary, topsoil should be stockpiled and replaced over the areas to which chemicals will be applied. Areas having little or no soil should be covered with imported soil about 1 foot deep; the soil should have an organic carbon content exceeding 1%.

3. Judicious use of fertilizers and pesticides, especially in the early establishment of turf, is essential, since pesticides and nitrogen will be more likely to move before an extensive root system and thatch layer are developed. Special care in pesticide application is also necessary during the winter months when runoff-producing storms are likely. We recommend that an IPM approach to pest management be used to reduce the amount of pesticide applied.

4. Only slow-release nitrogen fertilizers should be used during the rainy season (November through February). During drier periods, when evaporation greatly exceeds rainfall, application of small amounts of soluble fertilizer through the irrigation system (fertigation) may be used in conjunction with carefully controlled irrigation amounts so that leaching does not occur.

5. Although we do not anticipate significant movement of applied chemicals in either leachate or runoff, a modest monitoring program of groundwater in wells down-gradient from the golf course is appropriate. Since fertilizer nitrogen is applied in the largest amounts and nitrate nitrogen derived from this source is the most mobile and persistent chemical used in golf course management, it would be the most logical chemical for which to test initially.

6. As our conclusions are based on the assumption that sound management practices will be followed with regard to fertilizer and pesticide application and irrigation, we recommend that a qualified Golf

Course Superintendent be given the responsibility of managing the golf course.

I. INTRODUCTION

The area to be developed is presently unimproved pasture land for the most part. As such it is not fertilized nor is it treated with pesticides. This report addresses the potential environmental impact of fertilizer and pesticide application on the Makaiwa Hills Golf Course. The 18-hole golf courses will require application of fertilizers to supply essential nutrients to turfgrasses and ornamental plants, and pesticides to control their associated weed, disease, and insect pests. The term pesticide, used in its generic sense in this report, includes herbicides, fungicides and insecticides. The assessment provided in the report focuses principally on the potential for applied chemicals to move in surface runoff and to groundwater. Additionally, the potential for pesticide transport in the air and potential for negative impact on birds in the area are addressed briefly in the appendices. The toxicity and environmental behavior of pesticides which are likely to be used are considered in the analysis, as are soil, topographic and climatic factors which may impact on fertilizer and pesticide movement.

II. APPROACH

Key elements of the analysis are (1) calculation of quantities of applied chemicals (pesticides and fertilizer nutrients) which are likely to be used throughout the year, (2) compilation of soil, geologic and climatic information which will aid in the assessment of chemical movement, (3) estimation of water balance from rainfall, irrigation and evapotranspiration, (4) compilation of pesticide properties which may be of environmental significance, and (5) computation of the Attenuation Factor for pesticides used on golf courses, using properties of the chemicals and soil properties, in order to estimate the likelihood of chemical movement to groundwater.

A preliminary plan map and a topographic map showing the project boundaries were provided by William E. Wanket, Inc. A drainage area map and preliminary runoff rate and volume calculations were provided by Engineering Concepts, Inc. We visited the site on August 4, 1990.

III. ANALYSIS OF FACTORS IMPACTING ON CHEMICAL MOVEMENT

A. Site Factors

1. Topography, geology and soils

The project site is located just west of Makakilo town, mauka of Farrington Highway with the upper boundary along Palehua Road. The entire project area is 1915 acres, of which only 235 acres will be occupied by an 18-hole golf course. The golf course is tentatively located at the southwest corner along Farrington Highway. Our report focuses on the golf course.

The topography of the golf course area ranges from nearly level along Farrington Highway to as much as 30% on the broad ridges, and steeper on the slopes of gulches. The elevation ranges from 80 feet along Farrington Highway to 400 feet at the mauka boundary of the golf course. Three major drainage ways pass through the site, including Makaiwa Gulch near the middle and smaller gulches on either side. Another unnamed gulch west of Palailai Gulch is near the east boundary of the golf course; this drainage way will receive runoff from the most eastward slopes of the site. All of the gulches are dry most of the year.

The soil map (Foote et al., 1972) shows only two soil delineations. About 60% of the area is Stony Steep Land (mapping symbol rSY) in which about 50 to 90% of the surface consists of boulders and stones deposited by water and gravity on the side of drainageways. The remaining 40% is Lualualei extremely stony clay (symbol LPE) with slopes of 3 to 35%. This soil is principally in lower elevation areas of the site, but also extends up draws and around lower slopes of hills. Both land types have a Capability Classification of VIIs, indicating severe limitations for agricultural use due to stoniness and/or undesirable texture.

The Lualualei soil typically has only two horizons, the surface A horizon and the underlying parent material or C horizon. In areas of nearly level topography the *A horizon* may be about 2 feet deep but on the talus slopes the surface soil is expected to be thinner. This soil cracks widely upon drying, but has a high shrink-swell potential so that the cracks close when the soil is thoroughly wetted. This shrink-swell characteristic has a great impact on the infiltration of water and permeability of the soil. When the soil is dry, water infiltration into the surface soil can be rapid, but once the cracks close in the wetted soil, the infiltration of water is greatly reduced. Consequently, runoff is medium to rapid on the steeper slopes. The organic carbon content of the surface soil is generally about 0.5% and may decrease to less than 0.1% at a depth of 3 feet (Soil Conservation Service, 1976, p. 204).

2. Rainfall, evapotranspiration and potential recharge

The Makaiwa Hills area, on the leeward coast of Oahu, is relatively arid. Mean annual rainfall is approximately 20 to 30 inches and varies from about 4.2 inches in January to about 0.3 inches in July (Giambelluca et al., 1986). Mean pan evaporation is approximately 95 inches annually and varies from almost 10 inches in July and August to about 6 inches in December and January (Ekern and Chang, 1985) (Figures 1 and 2). There is an evaporation deficit of approximately 70 inches annually and there are no months when rainfall equals pan evaporation.Thus with careful irrigation, recharge of groundwater will be minimal.

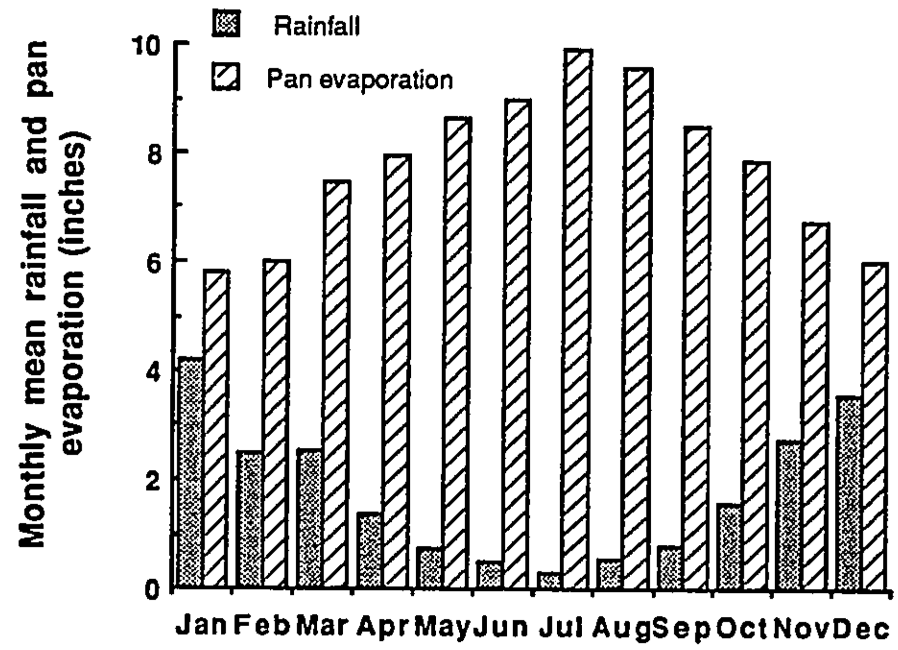

Figure 1. Mean monthly rainfall and pan evaporation for the Makaiwa Hills area (Ekern and Chang, 1985; Giambelluca et al., 1986).

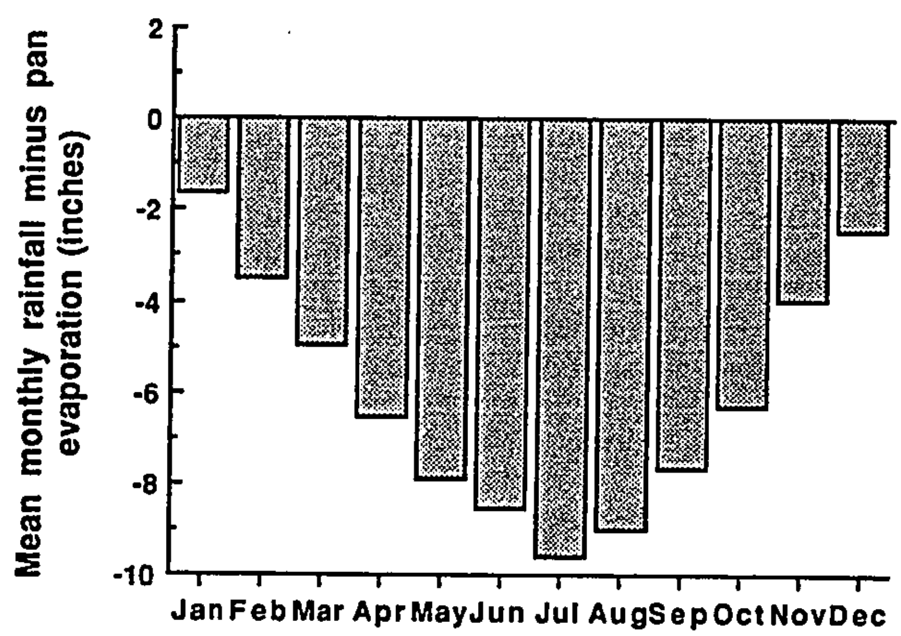

Figure 2. Mean monthly rainfall minus pan evaporation (evaporation deficit) for the Makaiwa Hills area.

3. Groundwater

Only one groundwater aquifer is associated with the recharge area represented by the golf course site. It is part of the Ewa Aquifer System of the Pearl Harbor Sector of Oahu (Mink and Lau, 1987). The aquifer is classified as basal and unconfined, occurring in flank lavas of the Waianae volcanic series. It contains high-quality water, is currently used, and is considered highly vulnerable to contamination.

B. Management Factors

1. Fertilizers

Fertilizers are applied to golf courses to supply those essential nutrients which are used in large amounts and which are deficient in most soils. In typical soils, the elements which are normally applied in a turfgrass fertilization program are nitrogen (N), phosphorus (P), and potassium (K). Fertilizers are normally applied to only the greens, tees, fairways, and part of the roughs of a golf course. Typical areas in each of these types of turf for a 18-hole golf course are estimated in the discussion below.

Turfgrasses use much more N than other elements. Based on turfgrass clipping composition, it has been shown that the turfgrasses grown in Hawaii use about twice as much N as K and about 4 times as much N as P.

The primary fertilizer elements of concern for contamination of ground and surface waters are nitrogen and phosphorus. Phosphorus is attached very tightly to soil clays and moves little if any from the site of application. Phosphorus,therefore will not cause any problem with contamination of drainage water. Ammonium nitrogen (NH_4) likewise moves little in soils. Nitrogen applied in the ammonium form, however, is rapidly converted to the nitrate form (NO_3) which is not bound to the soil and moves readily with water. Because of high nitrogen use rates by turfgrasses, however, nitrogen will be used rapidly after application. Only under conditions where rainfall occurs soon after application of a soluble nitrogen source would there be excessive loss by surface runoff or by leaching below the root zone. Thus nitrogen movement can be mitigated by applying a slow-release nitrogen fertilizer in which the nitrogen is in an insoluble form when applied (Brown, et al., 1977) or by applying small amounts of soluble N through the irrigation system and irrigating only to replace soil moisture used by evapotranspiration (Snyder, et al., 1984).

Fertilizer use rates for the different golf course areas are shown in Table 1. Complete fertilizers (ones containing N, P, and K) are usually applied. Because nitrogen is applied in larger quantities and also because it is the only fertilizer element likely to cause contamination of ground or surface waters, only nitrogen application rates are given.

Table 1. Approximate fertilizer use for an 18-hole golf course in Hawaii.

Type of turf	Area (acres)	Fertilizer amount (lb. N/1000 sq. ft.)	Application frequency	Total annual application (tons N)
Greens	3	0.5	2 weeks	0.85
Tees	3	1.0	3 weeks	1.15
Fairways	50	1.5	8 weeks	10.00
Roughs	30	1.0	3 months	2.60
Total	86			14.60

2. Pesticides

There are a number of weed, insect and disease pests of turfgrasses in Hawaii which sometimes require application of chemical pesticides. Pesticides are normally applied only in response to outbreaks of pests. There are few instances in which pesticides other than herbicides are applied in a regularly scheduled, preventative program. A typical pesticide program for golf courses in Hawaii is given in Table 2 below. There are several chemicals which may be substituted for certain ones in this suggested program. Properties of the chemicals listed in Table 2, as well as those of most chemicals used in turf in Hawaii, are given in Appendix Table B-1.

Table 2. Approximate pesticide use for an 18-hole golf course in Hawaii.

Turfgrass area	Area (acres)	Chemical	Frequency	Rate/application	Annual total
I. Herbicides					
A. Greens	3	MSMA	6 times/year	2 lb.. ai/acre	36 lb. ai
		bensulide	2 times/year	12 lb ai/acre	72 lb. ai
B. Tees	3	MSMA	6 times/year	2 lb. ai./acre	36 lb. ai
		Trimec®	3 times/year	1 pint/acre	9 pints
		bensulide	2 times/year	12 lb. ai./acre	72 lb. ai
C. Fairways	50	MSMA	6 times/year	2 lb. ai./acre	600 lb. ai
		Trimec®	3 times/year	1 pint/acre	19 gallons
		metribuzin	2 times/year	0.75 lb. ai./acre	75 lb. ai.
D. Perimeter areas	20	glyphosate	3 times/year	1.5 lb ai./acre	90 lb. ai.
II. Insecticides					
A. Greens	3	chlorpyrifos	As needed	1 lb. ai./acre	Approx. 18 lb. ai.
B. Tees	3	chlorpyrifos	As needed	1 lb. ai. acre	Approx. 18 lb. ai.
C. Fairways	Spot treatments	chlorpyrifos	As needed	1 lb. ai./acre	Approx. 50 lb. ai.
III. Fungicides					
A. Greens	3	metalaxyl	As needed	1.3 lb. ai./acre	Approx. 25 lb. ai.
		chlorothalonil	As needed	8 lb. ai./acre	Approx. 72 lb. ai.
B. Tees	3	metalaxyl	As needed	1.3 lb. ai./acre	Approx. 25 lb. ai.
		chlorothalonil	As needed	8 lb. ai./acre	Approx. 72 lb. ai.
C. Fairways	Spot treatments	chlorothalonil	As needed	8 lb. ai./acre	Approx. 250 lb.ai.

3. Irrigation

Because rainfall is not uniformly distributed throughout the year, all golf courses are irrigated to supplement rainfall. Golf courses usually have permanent sprinkler irrigation systems with sophisticated control systems. Many are computer controlled, so that each sprinkler head on the golf course can be adjusted to apply a selected amount of water on each cycle.

Irrigation requirements of plants can be calculated from pan evaporation (PE) and rainfall (R) data if the water use requirements (transpiration plus evaporation) of the crop being grown is known. The water use requirement of warm-season turfgrasses is approximately 50% of pan evaporation (Handreck and Black, 1984). Irrigation systems are never completely efficient. If one assumes a 90% efficiency of water application, then irrigation requirement can be calculated as (0.6 PE) - R. Water use requirement for warm-season turfgrasses was calculated for the Makaiwa Hills site from pan evaporation (Ekern and Chang, 1985) and rainfall (Giambelluca et al., 1986) data, assuming 150 acres of the golf course will be irrigated. Based on these data, average monthly irrigation requirements range from zero in January to over 20 million gallons in June, July and August (Figure 3). The total annual irrigation requirement for the Makaiwa Hills area averages approximately 146 million gallons. This is considerably less than the commonly cited one million gallons per day required for golf courses in Hawaii. Murabayashi (1989) reported that irrigation amounts for 11 golf courses in the State varied from 0.0023 million gallons per day per acre (mgd/acre) to 0.011 mgd/acre, a 478% difference. Average water use for the 11 golf courses was 0.006 mgd/acre. Based on Murabayashi's data, the average 150 acre golf course would require approximately 0.9 million gallons of water per day or 329 million gallons per year.

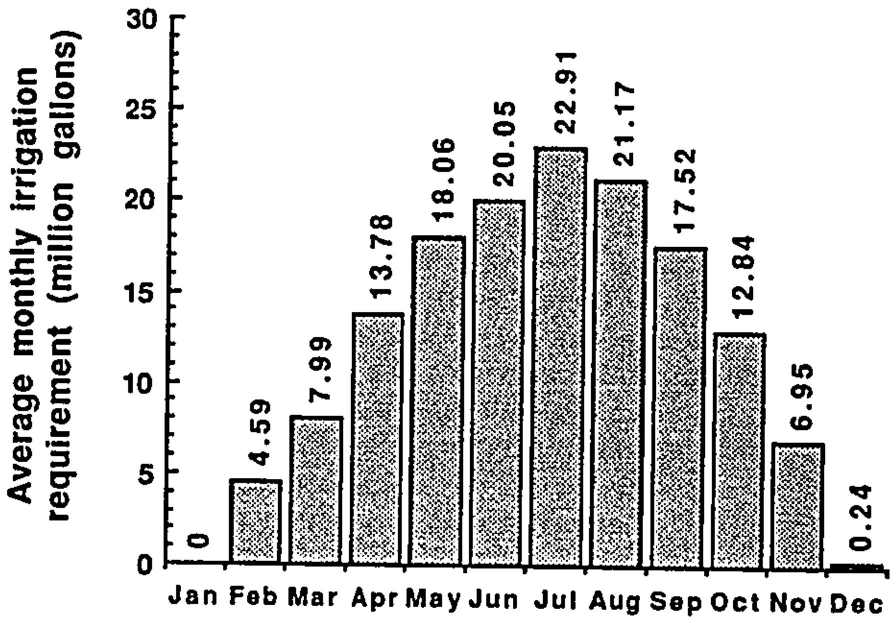

Figure 3. Mean monthly irrigation requirements for warm-season turfgrasses in the Makaiwa Hills area (based on 150 acres of irrigated turfgrass area).

Irrigation practices may have a large influence on the movement of soluble nitrogen fertilizers in soils. If excessive irrigation water is applied soon after application of soluble nitrogen sources, the likelihood of runoff or leaching of nitrogen below the root zone is increased. From the above it is apparent that basing irrigation amounts on calculated water use is a much more efficient method of water utilization than is currently being practiced. The data reported by Murabayashi (1989) was from golf courses in areas ranging from very arid (the Kona Coast, Keihi) to relatively wet (Princeville). The Makaiwa Hills area is relatively arid, with an extremely high annual pan evaporation rate, yet the average annual irrigation requirement for turfgrasses at this location is less than one-half the amount reported by Murabayashi. Basing irrigation scheduling on water use rates will not only result in large savings of water compared to present practices, but also reduce the likelihood of chemicals being leached from the rootzone.

IV. Potential for Chemical Movement to Groundwater and Surface Waters

A. Issues of concern and the scope of this assessment

The principal issue addressed in this report is the potential for movement of fertilizers and pesticides to groundwater and surface waters.

The presence of agricultural chemicals in groundwaters at many locations in the State (Honolulu Star Bulletin, Aug. 13, 1989) is reason for caution in the use of chemicals in recreational areas such as parks and golf courses as well as in agriculture. It is important to rècognize, however, that detection of a chemical in water bodies, even in potable water, does not necessarily constitute a health hazard as defined by the U. S. Environmental Protection Agency (EPA). In an effort to assist federal, state and local officials in responding to drinking water contamination, the EPA has set "Lifetime Health Advisory" levels (concentrations in drinking water) for many chemicals. EPA estimates these levels after reviewing available human data and experimental animal studies to evaluate potential human health effects. The Health Advisories are considered tentative and are updated as new information becomes available. Some agricultural chemicals which have reached groundwater in Hawaii, for example nitrate from fertilizers and the herbicide atrazine, have been detected at many locations in the State, but seldom are at a concentration considered a threat to human health. Also, Health Advisory Levels (HAL) vary widely for different chemicals: for nitrate the level is 10,000 micrograms per liter (10 milligrams/liter) of water while for atrazine it is 3 micrograms per liter. Thus for these two chemicals, the HAL's differ by a factor of 3,333. The relative oral toxicity of a number of pesticides registered for use in golf courses, given in Appendix Table B-1, reflect the wide range of toxicities obtained in animal feeding studies.

In the assessment which follows, we attempt to evaluate the potential for groundwater and surface water contamination by chemicals which might be applied to the proposed Makaiwa Hills Golf Course. Our assessment does not include an estimate of the chemical concentration in waters or of human exposure or risk. Useful estimates of health risk are not possible when concentrations of chemicals in water are not known. However, when the evidence indicates the likelihood of no contamination or of concentrations well below the Health Advisory Level, further analysis of health risk is neither possible nor appropriate.

B. Potential impact on groundwater quality

Because the area treated with pesticides on a golf course is small, the total amount of pesticide applied is relatively small also. Most pesticides used in golf course management in Hawaii (Table 2) are either rapidly degraded (half-life in soil of less than 60 days) or are tightly sorbed on soil organic matter (Koc exceeding 500), and move little from the site of application. The pesticides in Appendix Table 1 which are most likely to move below the root zone are metribuzin, mecoprop, dicamba, simazine, and trichlorfon. The relative mobility of these chemicals can be quantified by computation of the Attenuation Factor (AF) of each chemical for an appropriate set of conditions. Attenuation of chemical movement by the soil includes both retardation of movement due to sorption on soil organic matter and degradation in the soil by both biological and chemical pathways. The AF numerical index (Rao et al., 1985) is presently being evaluated (Khan and Liang, 1989; Loague et al., 1989) for use in an assessment methodology which the State of Hawaii will use in pesticide regulation. The AF index can have numerical values from AF = 0 (total attenuation) to AF = 1 (no attenuation). By definition, AF is the fraction of chemical remaining in the soil after a single application when the recharge is sufficient to carry the chemical to the bottom of a soil layer of a given depth (for example, 50 cm). For soil and water recharge conditions of practical interest in Hawaii, AF values for the five chemicals which are most likely to move beyond a depth of 50 cm are shown in Table 3. AF values range from 2.1×10^{-6} for simazine (lowest contamination potential) to 7.1×10^{-3} for trichlorfon (highest contamination potential). For comparison, DBCP, which was used for 25 years in pineapple and has contaminated groundwater at many locations, has AF = 4.6×10^{-1}, indicating a much higher likelihood for DBCP movement to groundwater than any of the chemicals listed in Table 3. Also, the total amounts of chemicals in Table 3 which are used on golf courses are relatively small. Trichlorfon is not used in Hawaii to our knowledge, although it is labeled. Mecoprop and dicamba are components of the herbicide Trimec®. Total annual mecoprop and dicamba application for the 18-hole golf course will be approximately 20 and 4 pounds, respectively. The total amount of metribuzin applied will be approximately 75 lb. annually. Simazine is used on few golf courses in Hawaii. If used, simazine application would not exceed 100 lb. annually.

Table 3. Attenuation factors (AF) for the most mobile pesticides labeled for use on golf courses.†

Pesticide	AF
Metribuzin	3.5×10^{-6}
Mecoprop	1.3×10^{-3}
Dicamba	7.1×10^{-5}
Simazine	2.1×10^{-6}
Trichlorfon	7.1×10^{-3}

†Based on the following conditions: soil organic carbon content = 1.5%; soil bulk density = 1.2 g/cm^3; soil water content = 35% by volume; water recharge = 0.1 cm/day; depth of penetration = 50 cm.

It is unlikely that any of the chemicals used on the golf course would reach the aquifer in sufficient concentration to adversely affect human health. Nitrate and metribuzin are the two chemicals which are applied in sufficient quantities and are sufficiently mobile and persistent to possibly be detected in groundwater. It is unlikely that the small amount of metribuzin used on golf courses would contribute a measurable amount to the groundwater and the contribution of nitrate from fertilizer may be small relative to background nitrate present in the aquifer. If fertilizer nitrate did reach the aquifer, it would not likely increase the level sufficiently to be of concern to human health; the nitrate Health Advisory Level (HAL) is 10 mg/L. The metribuzin HAL is 200 µg /L.; detection at even 1 µg/L in aquifer water is unlikely.

Considering the limited use of pesticides which have the potential to leach below the root zone and the high Health Advisory Level for nitrate, significant contamination of the aquifer by chemical use on a golf course seems unlikely. However, this site is dominated by shallow, rocky soils which provide less retardation of pesticide leaching than normal agricultural soils. The AF values in Table 3 are based on a soil layer 50 cm deep with an organic carbon content of 1.5%. Thus the shallow-soil areas of the golf course will require importation of soil to provide adequate protection against pesticide leaching. One foot of soil having an organic carbon exceeding 1% should be adequate when proper management is exercised in both irrigation and chemical use.

Thus we do not anticipate an adverse effect of fertilizers and pesticides on groundwater quality if sufficient topsoil is provided and proper management is exercised in both irrigation and chemical use.

C. Potential Impact on Surface Water Quality

The golf course is expected to constitute only about 10% of the total Makaiwa Hills development project. A small portion of the 180 acres in the golf course is located on fairly level land near Farrington Highway and most of the remaining useable area is on broad ridges just mauka of the level land. Some steep slopes on the sides of gulches are within the golf course boundaries, but presumably these areas would not be planted to turf. Given the low rainfall, most of the year (Figure 1), runoff is likely to occur only during the winter months. Runoff from the higher elevations (200 to 400 feet) will reach the major drainage ways defined in Section B. Eleven culverts presently exist at Farrington Highway to handle runoff water from the area proposed for the golf course.

Although the areas with slopes exceeding 10% are likely to produce runoff from major winter storms, the runoff produced from treated golf course areas will be a small fraction of the total runoff reaching major drainage channels. Thus possible contamination of runoff waters by nitrate and pesticides from treated areas will be mitigated by dilution with runoff waters from higher elevations outside the golf course. The existence of 10 separate, defined drainage areas which terminate at Farrington Highway suggests that the runoff is highly dispersed along the highway, in addition to the dilution from off-site runoff. These factors suggest no adverse impact of chemical use on the receiving shoreline waters south of Kahe Point. Careful management of irrigation and chemicals during the winter months will further reduce the likelihood of any adverse effect of agricultural chemicals on runoff waters.

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APPENDICES

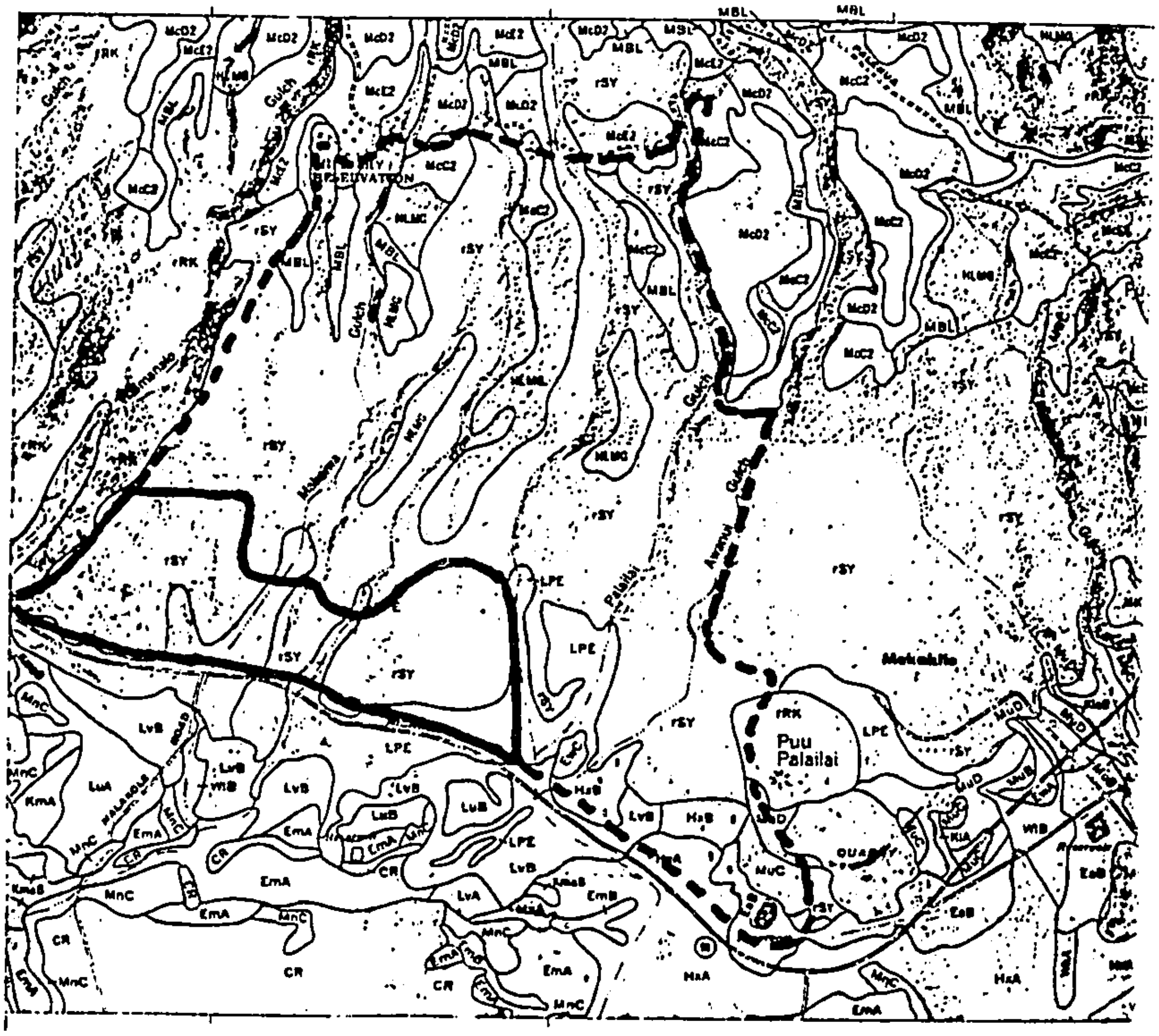

Figure A-1. Soil map of proposed Makaiwa Hills Golf Course (solid boundary) within the Makaiwa Hills project site (dashed boundary).

Scale 1:24 000

Appendix Table B-1. Properties of pesticides used on turf in Hawaii.

Pesticide common name	Trade name (s)	Oral LD-50 (mg/kg body wt)*	Toxicity to fish and wildlife*	Soil sorption index (Koc)**	Water solubility (mg/l)**	Half-life in soil (days)**	Leaching potential**
I. Herbicides							
MSMA	WeedHoe etc.	1800	Low	10000	1000000	100	Small
glyphosate	Roundup, Kleenup	150	Mod. to birds, none to fish	10000	1000000	30	Small
metribuzin	Sencor	2200	Moderate	41	1220	30	Large
2,4-D	part of mixtures	370-700	High to fish	109	300000	10	Medium
mecoprop	ditto	700-1500	Low	3	660000	21	Large
dicamba	ditto	1000-2000	Non toxic to fish	2	800000	14	Large
oryzalin	Surflan	10000	Mod. to birds, toxic to fish	2700	2.5	60	Small
oxadiazon	Ronstar	8000	Toxic to fish		0.7		
propyzamide	Kerb	5620-8350	Low	990	15	30	Small
simazine	Princep	>5000	Low	138	3.5	75	Large
chlorthal-dimethyl	Dacthal	>3000	Low	5000	0.5	30	Small
bensulide	Betasan, Betamec	770	Mod. to fish	10000	25	60	Small
paraquat dichloride	Ortho Paraquat CL	150	Mod. to birds, none to fish	100000	1000000	3600	Small
benfluralin	Balan	10000	Low to birds, high to fish	11000	0.1	30	Small
II. Insecticides							
chloropyrifos	Dursban	135-163	High	6070	2	30	Small
bendiocarb	Ficam	40-156	High				
carbaryl	Sevin	400-850	Moderate	229	40	7	Small
trichlorfon	Dylox	450-630	Moderate	2	154000	27	Large
III. Fungicides							
anilazine	Dyrene	<5000	Low	3000	10	1	Small
benomyl	Benlate	9590	Low	2100	2	100	Small
chlorothalonil	Daconil 2787	>10000	Low to birds, mod. to fish	1380	0.6	20	Small
iprodione	Chipco 26019 RP	3500	Low	500	13	20	Small
mancozeb	Dithane M-45	>8000	Low	1000	0.5	35	Small
qunitozone	PCNB, Terrachlor	12000	Non-toxic	1000	0.44	21	Small
thiram	Tersan	7500	Low	383	30	20	Medium
triadimefon	Bayleton	568	Low	273	260	21	Medium
metalaxyl	Subdue	669	Non-toxic	16	7100	7	Medium
thiophanate-methyl	Cleary 3336	7500	Low	1000	3.5	0	Small

*From: Hartley, Douglas and Hamish Kidd (Eds.) 1983. The Agrochemicals Handbook. Unwin Bros., Ltd. Old Working., Surrey, England.

**From: Wauchope, R. D. 1988. U. S. D. A.-ARS Interim Pesticide Properties Database, Version 1.0. Unpublished

Appendix Table B-2. Toxicity classes of pesticides.

Class	Description	Warning Statement	Oral LD50
1	Highly Toxic	Poison, Skull & Crossbones	1-50
2	Moderately Toxic	Danger	51-500
3	Low Toxicity	Warning	500-5,000
4	Very Low Toxicity	Caution	>5,000

APPENDIX C

IMPACT ON MIGRATORY BIRDS AND ENDANGERED HAWAIIAN WATERBIRDS.

The fertilizers, herbicides, and fungicides used in golf course maintenance pose little or no hazard to birds frequenting the grassed areas or ponds associated with golf courses. Fertilizers are relatively non-toxic unless ingested in large amounts. All herbicides and fungicides used in golf course maintenance in Hawaii are of low to moderate toxicity (Appendix Table 1). The only chemicals used in golf course maintenance in Hawaii which are highly toxic to birds are the organic phosphate insecticides, especially chlorpyrifos.

Although chlorpyrifos is toxic to birds, it is strongly adsorbed on the thatch layer of turf and moves little from the site of application. One reason for its weakness in controlling soil infesting insects is the inability to get the insecticide through the thatch layer to the depth needed to contact these insects. Recent studies (Sears and Chapman, 1980; Tashiro, 1980) have shown that chlorpyrifos applied to turfgrasses does not penetrate more than 2 to 3 centimeters in the soil. In addition to resistance to movement in the soil, it has been shown that it is rapidly degraded in the soil, both by hydrolysis and microbial action (Miles et al. 1979).

Because of the adsorption of organic phosphate insecticides on organic layers in turf and their rapid break down, there is little chance of their movement from grassed areas into the ponds associated with the proposed golf course. Label instructions for application of these pesticides (which turfgrass managers are required by law to follow) specifically prohibit their direct application to streams and ponds.

The likelihood of bird injury by pesticides used in maintenance of the proposed golf course can be reduced by proper application of pesticides with reduced toxicity to birds. Appendix Table 1 shows that carbaryl and trichlorfon are less toxic to birds than chlorpyrifos. In most cases these insecticides may be substituted for chlorpyrifos with little loss of effectiveness.

Golf courses are frequently visited by birds. As far as we are aware, there have been no reported incidents of bird kill in Hawaii from chemicals applied in golf course management. Waterfowl and fish appear to thrive in ponds and water hazards on golf courses in Hawaii. Many golf courses cultivate white amur fish in the ponds to control algae. Mosquito fish are generally stocked to prevent mosquito problems. We are aware of no incidents of fish or waterfowl injury from chemicals applied to golf courses.

The labeling of herbicides and pesticides by EPA for particular uses, enforced by the Hawaii Department of Agriculture, is perhaps the best assurance of protection of humans and wildlife from their hazards. All pesticides must be applied in compliance with federal and state laws regulating their use. Hazards to both humans and wildlife are included in the decision to label a pesticide for specific uses, including use on golf courses, and in developing regulations on allowable application procedures of the pesticide for various uses.

APPENDIX D

IMPACT ON AIR QUALITY

Most herbicides and pesticides used on golf courses are of relatively low mammalian toxicity, with LD_{50} values ranging from hundreds to several thousand mg/kg body weight (Appendix Table 1). None of the chemicals listed in Table 2 above are highly volatile. A measure of volatility is the vapor pressure (VP). The compounds used in highest quantity, for which vapor pressure data is readily available, are chlorothalonil (VP=1.3 x 10^{-5} atm at 25° C) and chlorpyrifos (VP=2.4 x 10^{-8} atm at 25° C). In comparison, DBPC, which is known to be volatile, has a vapor pressure of 1.2 x 10^{-3} atm at 21° C, i.e. at least 100 times the vapor pressure of chlorothalonil and 100,000 times the vapor pressure of chlorpyrifos. In addition, pesticides are applied on golf courses in dilute sprays (50 to 100 gallons of spray solution per acre) to open areas. For these reasons there is little likelihood of volatility once the pesticides are applied.

If properly applied, there is also little potential for drift of spray particles from golf course spray equipment. The greatest danger of significant drift of pesticides is from aerial application. Golf course pesticides are applied with ground spray equipment. Boom height of spray equipment is less than one meter. Low spray pressures (20 to 40 psi) and coarse spray droplets further reduce the hazard of airborne fine droplets. Droplets larger than 100 micrometers diameter are not highly subject to drift.

Most of the spray volume from typical flat-fan nozzles used in agricultural spray equipment is from droplets larger than 100 micrometers. Table 3 below shows a typical distribution of droplet sizes for a flat-fan nozzle (the type used in most golf course spray equipment). At the low concentrations used in pesticide application, this would not result in significant quantities of pesticides being carried downwind. High wind speed would increase the likelihood of drift of fine spray droplets, however, because high wind speed distorts spray patterns and results in poor coverage; spraying in periods of high wind is not common practice. Table 4 below shows the percent of spray application volume deposited at 4 and 8 feet downwind and the distance downwind for the volume to drop to 1% or below for flat-fan nozzles under different conditions. Even under high wind conditions (almost 10 mph) and spraying at 40 psi, the distance downwind at which 1% or less of the total spray volume was deposited was only 17 feet.

Appendix Table D-1 Droplet size range for a typical flat-fan nozzle at 20 and 40 psi. (from Hofman et al., 1986)

Droplet size range (microns)	Percent of spray volume 20 psi	40 psi
0-21	0.1	0.4
21-63	3.0	10.4
63-105	10.7	20.1
105-147	16.2	25.4
147-210	36.7	35.3
210-294	27.5	7.7
>294	5.8	0.7

Appendix Table D-2. Percent of spray volume deposited at 4 and 8 feet downwind and the distance in feet for the volume of spray solution to drop to 1% of the total spray volume (from Hofman et al., 1986).

Nozzle ht. (in.)	Pressure (psi)	Wind speed (mph)	Percent deposited 4 ft.	8 ft.	Distance to drop to 1% of volume
14	40	3.5	3.1	0.6	7.0
27	40	3.5	5.9	1.5	13.0
18	30	5.3	9.3	2.2	14.0
18	25	9.9	10.3	3.1	15.5
18	40	9.9	9.1	3.6	17.0

To facilitate spray operations and to comply with label instructions of some pesticides, spray applications are only made in late afternoon or early morning hours when golfers are not on the golf course. This reduces the risk of exposure of people to airborne spray particles. Sufficient buffer space with tall vegetation between the golf course and housing sites and facilities (such as the clubhouse) which will be used by people will further reduce the chance of exposure to airborne pesticide particles.

The greatest danger of airborne pesticides is to the applicators of pesticides themselves. Mixing of wettable powder formulations and being in close proximity to airborne spray particles, particularly when operating spray equipment in a downwind position, places spray operators in particularly vulnerable positions. EPA and OSHA have strict standards which specify that spray operators wear appropriate protective clothing and breathing apparatuses.

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Personal Data

Born: Atkins Arkansas, August 23, 1932
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Military Service: U. S. Navy, 1950-1955; Honorable Discharge

Education:

B. S. General Agriculture, University of Arkansas, 1959
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Ph. D. University of Illinois, 1966

Employment:

1970-present: Professor (1978-present) ; Associate Professor (1974-78);and Assistant Professor (1970-74) of Horticulture, University of Hawaii. 1966-70: Research Associate, Agronomy Department, University of Arkansas, Fayetteville, Arkansas. 1962-66: Graduate Research Assistant (1964-66) and Graduate Teaching Assistant (1962-64), Agronomy Department, University of Illinois, Urbana Illinois. 1950-62: Research Assistant, Southwest Branch Experiment Station, Hope, Arkansas.

Chairman, Horticulture Department Graduate Faculty (July,1986-present).

Acting Department Chairman,Horticulture Department, University of Hawaii, December, 1983 to September, 1984 and on numerous shorter periods when the Department Chairman has been away.

Research (60%), Extension (20%), and instruction (20%) in Turfgrass Management. State Extension Turfgrass Specialist. Teach Turfgrass Management. Research on turfgrass culture and management. Prepare extension publications and conduct educational programs for turfgrass managers on turfgrass culture and management.

Professional Society
Membership:

American Society for Horticultural Science
American Society of Agronomy
Crop Science Society of America
Soil Science Society of America

Hawaii Turfgrass Association (President, 1975), member, Board of Directors, 1970-present.

Honorary Societies:

Alpha Zeta,
Sigma Xi,
Gamma Sigma Delta [Treasurer, 1981-83; Secretary, 1983-84; President, 1984-85 (local chapter)].

Consulting Experience:

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BIOGRAPHICAL RESUME

for

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B.S.	1953	Colorado State University	Agriculture
M.S.	1957	University of Nebraska	Soil Fertility
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1957-58 Univ. Nebraska Instructor (Soils research)
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1962-present University of Hawaii, Asst., Assoc., and Prof.

OTHER EXPERIENCE:

Sabbatical leaves:
- 1968-69 AEC Savannah River Lab., Aiken, SC
- 1975 University of Florida, Gainesville
- 1983 EPA Environ. Research Lab., Athens, GA
- 1990 Univ. Calif., Davis

IAEA Expert in soil physics, Malaysia, Apr/May 1982
Associate Editor, SSSA Jour. (Soil Physics) 1980-86
Chairman, Div. S-1 (Soil Physics), Soil Sci. Soc. Amer., 1987

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Australia, N.Z., Fiji (1968); Papua-New Guinea (1975); Israel, Sweden, Netherlands (1976); Philippines (1979,80); Taiwan (1980); USSR (1981); Malaysia (1982).

AWARDS:

Fellow, Soil Science Society of America (1987)

CURRENT RESEARCH PROJECTS (PI or Co-PI):

Matching Drip Irrigation System Design and Operation to Soil Hydraulic Properties (CSRS-USDA support, 1985-90)

Evaluation of Fumigants and Non-Volatile Nematicides for Control of Reniform Nematodes (supported by special State legislative action to assist the pineapple industry, 1984-90)

Assessment of the Potential for Groundwater Contamination Due to Proposed Urban Development in the Vicinity of the Navy's Waiawa Shaft (Navy support through WRRC, 1987-89)

Implementation of a Computerized Procedure for Regulating the Sales and Use of Pesticides in Hawaii (State of Hawaii, Department of Agriculture, 1988-90)

Transformation and Sorption of Pesticides in the Vadose Zone and Impact on Mobility to Groundwater (Calif. Dept. of Food and Agric., 1987-1991)

INSTRUCTION:

Chairman of Graduate Field of Agronomy and Soil Sci., 1983-88
Graduate course, Soils 660 Hydrologic Processes in Soils
Direct thesis research of two graduate students currently
Member of several thesis committees with and outside dept.

CONSULTING:

Provide consulting service, in cooperation with Dr. Charles L. Murdoch, to land use planners/developers regarding the environmental impact of pesticides and fertilizers applied to golf courses in Hawaii, 1987-present.

Appendix L.

Botanical Survey
Makaiwa Hills Ewa District, Oahu
Char & Associates

BOTANICAL SURVEY
MAKA'IWA HILLS
'EWA DISTRICT, O'AHU

by

Winona P. Char

CHAR & ASSOCIATES
Botanical/Environmental Consultants
Honolulu, Hawai'i

Prepared for: William E. Wanket, Inc.

November 1990

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Field studies to assess the botanical resources on the project site were conducted on 19-21 October 1990. The primary objectives of the survey were to 1) describe the major vegetation types; 2) inventory the flora; and 3) search for threatened and endangered plant species as well as sensitive native plant communities.

Description of Existing Conditions

Three major vegetation types occur on the site; all are dominated by introduced or alien species. The grassland/shrubland vegetation type is found on the northern half of the site on the tops of the more or less broad foothills. Vegetation consists of an open grassland with scattered shrubs. Guinea grass is the most abundant of the grasses although pili grass, pitted beard grass, and buffel grass may be co-dominant in places. Common shrubs in this vegetation type are koa-haole, lantana, and klu. Kiawe forest occurs on the rocky steeply sloping areas and in gulches. The forest varies from closed to open canopy, with Guinea grass abundant in the bottoms of gulches. On the rocky gulch slopes both Guinea grass and buffel grass are the dominant ground cover plants. The buffel grass community is found on the level portion bordering Farrington Highway which was once in sugar cane cultivation. This area is now largely overgrown with buffel grass and scattered clumps of shrubs as koa-haole, Christmas berry, and pluchea. A large part of the site is used for grazing cattle and horses. Areas with erosion damage are common on the upper sections of the site.

A total of 103 vascular plant species were found on the site. Of these, 91 (88.3%) are introduced or alien species and 12 (11.7%) are native. None of the plants found on the site are officially listed, proposed, or candidate threatened and endangered species.

Probable Impacts and Mitigative Measures

The existing vegetation will be removed on the more or less leval areas suitable for development. However, there is not expected to be any significant negative impacts to the botanical resources as the vegetation occurring in these areas is dominated by introduced species. These species occur widely throughout the Hawaiian Islands in similar environmental habitats. Of the 12 native species found on the site, three are endemic, that is they occur only in the Hawaiian Islands; these three are kumu-niu (a fern), nehe, and pua-kala. All are found on the steep, rocky gulch slopes where no development is planned. In fact, large areas on the site will be retained in their open natural state because they are too rugged to be developed.

There is little of botanical interest or concern on the site as it is dominated by introduced species. Portions of the site have also been heavily grazed. Of concern, is the loss of soil once the vegetation cover is removed. It is therefore recommended that landscaping be initiated as soon as possible to prevent increased soil erosion.

BOTANICAL SURVEY
MAKA'IWA HILLS
'EWA DISTRICT, O'AHU

INTRODUCTION

The Maka'iwa Hills project site consists of approximately 1,915 acres on the slopes of the Wai'anae Mountain Range. It is bound by Makakilo to the east, Farrington Highway to the south, Waimanalo Gulch to the west, and Palehua Road and a former military installation (Nike site) to the north. Elevation ranges from approximately 50 ft. mean sea level (MSL) at Farrington Highway, to roughly 1,300 ft. MSL at the northern boundary. The topography consists of rolling foothills divided by three major gulches -- Awanui Gulch, Palailai Gulch, and Maka'iwa Gulch -- and three smaller unnamed gulches.

Vegetation on the hillsides consists of a grassland with scattered trees and shrubs. Gulch areas generally support dense thickets of kiawe trees. The level portions of the site bordering Farrington Highway were in sugar cane cultivation at one time; these areas are now overgrown with buffel grass and scattered patches of koa-haole. A large portion of the project site is currently being used for grazing cattle and horses by Tongg Ranch.

Field studies to asess the botanical resources on the ±1,915-acre project site were conducted on 19-21 October 1990. The primary objectives of the survey were to 1) describe the major vegetation types; 2) inventory the vascular flora; and 3) search for threatened and endangered plants as well as sensitive native plant communities.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical and biological studies conducted in the general area. A recent aerial photograph and topographic maps were examined to determine vegetation cover types, terrain characteristics, access, boundaries and reference points. In addition, a reconnaissance survey with various subconsultants and the applicant's representatives was made on 13 July 1990.

Access onto the lower boundary of the ±1,915-acre parcel was from along the Farrington Highway. Palehua Road provided the major access along the upper boundary. A number of fencelines, jeep roads, and powerlines are found on the property; these were used as reference points during the field studies.

A walk-through survey method was employed. Areas most likely to harbor native plant communities or rare species, as the steeper gulch slopes or rocky outcroppings, were more intensively examined. Notes were made on plant associations and distribution, substrate types, topography, exposure, moisture, etc. Species identifications were made in the field; plants which could not be positively identified were collected for later determination in the herbarium and for comparison with the recent taxonomic literature.

The species recorded are indicative of the season ("rainy" vs. "dry") and the environmental conditions at the time of the survey. A survey taken at a different time and under varying environmental conditions would no doubt yield slight variations in the species list especially of the weedy, annual taxa.

DESCRIPTION OF THE VEGETATION

Three major vegetation types are recognized on the project site and are discussed in detail below. A checklist of all the plants inventoried during the survey is presented at the end of the report.

Grassland/Shrubland

This vegetation type occurs primarily on the northern half of the property on the tops of the somewhat broad foothills and colluvial slopes. Soils on this portion of the site (Foote et al. 1972) consist of the following: Helemano silty clay (HLMG), Mahana-Badland complex (MBL), and Mahana silty clay loam (McC2, McD2, McE2). These are well-drained soils, dark reddish-brown to dark-red in color. The erosion hazard is severe to very severe, and, in many places, the surface layer has been lost. Thus, rock outcroppings, eroded spots where the highly weathered parent material is exposed, and hardpan areas are frequently encountered.

The general physiognomy of the vegetation is of an open grassland with scattered shrubs, although in places, shrubs such as klu (*Acacia farnesiana*) can become quite dense. Stands of kiawe trees (*Prosopis pallida*), 18 to 20 ft. high, are also scattered through this grassland/shrubland vegetation type. The most abundant grass is Guinea grass (*Panicum maximum*) with pili grass (*Heteropogon contortus*), buffel grass (*Cenchrus ciliaris*), and pitted beard-grass (*Bothriochloa pertusa*) becoming co-dominant in many areas. On eroded areas and rock outcrops Natal redtop (*Rhynchelytrum repens*) becomes more common. Because of the grazing animals, the grasses are kept low, from 1 to 3 ft. high. Around heavily used areas as watering troughs and pathways the vegetation is severely browsed and the bare soil compacted.

Woody, taller shrub components frequently encountered include klu, lantana (*Lantana camara*), and koa-haole (*Leucaena leucocephala*); these are usually 3 to 5 ft. tall. Smaller shrubs or subshrubs observed frequently are 'uhaloa (*Waltheria indica*), 'ilima (*Sida fallax*), indigo (*Indigofera suffruticosa*), comb hyptis (*Hyptis pectinata), and slender mimosa (Desmanthus virgatus). Along the slopes of the northern boundary, a few scattered trees and shrubs of Christmas berry (Schinus terebinthifolius), a'ali'i (Dodonaea viscosa), Java plum (Syzygium cumini), silk oak (Grevillea robusta), and a gum tree (Eucalyptus sp.) are found.

Because the survey was conducted before the onset of the rainy season, a few weedy annual species may have been missed. A few depauperate or dried plants found included Spanish needle (Bidens pilosa), hairy honohono (Commelina diffusa), spiny amaranth (Amaranthus spinosus), graceful spurge (Chamaesyce hypericifolia), and sowthistle (Sonchus oleraceus).

Kiawe Forest

This vegetation type occurs primarily on the areas classified as stony steep land (rSY) and Lualualei extremely stony clay (LPE), which is found along Farrington Highway (Foote et al. 1972). The kiawe trees vary from closed, canopy cover greater than 60%, to open forests, canopy cover less than 60%. The bottoms of gulches support dense, closed kiawe forests with trees from 12 to 25 ft. high. In some places, koa-haole shrubs form a subcanopy layer from 12 to 18 ft. high. Clumps of Guinea grass, sometimes 6 ft. tall, form a dense cover making botanizing difficult. Only along the boulder-strewn course of the intermittent streams is the vegetation sparse. Along the rocky streambeds, are pockets of soil which have remained somewhat damper; these support a number of species as castor bean (Ricinus communis), West Indian beggar's tick (Bidens cynapiifolia), pluchea (Pluchea symphytifolia), lion's-ear (Leonotis nepetifolia), cocklebur (Xanthium strumarium), and Chenopodium murale.

On gulch slopes, the kiawe forest is open with the trees forming 30 to 40% cover. In these areas, both Guinea grass and buffel grass are abundant. Large rocky outcroppings support two low-growing native shrubs, 'ilie'e (Plumbago zeylanica) and nehe (Lipochaeta lobata).

On the more level portions of the property, bordering Farrington Highway and the Board of Water Supply acccess road, the open-canopied forest is somewhat shorter in stature, 12 to 15 ft. tall. Ground cover may be patchy in areas with the gray-brown colored Lualualei soils exposed. Portions of the forest have been bull-dozed at various times and open, grassy areas with bare soil are common. Plants associated with these dozed areas include hoary abutilon (Abutilon incanum), 'ilima, 'uhaloa, cocklebur, swollen finger grass (Chloris barbata), Spanish needle, Achyranthes aspera, prickly sida (Sida spinosa), and hairy merremia (Merremia aegytia). Fires have also swept through the area occasionally as evidenced by burnt tree trunks and grass stubble.

Buffel Grass Community

The buffel grass community occupies only a small portion of the project site where it occurs on the level area between Farrington Highway and the Board of Water Supply's access road on lands formerly under sugar cane cultivation. Oahu Sugar Company ceased farming the fields in 1982. Weedy species have since invaded the fields from surrounding areas. When Char and Whistler surveyed the site in 1986, a few scattered clumps of sugar cane (Saccharum officinarum) still occurred on the site. No plants were observed during this field survey, however, parts of the irrigation system, especially the large reservoir, can still be seen; most of the canehaul roads have long since been overgrown.

Buffel grass forms a low mat from 1 to 3 ft. high. Pitted beard-grass is locally common forming scattered patches here and there. Shrubs as koa-haole, Christmas berry, and pluchea occur in small clumps. Where the buffel grass cover is less dense, subshrubs such as 'uhaloa, 'ilima, and virgate mimosa are found. The buffel grass community is presently being used to graze horses.

DISCUSSION AND RECOMMENDATIONS

Three major vegetation types are recognized on the project site. Grassland/shrubland vegetation occupies the more or less broad slopes on the upper elevation portions of the site. Kiawe forest is found on rocky steep slopes and gulches as well as along the lower portion of the site by Farrington Highway. The buffel grass community is found on lands formerly under sugar cane cultivation now overgrown by buffel grass and shrubby secondary species. Of a total of 103 plant species inventoried on the site, the majority, 91 (88.3%) are introduced or alien species; 12 (11.7%) are native species. Of the natives only 3 are endemic, i.e., occur only in the Hawaiian Islands. These endemics are the kumu-niu fern (*Doryopteris decipiens*), nehe, and pua-kala (*Argemone glauca*). None of the species found on the site are officially listed threatened or endangered species; nor are any candidate or proposed for such status (U. S. Fish and Wildlife Service 1989, 1990). Other biological and botanical surveys conducted on portions of the site (Char and Whistler 1986; Char 1985) or on adjacent lands as Makakilo (U. S. Dept. of Housing and Urban Development 1978) have recorded similar vegetation types and species present as those found during this survey.

There is little of botanical interest or concern on the site as it is dominated largely by introduced species; the land has also been in use for grazing cattle and horses for some time. The three endemic species found on the site occur on the steep gulch slopes which will not be developed. The proposed development should not have a significant negative impact on the botanical resources.

Of concern, is the removal of vegetation cover during construction which may result in increased soil erosion. It is therefore recommended that disturbed areas be landscaped as soon as possible.

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PLANT SPECIES LIST -- Maka'iwa Hills

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within each of three groups: Ferns, Monocots, and Dicots. The taxonomy and nomenclature of the Ferns follow Lamoureux (1984); the flowering plants, Monocots and Dicots, are in accordance with Wagner et al. (1990). In most cases, common English and/or Hawaiian names given follow St. John (1973) or Porter (1972).

For each species, the following information is provided:

1. Scientific name with author citation.

2. Common English and/or Hawaiian names, when known.

3. Biogeographic status. The following symbols are used:
   E = endemic = native only to the Hawaiian Islands
   I = indigenous = native to the islands and also elsewhere
   X = introduced or alien = all those plants brought to the islands intentionally or accidentally by humans after after Western contact (1778); not native.

4. Presence (+) or absence (-) of a particular species within each of three major vegetation types recognized on the project site (see text for discussion):
   g/s = Grassland/Shrubland
   kf = Kiawe Forest
   bg = Buffel Grass Community

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE g/s	kf	bg
FERNS					
SINOPTERIDACEAE (Cliffbrake Fern Family)					
Doryopteris decipiens (Hook.) J. Sm.	kumu-niu, 'iwa'iwa	E	+	-	-
MONOCOTS					
AGAVACEAE (Sisal Family)					
Agave sisalana Perrine	sisal	X	-	-	-
COMMELINACEAE (Spiderwort Family)					
Commelina benghalensis L.	hairy honohono	X	+	+	+
CYPERACEAE (Sedge Family)					
Cyperus rotundus L.	nutgrass, nut sedge	X	-	-	+
POACEAE (Grass Family)					
Bothriochloa pertusa (L.) A. Camus	pitted beardgrass	X	+	+	+
Brachiaria mutica (Forssk.) Stapf	California grass	X	-	-	+
Cenchrus ciliaris L.	buffel grass	X	+	+	+
Chloris barbata (L.) Sw.	swollen finger grass, mau'ulei	X	+	+	+
Chloris radiata (L.) Sw.	radiate finger grass	X	-	-	+
Cynodon dactylon (L.) Pers.	Bermuda grass, manienie	X	+	-	-
Digitaria ciliaris (Retz.) Koeler	crabgrass	X	-	+	-
Digitaria insularis (L.) Mez. ex Ekman	sourgrass	X	+	+	+
Digitaria setigera Roth	kukaipua'a	I	+	+	-
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.	love grass	X	-	-	+
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	pili, pili grass	I	+	+	-
Panicum maximum Jacq.	Guinea grass	X	+	+	+
Panicum maximum var. trichoglume Eyles ex Robyns	green panic grass	X	-	+	-
Rhynchelytrum repens (Willd.) Hubb.	Natal redtop	X	+	+	+
Setaria verticillata (L.) P. Beauv.	bristly foxtail	X	-	+	-

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE g/s	kf	bg
DICOTS					
ACANTHACEAE (Acanthus Family)					
Asystasia gangetica (L.) T. Anderson	Chinese violet	X	-	+	-
AMARANTHACEAE (Amaranthus Family)					
Achyranthes aspera L.	achyranthes	X	+	+	+
Amaranthus spinosus L.	spiny amaranth, pakai kuku	X	+	+	+
ANACARDIACEAE (Mango Family)					
Schinus terebinthifolius Raddi	Christmas berry	X	+	-	+
ARALIACEAE (Ginseng Family)					
Schefflera actinophylla (Endl.) Harms	octopus tree	X	-	+	-
ASCLEPIADACEAE (Milkweed Family)					
Cryptostegia grandiflora (Roxb.) R. Br.	Indian rubber vine	X	-	+	-
Stapelia gigantea N. E. Brown	carrion flower	X	+	-	-
ASTERACEAE (Sunflower Family)					
Acanthospermum australe (Loefl.) Ktze.	spiny -bur, star-bur	X	+	-	-
Ageratum conyzoides L.	ageratum, maile hohono	X	+	+	+
Ambrosia artemisiifolia L.	common ragweed	X	+	-	-
Bidens cynapiifolia Kunth	West Indian beggar's tick	X	-	+	-
Bidens pilosa L.	Spanish needle, ko'oko-'olau	X	+	+	+
Calyptocarpus vialis Less.	hierba del cabello	X	+	-	-
Conyza bonariensis (L.) Cronq.	hairy horseweed, ilioha	X	+	-	+
Emilia fosbergii Nicolson	red pualele	X	+	+	+
Lactuca serriola L.	wild lettuce	X	+	-	-
Lipochaeta lobata (Gaud.) DC.	nehe	E	+	+	-
Pluchea indica (L.) Less.	Indian pluchea	X	+	+	+
Pluchea symphytifolia (Mill.) Gillis	pluchea, sourbush	X	-	+	+

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE g/s	kf	bg
Sonchus oleraceus L.	sowthistle, pualele	X	+	+	+
Tridax procumbens L.	coat buttons	X	+	+	+
Verbesina encelioides (Cav.) Benth. ex Hook.	golden crownbeard	X	+	-	+
Vernonia cinerea var. parviflora (Reinw.) DC.	little ironweed	X	+	+	-
Xanthium strumarium var. canadense (Mill.) Torr. & A. Gray	cocklebur	X	+	+	+
BRASSICACEAE (Mustard Family)					
Lepidium virginicum L.	lepidium, peppergrass	X	+	-	-
CACTACEAE (Cactus Family)					
Opuntia ficus-indica (L.) Mill.	panini, papipi	X	+	-	-
CHENOPODIACEAE (Goosefoot Family)					
Atriplex semibaccata R. Br.	Australian saltbush	X	+	-	-
Chenopodium murale L.	'aheahea	X	-	+	-
CLUSIACEAE (Mangosteen Family)					
Clusia rosea Jacq.	autograph tree, copey	X	-	+	-
CONVOLVULACEAE (Morning-glory Family)					
Ipomoea cairica (L.) Sweet	koali	X?	+	+	+
Ipomoea obscura (L.) Ker-Gawl.	field bindweed	X	+	+	+
Merremia aegyptia (L.) Urb.	hairy merremia, koali kua hulu	X?	+	+	+
CUCURBITACEAE (Gourd Family)					
Cucumis dipsaceus Ehrenb. ex Spach	wild cucumber	X	+	-	-
Momordica charantia L.	wild bittermelon	X	-	+	+
EUPHORBIACEAE (Spurge Family)					
Chamaesyce hirta (L.) Millsp.	hairy spurge, garden spurge	X	+	+	+
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	X	+	-	-

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE g/s	kf	bg
Phyllanthus debilis Klein ex Willd.	phyllanthus weed	X	-	+	-
Ricinus communis L.	castor bean, koli	X	-	+	+
FABACEAE (Pea Family)					
Acacia confusa Merr.	Formosan koa	X	+	-	-
Acacia farnesiana (L.) Willd.	klu	X	+	+	+
Chamaecrista nictitans (L.) Moench.	partridge pea, lauki	X	+	+	+
Crotalaria incana L.	fuzzy rattlepod, kukae hoki	X	+	-	+
Crotalaria pallida Aiton	rattlebox	X	+	+	+
Crotalaria spectabilis Roth		X	+	-	-
Desmanthus virgatus (L.) Willd.	slender mimosa	X	+	-	+
Desmodium incanum DC.	Spanish clover, kaimi	X	+	-	-
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	X	+	-	-
Indigofera suffruticosa Mill.	indigo, 'iniko	X	+	+	+
Leucaena leucocephala (Lam.) de Wit	koa-haole	X	+	+	+
Macroptilium lathyroides (L.) Urb.	cow pea	X	+	-	-
Mimosa pudica var. unijuga (Duchass & Walp.) Griseb.	sensitive plant, puahilahila	X	+	-	-
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	kiawe	X	+	+	+
Senna surattensis (N. L.Burm.) H. Irwin & Barneby	kolomona	X	+	-	-
GENTIANACEAE (Gentian Family)					
Centaurium erythraea Raf.	bitter herb	X	+	+	-
LAMIACEAE (Mint Family)					
Hyptis pectinata (L.) Poit.	comb hyptis	X	+	+	+
Hyptis suaveolens (L.) Poit.		X	+	-	-
Leonotis nepetifolia (L.) R. Br.	lion's-ear	X	+	+	+
Ocimum basilicum L.	wild basil	X	-	+	-
MALVACEAE (Mallow Family)					
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	X	+	+	+
Abutilon incanum (Link) Sweet	hoary abutilon, ma'o	I?	+	-	+

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE g/s	kf	bg
Malvastrum coromandelianum (L.) Garcke	false mallow, hauuoi	X	+	+	+
Sida fallax Walp.	'ilima	I	+	+	+
Sida rhombifolia L.	Cuba jute	X	+	-	-
Sida spinosa L.	prickly sida	X	+	-	+
MORACEAE (Mulberry Family)					
Ficus microcarpa L. f.	Chinese banyan	X	+	-	-
MYRTACEAE (Myrtle Family)					
Eucalyptus sp.	gum tree	X	+	-	-
Syzygium cumini (L.) Skeels	Java plum	X	+	-	-
NYCTAGINACEAE (Four-o'clock Family)					
Boerhavia coccinea Mill.	red-flowered boerhavia	X	-	-	+
Boerhavia repens L.	alena, anena	I	+	-	-
PAPAVERACEAE (Poppy Family)					
Argemone glauca (Nutt. ex Prain) Pope	pua-kala, native poppy	E	+	-	-
PASSIFLORACEAE (Passion Fruit Family)					
Passiflora suberosa L.	huehue-haole	X	+	-	+
PLUMBAGINACEAE (Leadwort Family)					
Plumbago zeylanica L.	'ilie'e	I	+	+	-
PORTULACACEAE (Purslane Family)					
Portulaca pilosa L.	'ihi	X	+	+	-
PROTEACEAE (Protea Family)					
Grevillea robusta A. Cunn. ex R. Br.	silk oak	X	+	-	-
SAPINDACEAE (Soapberry Family)					
Dodonaea viscosa Jacq.	a'ali'i	I	+	-	-

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE g/s	kf	bg
SOLANACEAE (Nightshade Family)					
Lycopersicon pimpinellifolium (Jusl.) Mill.	currant tomato, wild tomato	X	+	-	-
Nicandra physaloides (L.) Gaertn.	apple-of-Peru	X	+	-	-
Solanum americanum Mill.	popolo	I?	+	+	-
Solanum linnaeanum Hepper & P. Jaeger	apple-of-Sodom	X	+	-	-
STERCULIACEAE (Cocoa Family)					
Waltheria indica L.	'uhaloa, hi'aloa	I?	+	+	+
VERBENACEAE (Verbena Family)					
Lantana camara L.	lantana	X	+	-	-
Stachytarpheta jamaicensis (L.) Vahl	Jamaica vervain, owi, oi	X	+	+	-
Stachytarpheta urticifolia (Salisb.) Sims	nettle-leaved vervain	X	+	-	-
Verbena litoralis Kunth	weed verbena, oi	X	+	-	-

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EDUCATION

Master of Science (M.S.) degree in the Botanical Sciences, University of Hawaii, Manoa. December 1983. Area of specialization: Plant taxonomy with special emphasis on the native Hawaiian flora. M.S. thesis topic: "A revision of the Hawaiian species of Sesbania (Leguminosae)."

Bachelor of Arts (B.A.) in the Botanical Sciences, University of Hawaii, Manoa. May 1970.

Graduate of Kaimuki High School. June 1965.

EXPERIENCE

Botanical Consultant - 1976 to present; self-employed. Field investigation, data analysis, and preparation of findings for the biological section in Environmental Impact Statements (EIS). The scope of work involves: (1) a discussion of rare, threatened or endangered plant species found on the study site; (2) a general description of the major vegetation types found on the study site; (3) an inventory of the flora on the study site; (4) the identification of areas of potential environmental problems or concerns; and (5) a summary of the extant botanical knowledge of the study site.

Natural Area Biologist, SR-21 - July 1985 to June 1986. One year funding. Natural Area Reserves System (NARS), State Department of Land and Natural Resources. Major duties: Plan, develop, and direct native and non-native plant and animal surveys within the reserves system. Evaluate existing and potential impact of non-native species within each reserve. Develop site-specific management programs as well as direct on-site management activity. Supervise a lower-level NARS biologist and, when available, part-time and volunteer workers.

Horticulturist, SR-18 - May 1978 to September 1979. Honolulu Botanic Gardens, City and County Department of Parks and Recreation. Major duties: Program director, Exceptional Trees Program. Working with the City Administration and the City Council in establishing a permanent staff organization and Arborist Advisory Committee necessary to fulfill the Exceptional Trees' Law; documentation and identification of the Exceptional Trees designated by the City and County Ordinance; identification of additional trees to the list. End of contract; left to complete M.S. degree program.

INTERESTS

Hiking, fishing native plants, bonsai, photography, trivia collector.

Member of the following organizations:

- Hawaiian Botanical Society. Life membership. Served as Chairman, Science Fair Committee, 1981, 1983. Secretary 1978, 1979. Director 1977. Native Coastal Plants Committee 1986.

- The Nature Conservancy. Sponsor 1986.

Community service:

- The Nature Conservancy. Resource person. Scientific Advisory Committee.

- State Department of Education (DOE). Resource person and lecturer, native plants and island ecosystems.

- Marine Advisory Program, Sea Grant, University of Hawaii. Resource person, strand vegetation.

PERSONAL BACKGROUND

One-quarter Hawaiian, that's why the active interest in native plants and island ecosystems. Single, 5 ft. 5 in. tall, roughly 128 lbs. Born 16 May 1947(a baby boomer).
References will be furnished on request.

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Char, W. P. 1976. Field studies of the Sesbania complex on the island of Hawaii. Pacific Tropical Botanical Garden Bulletin 6(2): 41.

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Appendix M.

Survey of the Avifauna and Feral Mammals at Makaiwa Hills, Ewa, Oahu

Phillip L. Bruner

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT MAKAIWA HILLS, EWA, OAHU

Prepared for

William E. Wanket Inc.

by

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Director, Museum of Natural History
BYU-H
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4 August 1990

INTRODUCTION

The purpose of this report is to summarize the findings of a two day (18,20 July 1990) bird and mammal field survey of property proposed for a golf course and residential development located at Makaiwa Hills, Ewa, Oahu (Fig.1). Also included are references to pertinent literature as well as unpublished reports.

The objectives of the field survey were to:

1- Document what bird and mammal species occur on the property or may likely occur given the range of habitats available.

2- Provide some baseline data on the relative abundance of each species.

3- Supplement these findings with published and/or unpublished data.

4- Evaluate the possible changes that might occur in the bird and mammal populations following the proposed development of the property.

5- Determine if any special or unique habitats important to birds and mammals occur on the property and if necessary suggest some possible ways these areas may be protected.

GENERAL SITE DESCRIPTION

The proposed project property of approximately 2000 acres is located on the west shore of Oahu at Makaiwa Hills (see Fig.1). The site presently contains scrubby second growth patches of trees and brush with an understory of dry grass. The dominant trees in the area are: Kiawe (*Prosopis pallida*) and Koa Haole (*Leucaena leucocephala*). No wetlands occur on the property.

Weather during the field survey was generally clear with some brief cloudy periods. Winds were NE trades at 10-20 mph.

STUDY METHODS

Field observations were made with the aid of binoculars and by listening for vocalizations. Attention was also paid to the presence of tracks and scats as indicators of bird and mammal activity.

At various locations (see Fig.1) eight minute counts were made of all birds seen or heard. Between these count stations walking tallys were also kept. These counts provide the basis for the population estimates given in this report.

Observations of feral mammals were limited to visual sightings and evidence in the form of scats and tracks. No attempts were made to trap mammals in order to obtain data on their relative abundance and distribution.

Scientific names used herein follow those given in the most recent American Ornithologist's Union Checklist (A.O.U. 1983), Hawaii's Birds (Hawaii Audubon Society 1989), Field Guide to the Birds of Hawaii and the Tropical Pacific (Pratt and al. 1987), Mammal Species of the World (Honacki et al. 1982) and Hawaiian Coastal Plants (Merlin 1980).

RESULTS AND DISCUSSION

Resident Endemic (Native) Land Birds:

No endemic land birds were recorded during the course of the field survey. The only likely endemic species which might occasionally forage in the area is the Short-eared Owl or Pueo (*Asio flammeus sandwichensis*). Pueo are diurnal and can be found in upland forest as well as lowland grasslands and fields. The State of Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife lists the Pueo as endangered on Oahu.

Resident Indigenous (Native) Land Birds:

No resident indigenous birds were recorded nor would any be expected at this site given the types of habitat available.

Resident Indigenous (Native) Seabirds:

Seabirds typically nest on offshore islands which are free from disturbance by dogs, cats, mongooses and rats. However, there are areas on the main islands were predators lack access and nesting can be successful (Bruner 1988a). No seabirds were found during the survey and it is unlikely any would nest at this site due to the presence of predators. Char and Whistler (1986) report seeing a White-tailed Tropicbird (*Phaethon lepturus*) flying over the makai section of the property.

Migratory Indigenous (Native) Birds:

No migratory shorebirds were recorded during the survey. Given the time of year it is unlikely any would be found since the spring migration had already taken place in late April and they do not return until August. The Pacific Golden Plover (*Pluvialis fulva*) and Ruddy Turnstone (*Arenaria interpres*) are common migrants which can be found on lawns and fields as well as along the intertidal zone. It is likely that both of these species occur on this property during the "winter" (August-April). Johnson et al. (1981) and Bruner (1983) have shown plover are extremely site-faithful on their wintering grounds and many establish foraging territories which they vigorously defend. Such behavior makes it possible to acquire a fairly good estimate of the abundance of plover in any one area. These populations likewise remain relatively stable over many years (Johnson et al. 1989).

Exotic (Introduced) Birds:

A total of 16 species of exotic birds were found during the field survey. Table One shows the species recorded and their relative abundance. The most abundant species were Zebra Dove (Geopelia striata), Red-vented Bulbul (Pycnonotus cafer), Common Waxbill (Estrilda astrild), Red Avadavat (Amandava amandava) and Nutmeg Mannikin (Lonchura punctulata). Exotic species not recorded on the actual survey but which potentially could occur at this locality include: Ring-necked Pheasant (Phasianus colchicus), Japanese Bush-warbler (Cettia diphone), Chestnut Mannikin (Lonchura malacca), Java Sparrow (Padda oryzivora), Eurasian Skylark (Alauda arvensis), Gray Francolin (Francolinus pondicerianus) and Barn Owl (Tyto alba) (Pratt et al. 1987; Bruner 1988b, 1990a, 1990b; Hawaii Audubon Society 1989).

Red-vented Bulbul have become one of Oahu's most abundant species in recent years. The adaptability of this species to a wide variety of habitats and its remarkable population increase have been well documented (Williams 1983; Williams and Giddings 1984; Williams and Evenson 1985). Java Sparrow are also presently experiencing an island wide population explosion (Hawaii Audubon Society 1989).

Feral Mammals:

The only feral mammals observed during the survey were cats and the Small Indian Mongoose (Herpestes auropunctatus). No rats or mice were recorded but they undoubtedly do occur on the property. Without a trapping program it is difficult to conclude much about the relative abundance of rats, mice, cats and mongooses at this site. It is likely that their numbers are typical of what one would find elsewhere in similar habitat on Oahu. Domestic cattle were found grazing over most sections of the property.

Records of the endemic and endangered Hawaiian Hoary Bat (*Lasiurus cinereus semotus*) are sketchy but the species has been reported from Oahu (Tomich 1986; Kepler and Scott 1990). None were observed on this field survey.

CONCLUSION

A brief field survey can at best provide a limited perspective of the wildlife present in any given area. Not all species will necessarily be observed and information on their use of the site must be sketched together from brief observations and the available literature. The number of species and the relative abundance of each species may vary throughout the year due to available resources and reproductive success. Species which are migratory will quite obviously be a part of the ecological picture only at certain times during the year. Exotic species sometimes prosper for a time only to later disappear or become a less significant part of the ecosystem (Williams 1987). Thus only long term studies can provide the insights necessary to acquire a complete understanding of the bird and mammal populations in a particular area. However, when brief studies are coupled with data gathered from other similar sites the value of the conclusions drawn are significantly increased.

The following are some broad conclusions related to bird and mammal activity on this property:

1- The present environment provides a limited range of habitats which are utilized by the typical array of exotic birds one would expect at this elevation and in this type of environment on Oahu. Population sizes of these species were within the limits of expectation for this area. Some species were unaccounted for but this may have been due to their distribution.

2- No migratory shorebirds such as Pacific Golden Plover were observed on the survey but this was due to the time of year. Plover are common in open short-grass fields and cleared areas during the months of August through April and undoubtedly utilize this property.

3- No native birds were recorded and it is unlikely any would occur in this area aside from perhaps the Pueo or Short-eared Owl.

4- A trapping program would be required to obtain more data on mammals. The brief observations of this survey did not reveal any unusual mammal activity.

5- From the perspective of birds there is nothing special or unique about this property. Abundant second growth habitat of this sort occurs throughout the lowlands of West Oahu.

6- The proposed development will result in the creation of a more diversified range of habitats. These changes may result in some species becoming more common while others may decline in abundance. Species which could become more common include: Pacific Golden Plover, House Sparrow (Passer domesticus), Common Myna (Acridotheres tristis) and Japanese White-eye (Zosterops japonicus). Those species which should decline in numbers as the present habitats are altered are: Erckel's Francolin (Francolinus erckelli), Red Avadavat, Common Waxbill and Nutmeg Mannikin.

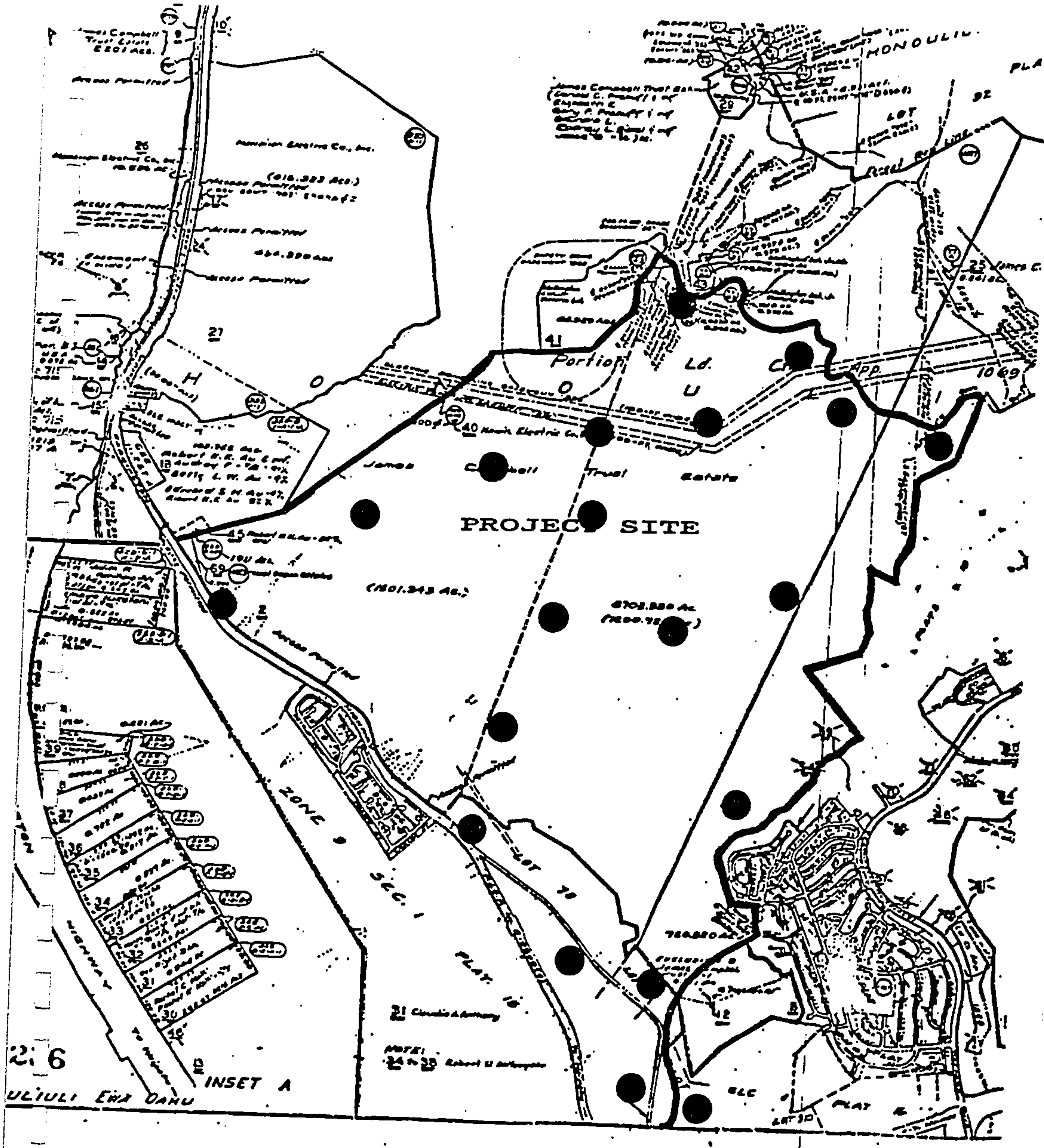

Fig. 1. Project site with faunal census stations marked by solid circles.

TABLE 1

Relative abundance of exotic birds at Makaiwa Hills, Oahu.

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*
Cattle Egret	*Bubulcus ibis*	R = 18
Erckel's Francolin	*Francolinus erckelii*	C = 9
Spotted Dove	*Streptopelia chinensis*	C = 5
Zebra Dove	*Geopelia striata*	A = 15
Rock Dove	*Columba livia*	R = 2
Common Myna	*Acridotheres tristis*	U = 4
Red-vented Bulbul	*Pycnonotus cafer*	A = 13
Northern Mockingbird	*Mimus polyglottos*	R = 3
Northern Cardinal	*Cardinalis cardinalis*	U = 2
Red crested Cardinal	*Paroaria coronata*	C = 10
Japanese White-eye	*Zosterops japonicus*	C = 8
House Sparrow	*Passer domesticus*	R = 9
House Finch	*Carpodacus mexicanus*	U = 4
Nutmeg Mannikin	*Lonchura punctulata*	A = 20
Red Avadavat	*Amandava amandava*	A = 12
Common Waxbill	*Estrilda astrild*	A = 25

* (see page 11 for key to symbols)

KEY TO TABLE 1

Relative abundance = number of individuals observed during walking survey or frequency on eight minute counts in appropriate habitat.

A = abundant (10+) on 8 min. counts

C = common (5-10) on 8 min. counts

U = uncommon (less than 5) on 8 min. counts

R = recorded but not on 8 min. counts (number which follows is the total recorded over the course of the entire survey)

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PROFESSIONAL VITA

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Biographical Data

Born: Salt Lake City, Utah 4-8-44
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Educational Preparation

B.S. Biology Church College of Hawaii 1970
M.S. Zoology Louisana State University 1974
Graduate work University of Hawaii 1976-1986

Work Experience

Academic Advisor and part time instructor BYU-H 1974-1978
Assistant Professor of Biology and Director, Museum of Natural History at BYU-H 1978-present
Environmental Consultant

Research

1970-1971 Ornithological survey of French Polynesia
1976, 1978 " " " Micronesia
1977 " " " Samoa, Fiji, Tonga
1979-present Behavorial ecology study of the wintering behavior of Pacific Golden Plover at BAFS, Oahu
1984 Ornithological survey of Austral Islands, French Polynesia
1985, 1987 " " " Southern Marquesas Islands, French Polynesia
1986-present Morphometric study of Black-crowned Night Heron in Hawaii.

Literature

Field Guide to the birds of French Polynesia, Pacific Scientific information Center, B.P. Bishop Museum, 1972, 135pp.

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A field guide to the birds of Hawaii and the tropical Pacific. Princeton University Press. 1987. 500pp.

Other associated professional experience:

President, Hawaii Audubon Society 1986,1987
Animal Species Advisory Commission - State of Hawaii 1988-1992

Previous Ornithological Survey/Work Experience

Contractor: Ahuimanu Productions
Project:
1- Ornithological survey of Hawaiian Wetlands. 1977.
2- Avifaunal survey of the central Koolau range, Oahu. 1978.

Contractor: The Hawaii State Dept. of Planning and Economic Develop.
Project:
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Contractor: AECOS
Project:
1- Master plan for Kahului Airport - Kanaha Pond and adjacent lands, Maui. 1981.

Contractor: R. M. Towill Corporation
Project:
1- An avifaunal and feral mammal survey of Kokohead and Puu Papaa, Oahu, for a GTE Mobilnet Project. 1984.

Contractor: VTN Pacific, Inc.
Project:
1- An Avifaunal and feral mammal survey of property designated for a Loran-C Station, Barrigada, Guam. 1984.

Contractor: Belt,Collins and Associates
Project:
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2- An avifaunal and feral mammal survey of Princeville Phase II, Kauai. 1979.
3- An avifaunal and feral mammal survey of Mahukona Properties, Hawaii. 1979.
4- An avifaunal and feral mammal survey of Ninini Point, Kauai. 1980.
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6- An avifaunal and feral mammal survey of property for the Kahuku Seafood Farms, Oahu. 1980.
7- An avifaunal and feral mammal survey of Olohana Properties and Mauna Loa Lands, Hawaii. 1980.
8- An avifaunal and feral mammal survey of Kohala Makai I, Hawaii. 1981.
9- An avifaunal and feral mammal survey of the Wailua-Haleiwa Wastewater Facilities, Oahu. 1982.
10- An avifaunal and feral mammal survey for the proposed Ford Island Causeway, Oahu. 1984.
11- An avifaunal and feral mammal survey of Mauna Lani, Hawaii. 1984.
12- An avifaunal and feral mammal survey of Mauna Kea Properties, Hawaii. 1984.

Previous Ornithological Survey/Work Experience (cont.)

Contractor: Belt, Collins and Associates (cont.)
Project:
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15- An avifaunal and feral mammal survey of the Foster Petroleum Corp. proposed light industrial park property, Kilauea, Kauai. 1985.
16- An avifaunal and feral mammal survey of property proposed for development at Parker Ranch, Hawaii. 1985.
17- An avifaunal and feral mammal survey of Kapalua Development Subdivision, Honokahua, Lahaina, Maui. 1986.
18- An avifaunal and feral mammal survey of Mokule'ia property designated for possible development of the Waialua-Haleiwa Wastewater Facility. 1986.

Phillips Brandt Reddick and Associates

1- An avifaunal and feral mammal survey of property proposed for development at Makalawena, North Kona, Hawaii. 1986.

Black and Veatch

1- An avifaunal survey of proposed coal ash disposal sites for the Taichung coal-fired thermal project, Taiwan Power Company, Taiwan, Republic of China. 1986.

Department of Land and Natural Resources, Division of Forestry and Wildlife, State of Hawaii.

1- Densities and population sizes of urban birds in Waikiki Beach. 1986.

1987-1988 Projects

1- Avifaunal and feral mammal survey of Hawaiian Riviera Resort property at Ka'u, Hawaii. Belt Collins and Assocaites. 1987.

2- Avifaunal and feral mammal survey of property located at Kunia, Central Oahu. William E. Wanket Inc. 1987.

3- Avifaunal and feral mammal survey of Maili Kai property, Maili, Waianae district, Oahu. Phillips Brandt Reddick. 1988.

4- Survey of the avifauna and feral mammals at Grove Farm Properties, Poipu, Kauai. Belt Collins and Associates. 1988.

5- Survey of the avifauna and feral mammals at Makena 700 Property, Makena, Maui. Phillips Brandt Reddick. 1988.

6- Survey of the avifauna and feral mammals at Palauea Lands, Makena, Maui. Phillips Brandt Reddick. 1988.

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10- Survey of the avifauna and feral mammals at Keauhou resort project property, Kona Hawaii. 1988

11- Mariana Common Moorhen (Gallinula chloropus guami) and the problems posed by transmission lines. 1988

12- Survey of the avifauna and feral mammals at the proposed Waihee golf course site, Waihee, Maui. 1988

13- Survey of the avifauna and feral mammals at Waikoloa village property, Waikoloa, Hawaii. 1988

14- Field survey of the avifauna and feral mammals at Grove Farm properties, Lihue/Puhi, Kauai. 1988

15- Avifaunal and feral mammal survey of Royal Kunia-phase II property located at Kunia, Central Oahu. 1988

16- Survey of the avifauna and feral mammals at Kaupulehu property, Hawaii. 1988

17- Survey of the avifauna and feral mammals at South Beach mauka, Kaanapali, Maui. 1988

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1989 Projects (cont.)

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5- Field survey of the avifauna and feral mammals at Kalaupapa, Molokai; Phase I and II report. 1989. Prepared for Edward K. Noda and Associates

6- Avifaunal and feral mammal survey of Campbell estate property, Kahuku, Oahu. 1989. Prepared for William E. Wanket Inc.

7- Survey of the avifauna and feral mammals at Mauna Lani Marina south Kohala,Hawaii. 1989. Prepared for Belt Collins and Associates

8- Survey of the avifauna and feral mammals at Queen Liliuokalani Trust property, Kailua, Kona, Hawaii. 1989. Prepared for Belt Collins and Associates.

9- Field survey of the avifauna and feral mammals at Puu Po'a Point, Princeville, Kauai. 1989. Prepared for Belt Collins and Associates.

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Appendix N.

Market Feasibility Analysis of Residential and Retail Development Opportunities and Market Positioning for Makaiwa Hills at Kapolei, A Master Planned Development of 2000+ Acres in Oahu, Hawaii

Robert Charles Lesser & Co.

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ROBERT CHARLES LESSER & CO.
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MARKET FEASIBILITY ANALYSIS OF RESIDENTIAL AND RETAIL DEVELOPMENT OPPORTUNITIES AND MARKET POSITIONING FOR MAKAIWA HILLS AT KAPOLEI, A MASTER PLANNED DEVELOPMENT OF 2,000+ ACRES IN OAHU, HAWAII

Prepared for:
THE ESTATE OF JAMES CAMPBELL
(EIS Document)

August 20, 1990

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APPENDIX

APPENDIX

EXECUTIVE SUMMARY

A. Introduction

The Makaiwa Hills property is a 2,000-acre hillside parcel located on H-1 across from the proposed City of Kapolei and the Ko Olina Resort within the Kapolei community on the Leeward Coast of Oahu. As currently envisioned, Makaiwa Hills will accommodate some 2,000 to 2,500 residential units and an 18-hole golf course, and will target executives, retirees and second home buyers. Further, approximately 110 acres have been set aside on the southeast portion of the site for development of a regional mall.

B. General Conclusions

The Makaiwa Hills property is considered to be a critical component to the successful development of the larger Kapolei community. The development opportunities at Makaiwa Hills should be maximized with a view towards their impact on future commercial activity at Kapolei.

Residential Development Opportunities

The Makaiwa Hills property is well-suited for development of "executive" housing given its hillside location, mountainous topography, and proposed golf course. By offering a broad array of executive housing products including custom lots, single-family detached homes and townhomes which maximize golf frontage and view potentials, the Makaiwa Hills property is expected to successfully compete with more established executive housing locations in Kailua, Hawaii Kai and Kahala.

The attraction of corporate decision-makers to the area is key to the long term viability of the City of Kapolei as a major economic center. Decision-makers create employment opportunities and have a vested interest in improving the desirability and value of the area in which they live. Executive housing is considered to be critical in drawing regional "Class A" office users to an emerging core location.

Makaiwa Hills' location in proximity to the "Second City" of Kapolei will enhance its desirability as a place to live near employment. Office and retail development in the area should enhance Makaiwa Hills' attractiveness to all targeted categories of home buyers including executives and retirees. Development of the Ko Olina Resort and Ewa Marina will further aid in attracting executive buyers to the Ewa area.

The Makaiwa Hills development is expected to meet an identified target niche, and ensure that a broad range for housing opportunities, affordable, mid-priced, and upper-end, are available within the Kapolei community. The highly-amenitized Makaiwa Hills property will become a "jewel" in the Kapolei development, establishing Kapolei as an executive housing location.

Regional Mall Development Opportunities

The southeast portion of the subject property has been appropriately set aside for development as a regional mall. The subject property enjoys excellent visibility and freeway access from H-1. Mall development will take advantage of the rising permanent resident and visitor population within the Ewa region and is expect to add to the "critical mass" of commercial development activity at Kapolei.

Regional mall development provides a further catalyst for attracting regional-serving office and other employment activities to an emerging core location. Regional malls provide a focal point for development, enhance regional name recognition, and add to the upscale, "class A" image of the emerging core, an important component in attracting regional-serving employers to an area.

Findings and recommendations in support of these conclusions have been summarized below.

C. Regional Housing Trends

The long-term growth potential for the Oahu regional economy remains strong. Absorption rates and the recent rapid housing price escalations, however, are likely to decrease from their current "heated" levels. Healthy employment and population growth on Oahu are expected to create average levels of household growth of 4,900 to 6,500 per year through 2010.

There currently exist significant levels of pent-up demand for housing of all prices. These pent-up demand conditions are the result of the historical gap between new housing production and household growth statistics, averaging some 1,000 units per year during the 1980s alone.

Further strength of the high-end housing market is attributed to the historical lack of high quality, amenity-oriented development on Oahu. Makaiwa Hills will be one of the few master-planned communities addressing this level of demand by offering a well executed community with golf course and ocean views.

The greatest concentration of new housing growth is expected to occur in the Ewa and Central Oahu Development Plan Areas. The rest of the desirable locations on the island are at or near build-out (Hawaii Kai, Kahala, Downtown Honolulu). The Ewa Development Plan Area (specifically Kapolei) is expected to become the second urban core area in Oahu, with employment centers, shopping areas, resorts and a broad array of housing choices.

Development currently under way in the Ewa area will enhance Makaiwa Hills' market positioning. Contributing factors to the potential of the Ewa Development Plan Area include: the initial development of Ko Olina, a luxury resort and golf course community immediately west of the Makaiwa Hills property, the planned City of Kapolei, the planned Ewa Marina residential community, other residential communities now under way (including Ewa Gentry, West Loch Estates and the Villages of Kapolei), and development of the subject property.

D. Residential Competitive Positioning and Demand

Makaiwa Hills is well positioned to take advantage of the potential growth of the Ewa Development Plan Area. The key factors contributing to Makaiwa Hills' positioning are its privacy and views, both of which are attractive to executive home buyers. Also, the prestige of a golf course community and anticipated high-quality master-planned environment will heighten the marketing advantage of Makaiwa Hills.

Current and proposed development activity in the area is not expected to adversely affect Makaiwa Hills. In fact, such development is expected to increase the desirability of the general vicinity and to improve demand for executive housing developments such as Makaiwa Hills.

Makaiwa Hills' primary market audiences consist of affluent local residents and executive home buyers from throughout the island of Oahu. Specifically, Makaiwa Hills is expected to attract upper middle-income and upper income market segments comprising primary executive home buyers, affluent retirees from Oahu, and second home buyers.

Building on its views, and golf course and recommended tennis club amenities, Makaiwa Hills should be priced near the top of the market. Makaiwa Hills should position itself above most currently active projects in Ewa (with the exception of Ko Olina, which has positioned itself at the highest end of the Ewa Development Plan Area, and Ewa Marina, also expected to be at the high end of the market), and similarly to prices of new and resale projects in Kailua, Hawaii Kai and, to some extent, the Kahala area.

Residential products at Makaiwa Hills are expected to be absorbed at rates of 160 to 370 units and lots per year. This absorption is predicated on the assumption of a full array of upper-end products, enabling maximum absorption potential to different executive buyer segments.

E. Residential Development Strategy Recommendations

Makaiwa Hills must offer highest quality products. Community-wide features, such as landscaping, signage, set-back requirements and tight architectural controls, must be implemented to ensure the creation and maintenance of the appropriate levels of image and perceived value at Makaiwa Hills.

Makaiwa Hills should offer a wide array of product types and price ranges for executive housing. This will maximize market absorption potential and create the requisite critical momentum. Specifically, by offering both golf and non-golf amenities, a variety of products can be provided concurrently, thus, reducing the absorption time for the project overall.

The development should be staged. This would insure the availability of a broad spectrum of product types, price ranges and amenity orientations throughout the marketing phases of the community, while offering the flexibility to maintain the proper focus on executive, high-end housing.

Makaiwa Hills will be largely dependent on move-up buyers. Therefore decreased activity in the resale market, due to higher interest rates and slower economic growth, could slow demand and absorption at the property. Development parcels should be sized to achieve sellout within no more than three years. This will afford the opportunity to constantly offer new product design, respond to current market conditions and to avoid stagnation of product and/or marketing.

The following product matrix offers a "menu" of product alternatives for the Makaiwa Hills property. Absorption ranges represent stable growth assumptions. All prices, which include a fee simple interest in the land, are stated in 1990 dollars and exclude premiums.

PRODUCT TYPE	DENSITY	LOT SIZE RANGE/ RANGE	UNIT SIZE RANGE	BASE PRICE ABSORPTION	AVERAGE ANNUAL BUILD-OUT
SFD-1	Custom Lot	12,000 - 20,000	NA	$450,000 - $750,000	36
SFD-2	Custom Lot	8,000 - 12,000	NA	$380,000 - $450,000	36
SFD-2a	Custom Golf	8,000 - 12,000	NA	$400,000 - $520,000	36
SFD-3	Semi-Custom Single-Family	8,000 12,000	3,200 - 4,500	$800,000 - $1,100,000	24
SFD-4	Golf Cluster	3,500 6,000	2,800 - 3,600	$450,000 - $575,000	48
SFD-4a	SF Golf	5,000 - 6,000	2,500 - 4,000	$650,000 - $850,000	72
SFD-5a	Single-Family	5,000 - 6,000	1,600 - 2,400	$475,000 - $575,000	60
SFD-5b	Single-Family	5,000 - 6,000	2,200 - 3,200	$550,000 - $630,000	60
SFA-6b	Townhome	4 - 5	1,900 - 2,600	$470,000 - $580,000	42
SFA-6c	Townhome	4 - 6	1,500 - 2,100	$350,000 - $500,000	72

Overall, recommended prices for market-rate units range from $350,000 to $1.1 million (1990 dollars). The majority of units are expected to be in the $400,000 to $750,000 range, averaging approximately $285 per square foot.

F. Regional-Serving Retail Demand

Rapid growth in population and employment within the Kapolei region is expected to create opportunities for regional-serving retail development. Given its location along H-1 across from the emerging office center at the City of Kapolei, the proposed regional mall at Makaiwa Hills is expected to draw from a trade area which includes Waianae, Wahaiwa and Ewa Tax Districts.

Increasing resident and tourist retail expenditures are expected to support at least two additional department stores in the primary trade area by 2005. This assumes additional department store demand is meet by the existing three anchor tenants, J.C. Penny's, Liberty House, and Sears, already present in Hawaii.

Market support for an upscale fashion mall exists in the short (5 to 7 year) term. This assumes at least one new upscale department store can be attracted to the Hawaii market.

The Makaiwa Hills property, with its central location to a growing population base and major employment center, has a superior location for regional mall within the primary trade area. It is expected that at least 600,000 square feet of regional mall space could be supported at the subject property by the year 2005 to 2010. Given the long term nature of such development, Campbell should beginning marketing the regional mall development (to prospective tenants and developers) immediately.

Please refer to the enclosed report and exhibit package for a detailed discussion of the findings and analysis leading to the recommendations summarized previously.

I. INTRODUCTION

A. Background

The proposed Makaiwa Hills development is a golf-oriented residential community, consisting of a 2,000-acre hillside parcel within the Kapolei master-planned community in Western Oahu (Ewa). As currently envisioned, Makaiwa Hills will accommodate approximately 2,000 to 2,500 residential units, an 18-hole golf course. In addition, a 110 acre parcel located on the southeast corner of the site (fronting H-1) has been set aside for development of a regional mall.

Makaiwa Hills is expected to provide a much needed executive housing location for the Kapolei master-planned community, taking advantage of the site's mountainous topography and excellent views of the Pacific Ocean. Master-planning and high-quality execution of the executive housing program should differentiate the project from other existing and proposed projects in the immediate area. Executive housing is considered to be critical to attracting "decision makers" to Kapolei, and ultimately to the successful development of the new City at Kapolei.

Further, the presence of a regional mall within the Kapolei Community, is considered essential to the long term viability of the development. A regional mall will further regional name recognition of Kapolei, enhance "critical massing" of commercial development, and draw additional residents and visitors to the Kapolei region. The regional mall is expected to added additional support to demand for both commercial and residential activity within Kapolei.

B. Objectives

Robert Charles Lesser & Co. has been retained by Campbell to evaluate the market feasibility of the residential and regional retail development components of Makaiwa Hills property, provide pricing recommendations and absorption estimates for residential products defined by the Land Use Plan (the "CYP, Inc." scenario), and where appropriate, suggest alternatives to the CYP plan based upon market findings.

Specific objectives of this undertaking were as follows:

1. Evaluate market and development trends that are affecting the development potential of residential and regional retail land uses at Makaiwa Hills.

2. Prepare market demand-based absorption estimates for executive housing and a regional mall at Makaiwa Hills.

3. Translate market findings into market positioning, land development, product programming and pricing strategy recommendations for the residential component of Makaiwa Hills.

4. Review the plan prepared by the design team, comment on its responsiveness to our market findings, and suggest modifications and alternatives where appropriate.

C. Methodology

To accomplish the above objectives, a qualitative and quantitative review of the housing and regional retail markets was conducted, utilizing both primary and secondary research methodologies. This included a review of pertinent socioeconomic base data, surveys of selected competitive and planned residential and regional mall developments, and interviews with key real estate professionals, public officials and institutional sources. The interviews focused on developments, market trends and future forecasts that assisted in understanding the development positioning of current and planned projects.

D. Critical Assumptions

The analysis and recommendations presented herein rely on several critical assumptions:

- On the average, the local real estate market will experience stability and efficiency during the build-out of Makaiwa Hills. This translates into underlying strength of the resale market, and into the availability of qualified, motivated buyers in the market, who are met with an array of well-designed, fairly priced and adequately financed housing alternatives. Although the housing market is expected to be cyclical in nature during this period, it is not possible to accurately predict the timing and magnitude of the up or down market "swings."

- Investor and/or foreign (especially Japanese) tourists and home buyers will continue to contribute to the dynamic retail spending patterns and housing market on Oahu. Their presence, however, will be secondary to that of primary residents and they are not considered to be the primary target market for the Makaiwa Hills properties.

- No major national recessions or drastic changes in the availability or cost of mortgage financing will occur during the absorption period. Again, while there will undoubtedly be recessions and fluctuations during this period, their timing, duration and depth is incalculable.

- Planned and proposed private sector and state developments will occur in the time frame projected by local real estate professionals and government officials as summarized herein.

- The recommendations are based on field research and present knowledge of Oahu and the Ewa area as of April 1990. That information is assumed to be complete and accurate.

- The analysis does not include the possible impact of unforeseen government restrictions on the property or on other projects in the market. In particular, it is assumed that Makaiwa Hills will be developed to include approximately 2,000 to 2,500 units, an 18-hole golf course, and the regional mall as planned.

- Estimates of market potential assume growth of the local economy as projected by the data sources cited herein. Slower economic growth may adversely impact prices and absorption potential at Makaiwa Hills. Conversely, more rapid growth would propel the market into very heated conditions, similar to those experienced during the late 1980s.

- Campbell must exercise control of overall product quality and marketing efforts for all products within Makaiwa Hills. This recognizes the necessity for Campbell to have input into all factors affecting the overall image and quality reputation critical to the success of Makaiwa Hills, including those elements within and surrounding Makaiwa Hills.

- Makaiwa Hills is expected to offer the golf course amenity described in the development program from the inception of the development. Similarly, the necessary level of infrastructure development must be in place before the commencement of the successful marketing of the community, particularly as related to major roads, landscaping, information and marketing center, etc. Absence of the above, or failure to provide these and similar facilities and improvements early on, may adversely affect the marketing success of the community.

E. Report Organization

Following this introductory chapter is the Subject Property chapter, which summarizes key physical characteristics and the proposed development plans for Makaiwa Hills.

The next four chapters of the report cover opportunities to develop housing at Makaiwa Hills. Regional demographic trends and Ewa/Kapolei household growth patterns are covered in the Regional Housing Trends chapter. The Residential Demand Analysis chapter covers market demand potential and expected capture/absorption opportunities for housing at Makaiwa Hills. The Residential Competitive Market Analysis chapter discusses current and projected development trends and housing market conditions on Oahu, concluding with Makaiwa Hills' competitive positioning recommendations. Finally, the Residential Development Conclusions and Recommendations chapter summarizes positioning and development recommendations based on the analysis contained in the other chapters of the report.

The Regional Retail Development Opportunities chapter provides an analysis of market demand potential for including a regional mall on a portion of the property.

Data supporting the analysis, conclusions and recommendations of this report are contained in the attached exhibit package.

II. SUBJECT PROPERTY

The Makaiwa Hills property is part of the larger Kapolei community which encompasses some 32,000 acres on the leeward side of Oahu. The following section discusses existing and proposed land uses within Kapolei, their impact on the subject property, and the suitability of the Makaiwa Hills site for "executive" residential development and as a site for a regional mall. Issues considered in this analysis include access, visibility, consistency with surrounding land uses, topography and the regional appeal of the Kapolei area.

A. Kapolei Planning Area

Kapolei is a large-scale, master-planned community located approximately 20 miles west of downtown Honolulu. The cornerstone of the Kapolei master plan is the 570-acre City of Kapolei. Known as the "second city," the City of Kapolei is expected to contain approximately 1.2 million square feet of class A office space, over 1 million square feet of community-serving shopping center space, a regional-serving power center, and 3,000 to 4,000 housing units by the year 2010. The first 140,000-square foot shopping center and 120,000 square feet of office development at Kapolei are expected to come on-line in 1992 and 1993, respectively. In addition, over 2 million square feet of light industrial development are proposed for the adjacent Kapolei Business-Industrial Park.

The proposed commercial development at Kapolei represents a significant transition from existing land uses and image of the Ewa region (Kapolei comprises approximately 90% of the Ewa region as defined by the City and County of Honolulu's General Planning Areas). Prior to 1987, commercial activity in Ewa consisted mainly of the heavy industrial Campbell Industrial Park, Barbers Point Naval Air Station, and several public facilities including a power plant (proximate to the subject property). By the year 2010, proposed development within the Ewa region including the City of Kapolei, Ko Olina Resort, and Kapolei Business-Industrial Park is expected to create over 20,000 new jobs. As such, Kapolei will be one of the largest, if not the largest center of employment outside of Honolulu.

Future commercial activity at Kapolei is expected to impact the overall image of Kapolei as a desirable place to live for a wide range of prospective residents. New residential development will target the range of homebuyers and renters who wish to live close to work and retail services. Diverse housing needs will create development opportunities in all price range categories including affordable, mid-range and upper end, executive housing.

Makaiwa Hills provides a critical opportunity for Campbell to develop housing product which promotes the transformation of Kapolei into a major regional economic center. Providing executive housing and attracting decisions-makers to Kapolei is one way to encourage economic growth.

B. Subject Property Characteristics

The Makaiwa Hills property is comprised of 2,000 acres, to be developed as 2,000 to 2,500 residential units, an 18-hole golf course and a regional mall. The location of Makaiwa Hills within Honolulu County plan areas and relative to other Oahu communities is shown in EXHIBITS 1 and 2.

Access and Visibility

Excellent regional access to Kapolei and the Makaiwa Hills property is provided via H-1. H-1 is a four- to six-lane highway which connects Kapolei to the airport, Downtown Honolulu and Central and Windward Oahu. Currently, commuters on the H-1 experience limited traffic congestion, prior to the intersection of H-1 and H-2. The commute time between Makaiwa Hills and Downtown Honolulu is estimated to be approximately 30 to 40 minutes, less than, or equivalent to commuting time experienced by residents on the Windward side of Oahu, or in Central Oahu.

Visitors and residents will have direct access to the Makaiwa Hills property from two interchanges, one at the southeast corner of the property at the intersection of H-1 and Kalaeloa Boulevard leading directly to the regional mall site, and the other approximately 6,000 feet north along H-1, which is likely to be the main entrance to the residential component at Makaiwa Hills.

The regional mall site has excellent frontage and visibility from H-1. Further, the entrance to the residential component of Makaiwa Hills as well as portions of the golf course, will also be visible from the H-1.

Adjacent Land Uses

Adjacent land uses are comprised of agricultural and preservation land to the north, residential development to the east (Makakilo), the City of Kapolei and Ko Olina Resort to the south across H-1, and unimproved hillside, and landfill site to the west.

Makaiwa Hills' proximity to the City of Kapolei is considered a major attribute for the property for both proposed residential land uses and the regional mall. Employment centers in the City of Kapolei should increase the attractiveness of Makaiwa Hills to executive buyers and the general proximity to retail services should increase the desirability of Makaiwa Hills for empty nester and retiree buyers, as well as executives. Eventually, it is expected that residential development at Makaiwa Hills will offer a retreat from the emerging urban center, similar to residential communities in the hills above downtown Honolulu.

Regional employment opportunities within the City of Kapolei are expected to draw employees from other areas of the island (i.e., Waianae and Central Oahu) to Kapolei. The expanded daytime population creates the opportunity for retailers at Kapolei to draw from a trade area which is much larger than just the Ewa/Kapolei population base.

Existing and proposed residential development in Kapolei is expected to have a positive impact on the Makaiwa Hills development, by attracting more residents and tourist (and spending dollars) to the Kapolei area, and firmly establishing Kapolei regionally as a residential community.

Makakilo, the 23-year old residential community located to the east of the subject property in the hills north of H-1, consists of mid-priced single-family and multifamily homes. Approximately 3,000 homes have been developed to date, with an additional 2,200 units planned by Finance Realty and Aina Lani Associates. The developers of Makakilo have indicated that future phases will target a higher end market.

It is recommended, that Makaiwa Hills distinguish itself in the minds of home buyers by creating a major entry statement which clearly sets Makaiwa Hills apart from its neighbors. Further, Campbell should create an internal orientation for the residential community, focusing on views, and golf course amenities.

Development of the Ko Olina Resort will have a positive impact on residential and mall uses at Makaiwa Hills. The 640-acre first phase of Ko Olina will include 4,000 hotel rooms and 5,200 housing units (3,700 condominiums and apartments and 1,500 lower density units), and an 18-hole golf course. Second phase development of 600 acres will include an additional 18-hole golf course and 4,300 residential units. Other project amenities include one to two shopping centers and a 400-slip marina.

Ko Olina reports that three hotels will be built by 1992. More than half of the first 130-unit luxury high-rise condominium project has been sold at prices averaging $1,000 per square foot. The project's early success seems to signal that the location is acceptable as a luxury resort address, paving the way for Makaiwa Hills to establish the area's desirability as a residential address. Further, tourist spending dollars are expected to enhance demand for the regional mall.

Finally, in the short to mid-term, the landfill to the west of the property will have a negative impact on development at Makaiwa Hills. While the site is physically separated from the adjacent landfill by a ridge, its presence is expected to have an adverse impact on the eastern portion of the subject property as long as the landfill remains active (at least the next 7-10 years).

It is recommended that the residential products on central and western portions of the subject property be developed first. Land planning efforts should focus on using the golf course as a buffer between the landfill and residential products. By delaying residential development on the eastern portion of Makaiwa Hills until the landfill becomes inactive, Campbell will be able to optimize golf-oriented premiums and prevent the need to discount units.

Views and Topography

The property is mostly hilly, with four to five ridgelines offering excellent ocean and mountain view opportunities. The southern portion of the property (which abuts H-1) is relatively flat and is well suited for the proposed location of the 18-hole golf course, and regional mall as well as for single-family and multifamily development.

Golf course frontage and views should be maximized through land planning and building siting and configurations. Every parcel should have the maximum amenity exposure possible, while non-amenity parcels will have privacy and view orientation. In this way, the property's views, proposed amenities and topography will vary from one part of the property to the other, offering a variety of different orientations to meet buyer needs.

Regional Appeal

Historically an agricultural area offering low-priced housing, the Ewa area is gradually transforming into a balanced housing environment in Oahu. This change is precipitated by the growth of the Kapolei community as the designated "second urban core" on Oahu. At the time products at Makaiwa Hills are expected to be offered (after 1995), the Kapolei area will consist of several large-scale residential communities, a luxury resort, at least one or two class A office buildings, and several community-serving retail centers.

Development of commercial office and retail space in City of Kapolei will enhance the area's desirability as a place to live and work. Employment centers and retail services typically attract executive buyers to a local area. The substantial investment, both by Campbell and other developers in Kapolei over the next five years are expected to have a positive impact on the area's reputation and image among Oahu residents.

A significant challenge to establishing Kapolei as an executive housing location pertains to the schools. At the moment, the public school system is not perceived by affluent families as adequate, thus most enroll their children in private schools, primarily in the downtown Honolulu area. Public officials indicate that the next school to be built in the area (when funds become available) would be an elementary school. Private schools should also be made available for those residents who desire this alternative.

C. Development Plans

Residential

A preliminary development program for the residential component of Makaiwa Hills, as depicted in the CYP, Inc. (planners) land use plan provided in May, 1990 consists of an array of residential products, from custom lots to townhomes.

Custom lots (residential products SFD-1 and SFD-2) represent 356 of the total 1,822 units in the program, and would be developed mostly in the northern portions of the property on the ridge lines. Semi-custom homes (SFD-3) will consist of 148 units, also in the northern portions of the property. The custom lots and semi-custom homes will have excellent ocean and mountain views, as well as views of the golf course.

Single-family homes (SFD-4a, SFD-4b, SFD-5a and SFD-5b) will consist of 1,193 units developed throughout the property. Some of these homes will have golf course frontage. Townhomes (SFA-6a and SFA-6b) will consist of 584 units, and will be located along the golf course and southern portions of the property. Many of these units will have golf course frontage.

Recreational Amenities

The golf course is currently planned to be located in the southern portion of the property, mostly on flat terrain. There are only limited advantages to developing the course through the ravines because of the lack of golf course frontage and corresponding premiums which could be achieved with such a program. Premium potential, therefore, is maximized through view potentials in the northern, upper sections of the property and golf course frontage in the southern, lower sections of the property. The only detectable loss would be less variance in the topography of the golf course.

In addition to the golf course, it is recommended that a tennis and swim club facility be offered as an additional community amenity to Makaiwa Hills residents. This facility could be incorporated into the golf course facilities, or be provided separately.

Commercial

The primary commercial land use proposed for the Makaiwa Hills property consists of approximately 140 acres set aside for development of a regional mall on the southeast corner of the subject site. The site area is sufficient to accommodate a two to four department store anchored mall of over 1.2 million square feet. Other commercial land uses proposed for Makiawa Hills include a fire station and an elementary school, utilizing a total of nine acres adjacent to the regional mall.

D. Conclusions

Within the overall Kapolei master-planned community, the subject property's hillside location offers the opportunity to provide executive housing in an amenity (golf) oriented setting, with substantial view potential. By focusing on golf and view orientations, Makaiwa Hills would be able to differentiate itself from other area developments such as West Loch, Villages of Kapolei and Ewa Gentry and satisfy the needed for a balanced housing program at Kapolei which targets many different markets.

If developed as an executive residential community, Makaiwa Hills will both complement and benefit from commercial development in Kapolei. The improved image of Kapolei and growing employment opportunities as services in the area will attract a greater diversity of homebuyers and renters to Kapolei, including executives. In turn, an increasing number of executives (decision-makers) in Kapolei will enhance future employment opportunities as business relocate to areas closer to key employees.

Makaiwa Hills is planned for a variety of residential products, consisting of: custom lots; semi-custom homes; single-family detached homes; and townhomes. Many of the product types have similar orientations, due to land planning constraints in the lay-out of the golf course. Because of this, the development should seek to differentiate various product types and locations by use of infrastructure, amenity orientation, and signage.

Finally, the southeast portion of the Makaiwa Hills property is well suited for development as a regional mall given its direct freeway frontage and access along H-1 and its central location vis-a-vis existing and future commercial and residential development in Kapolei.

III. REGIONAL HOUSING TRENDS

During the latter half of the 1980s, Oahu experienced unprecedented increases in housing prices and rapid absorption of available new units. This situation has been largely attributed to a prolonged undersupply of new housing in light of growth in the Oahu population, declining household sizes, and growing demand among the second home and/or seasonal buyer markets.

Kapolei, which has a large concentration of unimproved land, has been targeted as critical to accommodating the future housing needs on Oahu. Makaiwa Hills is one of several residential developments in Kapolei expected to benefit from continued demand for new housing.

The following section provides a more detailed discussion of regional housing trends including the impact of population and household growth trends on demand for housing in Kapolei and at Makaiwa Hills.

A. Regional Growth Patterns

Overall population growth within Honolulu County was healthy during the 1980s, with an average annual growth of 1.1%, or 8,700 persons (4,700 households). Growth is projected to average 6,300 persons per year in the 1990-2000 period and 8,700 during the 2000-2010 period, resulting in 4,900 and 6,500 new households per year, respectively, a strong indicator of demand for new housing (EXHIBITS 6 through 12).

Second home and seasonal housing is estimated to comprise 10% of Oahu housing growth activity, based on the survey results and discussions with real estate sources. This creates an additional need for new housing units beyond that which is necessary to accommodate new household growth.

Building permit activity is often a strong indicator of overall economic conditions, and trends over the last 20 years within Honolulu County reflect the cyclical nature of the regional economy (EXHIBITS 13 through 17). The 20-year (1970-1989) average of just under 5,700 units per year is much greater than the 10-year 1980 to 1989 average of 3,700, and represents a substantial deficit relative to historical and future household growth in the county. During the 1980s, annual household growth averaged 4,700 households annually, well above the annual production of new units as measured by building permits issuance of approximately 3,550 units annually from 1980 through 1984 and 3,850 annually from 1985 through 1989 (EXHIBIT 18).

The exceedingly rapid price appreciation during the late 1980s has led to the pricing of many low- and middle-income families out of the market for new homes. Although the luxury buyer has probably not been priced out, the lack of new supply has limited luxury buyer options to mostly resale product or very expensive new product.

Population and household growth will continue to create demand for new residential products on Oahu in general and the Ewa area in particular. The current deficit in residential permits relative to household growth indicates substantial demand. The lack of available new product for luxury buyers and investors has created an opportunity for Makaiwa Hills to supply product to this segment of the housing market.

B. Ewa/Kapolei Growth Patterns

Since 1970, the Ewa Development Plan Area has experienced average growth of 1,600 to 1,800 households annually. Projections indicate 1,900 new households annually from 1990 to 1995, increasing in each subsequent five-year period to 3,800 new households annually from 2005 to 2010. From 1990 to 2010, the Ewa Development Plan Area is expected by the Honolulu Department of General Planning to capture 54.1% of total population growth on Oahu. The Central Oahu Development Plan Area is expected to capture 17.8% of Oahu population growth during the same period.

As of 1989, the primary market area (the combined Ewa and Central Oahu Development Plan Areas) had a smaller percentage of households in the upper income categories, i.e., $50,000 and greater, than in Honolulu County overall. The new development now planned will attract higher income households to the area, thus increasing the percentage of high-income households at a rate faster than Honolulu County as a whole (EXHIBITS 19 through 21).

A significant factor in the Ewa area's growth is the creation of the new City of Kapolei, the designated "second city" on Oahu, which will include office, retail and residential development. Creation of a new "urban core" in Kapolei will enhance the attractiveness of the area for new household growth and will aid in attracting executive home buyers, currently a small or missing segment of the market.

The Ewa Development Plan Area's substantial share of future population and household growth on Oahu should have a positive impact on Makaiwa Hills, increasing the availability of new households from which the project will draw its demand. Positive real income growth and Ewa's share of that growth are positive factors for development in the Ewa Development Plan Area and Makaiwa Hills. Creation of the new City of Kapolei should have a substantial positive effect on the development of Makaiwa Hills, given its location adjacent to the subject property.

C. Conclusions

Demand for housing at Makaiwa Hills will depend on factors exhibited previously throughout the island, including the general conditions of continued population and household growth and limited availability of new competitive housing inventories. These conditions are prevalent now and are projected to continue throughout the 1990 to 2010 period.

The current heated housing market should continue to price low- and middle-income buyers out of the new home market, especially those with no equity, and will thus continue to push prices up for all types of residential products. The situation will continue as long as construction levels fall short of household growth, increasing an existing deficit.

The impact of this shortage on new affordable units is strong demand for existing (resale) units in the lower price ranges, allowing for move-up activity as people upgrade their housing from quality, location and amenity standpoints. This contributes to the strength of demand for higher priced housing, particularly due to the very significant equities built up in the market by homeowners who have lived in their current residence for more than five years.

The preference for new product among executive buyers should have a positive impact on absorption at Makaiwa Hills. The emergence and growth of the City of Kapolei as a new urban core should make the Ewa Development Plan Area more desirable for executives. Additional opportunities for commercial office and retail development may become evident with new household growth for the Ewa Development Plan Area predicted to comprise the majority of new population growth on Oahu for the 1990-2010 period. These factors are all indicative of excellent opportunities for executive level residential development at Makaiwa Hills.

IV. RESIDENTIAL DEMAND ANALYSIS

A. Introduction

A statistical demand analysis was conducted to quantify the depth of the market for the residential component of Makaiwa Hills. The results of this analysis were utilized with primary market data as input for absorption projections.

The primary market area, defined as the area from which the majority of demand will emanate, consists of the Ewa and Central Oahu Development Plan Areas (EXHIBIT 1 shows the location of these plan areas).

Two demand analyses, one for the primary market area and one for Honolulu County, were conducted. The framework and computation of these analyses are presented in EXHIBITS 23 through 25 for Honolulu County and EXHIBITS 26 through 28 for the primary market area.

B. Methodology

Demand for housing is created as either new households enter the market (net household growth) or as households already in the market move from one home to another (turnover). For the purpose of this analysis, Makaiwa Hills is expected to experience demand for both ownership (owner-occupied) and rental units. As such, the analysis investigated the extent of market depth for both forms of tenure.

For owner-occupied housing, four sources of demand were identified: new household growth, turnover of existing renter households, turnover (owner preference) of existing owner households, and seasonal population (second home buyers). In order to further segment the market potential, each of the demand sources was broken down into household income ranges corresponding to housing price ranges by affordability.

Demand for renter-occupied housing in Hawaii is primarily satisfied by housing units owned by investors and to a much smaller extent, by rental housing complexes. For renter-occupied housing, three sources of demand were identified: new household growth, turnover of existing renter households, and seasonal population (seasonal renters). Owner turnover was not a factor in renter-occupied demand, as it is assumed that most existing homeowners will not opt for turnover into rental housing.

In all demand analyses, the base household figures and growth projections utilized were derived from the population and household growth projections discussed previously. Data on the estimated total number of households in the primary market area and Honolulu County for each period were used in the determination of demand from turnover.

To arrive at the number of income-qualified households in each income category for both the primary market area and Honolulu County, the data on household income distribution, from Urban Decision Systems, Inc. (a national demographics research organization), were multiplied by annual new household growth or the base household figure, as appropriate. These income categories corresponded to specific home price or rental range categories, depending on the extent of down payment. Average down payments, estimated based on surveys of residential projects on Oahu, range from 30% to 50% as a result of substantial equity gains arising from rapid price appreciation during the last five years.

The number of income-qualified households in each price or rental category was multiplied by owner and renter propensities from the 1980 U.S. Census (unfortunately this data will not be updated until the 1990 census results are published in 1991). The result was estimates of income- and tenure-qualified households as sources of demand.

To arrive at total annual demand by demand source for each price and rental rate category, estimated active market percentages were applied to income- and tenure-qualified household figures. Estimated active market factors out the propensity of qualified households not to purchase a new unit (i.e., they may choose to rent or buy an existing versus new unit). For owner-occupied housing, this percentage was defined as the relationship between new building permit and resale activity on Oahu. For rental housing, the percentage was estimated based on historical rental trends in typical metropolitan markets.

Demand from turnover households (both rental and owner) also utilized the estimated active market percentages, but only after multiplying income- and tenure-qualified household figures by average annual turnover factors which were calculated based on turnover data from the 1980 U.S. Census. The household figures used for turnover demand were total household figures, since turnover comes from existing rather than new households.

The resultant demands from new household growth, renter turnover, and owner preference (owner preference applies only to owner-occupied demand) were summed to arrive at total annual demand potential for each five-year period, by price or rental range.

Demand from second home buyers was calculated subsequent to the initial net demand figures from new household growth and renter and owner turnover. Although second-home buyers are not prevalent in the Ewa area currently, their presence is expected with continued development of the area, including the City of Kapolei, Ko Olina Resort, and Ewa Marina. Seasonal demand as a percentage of total demand is expected to increase over time as the Ewa area integrates higher-end housing and becomes more attractive to second home buyers and investors.

Seasonal demand is projected to represent 10% of total demand for the market areas during 1990 to 1994, 20% for owner-occupied and 10% for renter-occupied housing during 1995 to 1999, and 30% for owner-occupied and 15% for renter-occupied housing during 2000 to 2010. The seasonal demand was calculated as a percentage of total demand, rather than net demand which does not include the seasonal population effect. The resultant seasonal demand figure correctly represents the percentage of total demand for each type of ownership, but its relationship to net demand is inverse (see table).

C. Primary Market Demand Conclusions

The results of the demand analysis for the primary market area are summarized below:

	AVERAGE ANNUAL DEMAND			
	1990-1994	1995-1999	2000-2004	2005-2010
Total Owner-Occupied Demand	1,269	1,765	1,633	2,039
+ Total Renter-Occupied Demand	833	1,056	2,147	2,742
	=====	=====	=====	=====
= Total Primary Market Demand	2,102	2,821	3,780	4,781

The primary market area's share of total Honolulu County demand, calculated by a comparison of the primary market area and Honolulu County demand analyses, starts at 41% of total Honolulu County demand, increasing to 52% over time as the Ewa and Central Oahu Development Plan Areas continue to comprise a larger percentage of total household growth in the county. This is consistent with Honolulu County Planning Division projections that 48% of Oahu's new housing growth will occur in the Central Oahu and Ewa Development Plan Areas.

The Ewa and Central Oahu Development Plan Areas, therefore, will comprise the greatest concentration of housing development over the next 20 years. This "critical mass" of new development should help attract more Oahu residents to the Ewa area and should enable the area to transition in an orderly manner to include a broad range of housing.

Regional economic conditions could adversely affect demand and resultant absorption at Makaiwa Hills. The higher interest rates and slower economic growth associated with recessions would have a negative impact on new and resale activity because of decreased ability to finance homes. As Makaiwa Hills will be vitally dependent on move-up buyers for a large segment of its buyer group, decreased activity in the resale market would slow demand and absorption within the primary market area and at Makaiwa Hills.

D. Makaiwa Hills Capture

The final element of the statistical demand analysis is to determine the capture rate for the Makaiwa Hills property. As previously mentioned, Makaiwa Hills will target executives, retirees, and second home buyers who seek an amenity-oriented environment. As such, Makaiwa Hills will target the upper end, second time move-up, upgrade and luxury, portion housing market ($370,000 and above among owner-occupied units and $1,000 and above among renter occupied units).

As previously mentioned, demand for rental housing on Oahu is largely satisfied by investors who acquire for-sale units and then place the unit on the rental market. As such, demand for renter-occupied units indirectly contributes to the total demand for for-sale housing on Oahu. Makaiwa Hills, which is likely to offer a majority of for-sale product is expected to benefit from future market demand for both owner-occupied and renter-occupied housing.

Estimated annual demand within the primary market area for units within these upper end price categories are as follows:

	1990-1994	1995-1999	2000-2004	2005-2010
Owner Occupied Demand ($370,000 plus)	819	1,165	1,276	1,230
Renter-Occupied Demand ($1,000 plus per month)	390	492	854	1,219
Total Price Qualified Owner and Renter Demand	1,209	1,657	2,130	2,449
Makaiwa Hills Demand				
10% Capture	121 -	66 -	213 -	245 -
15% Capture	181	249	319	367

Project capture was estimated based on planned and proposed residential construction in the Ewa and Central Oahu Development Plan Areas (EXHIBIT 29). As shown, Makaiwa Hills would have a 5% fair share of all units in the primary market area. However, Makaiwa Hills is unique in its executive housing, hillside and amenity orientation and is likely to have a competitive advantage in capturing market demand. It is estimated that Makaiwa Hills could capture 10% to 15% of primary market area demand, or 120 moving to 370 units per year.

E. Conclusions

The above projected absorption rates may seem rather conservative when compared with the aggressive sales rates achieved on Oahu during the recent heated market conditions (see Residential Competitive Market Analysis). However, this type of activity, indicative of pent-up demand condition where market demand is not beginning met with an adequate supply of acceptable housing choices, exemplifies an inefficient market where the supply of high quality, well designed products is not meeting the demand.

Unfortunately, pent-up demand conditions are impossible to accurately measure, in terms of depth and duration. Thus, while a more conservative approach to demand analysis was undertake, it is urged that as new information become available, this analysis be updated to most effectively predict housing demand and project absorption for Makaiwa Hills.

Given the recommended development program which would tap the broadest array of market segments while maintaining the project's executive housing orientation, Makaiwa Hills has the potential to perform at a level of 160 to 320 units per year during the estimated construction period (1995-1999). These figures are reflected in the absorption schedules of EXHIBIT 3 and 4, but vary depending upon the number of different product types offered in a given year. This assumes the project capture of total market activity and the statistical demand analysis discussed previously.

V. COMPETITIVE MARKET ANALYSIS

A. Competitive Market Area Definition

The competitive market area (CMA) for Makaiwa Hills consists of the Ewa and Central Oahu Development Plan Areas. Due to the limited levels of current activity in the CMA, however, the survey of competitive projects was extended to cover representative developments throughout Oahu. Surveyed projects are summarized in EXHIBITS 30 and 31.

The most significant competition to Makaiwa Hills are new and resale units in Hawaii Kai, Kailua area and Kahala in that these areas represent the greatest concentration of executive housing on Oahu. In addition, planned upper-priced projects in the Ewa (i.e., Ewa Marina) and Central Oahu Plan Areas are expected to compete with future development at Makaiwa Hills. Comparable, currently active projects in Ewa and Central Oahu, for the most part, lack the executive housing master-planned community orientation of Makaiwa Hills and thus are not directly competitive.

B. General Executive Housing Characteristics

Comparable current and recent executive development activity in Oahu has included both custom lots and production-type housing. A small portion of the development in Hawaii Kai offers golf course orientation. The hillside developments such as Hawaii Loa, Waialae Iki, and Royal Summit do not offer a golf amenity. Makaiwa Hills, therefore, will be one of the only master planned communities within the Honolulu area to offer a combination of golf course frontage, and ocean and mountain views. Other projects in the area which will offer similar amenity orientations include Ewa Marina and Ko Olina. However, due to their water orientation and ocean frontage, both of these developments will be priced higher than Makaiwa Hills, with luxury products targeting wealthy local and foreign buyers.

Custom lot development in the Honolulu area has taken the form of "ridge hopping," where hillside development occurred in an in-fill manner as flat land along the coast became completely built-out. This is especially evident in the Hawaii Kai/Kahala area, where older neighborhoods were circumvented by ridge hopping, and new high-end clusters are scattered among less desirable areas.

The executive market consists of five basic market segments: local executives upgrading or moving for lifestyle reasons; retirees from either Hawaii or the mainland; U.S. second home buyers; foreigners (mostly Asians in the recent past); and investors (Hawaiians, mainlanders and foreigners).

Currently, the majority of foreign buyers are Japanese who purchase in Downtown Honolulu (condominiums), Kahala (single-family homes) and Waikiki (resort condominiums). These areas have historically generated the highest housing values, and the Japanese interests have even further escalated prices. Hawaii Kai has a mixture of speculative buyers of various nationalities and executives who work in Downtown Honolulu. Hawaii Kai is desirable for many second home buyers given its lower pricing and greater safety relative to downtown. Additional executive housing can be found in Kailua, and Pearl City. Mainland retirees, second homeowners and investors can be found throughout the Honolulu area.

Investors and second-home buyers were present in varying degrees during the 1980s. Although a strong influence in 1986 and 1987, the influence of Japanese buyers has waned somewhat, especially in recent months, as the direction of the Japanese economy has become more uncertain. Surveys of the residential products on Oahu and discussions with local real estate professionals indicate that some of the loss of Japanese speculators has been compensated for by mainland, Taiwanese, Korean and Chinese buyers.

In Kapolei, speculation has been limited to local residents, and second home buyers are currently a rarity. This situation is expected to change with the development of Ko Olina, where preliminary indications are that Ko Olina has experienced interest from foreign investors for its first phase of condominium units. Kapolei is likely to attract executive and investor buyers who have a preference for new product. Second home buyers are expected to become more active in Kapolei as new higher-end products are developed near new retail services and the Ko Olina Resort. Most of these buyers are currently purchasing in Hawaii Kai and Kailua, with some activity also in the Aiea area.

Ewa, and Kapolei, is currently perceived as a low- to middle-income area. The Aiea/Pearl City area was similarly perceived a decade ago. This area has recently transitioned to include significant levels of executive housing as closer in projects built-out, and as Mililani became a better perceived residential address.

A similar change is expected to occur in Kapolei with development of commercial office and retail development in the City of Kapolei and new housing communities now under way. In fact, the level of amenities and planning for the proposed Ewa area high-end residential development should assist the area's transition to include luxury development as well as affordable and mid-priced housing.

Executive home buyers tend to be motivated by proximity to employment centers, exclusivity, and the presence of amenities. The presence of all these factors at Makaiwa Hills as part of the Kapolei community should enhance pricing and absorption potential at the subject property.

C. Single-Family Detached Housing

General

Categorically, sales performance in all price ranges has been very good. The majority of successful currently active detached projects are located in Ewa and Central Oahu. The master-planned communities of Ewa Gentry, West Loch Estates and the Villages of Kapolei (in Ewa) and Mililani (in Central Oahu) have been successful because of timing and pricing. Moreover, Ewa and Central Oahu are two of the few areas of the island with new housing units that are still relatively affordable. The following is a summary of existing product types by market orientation category: affordable, starter, first- and second-time move-up, and luxury. Unless otherwise indicated, stated prices are for fee simple land ownership in 1990 dollars.

Affordable Housing

Single-family detached affordable housing units, those which satisfy the government requirements of affordability to households with income levels of 80% to 120% of median, are primarily located in Ewa. Lot sizes typically range from 3,000 to 4,000 square feet, with home sizes from 950 to 1,700 square feet. Prices range from $96,000 to $170,000 in current projects. All products offered under the affordable housing programs were sold out instantly

Starter

Starter single-family detached products are mostly located in the Ewa and Central Oahu areas. Lot sizes typically range from 3,000 to 5,000 square feet, with home sizes from 800 to 1,500 square feet. Prices range from $230,000 to $300,000 in current projects and resales. Over the past several years, all projects offered in this price range were sold out instantly, with substantially high resale prices accomplished almost immediately. Price escalations from phase to phase have seemingly no upward limit, expressing the severe pent-up demand discussed earlier in this report.

First Time Move-Up

First time move-up single-family detached products are also predominantly located in the Ewa and Central Oahu areas. Lot sizes typically range from 4,000 to 5,500 square feet, with some lots as large as 9,000 square feet on a limited basis. Home sizes range from 1,400 to 2,200 square feet. Prices in currently active projects range from $330,000 to $400,000 with resales ranging up to $400,000 to $515,000. Starter and first-time move-up products tend to be the "bread and butter" for the market. These product types do not require amenity orientation.

At Kumu Iki, the first phase of which was sold in September 1989, market-rate resales range in size from to 1,295-1,930 square feet on 4,300- to 5,700-square foot lots, and are priced from $335,000 (fee), or $258 per square foot. There are no premiums at the project, which has no amenities.

At West Loch Estates, which sold out its first phase in September 1988, market-rate resale units range in size from 1,420 to 1,756 square feet on 4,000- to 5,000-square foot lots, and in price from $330,000 to $375,000 (fee), or $214 to $232 per square foot. Premiums for golf course frontage range from $25,000 to $50,000.

West Cliff, a planned project in Makakilo Heights, is notable for its proximity to Makaiwa Hills and its similar product program. Unit sizes will range from 1,450 to 2,200 square feet on 5,000- to 9,000-square foot lots, with base prices from $300,000 to $440,000 ($340,000 average), or $200 to $207 per square foot. Premiums of less than $25,000 are expected for views of Diamond Head and the Pacific Ocean. The developer reports that average resale prices in the Makakilo area are $340,000 to $350,000. The first increment of 100 homes (out of 500 total) is scheduled for release at the end of this year.

Second Time Move-Up

At present, second time, move-up single-family detached developments are primarily located in Hawaii Kai and the windward side of the island. Lot sizes range anywhere from 3,500 to over 8,000 square feet. Home sizes range from 1,600 to 2,100 square feet. Prices range from $500,000 to $625,000 for resales (there are no currently active projects in this price range).

The best examples of second time move-up products are Laulima O Hawaii Kai and Queen's Gate, located in Hawaii Kai, and Royal Summit in Aiea. These projects have successfully attracted the local move-down empty nester market, as well as retirees from the mainland, resulting in average absorption of nine units per month at Laulima and seven units per month at Royal Summit.

At Laulima, units range in size from 1,600 to 2,100 square feet on 3,500- to 5,000-square foot lots, and in price from $440,000 to $480,000 for land lease tenure (no data on fee simple land ownership was available), or $229 to $275 per square foot. Premiums for units with golf course frontage range from $50,000 to $80,000.

At Queen's Gate, units range in size from 1,790 to 2,143 square feet on 6,240- to 8,175-square foot lots, and in price from $500,000 to $570,000, including $50,000 to $75,000 ($261 to $265 per square foot) in golf course frontage premiums.

At Royal Summit, which sold out in 1986, units range in size from 2,500 to 4,500 square feet on 6,000- to 18,000-square foot lots. Resales range in price from $600,000 to $1.3 million ($240 to $290 per square foot), with premiums for perimeter units, which have better mountain and ocean views, averaging $150,000.

Luxury

Luxury single-family detached products are limited to Hawaii Kai, Kahala and the windward side of the island, and are located mostly in custom lot projects. Lot sizes range anywhere from 7,600 to 25,000 square feet. Home sizes are typically from 2,500 to 4,000+ square feet, although some Kahala estate residences are much larger. Resale prices range from $1.3 million to $5.0 million for the majority of homes (non-beachfront properties). Beachfront properties list for $7.0 million and up.

Hawaii Loa Ridge, a luxury single-family development in East Honolulu, offered 7,600 to 25,000 square-foot lots when introduced. Current resales of homes in this development range from $1.65 million to $3.5 million for 4,000+ square foot homes on 10,000- to 20,000-square foot lots (over $350 per square foot). The project sold 104 lots last year, with sales primarily to established families, although all buyer groups were represented. The influence of the Japanese buyer has decreased from about 60% of sales in 1987 to 10% in 1990. Approximately 50% of the loss in Japanese buyers has been replaced by buyers from Korea, Taiwan and Hong Kong. Cash buyers have comprised 80% of total sales.

Conclusions

Based on the data presented above, Makaiwa Hills single-family detached product should be base-priced similarly to Hawaii Kai area projects and above those of the surrounding area. This is consistent with positioning Makaiwa Hills below Ko Olina and Ewa Marina and above other projects in the competitive market area. A marketing strategy targeting executive buyers and retirees which emphasizes the factors attractive to such buyers would also support higher base prices.

D. For-Sale Attached Housing

The majority of successful resale and currently active attached products are in Ewa, Mililani, Hawaii Kai and Downtown Honolulu. Ewa and Mililani have been successful because they offer relatively inexpensive products for those who cannot afford single-family detached homes. Hawaii Kai has been successful due to its development timing, amenity orientation, and the fact that its products represent a convenient alternative to single-family detached housing for busy commuters. Downtown Honolulu products have been successful because they have enjoyed a convenient location in the primary urban core. Additionally, the location of these downtown products in prestigious and extremely expensive areas is attractive to Japanese buyers and investors.

Recent townhome developments have been mostly located in Mililani and Hawaii Kai. Unit sizes are typically from 1,200 to 1,900 square feet. Resale prices range from $190,000 to $265,000 in Mililani and from $300,000 to $400,000 in Hawaii Kai.

No directly comparable examples of competition in the townhome product type relative to proposed product at Makaiwa Hills exist, although two projects in Mililani are positioned below Makaiwa Hills. Mililani Pinnacle and Mililani Point both sold out immediately when released in 1989, and offer 1,200- to 1,900-square foot units at a density of 9 to 12 units per acre. Today, these units are resale-priced from $192,000 to $260,000, or $137 to $160 per square foot Mililani Pinnacle achieves premiums of $40,000 to $60,000 for golf course frontage, while Mililani Point has no amenities or premiums.

Stacked flat condominiums in low- and mid-rise projects are located in all areas of the island, typically with sizes from 700 to 1,600 square feet. Resale prices range from $155,000 to $215,000 ($134 to $221 per square foot) in the Ewa and Central Oahu areas, and from $240,000 to $495,000 ($309 to $343 per square foot) in Hawaii Kai (land lease tenure is the standard for units in Hawaii Kai projects). On the windward side, sizes range from 800 to 2,000 square feet, with resale prices from $165,000 to $300,000 ($150 to $206 per square foot) for land lease tenure.

Mawaena Kai, a low-rise condominium development in Hawaii Kai, has successfully attracted singles and retirees, as well as some mainland buyers, with a one-day sellout at opening in September 1987. Units range in size from 1,000 to 1,400 square feet. Resale prices range from $370,000 to $425,000 ($310 to $330 per square foot) for land lease units. No premium for fee simple tenure has been determined, with only land lease tenure offered to date. The only determinable premium for Mawaena Kai is a boat mooring premium of $5,000, although other similar projects report view premiums of $20,000 to $30,000.

The top end of the attached market is represented by high-rise condominium products. Current and recent new development in Downtown Honolulu features units of 800 to 4,475 square feet with resale and escrow prices from $390,000 to $4,500,000 ($488 to $1,327 per square foot) for land lease and fee simple ownership projects combined.

The Imperial, in Downtown Honolulu, has attracted 70% local, 20% Japanese and 10% mainland buyers. Units of 1,035 to 2,260 square feet are currently in escrow with prices of $390,000 to $3,000,000 ($377 to $1,327 per square foot) for fee simple ownership.

Resales at One Waterfront Towers, also in Downtown Honolulu, range from $425,000 to $4,500,000 for land lease tenure of 804- to 4,475-square foot units ($529 to $1,006 per square foot).

Ko Olina has taken reservations on its first phase of 316 condominium units. Prices varied from $1,000,000 to $2,700,000 for units ranging from 1,300 to 2,400 square feet ($1,120 to $1,150 per square foot). These prices compare favorably to high-rise condominium prices in Downtown Honolulu and Waikiki. Japanese buyers, another component of downtown and Waikiki sales, are also rumored to be an important buyer segment for Ko Olina.

Conclusions

Attached products at Makaiwa Hills should be base-priced similarly to Hawaii Kai projects such as Mawaena Kai and above prices in the surrounding area, due to its amenity orientation and expected high-quality execution. This is consistent with positioning Makaiwa Hills below Ko Olina and Ewa Marina and above other projects in the competitive market area. The combination of amenities and privacy in a new development will be major attractions for executive/professionals, second home buyers, and retirees.

Makaiwa Hills projects have the opportunity to offer high-quality, new product to many buyers who previously have had very few new projects from which to choose and instead have bought in the resale market. Existing equities should allow resident buyers to buy new product in the Makaiwa Hills community. These buyers will be attracted to attached product at the project as a convenient, low-maintenance alternative to single-family detached products.

E. Custom Lot Programs

Existing custom lot offerings are found mostly in Kahala and Hawaii Kai. Attracting professional, established families and Japanese buyers, these projects are now selling mostly resale lots. Recently buyers of waterfront and Kahala Drive lots in Kahala have been almost all Japanese, while Hawaii Kai projects have a mix of buyers. Custom lot projects seldom have any amenities, although most offer fair to spectacular views as well as the privacy of large lots.

The two projects most directly comparable to proposed development at Makaiwa Hills are Hawaii Loa Ridge and Waialae Iki, both near Hawaii Kai. Hawaii Loa Ridge base prices for 7,600- to 12,000-square foot interior lots range from $550,000 to $650,000. View lots of 9,000 to 25,000 square feet command a premium of approximately 50%. Waialae Iki lots command a premium of approximately $100,000 for view lots. Some exceptional view lots command a premium of about $200,000 over the base price of $440,000 to $480,000 for its 8,500- to 12,000-square foot lots.

Only a few other custom lot projects exist on Oahu, and continuing shortages of fully zoned land will not improve the situation. Most custom lot projects have no amenities, but do offer views. Buyers are attracted to these developments for their views, seclusion and privacy.

Conclusions

Makaiwa Hills' custom lots should be base-priced similarly to Hawaii Loa and Waialae Iki, since Makaiwa Hills will offer a superior golf amenity oriented product in an area which is not well established. Competition for Makaiwa Hills is expected from continued, though limited, custom lot development in the ridgeline developments between Downtown and Hawaii Kai, and custom lots at Ko Olina and Ewa Marina.

F. Premiums

Compared to current and resale projects in the competitive market area, master-planned projects such as Hawaii Kai and Mililani typically command 10% to 20% higher base prices over standard subdivision development. The amenity orientation and "planned" environment increase the perceived value of products in these communities, and therefore buyers are typically willing to pay more than in a community without these features. Further, among projects within the competitive market area, a variety of premiums are achieved for golf frontage or views.

G. Planned and Proposed Development

An investigation of public records indicates that there are at least 18 known new planned residential communities in the development or planning stages in the Central Oahu and Ewa area, mostly in Kapolei. (This excludes small developments and unknown additional projects not announced as of April 1990.) These projects total almost 73,000 units, or which approximately 13,000 have already been built.

Distinguishing Makaiwa Hills from other projects will be vitally necessary. A significant number of new projects are planned within the competitive market area which could result in substantial oversupply in the middle-price categories. While the current housing storage on Oahu will aid in absorbing some of these units, Makaiwa Hills must insist on high-quality execution and stress golf amenities, and views.

Ewa Marina and Ko Olina, although expected to be higher-end and therefore higher priced than Makaiwa Hills due to their waterfront/marina orientations, may still compete with the subject property in specific product categories. These include golf-oriented single-family products, townhomes and custom lots. Much competition will come as a result of targeting similar buyer segments, i.e., executives, empty nesters and retirees. Makaiwa Hills will have the advantage of excellent views and access, and lower relative pricing. Makaiwa Hills will be at a disadvantage in attracting executive buyers who desire water frontage or the exclusivity of buying in a resort community.

Conclusions

Orderly execution of the extensive levels of planned activity is likely to have a positive, synergistic impact on the desirability of the Kapolei region.

New development in the Ewa area will have a positive impact in changing the area's orientation to one that is higher-end and more conducive to executive living. Most significant of these changes is the development of office, retail and business park space at the City of Kapolei and the development of Ko Olina Resort and Ewa Marina. The trend toward a broader range of housing and the dynamic, changing atmosphere of the Ewa area are indicative of opportunities for executive housing at Makaiwa Hills.

H. Summary

The Ewa Development Plan Area is expected to undergo a transition in the next few years, as it comprises a major portion of total county population growth. The development of Ko Olina and Ewa Marina should be instrumental in introducing a broader range of home buyers, thereby encouraging executive home purchases at Makaiwa Hills as well.

Pricing of Makaiwa Hills, for all product types, should be similar to that of Hawaii Kai. This pricing will position Makaiwa Hills above other Ewa area projects, yet below Ko Olina and Ewa Marina, thus allowing Makaiwa Hills to fill a market niche between the typical, average quality mid-range product and oceanfront luxury housing. This differentiation should be a result of Makaiwa Hills' unique hillside, golf-oriented development. As a result, pricing of Makaiwa Hills is comparable to products in Hawaii Kai and Kailua than in the surrounding Ewa area.

Retirees are expected to be attracted by the security and seclusion of Makaiwa Hills, while executives will locate in Makaiwa Hills for proximity to the services and employment centers of a master-planned community. The availability of new product within a master-planned context will be attractive to those buyers whose previous options were limited to resale products. Both the golf course and tennis club facilities should be critical elements in attracting executive and retiree buyers.

Planned and proposed activity in the competitive market area currently includes at least 18 residential projects will create the opportunity for the Ewa area to provide a diversity of residential product types, including executive housing. Makaiwa Hills' combination of a golf course and ocean and mountain views will set it apart from other planned projects.

VI. RESIDENTIAL CONCLUSIONS AND RECOMMENDATIONS

A. Competitive Positioning

Makaiwa Hills is well positioned for successful development given its locational advantages which provide for the unique combination of amenities and views and the presence of strong demand for high-end, amenity-oriented projects.

A high-quality executive housing community will attract decision-makers to the area. Decision-makers create employment opportunities and have a vested interest in improving the desirability and value of the area in which they live.

Makaiwa Hills is well positioned to become a prestigious executive housing community on Oahu. The creation of a new urban core at the City of Kapolei, including office and retail development, should be a boon to the development of housing at Makaiwa Hills and in the Ewa area in general. The development of a range of housing products in the area should create a "critical mass" beneficial to the development of an integrated image for Ewa.

The competitive market area currently lacks a true diversity of residential product types. Although physically constrained by its attractive and varied topography, Makaiwa Hills will attempt to fill many of the voids in product opportunities by offering a broad spectrum of unit and lot sizes, as well as varied single-family and multifamily product types. This will also enhance absorption potential.

The marketing strengths of Makaiwa Hills, arising from the golf course amenity, excellent views, and mountainous topography, will enhance its position relative to the competition. Additionally, demand for executive move-up products at Makaiwa Hills will strengthen, as Kapolei becomes more upscale and resale buyers utilize their equity to buy new product in Makaiwa Hills.

The development of Ko Olina Resort and Ewa Marina will not adversely affect the build-out of Makaiwa Hills. Makaiwa Hills stands to benefit from the enhanced reputation of the area which will occur with the development of Ko Olina, which is located immediately southwest of the property. The proper market positioning for Makaiwa Hills will be to complement Ko Olina and Ewa Marina by offering high quality and price in a private, amenity setting.

Makaiwa Hills' price positioning should be near the top of the Ewa market, yet below Ko Olina's. Absolute prices should be higher than the market in many cases (due to unit sizes larger than typically found in the market). For the most part, units at Makaiwa Hills should be priced in the $400,000 to $750,000 range (1990 dollars). Typically, value ratios of $200 to $300 are appropriate with densities diversifying as the community becomes established.

B. Market Demand Potential

Potential demand for residential products at Makaiwa Hills was calculated using a statistical demand analysis. On the average, through 2010, demand in the Ewa and Central Oahu area is expected to support development of between 2,100 and 4,800 units per year (rounded) in the general $370,000+ (sale) price range, $1,000 (rental) categories. Based on currently known levels of planned and proposed housing activity, Makaiwa Hills' market share is estimated to range from 10% to 15% of upper-end housing activity in the primary market area, equivalent to 120 to 370 units per year.

These levels of demand are dependent on the implementation of a high-quality development program, the existence of recommended amenities, and the availability of a broad and simultaneous array of product types.

C. Residential Recommendations

Accomplishment of the desired positioning and values is expected to require that the golf course and other infrastructure are in place at the inception of the development program. This includes improvements in the form of major roads, landscaping, information and marketing center, etc. Without the golf course and infrastructure improvements, the development's marketing campaign may be adversely affected and jeopardize the level of marketing success (i.e., pricing, absorption, community perception) currently envisioned.

Makaiwa Hills should offer the highest quality products, with a variety of pricing structures and products to attract the various market segments. Excellent value can be created with the development of attractive amenities, tight architectural controls, landscaping, setbacks and signage. This value will be retained, consequently, at the same level as these amenities and additional features are maintained. Because of this overall higher value and its amenity orientation, Makaiwa Hills will be better positioned and more desirable than other planned projects in the eyes of buyers.

The diversity of market segments and amenity orientation offered by Makaiwa Hills lends itself to concurrent multi-product development. Once the infrastructure and amenities are in place, development of a number of residential products should be commenced. It is important to offer as broad a spectrum of housing choices as possible, thus maximizing market appeal, market capture and absorption potential for the community. Development parcels should be sized to achieve sell-out within no more than three years. This will afford Makaiwa Hills the opportunity to constantly offer new product design and to avoid stagnation of product and/or marketing, a common problem in planned community developments of the scale of Makaiwa Hills.

Recommended Development Program

Based on the analysis conducted under this assignment and keeping the aforementioned strategic issues in mind, a set of market-driven product recommendations were developed for Makaiwa Hills. These recommendations were summarized in EXHIBIT 3. The matrix details a "menu" of residential products which are feasible at Makaiwa Hills, from a market standpoint.

Custom lot product (SFD-1, SFD-2, and SFD-2A) represents a three-tiered custom lot program. SFD-1 consists of 12,000- to 20,000-square foot lots, while SFD-2 consists of 8,000- to 12,000-square foot lots. SFD-2A is a golf-oriented custom lot program also consisting of 8,000- to 12,000-square foot lots. Base prices should range from $350,000 to $600,000 ($30 to $50 per square foot). This product should target established families, second home buyers, and to a lesser degree, retirees and empty nesters. Golf-oriented custom lots are expected to achieve a 15% premium in base prices over non golf-oriented custom lot product. Custom lots at Makaiwa Hills are expected to be competitive with lots at Hawaii Loa Ridge and Waialea Iki. Assuming stable market conditions, less active than the current market but stronger than the recession market of the early 1980s, both custom product types are expected to absorb at a rate of 36 lots per year.

Semi-custom single-family homes (SFD-3) should consist of 3,200- to 4,000-square foot units on 8,000- to 12,000-square foot lots. While there are no similar semi-custom products currently active in Oahu, this product is expected to be competitive with resales in Hawaii Loa, Royal Summit and homes off the water in Kahala. Semi-custom homes are estimated to absorb at a stable rate of 24 units annually. Base prices should range from $800,000 to $1.1 million per unit.

Two additional golf-oriented single-family products are recommended (SFD-4 and SFD-4a). Both products are considered similar to and competitive with Laulima O Hawaii Kai, and Queen's Gate (also in Hawaii Kai). Golf cluster units (SFD-4) are comprised of 2,000- to 3,000-square foot units on 3,500- to 6,000-square foot lots and should largely target empty nester, some professional singles and couples, young families and second home buyers. Base prices for golf cluster units should range from $450,000 to $575,000. Units are expected to absorb at a stable rate of 48 units per year. The single-family golf units (SFD-4a) of 2,500 to 4,000 square feet on 5,000 to 6,000 square foot lots will target mature families, as well as retirees and second home buyers. Units will absorb at a stable rate of 72 per year, at base prices of $650,000 to $800,000.

Standard single-family detached products (SFD-5, SFD-5a and SFD-5b) vary in terms of their lot and unit size. SFD-5 consists of a 2,800- to 3,600-square foot unit on a 6,000- to 8,000-square foot lot. Base prices range from $600,000 to $750,000. The SFD-5 single-family will target mostly established families and is positioned to compete with similar products in Kailua, and off-water Kahala. An annual stable absorption rate of 48 units per year is expected.

SFD-5a is the product most consistent with executive housing development in Kailua, Hawaii Kai, and new development in Mililani. Units of 1,600 to 2,400 square feet on 5,000- to 6,000-square foot lots are priced at $475,000 to $575,000. This product largely targets young and established families.

Once Makaiwa Hills is established, it is anticipated that large single-family units (2,200 to 3,200) will be accommodated on smaller 5,000 to 6,000 square foot lots (product SFD-6). Base prices for this product are assumed to be $550,000 to $630,000 ($197 to $250 per square foot). Both SFD-5a and SFD-5b single-family products are expected to achieve stable absorption rates of 60 units per year.

Finally, two townhome products (SFA-6b and SFA-6c) have been identified as potential products for Makaiwa Hills. SFA 6A is a golf-oriented townhome (4 to 5 units to the acre) with units ranging from 1,900 to 2,600 square feet, priced from $470,000 to $580,000 ($223 to $247 per square foot). This product is most comparable with

Mawaena in Hawaii Kai, although it will be golf rather than water oriented. This townhome product is likely to target a number of professional singles and couples as well as empty nesters and retirees, absorbing at an estimated stable rate of 42 units per year.

The second townhome product (SFD-6c) will target young families as well as empty nesters and professional singles and couples. Units of 1,500 to 2,100 square feet could be priced from $350,000 to $500,000. This product is expected to compete with attached products in Mililani and Hawaii Kai and provide a unique opportunity for buyers to purchase a relatively "affordable" product within an amenity-oriented community. Stable absorption estimates are 72 units per year.

As stated earlier, the golf course amenity will be essential for Makaiwa Hills to establish its identity and keep it competitive with other projects in the area, many of which will have golf courses. The golf course and view orientation will also be vital in generating the values and premiums previously discussed. In an area with little current name recognition, a golf course is essential for attracting executive buyers. The product program described above was constructed with the objective of maximizing use and premium generation from these amenities, under the assumption of first-rate execution and operational maintenance of the amenities.

D. Marketing Strategy Recommendations

Makaiwa Hills needs an aggressive, well-planned marketing program. As part of this program, Campbell must provide community features and amenities from the inception of project development. These include infrastructure improvements discussed earlier, as well as the golf course and recommended tennis club facilities. It is unlikely that substantial demand for executive housing products can be created without the existence of these infrastructure and amenity features.

Specifically, a marketing center should be located on-site, with the appropriate presentation aids and well-trained staff to provide project information and handle the sales program for the community. While each project within Makaiwa Hills may have a separate sales office, the central marketing center should be an important tool in creating and maintaining Makaiwa Hills' community-wide appeal as a master-planned development, especially early on.

Further, Campbell must establish a cooperative marketing program which promotes Makaiwa Hills as a whole, in addition to individual builders within Makaiwa Hills promoting their own projects. This is critical in maintaining Makaiwa Hills' image as a total community. Absent such promotional effort, there is a risk that Makaiwa Hills' image will become diffused by that of the project's components, possibly losing the advantage of the critical mass. It is important to note that the object of community development is to create a "whole" that is more valuable than the "sum of the parts." A comprehensive marketing strategy is a critical element in achieving this objective.

E. Residential Summary

Overall, we are enthusiastic and optimistic about Makaiwa Hills' prospects during the short and long term. The Ewa market should be a very strong component of the Oahu housing market over the next 20 years. In this context, Makaiwa Hills should offer high-quality housing in an amenity-oriented executive community, oriented to views and including a golf course. Makaiwa Hills' value in the Oahu housing market would be assured with proper infrastructure and amenity development from the start of the project, a focused marketing campaign, and Campbell's commitment to strong execution of all aspects of the development program. Such a commitment should enable Makaiwa Hills to become a "jewel" community on Oahu and accordingly, a highly desirable area for executives, retirees and second home buyers.

VII. REGIONAL RETAIL OPPORTUNITY ANALYSIS

Approximately 140 acres have been set aside on the southeastern portion of the Makaiwa Hills property for development as a regional mall. The dramatic rise in population and employment projected to occur in the Ewa region between 1990 and 2010 is expected to create opportunities to capture a portion of the regional-serving retail market. The following section analyses demand for regional-serving retail (as measured by support for additional department stores) in Ewa and at the Makaiwa Hills site.

A. Primary Market Area Definition

The primary market area (PMA) is defined as that geographic area from which the majority of regional retail space demand at the subject property will emanate. Based on historical trade area patterns on Oahu, the regional access afforded the property due to its location on H-1, and the expected growth of the City of Kapolei as a major employment center, the PMA for regional-serving retail development at Kapolei was determined to include the Ewa, Waianae and Wahaiwa Tax Districts. (See EXHIBIT 32 for the location and boundaries of the PMA.)

B. Department Store Retail Sales Trends

A statistical demand analysis was used to determine unmet department store demand in the Kapolei trade area (EXHIBIT 35). Structurally, department store demand was determined by multiplying the trade area population by per capita annual department store purchases, estimated at $426 per person annually (1990 dollars) according to date provided by Urban Decisions Systems, Inc, a national demographics research firm.

Demand increases overtime as market area population increases and expected growth in real income leads to higher per capita department store spending. A downward adjustment was made to reflect a 20% leakage of potential department store sales to areas outside the trade area.

Current residents within the primary trade area are expected to generate annual net department store sales of approximately $103,701,000 in 1990 increasing to over $234,840,000 by 2010.

In addition to per capita resident spending, it is estimated that tourism will contribute to department store demand in Kapolei. Assuming a department store capture of 15% of total estimated per capita visitor expenditures on apparel and gifts, it is expected that tourists will generate roughly $541,000 (1990) to $2,165,000 (2010) in department store sales in the primary market area.

In combination, total department store sales potential within the PMA generated by existing and future residents and tourists is estimated to be approximately $104,242,000 in 1990 increasing to over $237,004,000 in 2010.

C. Competitive Environment

Future regional mall development at Kapolei is expected to compete to a certain degree with existing mall developments. This is due to the fact that there are only three major department store tenants present in Hawaii, J.C. Penney's , Liberty House and Sears. Each of the four regional malls on Oahu - Ala Moana, Pearlridge, Windward and Kahala - are anchored by one or more of these department stores (See EXHIBIT 33). As such, individual regional malls compete heavily with one another for potential department store sales.

For the purpose of this analysis, competitive malls were defined as all regional shopping centers with a gross leasable area of 450,000 square feet or more, and having a trade area that penetrates the primary trade are defined for the subject property. Based upon the above criteria, two regional malls on Oahu were found to have a trade area that overlaps with the subject Makaiwa Hills site, Ala Moana and Pearlridge.

Ala Moana has 832,670 square feet of department store space with three tenant anchors (J.C. Penney's, Liberty House and Sears). Built in 1959, Ala Moana is considered the most successful regional mall in Oahu (as measured by annual sales per square foot) and has an estimated trade area the encompasses the entire island of Oahu. Therefore, while Ala Moana is not located within the defined primary trade area for the subject site, continued preference among residents and tourist to shop at this well known center, will result in approximately 40% of the gross department store leasable area at Ala Moana (333,068 square feet) being competitive with new space at the subject property.

Pearlridge, which is located approximately four miles from the subject property, has an estimated trade area of 10 miles. J.C. Penney's, Liberty House and Sears are also the three department store anchors at Pearlridge, and in combination account for 380,000 square feet of gross leasing area. Given Pearlridge's' central location within the PMA (proximate to residential communities along both the H-1 and H-2 corridors), it is expected that up to 75% of gross department store leasable area at Pearlridge (285,000 square feet) would overlap with the subject property.

In total, current residents and tourist within the PMA support an estimated 618,068 square feet of department store space in Ala Moana and Pearlridge (See EXHIBIT 34). Using an average sales per square foot figure of $250, it is estimated that competitive department store leasing area is supported by $154,517,000 in annual sales attributed to PMA residents and tourists.

D. Regional Mall Demand

Unmet department store demand is determined by equating the difference between demand potential, as measure by per capita sales potential, and existing department store sales. On the basis of the statistical analysis, it is estimated that demand for additional department store space will not exceed supply in the primary market area until after 2000. By the year 2010, demand for two additional department stores (approximately 300,000 square feet of gross leasing area, averaging 150,000 square feet per department store anchor) in the PMA is expected. Assuming department stores typically equal 50% of the total gross leasable area within a regional mall, the PMA is expected to support one additional 600,000-square-foot regional mall by the year 2010.

In addition to the proposed regional mall on the Makaiwa Hills property, Amfac/JMB may consider developing a one-anchor regional center on its retail site in Waipio. This center would directly compete with the subject Makaiwa Hills property for identified future demand. This proposed development has even greater significance in that Amfac/JMB owns Liberty House and could prevent the Makaiwa Hills property from attracting them as a tenant.

The Waipio site is considered inferior to the subject property, in that it lacks sufficient adjacent land area to become more than a one-anchor mall, and it does not have the immediate proximity to an employment and tourism base similar to what is expected with the development of Kapolei.

E. High-End Fashion Mall Opportunity.

An alternative demand analysis was conducted which looks at the possibility of developing a high-end fashion mall to Kapolei. The analysis assumes that one or more new, high-end fashion anchor tenant (i.e., Nordstroms, Neiman-Marcus, Saks, etc.) could be attracted to Hawaii and ultimately to the Makaiwa Hills development. Unlike the intense competition among existing malls which are all anchored by the same tenants, a new anchor tenant is expected to achieve greater market share of department store demand within the PMA as well as attract spending dollars from outside the PMA. It should be noted that for the purpose of this discussion Liberty House is not considered a high-end fashion retailer.

Under this analysis (EXHIBIT 36), department store sales potential is segmented by household income, to reflect a higher propensity for households earning $50,000 or more to shop in high-end fashion stores than households that earn less than $50,000 per year. Due to typically higher pricing of merchandise, the actual estimated spending potential among PMA residents and tourists is less for an upscale fashion mall than for department stores as a whole (an estimated $68,917,000 for high-end department stores in 1990 versus $104,242,000 for all department stores). However, in the absence of any competing upscale anchor tenants, unmet demand for this type of department store product within the PMA is estimated at 197,000 square feet in 1990 (1.3 anchor tenants) increasing at a rate of one new anchor tenant every ten years to 2.9 tenants (429,000 square feet) by 2010.

F. Conclusions

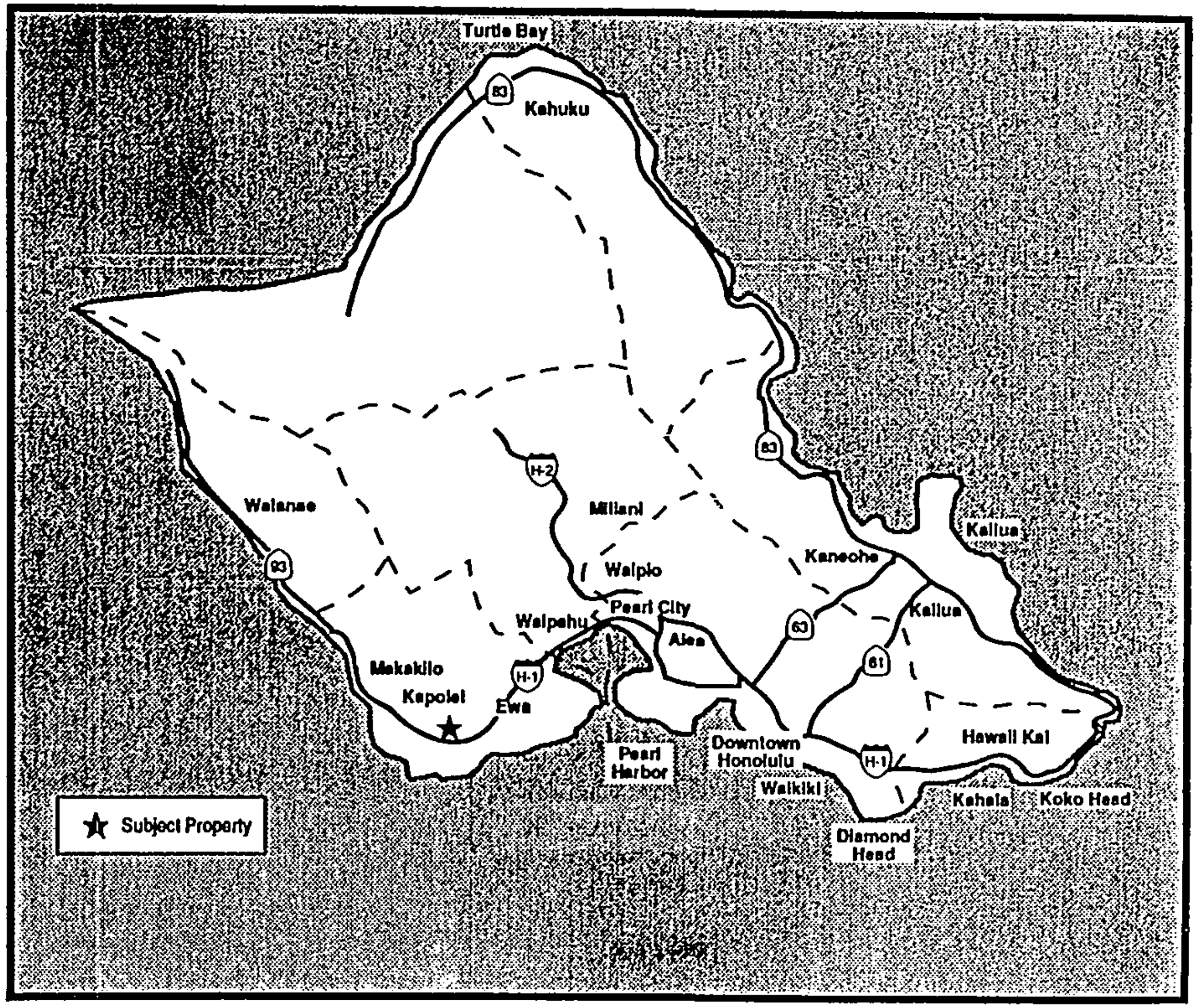
Over the long term (15 to 20 years), and in the absence of any new anchor tenants in the Oahu market, growth in resident and tourist population in Ewa is expected to generate demand for a regional mall of approximately 600,000 square feet with at least two major anchors. However, should Campbell be successful in attracting a new department store anchor to Oahu, and Makaiwa Hills, development of a regional mall could occur as soon as 1995 to 2000.

Presence of a regional mall is considered critical to creating an urban core or "second city" at Kapolei. Regional malls act as catalyst for further commercial development, establishing regional name recognition, adding to "critical mass" and providing focus to the emerging core. Therefore, despite limited short-term support for the regional mall, it is recommended that Campbell make every effort to attract a strong regional mall developer to the Makaiwa Hills project who is willing to recruit existing and new anchor tenants for the project. Further, Campbell should generate marketing momentum for the project by announcing long range plans to develop a regional shopping center at the Makaiwa Hills site.

APPENDIX

EXHIBIT 1 01-2728.05a

DEVELOPMENT PLAN AREA
CITY AND COUNTY OF OAHU

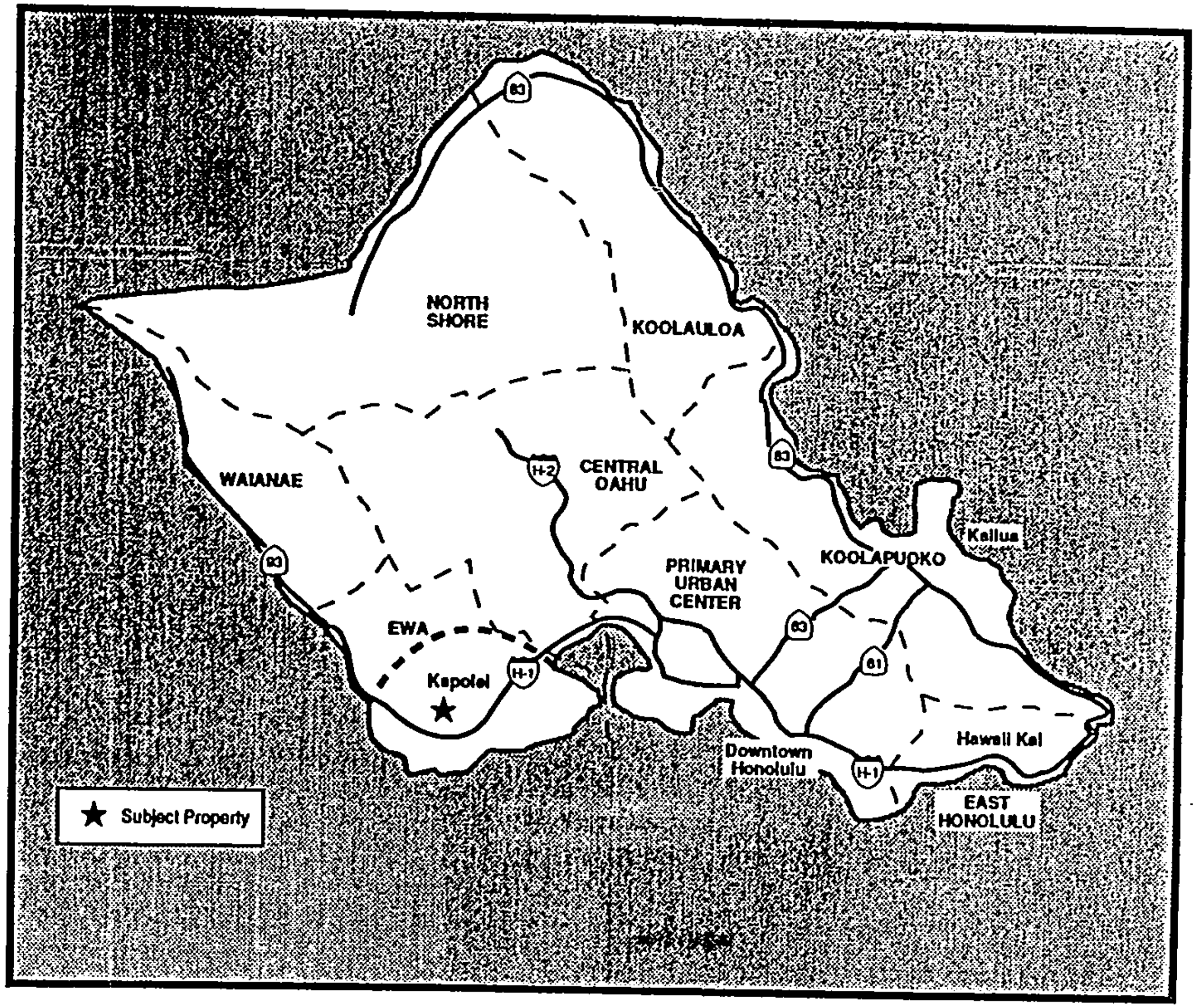


SOURCE: Robert Charles Lesser & Co.

01-2728.05b

EXHIBIT 2

LOCATION OF SELECTED OAHU COMMUNITIES



SOURCE: Robert Charles Lesser & Co.

EXHIBIT 3

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PRODUCT PROGRAM OPPORTUNITY MATRIX
MENU OF PRODUCT ALTERNATIVES
MAKAIWA HILLS MASTER-PLANNED COMMUNITY
1996-2010

PRODUCT TYPE	DENSITY/ LOT SIZE (SF)	APPROX. UNIT SIZE RANGE (SF)	APPROX. BASE PRICE RANGE (1990 dollars)	AVERAGE VALUE RATIO ($/SF)	ANNUAL ABSORPTION ESTIMATES SLOW	STABLE	RAPID	COMPETITIVE POSITION	TARGET MARKET SINGLES/ COUPLES	RETIREES/ EMPTY NESTERS	YOUNG FAMILIES	ESTABLISHED/ MATURE FAMILIES	SECOND HOME
CUSTOM LOTS													
SFD-1 Custom	12,000 - 20,000	-	$450,000 - $800,000	$30 - $38	18	36	60	Kahala Kua, Hawaii Loa Ridge, Waialae Iki		X		XX	XX
SFD-2 Custom	8,000 - 12,000	-	$350,000 - $450,000	$38 - $44	18	36	60	Hawaii Loa Ridge, Waialae Iki		X		XX	XX
GOLF ORIENTED													
SFD-2a Custom Golf	8,000 - 12,000	-	$400,000 - $520,000	$50 - $43	18	36	60	New product, considered competitive with Hawaii Loa, etc.		X		XX	XX
SFD-4 Golf Cluster	3,500 - 6,000	2,000 - 3,000	$450,000 - $575,000	$182 - $225	24	48	140	Laulima O Hawaii Kai	X	XX	X	XX	X
SFD-4a SF Golf	5,000 - 8,000	2,500 - 4,000	$450,000 - $850,000	$130 - $142	36	72	140	Laulima O Hawaii Kai, Queens Gate		X		XX	X
SFA-6b Townhomes	4 - 5	1,800 - 2,800	$470,000 - $580,000	$223 - $247	21	42	67	New product, considered competitive with Mawaena	XX	XX			XX
FOR SALE SINGLE FAMILY													
SFD-3 Semi Custom	8,000 - 12,000	3,200 - 4,500	$800,000 - $1,100,000	$244 - $250	12	24	48	New product, considered comp. with Royal Summit, Hawaii Loa, etc.		X		XX	XX
SFD-5 Single Family	6,000 - 8,000	2,800 - 3,600	$600,000 - $750,000	$208 - $214	24	48	80	Kailua, off-water Kahala				XX	X
SFD-5a Single Family	5,000 - 6,000	1,600 - 2,400	$475,000 - $575,000	$240 - $297	30	60	96	Kailua, Hawaii Kai, Mililani	X	X	XX	XX	
SFD-5b Single Family	5,000 - 6,000	2,200 - 3,200	$550,000 - $630,000	$197 - $250	30	60	120	Kailua, Off-water Kahala, etc.		X		XX	X
MULTIFAMILY													
SFA-8c Townhomes	4 - 8	1,500 2,100	$350,000 - $500,000	$233 $238	36	72	96	Mililani, Hawaii Kai	XX	XX	XX		

TOTAL:

PREMIUMS	% above base price	
Golf Frontage	20% - 30%	homes
Golf Frontage	45% - 65%	lots
View	10% - 20%	homes
View	40% - 60%	lots

SOURCE Robert Charles Lesser & Co.

ROBERT CHARLES LESSER & CO.

EXHIBIT 4

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PRODUCT PROGRAM OPPORTUNITY MATRIX
CURRENT LAND USE PLAN
MAKAIWA HILLS MASTER-PLANNED COMMUNITY
1996 - 2010

PRODUCT TYPE		DENSITY/ LOT SIZE (SF)	APPROX UNIT SIZE RANGE (SF)	APPROX BASE PRICE RANGE (1990 dollars)	AVERAGE VALUE RATIO ($/SF)	ANNUAL ABSORPTION ESTIMATES SLOW	STABLE	RAPID	ABSORPTION SCHEDULE (STABLE) YEAR 1 (PHASE I)	2	3	4	5	6 (PHASE II)	7	8	9	10	11 (PHASE III)	12	13	14	15	TOTAL UNITS ABSORB
CUSTOM LOTS																								
SFD-1	Custom	20,000 - 43,560	- -	$500,000 - $750,000	$17 - $25	12	36	60	0	0	0	36	19	0	0	0	0	0	0	0	0	0	0	55
SFD-2	Custom	11,000 22,000	- -	$400,000 - $600,000	$27 - $36	12	36	60	0	0	0	36	36	36	36	36	36	36	46	0	0	0	0	298
	SUBTOTAL:								0	0	0	72	55	36	36	36	36	36	46	0	0	0	0	353
FOR SALE SINGLE FAMILY																								
SFD-3	Semi-Custom	10,000 -	3,200 - 4,500	$800,000 - $1,100,000	$244 - $250	12	24	60	0	0	24	24	24	26	0	0	24	26	0	0	0	0	0	107
SFD-4a	Single Family	7,200 -	2,200 - 3,200	$550,000 - $630,000	$197 - $250	30	60	120	60	60	60	72	0	0	0	0	0	0	0	0	0	0	0	252
SFD-4b	Single Family	7,200 -	2,800 - 3,600	$600,000 - $750,000	$208 - $214	24	48	77	0	0	48	48	48	48	48	48	48	48	67	0	0	0	0	451
SFD-5a	Single Family	5,000 - 6,000	1,600 - 2,400	$475,000 - $575,000	$240 - $287	30	60	120	60	60	0	0	0	0	0	0	0	0	0	0	0	0	0	120
SFD-5b	Single Family	5,000 - 6,000	2,200 - 3,200	$550,000 - $630,000	$197 - $250	30	60	120	0	0	0	0	60	60	60	83	0	0	0	0	0	0	0	263
	SUBTOTAL:								120	120	132	144	132	134	108	131	72	74	67	0	0	0	0	1,193
MULTIFAMILY																								
SFA-6a	Townhomes	5.8 - 6.3	1,500 - 2,200	$350,000 - $500,000	$227 - $233	36	72	96	0	72	72	72	72	81	0	0	0	0	0	0	0	0	0	369
SFA-6b	Townhomes	5.8 - 6.3	1,900 - 2,400	$470,000 - $560,000	$247 - $242	21	42	67	0	0	0	0	42	36	0	42	42	42	11	0	0	0	0	215
	SUBTOTAL:								0	72	72	72	114	117	0	42	42	42	11	0	0	0	0	584
	TOTAL:								120	192	204	288	301	287	144	209	150	152	124	0	0	0	0	2,130

PREMIUMS	% above base price	
Golf Frontage	20% - 30%	homes
Golf Frontage	45% - 65%	lots
View	10% - 20%	homes
View	40% - 60%	lots

Source: CYP, Inc. and Robert Charles Lesser & Co.

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EXHIBIT 5

PRODUCT PROGRAM OPPORTUNITY MATRIX
MARKET-BASED ALTERNATIVE
MAKAIWA HILLS MASTER-PLANNED COMMUNITY
1996-2010

PRODUCT TYPE	DENSITY/ PAD SIZE 1/ (SF)	APPROX. UNIT SIZE RANGE (SF)	APPROX BASE PRICE RANGE (1990 dollars)	AVERAGE VALUE RATIO ($/SF)	ANNUAL ABSORPTION ESTIMATES SLOW	STABLE	RAPID
CUSTOM LOTS							
SFD-1 Custom	12,000 - 20,000	-	$350,000 - $600,000	$29 - $30	18	36	80
GOLF ORIENTED							
SFD-2a Custom Golf	12,000 - 20,000	-	$400,000 - $520,000	$33 - $26	18	36	80
SFD-4 Golf Cluster	5,000 - 8,000	2,000 - 3,000	$450,000 - $575,000	$182 - $225	24	48	140
SFD-4a SF Golf	8,000 - 10,000	2,500 - 4,000	$650,000 - $850,000	$213 - $260	24	48	140
SFA-6b Townhomes	4 - 5	1,800 - 2,600	$470,000 - $580,000	$223 - $247	21	42	67
FOR SALE SINGLE FAMILY							
SFD-5 Single Family	8,000 - 10,000	2,400 - 3,600	$600,000 - $750,000	$208 - $250	24	48	80
SFD-5a Single Family	7,000 - 9,000	1,600 - 2,400	$475,000 - $575,000	$240 - $297	30	60	96
SFD-5b Single Family	7,000 - 9,000	2,200 - 3,200	$550,000 - $630,000	$197 - $250	30	60	120
MULTIFAMILY							
SFA-6c Townhomes	4 - 6	1,500 2,100	$350,000 - $500,000	$238 - $233	36	72	96
TOTAL:							

PRODUCT TYPE	ABSORPTION SCHEDULE (STABLE) YEAR 1 (PHASE I)	2	3	4	5	6 (PHASE II)	7	8	9	10	11 (PHASE III)	12	13	14	15	TOTAL UNITS ABSORB
CUSTOM LOTS																
SFD-1 Custom	36	36	36	36	60	60	60	29	0	0	0	0	0	0	0	353
GOLF ORIENTED																
SFD-2a Custom Golf	36	36	35	0	0	0	0	0	0	0	0	0	0	0	0	107
SFD-4 Golf Cluster	0	0	48	48	11	0	0	0	0	0	0	0	0	0	0	107
SFD-4a SF Golf	48	48	48	48	24	0	0	0	0	0	0	0	0	0	0	216
SFA-6b Townhomes	0	0	0	42	42	42	42	42	12	0	0	0	0	0	0	222
	84	84	131	138	77	42	42	42	12	0	0	0	0	0	0	652
FOR SALE SINGLE FAMILY																
SFD-5 Single Family	48	48	48	48	48	48	55	0	0	0	0	0	0	0	0	343
SFD-5a Single Family	60	60	0	0	0	0	0	0	0	0	0	0	0	0	0	120
SFD-5b Single Family	0	0	60	60	60	60	60	0	0	0	0	0	0	0	0	300
	108	108	108	108	108	108	115	0	0	0	0	0	0	0	0	763
MULTIFAMILY																
SFA-6c Townhomes	0	0	72	72	72	72	74	0	0	0	0	0	0	0	0	362
TOTAL:	228	228	347	354	317	282	291	71	12	0	0	0	0	0	0	2,130

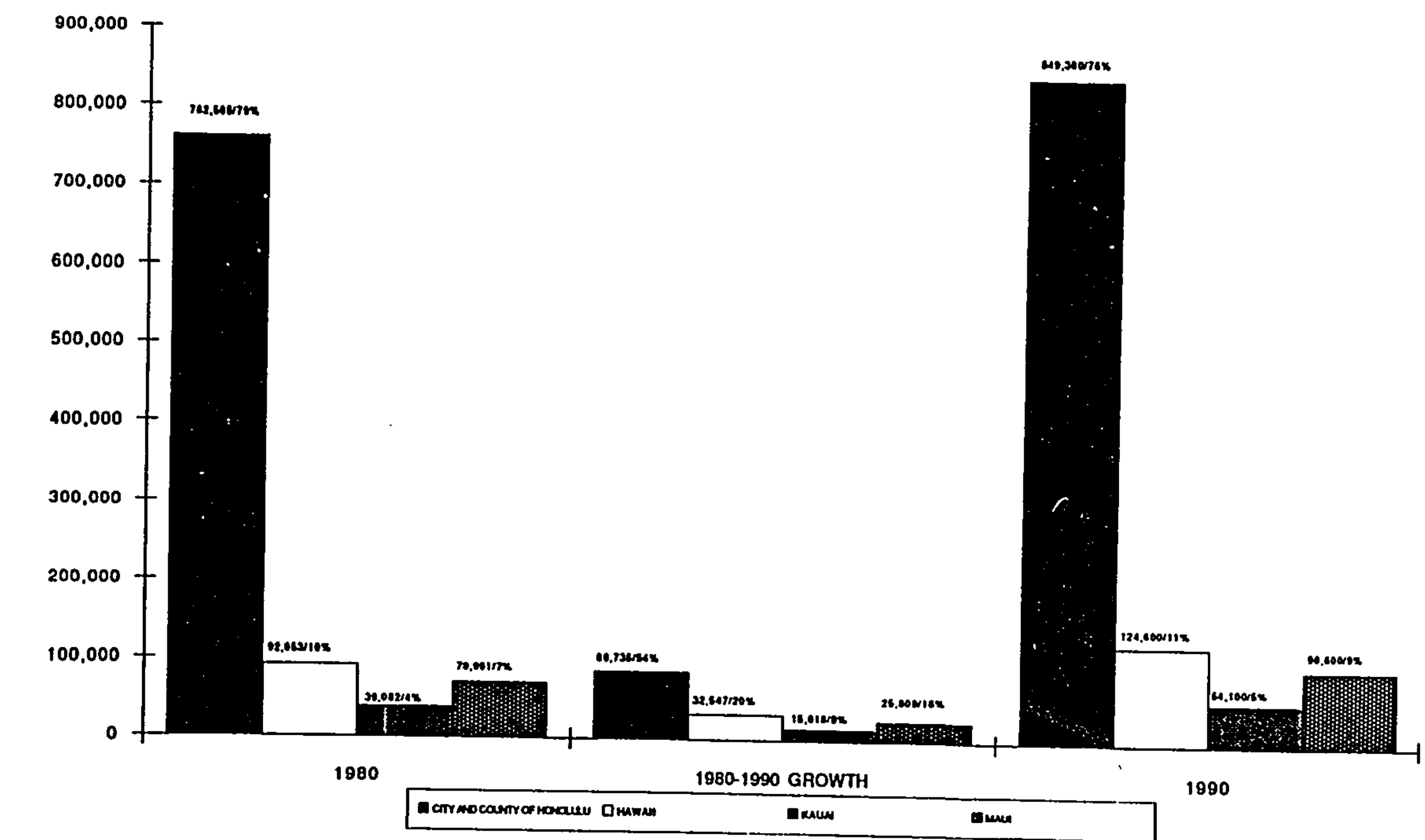
PREMIUMS	% above base price	
Golf Frontage	20% - 30%	homes
Golf Frontage	45% - 65%	lots
View	10% - 20%	homes
View	40% - 60%	lots

1/ Minimum pad size recommendations allowing for lot sizes to range up to one acre plus.

SOURCE: Robert Charles Lesser & Co.

01-2728 05

EXHIBIT 6
POPULATION DISTRIBUTIONS
HONOLULU, HAWAII, KAUAI, AND MAUI COUNTIES
1980 - 1990

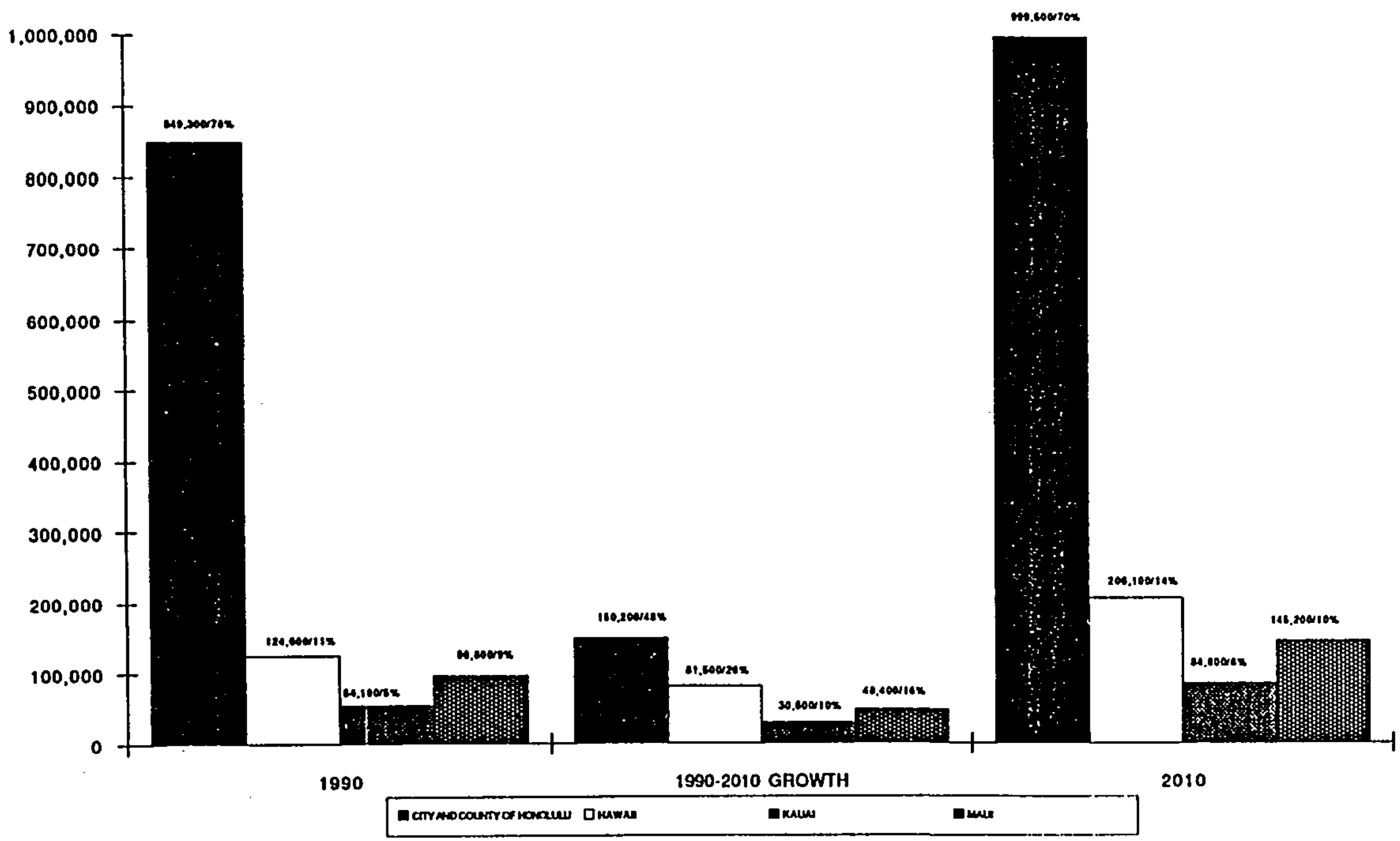


SOURCE: Department of Business and Economic Development (M-K Projections) as employed by RCLCo

ROBERT CHARLES LESSER & CO.

01-2728 05

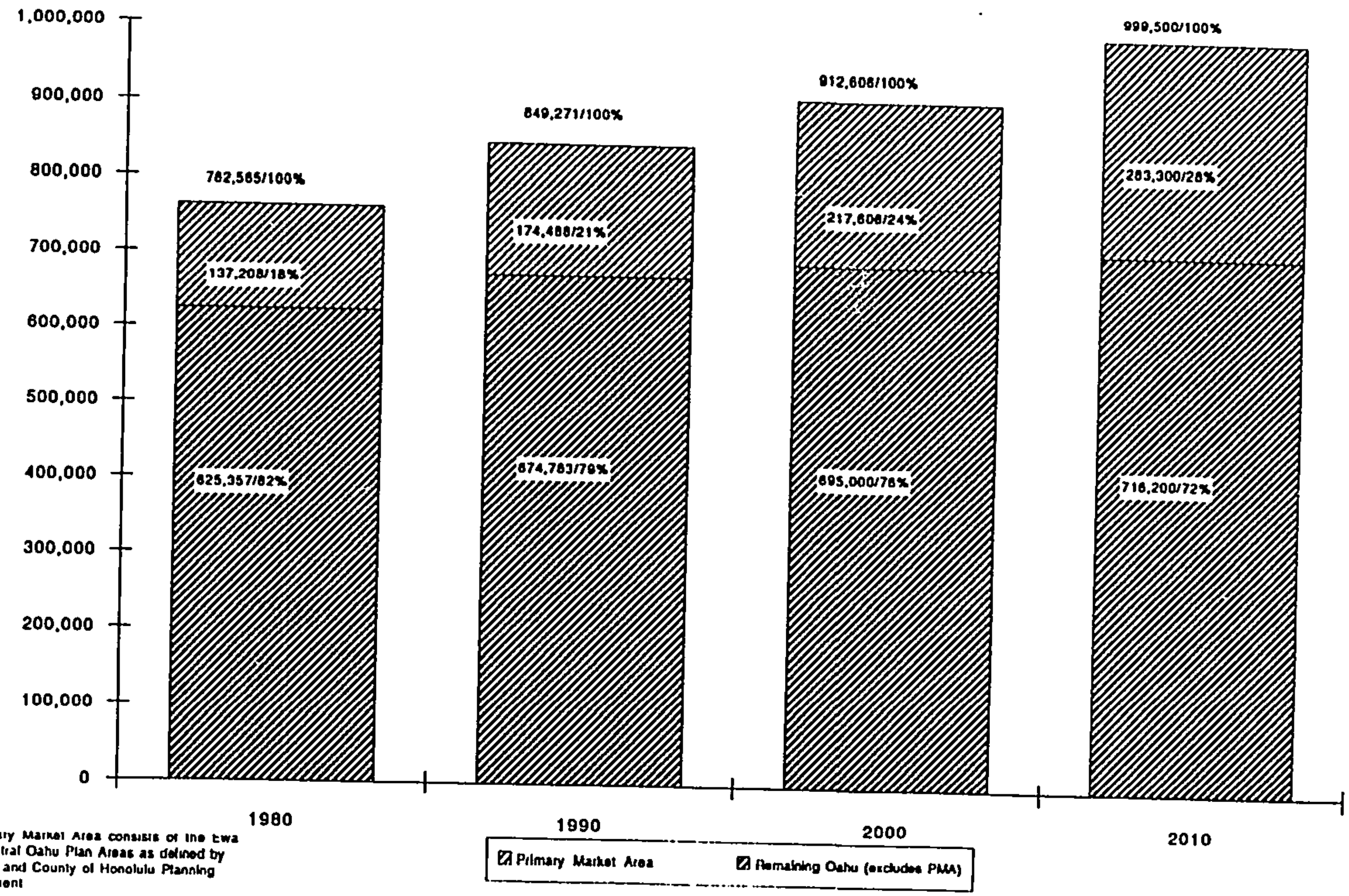
EXHIBIT 7
PROJECTED POPULATION DISTRIBUTIONS
HONOLULU, HAWAII, KAUAI, AND MAUI COUNTIES
1990-2010



SOURCE: Department of Business and Economic Development (M-K Projections) as employed by RCLCo

01-2726.05

EXHIBIT 8
POPULATION DISTRIBUTIONS
OAHU AND PRIMARY MARKET AREA 1/
1980-2010

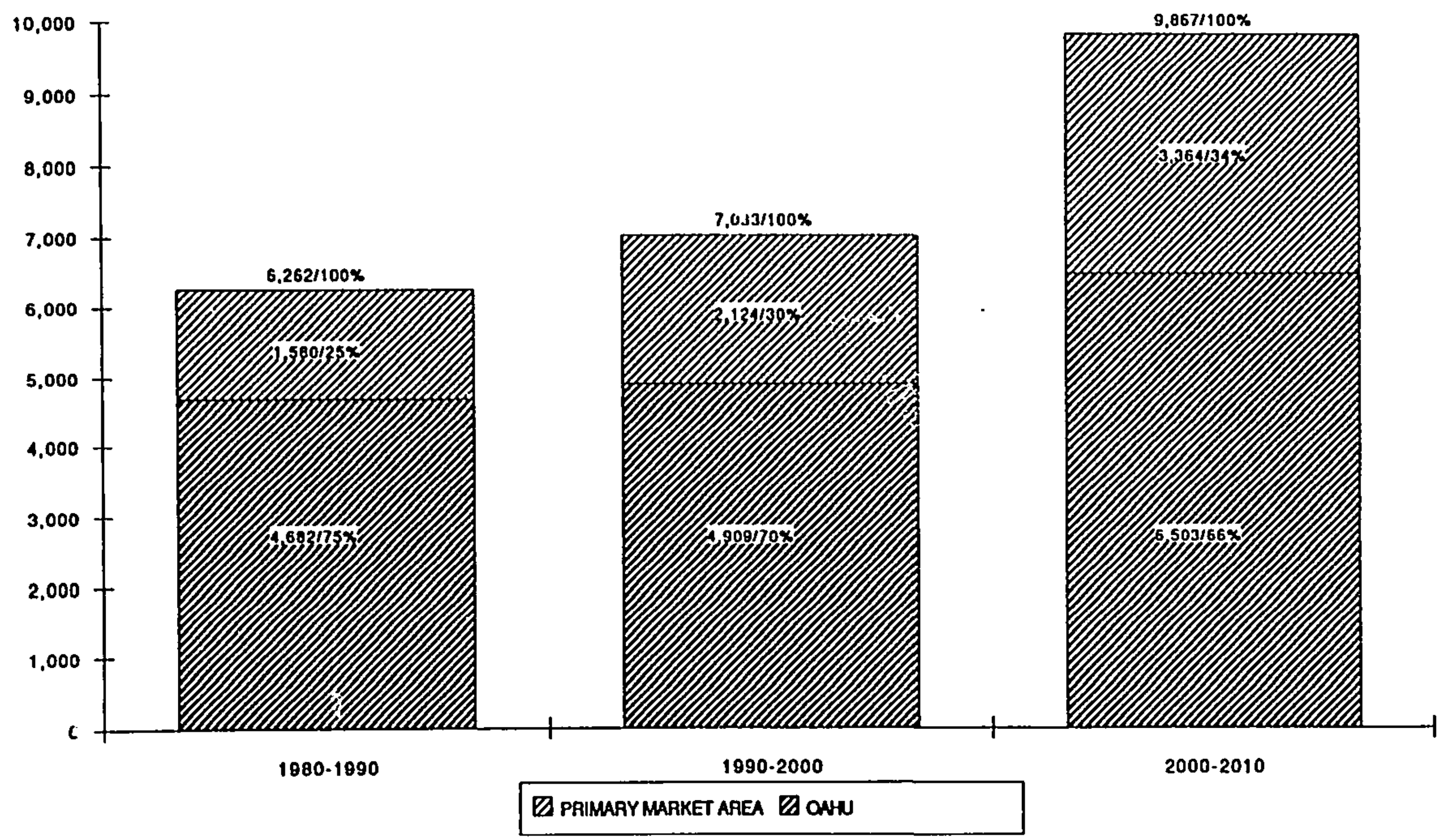


1/ Primary Market Area consists of the Ewa and Central Oahu Plan Areas as defined by the City and County of Honolulu Planning Department

Source: State Department of Business and Economic Development; Honolulu City and County Office of General Planning and Robert Charles Lesser & Co.

01-2728.05

EXHIBIT 9
ANNUAL HOUSEHOLD GROWTH
PRIMARY MARKET AREA
1980-2010



SOURCE: State Department of Business and Economic Development; Honolulu City and County Office of General Planning and Robert Charles Lesser & Co.

01-2728.05
histpop

EXHIBIT 10

HISTORICAL POPULATION DISTRIBUTION
CITY AND COUNTY OF HONOLULU BY DISTRICT
1970 - 1988

	1970		1980		1988		1970 - 1988		
DISTRICT	TOTAL	PERCENT TOTAL	TOTAL	PERCENT TOTAL	TOTAL	PERCENT TOTAL	TOTAL POPULATION GROWTH	PCT. TOTAL GROWTH	FAIR SHARE INDEX 1/
PRIMARY URBAN CORE	365,062	58.7%	417,240	54.7%	442,763	52.8%	77,701	35.8%	0.68
EWA	24,087	3.9%	35,523	4.7%	39,413	4.7%	15,326	7.1%	1.50
CENTRAL OAHU	67,586	10.9%	101,685	13.3%	128,301	15.3%	60,715	28.0%	1.83
EAST HONOLULU	28,649	4.6%	43,213	5.7%	47,798	5.7%	19,149	8.8%	1.55
KOOLAUPOKO	92,215	14.8%	109,373	14.3%	119,077	14.2%	26,862	12.4%	0.87
KOOLAULOA	10,562	1.7%	10,983	1.4%	11,740	1.4%	1,178	.5%	0.39
NORTH SHORE	9,171	1.5%	13,061	1.7%	14,256	1.7%	5,085	2.3%	1.38
WAIANAE	24,077	3.9%	31,487	4.1%	35,220	4.2%	11,143	5.1%	1.22
TOTAL POPULATION	621,409	100.0%	762,565	100.0%	838,568	100.0%	217,159	100.0%	1.00

1/ Fair Share Index equals percentage of total growth divided by original percentage of total population.

SOURCE: Hawaii State Department of Business and Economic Development; Honolulu City and County Office of General Planning and Robert Charles Lesser & Co.

01-2728.05
projpop

EXHIBIT 11

PROJECTED POPULATION DISTRIBUTION
CITY AND COUNTY OF HONOLULU BY DISTRICT
1988 - 2010

COUNTY	1988 TOTAL	1988 PERCENT TOTAL	1990 2/ TOTAL	1990 2/ PERCENT TOTAL	1995 2/ TOTAL	1995 2/ PERCENT TOTAL	2000 2/ TOTAL	2000 2/ PERCENT TOTAL	2005 2/ TOTAL	2005 2/ PERCENT TOTAL	2010 3/ TOTAL	2010 3/ PERCENT TOTAL	1988 - 2010 TOTAL POPULATION GROWTH	1988 - 2010 PCT. TOTAL GROWTH	1988 - 2010 FAIR SHARE INDEX 1/
PRIMARY URBAN CORE	442,763	52.8%	445,541	52.5%	452,563	51.5%	459,696	50.4%	466,941	49.0%	474,300	47.5%	31,537	19.6%	0.37
EWA	39,413	4.7%	43,818	5.2%	57,105	6.5%	74,421	8.2%	96,989	10.2%	126,400	12.6%	86,987	54.1%	11.50
CENTRAL OAHU	128,301	15.3%	130,670	15.4%	136,784	15.6%	143,185	15.7%	149,886	15.7%	156,900	15.7%	28,599	17.8%	1.16
EAST HONOLULU	47,798	5.7%	48,452	5.7%	50,125	5.7%	51,856	5.7%	53,647	5.6%	55,500	5.6%	7,702	4.8%	0.84
KOOLAUPOKO	119,077	14.2%	118,785	14.0%	118,057	13.4%	117,333	12.9%	116,615	12.2%	115,900	11.6%	-3,177	-2.0%	-0.14
KOOLAULOA	11,740	1.4%	11,890	1.4%	12,274	1.4%	12,659	1.4%	13,078	1.4%	13,500	1.4%	1,760	1.1%	0.78
NORTH SHORE	14,256	1.7%	14,486	1.7%	15,077	1.7%	15,693	1.7%	16,333	1.7%	17,000	1.7%	2,744	1.7%	1.00
WAIANAE	35,220	4.2%	35,630	4.2%	36,675	4.2%	37,752	4.1%	38,860	4.1%	40,000	4.0%	4,780	3.0%	0.71
TOTAL POPULATION	838,568	100.0%	849,271	100.0%	878,661	100.0%	912,606	100.0%	952,348	100.0%	999,500	100.0%	160,932	100.0%	1.00

1/ Fair Share Index equals percentage of total growth divided by original percentage of total population.
2/ Mid period figures determined by using a straight line average between 1988 estimates and 2010 projections provided by the General Plan.
3/ Figure is the mid-point of the high and low population projections provided under the General Plan.

SOURCE: Hawaii State Department of Business and Economic Development; Honolulu City and County Office of General Planning and Robert Charles Lesser & Co.

01-2728.05

EXHIBIT 12

POPULATION AND HOUSING GROWTH AND PROJECTIONS
OAHU AND PRIMARY MARKET AREA 1/
1970-2010

OAHU

YEAR	TOTAL	ANNUAL CHANGE	ANNUAL % CHANGE
POPULATION			
1970	621,409	-----	-----
1980	762,565	14,116	2.07%
1990	849,271	8,671	1.08%
1995	878,661	5,878	0.68%
2000	912,606	6,789	0.76%
2005	952,348	7,948	0.86%
2010	999,500	9,430	0.97%
HOUSEHOLDS 2/			
1970	172,614	-----	-----
1980	242,084	6,947	3.44%
1990	288,907	4,682	1.78%
1995	311,884	4,595	1.54%
2000	337,998	5,223	1.62%
2005	368,032	6,007	1.72%
2010	403,024	6,998	1.83%

PRIMARY MARKET AREA

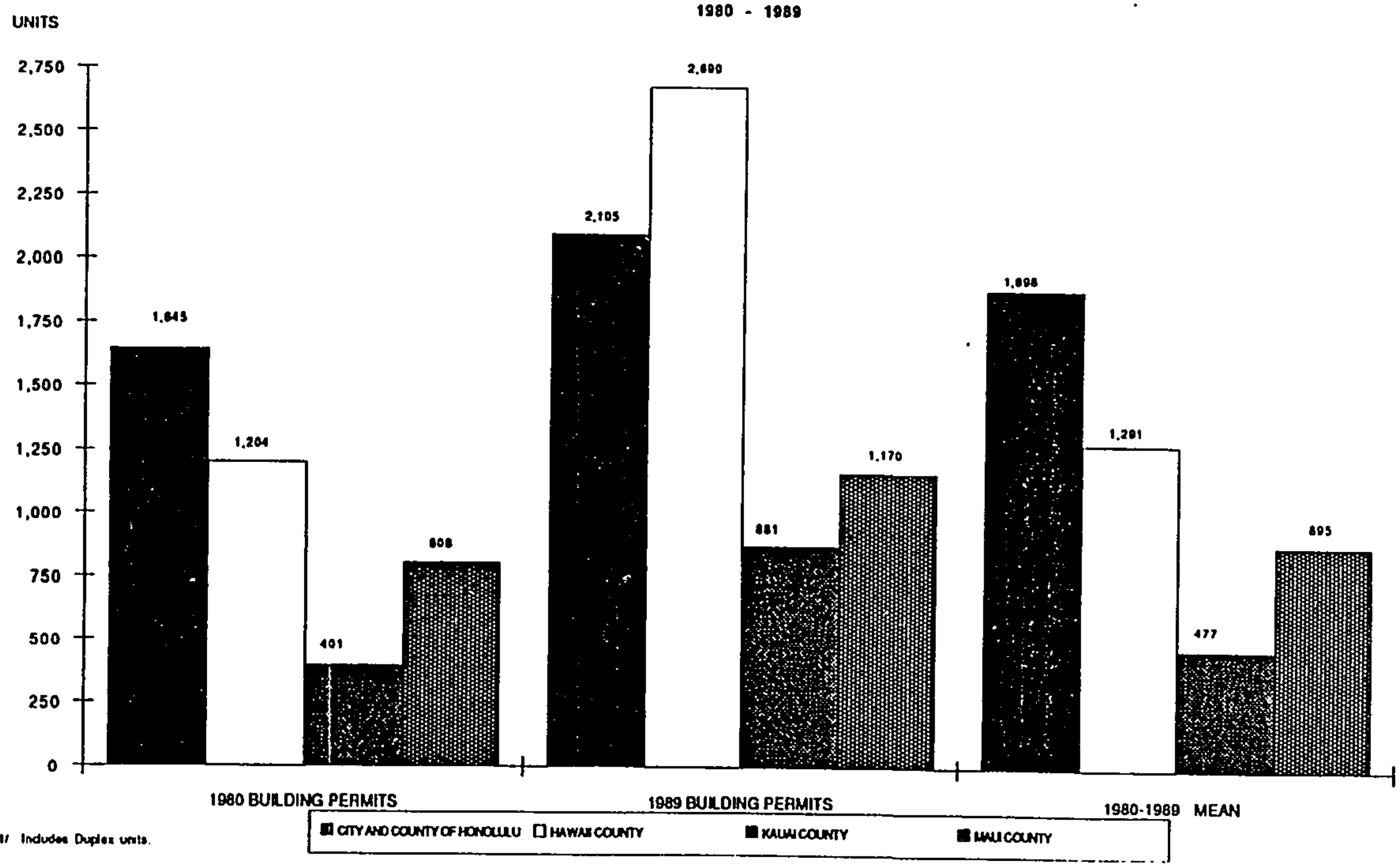
YEAR	POPULATION	ANNUAL CHANGE	ANNUAL % CHANGE
POPULATION			
1970	91,673	-----	-----
1980	137,208	4,554	4.12%
1990	174,488	3,728	2.43%
1995	193,889	3,880	2.13%
2000	217,606	4,743	2.33%
2005	246,875	5,854	2.56%
2010	283,300	7,285	2.79%
HOUSEHOLDS 2/			
1970	25,465	-----	-----
1980	43,558	1,809	5.51%
1990	59,358	1,580	3.14%
1995	68,822	1,893	3.00%
2000	80,594	2,354	3.21%
2005	95,404	2,962	3.43%
2010	114,234	3,766	3.67%

1/ City and County of Honolulu Planning Department. Plan Areas of Ewa and Central Oahu.
2/ Households were calculated from population numbers using Honolulu County household size estimates and projections for each year shown.

Source: City and County of Honolulu Planning Department and Robert Charles Lesser & Co.

01-2728 05

EXHIBIT 13
SINGLE FAMILY BUILDING PERMITS
AUTHORIZED BY COUNTY 1/
STATE OF HAWAII
1980 - 1989

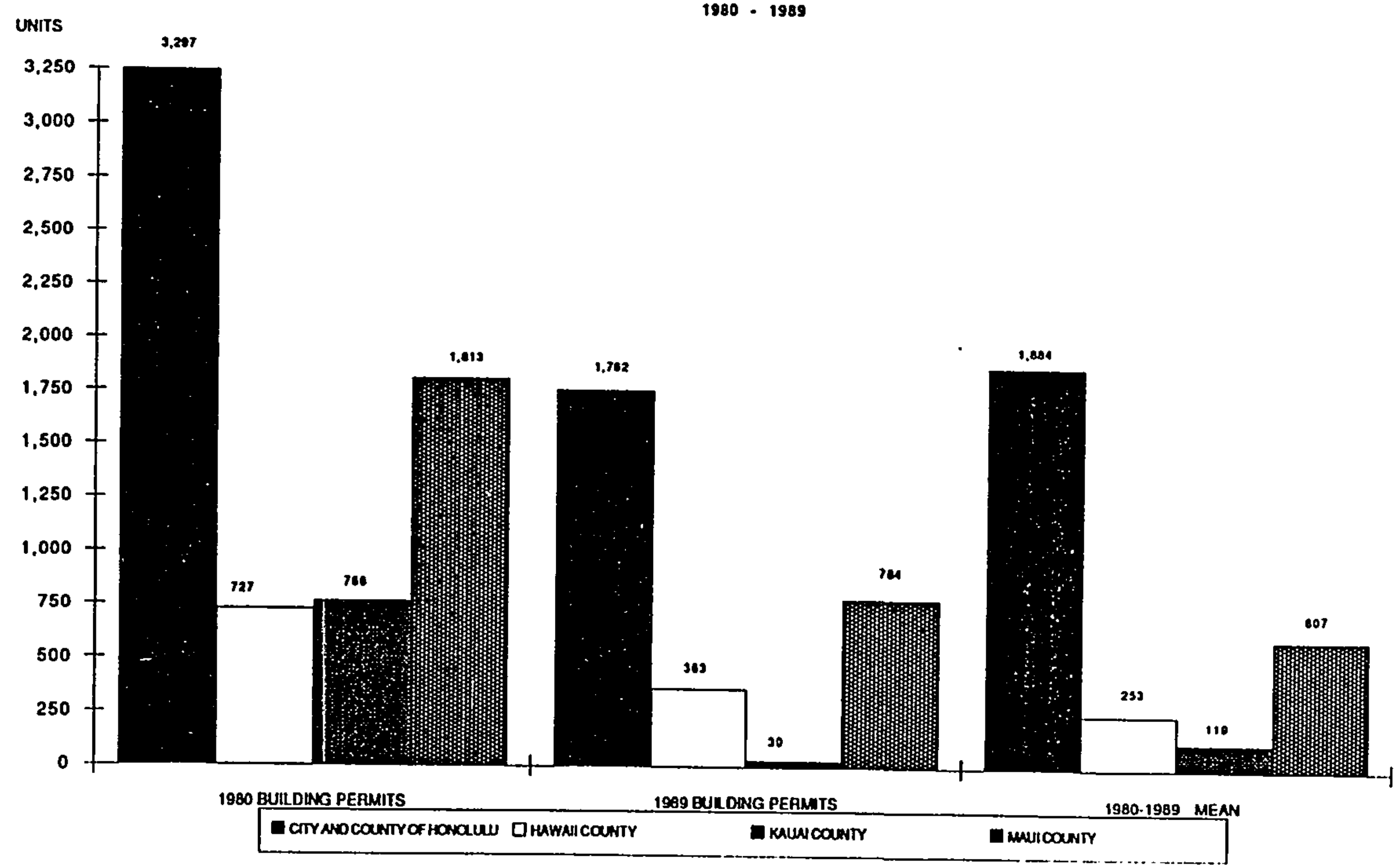


1/ Includes Duplex units.

SOURCE: Dept. of Business and Economic Development; Robert Charles Lesser & Co.

01-2728 05

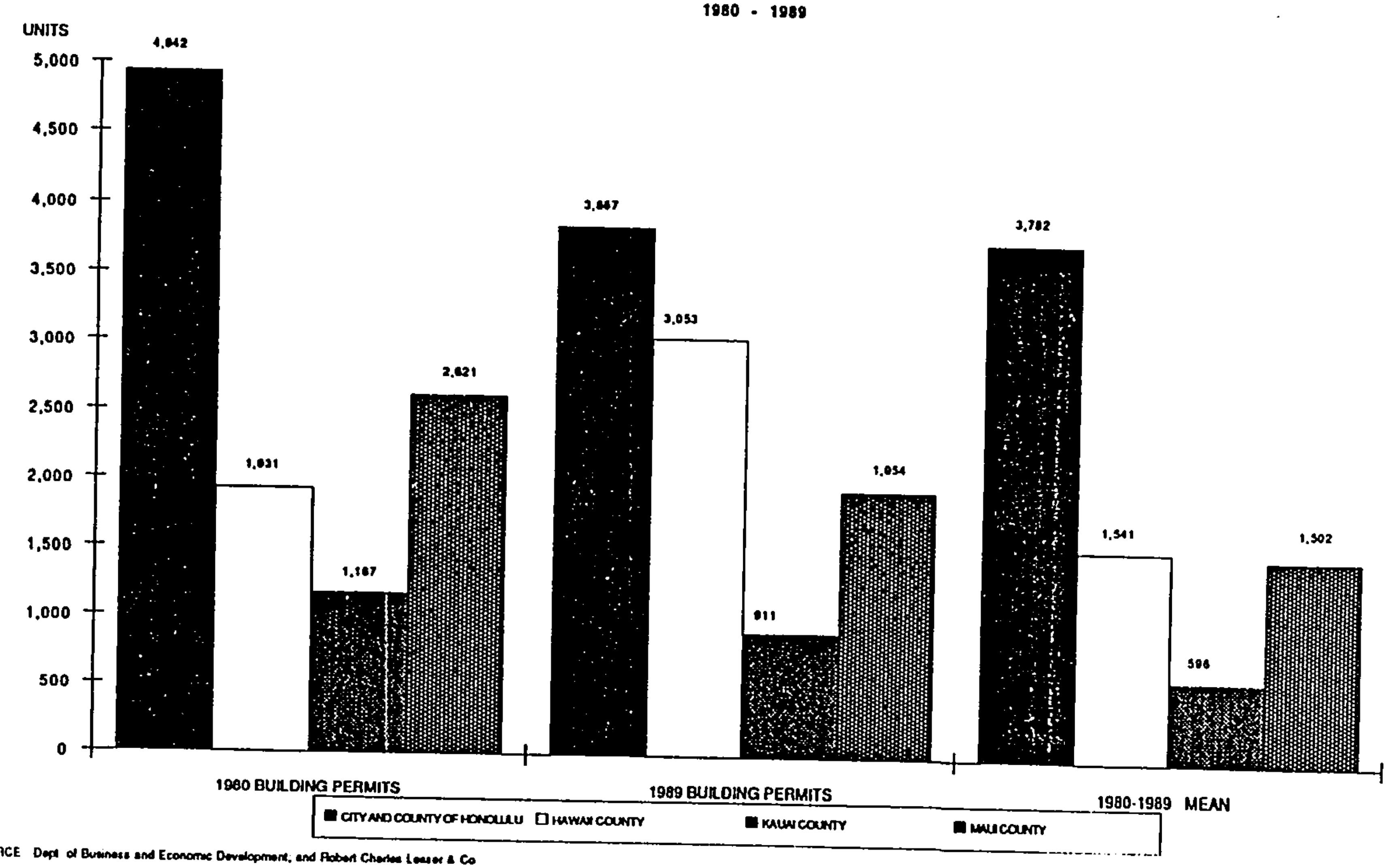
EXHIBIT 14
MULTIFAMILY BUILDING PERMITS
AUTHORIZED BY COUNTY
STATE OF HAWAII
1980 - 1989



SOURCE Dept of Business and Economic Development, Robert Charles Lesser & Co.

01-2728 05

EXHIBIT 15
TOTAL SINGLE FAMILY AND MULTIFAMILY BUILDING PERMITS
AUTHORIZED BY COUNTY
STATE OF HAWAII
1980 - 1989



SOURCE Dept of Business and Economic Development, and Robert Charles Lesser & Co

ROBERT CHARLES LESSER & CO.

EXHIBIT 16

BUILDING PERMITS ISSUED
STATE OF HAWAII AND COUNTY OF HONOLULU
1983 - 1989

PRODUCT TYPE/ YEAR	STATE TOTAL	HONOLULU COUNTY TOTAL	HONOLULU COUNTY % STATE
New Single Family			
1983	3,387	1,562	46%
1984	4,117	2,197	53%
1985	4,663	2,323	50%
1986	4,985	2,024	41%
1987	5,813	2,684	46%
1988	6,067	2,001	33%
1989	6,538	2,105	32%
	-----	-----	
Total	35,570	14,896	42%
Averages	5,081	2,128	
New Duplex Units			
1983	138	60	43%
1984	146	112	77%
1985	208	112	54%
1986	166	112	67%
1987	182	124	68%
1988	205	172	84%
1989	308	120	39%
	-----	-----	
Total	1,353	812	60%
Averages	193	116	
New Multi-Family			
1983	1,341	1,220	91%
1984	1,134	942	83%
1985	2,388	1,744	73%
1986	2,570	2,076	81%
1987	1,671	785	47%
1988	2,802	1,377	49%
1989	2,939	1,762	60%
	-----	-----	
Total	14,845	9,906	67%
Averages	2,121	1,415	
TOTALS			
1983	4,866	2,842	58%
1984	5,397	3,251	60%
1985	7,259	4,179	58%
1986	7,721	4,212	55%
1987	7,666	3,593	47%
1988	9,074	3,550	39%
1989	9,785	3,987	41%
	-----	-----	
Total	51,768	25,614	49%
Averages	7,395	3,659	

SOURCE: Hawaii State Department of Business and Economic Development and Robert Charles Lesser & Co.

EXHIBIT 17

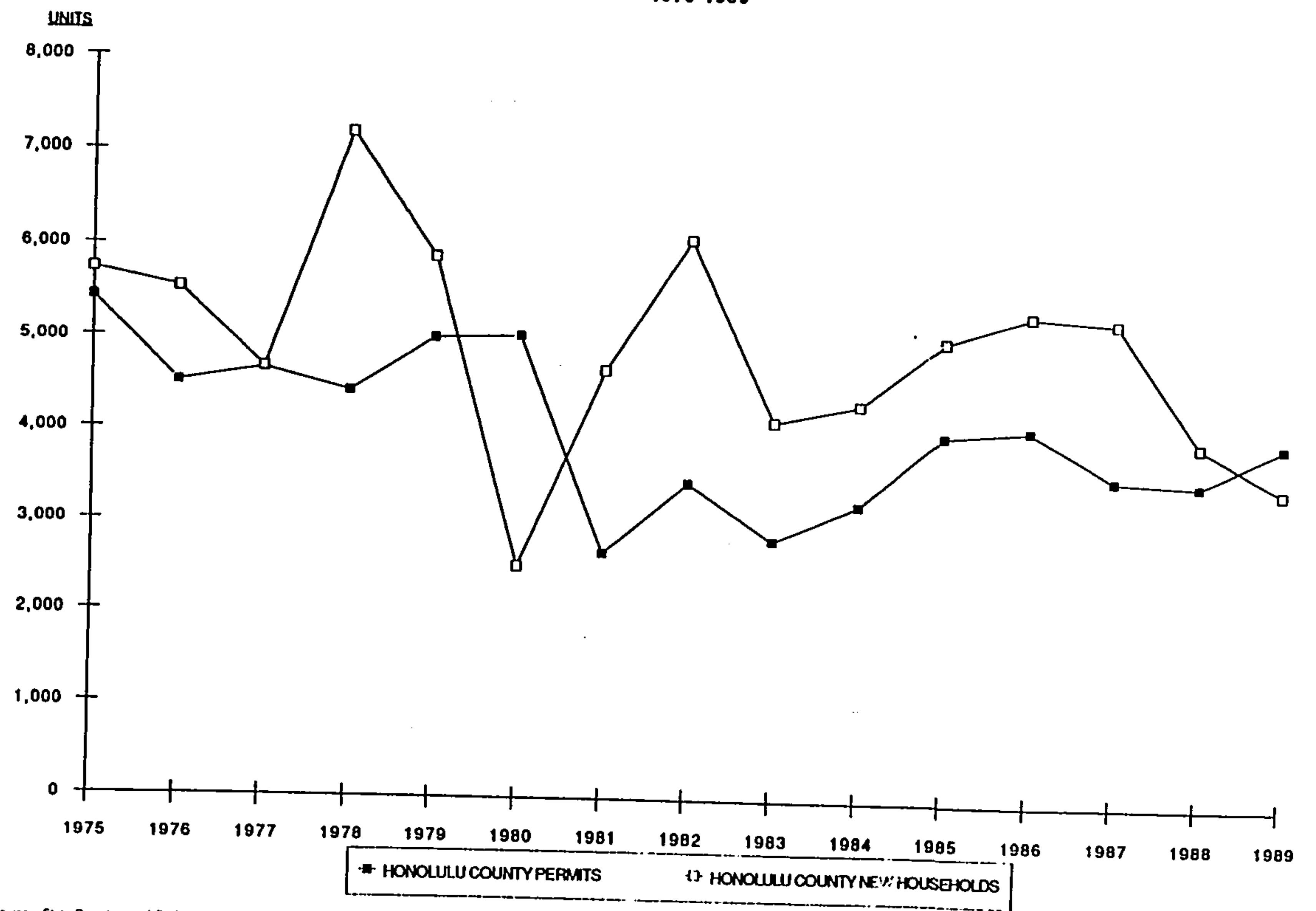
BUILDING PERMITS ISSUED
CITY AND COUNTY OF HONOLULU
1970 - 1989

YEAR	SINGLE-FAMILY		MULTIFAMILY		
	TOTAL	PERCENT	TOTAL	PERCENT	TOTAL
1970	3,809	47.7%	4,172	52.3%	7,981
1971	3,771	48.0%	4,087	52.0%	7,858
1972	3,352	31.6%	7,265	68.4%	10,617
1973	3,008	23.0%	10,057	77.0%	13,065
1974	1,626	12.4%	11,534	87.6%	13,160
1975	1,078	19.9%	4,352	80.1%	5,430
1976	1,326	29.3%	3,198	70.7%	4,525
1977	2,210	47.2%	2,472	52.8%	4,682
1978	2,075	46.7%	2,371	53.3%	4,446
1979	3,046	60.5%	1,988	39.5%	5,034
1980	1,650	32.6%	3,411	67.4%	5,061
1981	768	28.6%	1,915	71.4%	2,683
1982	891	25.6%	2,585	74.4%	3,476
1983	1,562	55.0%	1,280	45.0%	2,842
1984	2,199	67.6%	1,054	32.4%	3,253
1985	2,133	52.8%	1,905	47.2%	4,038
1986	2,021	49.1%	2,095	50.9%	4,116
1987	2,024	56.3%	1,570	43.7%	3,593
1988	2,001	56.4%	1,549	43.6%	3,550
1989	2,105	52.8%	1,882	47.2%	3,987
Total	42,655	37.6%	70,742	62.4%	113,397
Average (1970-1989)	2,133	42.2%	3,537	57.8%	5,670
AVERAGE					
1970-1974	3,113	41.5%	7,423	58.5%	10,536
1975-1979	1,898	41.9%	2,965	58.1%	4,863
1980-1984	1,534	43.0%	2,025	57.0%	3,559
1985-1989	2,057	44.7%	1,800	55.3%	3,857

SOURCE: Department of Business and Economic Development; and Robert Charles Lesser & Co.

01-2728.05

EXHIBIT 18
HONOLULU RESIDENTIAL BUILDING PERMITS AND NEW HOUSEHOLD GROWTH
1975-1989



Source: State Department of Business and Economic Development, Honolulu City and County Office of General Planning, Robert Charles Lesser & Co

ROBERT CHARLES LESSER & CO.

01-2728.05

EXHIBIT 19

HOUSEHOLD INCOME DISTRIBUTION
PRIMARY MARKET AREA 1/

1990 - 2010

INCOME RANGE	1980 2/ TOTAL	1980 2/ PERCENT	1990 3/ TOTAL	1990 3/ PERCENT	1995 3/ TOTAL	1995 3/ PERCENT	2000 3/ TOTAL	2000 3/ PERCENT	2005 3/ TOTAL	2005 3/ PERCENT	2010 3/ TOTAL	2010 3/ PERCENT
< $5,000	1,873	4.3%	1,751	3.0%	1,858	2.7%	1,968	2.4%	2,051	2.2%	2,090	1.8%
$5,000 - $9,999	4,138	9.5%	2,309	3.9%	2,622	3.8%	3,008	3.7%	3,473	3.6%	4,055	3.6%
$10,000 - $14,999	5,271	12.1%	3,803	6.1%	4,047	5.9%	4,588	5.7%	5,219	5.5%	5,986	5.2%
$15,000 - $19,999	5,532	12.7%	4,381	7.4%	5,003	7.3%	5,771	7.2%	6,707	7.0%	7,871	6.9%
$20,000 - $24,999	5,575	12.8%	4,102	6.9%	4,783	7.0%	5,634	7.0%	6,716	7.0%	8,099	7.1%
$25,000 - $29,999	5,488	12.6%	4,155	7.0%	4,811	7.0%	5,625	7.0%	6,650	7.0%	7,951	7.0%
$30,000 - $34,999	4,968	11.4%	4,096	6.9%	4,758	6.9%	5,577	6.9%	6,611	6.9%	7,928	6.9%
$35,000 - $39,999	3,748	8.6%	3,688	6.2%	4,315	6.3%	5,102	6.3%	6,108	6.4%	7,391	6.5%
$40,000 - $49,999	4,225	9.7%	8,001	13.5%	8,857	12.9%	9,841	12.2%	10,962	11.5%	12,246	10.7%
$50,000 - $59,999	1,525	3.5%	7,544	12.7%	8,802	12.8%	10,372	12.9%	12,364	13.0%	14,908	13.1%
$60,000 $74,999	740	1.7%	7,770	13.1%	8,988	13.1%	10,483	13.0%	12,393	13.0%	14,782	12.9%
$75,000 - $99,999	305	0.7%	5,324	9.0%	6,407	9.3%	7,810	9.7%	9,638	10.1%	12,040	10.5%
$100,000 +	131	0.3%	2,635	4.4%	3,585	5.2%	4,811	6.0%	6,526	6.8%	8,876	7.8%
Total 4/	43,558	99.9%	58,358		68,822	100.0%	80,584	100.0%	95,404	100.0%	114,234	100.0%
ANNUAL GROWTH			1,580		1,893		2,354		2,952		3,766	

1/ City and County of Honolulu Planning Department. Plan Areas of Ewa and Central Oahu.
2/ 1980 income in 1980 dollars.
3/ 1990 through 2010 incomes in 1989 dollars. Estimates in real growth are based upon historic real growth rates for 1980 to 1989
4/ Percentage may not total 100% due to rounding.

SOURCE: Urban Decision Systems; City and County of Honolulu Planning Department; and Robert Charles Lesser & Co.

ROBERT CHARLES LESSER & CO.

01-2728.05

EXHIBIT 20

HOUSEHOLD INCOME DISTRIBUTION
CITY AND COUNTY OF HONOLULU

1980 - 2010

INCOME RANGE	1980 /1 TOTAL	1980 /1 PERCENT	1990 /2 TOTAL	1990 /2 PERCENT	1995 /2 TOTAL	1995 /2 PERCENT	2000 /2 TOTAL	2000 /2 PERCENT	2005 /2 TOTAL	2005 /2 PERCENT	2010 /2 TOTAL	2010 /2 PERCENT
< $5,000	18,388	7.6%	12,539	4.3%	12,787	4.1%	12,337	3.7%	12,035	3.3%	11,526	2.9%
$5,000 - $9,999	31,955	13.2%	19,270	6.7%	20,241	6.5%	21,328	6.3%	22,487	6.1%	23,778	5.9%
$10,000 - $14,999	33,882	14.0%	24,470	8.5%	26,011	8.3%	27,682	8.2%	29,590	8.0%	31,718	7.9%
$15,000 - $19,999	30,281	12.5%	25,684	8.9%	27,633	8.9%	29,845	8.8%	32,387	8.8%	35,305	8.8%
$20,000 - $24,999	28,082	11.6%	22,304	7.7%	24,358	7.8%	26,702	7.9%	29,479	8.0%	32,726	8.1%
$25,000 - $29,999	23,968	9.9%	20,541	7.1%	22,300	7.2%	24,336	7.2%	26,882	7.3%	29,461	7.3%
$30,000 - $34,999	19,851	8.2%	18,808	6.5%	20,428	6.6%	22,308	6.6%	24,474	6.7%	27,043	6.7%
$35,000 - $39,999	15,251	6.3%	17,074	5.9%	18,557	6.0%	20,280	6.0%	22,268	6.1%	24,625	6.1%
$40,000 - $49,999	19,851	8.2%	31,578	10.9%	32,873	10.5%	34,238	10.1%	35,682	9.7%	37,158	9.2%
$50,000 - $59,999	9,441	3.9%	26,926	9.3%	29,473	9.5%	32,414	9.6%	35,648	9.7%	39,859	9.9%
$60,000 $74,999	5,810	2.4%	28,882	10.0%	31,001	9.9%	33,394	9.9%	36,141	9.8%	39,335	9.8%
$75,000 - $99,999	3,389	1.4%	23,188	8.0%	25,512	8.2%	28,189	8.3%	31,320	8.5%	35,063	8.7%
$100,000 +	2,178	0.9%	17,652	6.1%	20,927	6.7%	24,877	7.4%	29,627	8.1%	35,426	8.8%
Total 3/	242,084	100.1%	288,907	100.0%	311,884	100.1%	337,898	100.0%	368,032	100.0%	403,024	100.0%
ANNUAL GROWTH			4,882		4,595		5,223		6,007		6,998	

1/ 1980 income in 1980 dollars
2/ 1990 through 2010 incomes in 1988 dollars. Estimates of real growth are based upon historic real growth rates for 1980 to 1988.
3/ Percentages may not total 100% due to rounding.

SOURCE: Urban Decision Systems; City and County of Honolulu Planning Department; and Robert Charles Lesser & Co

EXHIBIT 21

CITY AND COUNTY OF HONOLULU
INFLATION AND INCOME GROWTH 1980-1989

	1980-1989
TOTAL GROWTH IN INCOME	100.15%
CONSUMER PRICE INDEX (HONOLULU)	55.06%
REAL GROWTH IN INCOME	45.09%
COMPOUND ANNUAL REAL GROWTH RATE	4.22%
COMPOUND ANNUAL TOTAL GROWTH RATE (REAL GROWTH PLUS INFLATION)	8.02%

SOURCE: Figures compiled from Hawaii State Data Center; 1980 Census; UDS; and Robert Charles Lesser & Co.

EXHIBIT 22

01-2728.05

RESALE ACTIVITY
CITY AND COUNTY OF HONOLULU
1968 - 1988

YEAR	TOTAL UNITS SOLD	SINGLE-FAMILY UNITS SOLD	SINGLE-FAMILY PERCENT OF TOTAL	SINGLE-FAMILY MEAN SALES PRICE	SINGLE-FAMILY CHANGE IN SALES PRICE	MULTIFAMILY UNITS SOLD	MULTIFAMILY PERCENT OF TOTAL	MULTIFAMILY MEAN SALES PRICE	MULTIFAMILY CHANGE IN SALES PRICE
1968	1,133	--	--	--	--	--	--	--	--
1969	1,422	--	--	--	--	--	--	--	--
1970	1,693	--	--	--	--	--	--	--	--
1971	2,157	--	--	--	--	--	--	--	--
1972	4,555	--	--	--	--	--	--	--	--
1973	5,348	--	--	--	--	--	--	--	--
1974	4,821	--	--	--	--	--	--	--	--
1975	4,174	--	--	--	--	--	--	--	--
1976	4,311	--	--	--	--	--	--	--	--
1977	5,523	--	--	--	--	--	--	--	--
1978	5,714	--	--	--	--	--	--	--	--
1979	8,009	--	--	--	--	--	--	--	--
1980	5,553	--	--	--	--	--	--	--	--
1981	3,735	--	--	--	--	--	--	--	--
1982	2,948	--	--	--	--	--	--	--	--
1983	4,868	--	--	--	--	--	--	--	--
1984	4,732	--	--	--	--	--	--	--	--
1985	5,261	2,146	41%	$188,900	--	2,901	55%	$98,000	--
1986	6,467	2,595	40%	$209,400	11%	3,600	56%	$107,700	10%
1987	8,855	4,329	49%	$282,000	35%	5,473	62%	$128,540	19%
1988	9,886	3,026	31%	$312,300	11%	6,599	67%	$144,496	12%
1989	9,405	2,919	31%	$373,913	20%	6,486	69%	$164,498	14%

Average Number of Units Sold 1968-1989	5,026	Average SF Sales Price 1985-1989	$273,303	Average Annual SF Price Appreciation 1985-1989	38%
Average Number of Units Sold 1985-1989	7,975	Average MF Sales Price 1985-1989	$128,647	Average Annual MF Price Appreciation 1985-1989	62%

NOTE: Excludes "other" permits, including vacant land, commercial/industrial, income property and business opportunities.

SOURCE: Honolulu Board of Realtors, Multiple Listing Service and Robert Charles Lesser & Co.

EXHIBIT 23A

01-2728.05

ESTIMATED ANNUAL DEMAND POTENTIAL FOR OWNER-OCCUPIED UNITS
PRICED FROM $185,000
1990 - 1994
CITY AND COUNTY OF HONOLULU 1/
April 1990

DEMAND SOURCE		Entry Level	1st Time Move-Up	2nd Time Move-Up	Upgrade Luxury	TOTAL
Home Price:	2/	$185,000 $269,999	$260,000 $369,999	$370,000 $530,000	$530,000 +	
Income:	3/	$50,000 $59,999	$60,000 $69,999	$70,000 $99,999	$100,000 +	
Down Payment:		30%	50%	50%	50%	
New Household Growth						
Total Annual New Households	4/	4,595	4,595	4,595	4,595	4,595
x Percentage Income Qualified	5/	9.3%	6.7%	11.3%	6.1%	33.4%
= Income Qualified		427	306	521	280	1,535
x Demonstrated Owner Propensity	6/	60.0%	76.5%	83.3%	86.7%	76.1%
= Total Potential New Owner Households		256	234	434	243	1,168
x *Estimated Active Market*	7/	37.4%	37.4%	37.4%	37.4%	37.4%
		------	------	------	------	------
Total Annual Demand From New Households		96	88	162	91	437
Renter Turnover						
Total Households		288,907	288,907	288,907	288,907	288,907
x Percentage Income Qualified	5/	9.3%	6.7%	11.3%	6.1%	33.4%
= Income Qualified		26,868	19,260	32,743	17,623	96,495
x Estimated Renter Propensity		40.0%	23.5%	16.7%	13.3%	23.9%
= Total Estimated Renter Households		10,747	4,526	5,468	2,344	23,085
x Average Annual Turnover Factor	6/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households		3,590	1,512	1,826	783	7,711
x Estimated Active Market	8/	7.5%	7.5%	7.5%	7.5%	7.5%
		------	------	------	------	------
Total Annual Demand from Renter Upgrading		269	113	137	59	577
Owner Preference						
Total Households		288,907	288,907	288,907	288,907	288,907
x Percentage Income Qualified	5/	9.3%	6.7%	11.3%	6.1%	33.4%
= Total Income Qualified Households		26,868	19,260	32,743	17,623	96,495
x Estimated Owner Propensity		60.0%	76.5%	83.3%	86.7%	76.1%
= Total Estimated Owner Households		16,121	14,734	27,275	15,279	73,409
x Average Annual Turnover Factor	6/	10.4%	10.4%	10.4%	10.4%	10.4%
= Total Qualified/Turnover Owner Households		1,677	1,532	2,837	1,589	7,635
x Estimated Active Market	9/	22.4%	22.4%	22.4%	22.4%	22.4%
		------	------	------	------	------
Total Annual Demand From Owner Preference		376	344	637	357	1,713
Net Annual Estimated Demand		741	545	935	506	2,727

1 / Includes Primary Market Area (Central Oahu and Ewa planning areas as shown in EXHIBIT 1 map).
2 / Based upon market area surveys; March 1990 dollars.
3 / Assumes 10% interest on a 30-year mortgage and a monthly mortgage payment equivalent to 28% of gross income, with a down payment of 30% for entry level and 50% for all other price ranges.
4 / Based on City and County of Honolulu projections (see EXHIBIT 3).
5 / As determined by Urban Decision Systems and adjusted by RCLCo to reflect real income growth during the projection period.
6 / From U.S. Census,1980 (Metropolitan Housing Characteristics, Tables A-7, B-1, B-4 and B-8).
7 / Based upon Oahu new home vs resale figures, as determined by the relationship between residential building permits and resale activity from the Honolulu Board of Realtors Multiple Listing Service.
8 / Assumes approximately 20% of renter turnover will purchase homes of which 37.4% will buy a new home.
9 / Assumes that existing home owners have a 40% higher propensity than new households to buy an existing home.

Source: Urban Decision Systems, Incorporated, U.S. Bureau of the Census and Robert Charles Lesser & Co.

EXHIBIT 23B

01-2726.05

ESTIMATED ANNUAL DEMAND POTENTIAL FOR OWNER-OCCUPIED UNITS
PRICED FROM $185,000
1995 - 1999
CITY AND COUNTY OF HONOLULU 1/
April 1990

	Entry Level	1st Time Move-Up	2nd Time Move-Up	Upgrade Luxury	TOTAL
Home Price: 2/	$185,000 $269,999	$260,000 $369,999	$370,000 $530,000	$530,000 +	
Income: 3/	$50,000 $59,999	$60,000 $69,999	$70,000 $99,999	$100,000 +	
Down Payment:	30%	50%	50%	50%	
DEMAND SOURCE					
New Household Growth					
Total Annual New Households 4/	5,223	5,223	5,223	5,223	5,223
x Percentage Income Qualified 5/	9.5%	6.6%	11.5%	6.7%	34.3%
= Income Qualified	496	345	601	350	1,7[illegible]
x Demonstrated Owner Propensity 6/	60.0%	76.5%	83.3%	86.7%	76.2%
= Total Potential New Owner Households	293	264	500	303	1,365
x Estimated Active Market 7/	37.4%	37.4%	37.4%	37.4%	37.4%
	------	------	------	------	------
Total Annual Demand From New Households	111	99	187	113	511
Renter Turnover					
Total Households	311,884	311,884	311,884	311,884	311,884
x Percentage Income Qualified 5/	9.5%	6.6%	11.5%	6.7%	34.3%
= Income Qualified	29,629	20,584	35,867	20,896	106,976
x Estimated Renter Propensity	40.0%	23.5%	16.7%	13.3%	23.8%
= Total Estimated Renter Households	11,852	4,837	5,990	2,779	25,458
x Average Annual Turnover Factor 6/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households	3,958	1,616	2,001	928	8,503
x Estimated Active Market 8/	7.5%	7.5%	7.5%	7.5%	7.5%
	------	------	------	------	------
Total Annual Demand from Renter Upgrading	296	121	150	70	636
Owner Preference					
Total Households	311,884	311,884	311,884	311,884	311,884
x Percentage Income Qualified 5/	9.5%	6.6%	11.5%	6.7%	34.3%
= Total Income Qualified Households	29,629	20,584	35,867	20,896	106,976
x Estimated Owner Propensity	60.0%	76.5%	83.3%	86.7%	76.2%
= Total Estimated Owner Households	17,777	15,747	29,877	18,117	81,518
x Average Annual Turnover Factor 6/	10.4%	10.4%	10.4%	10.4%	10.4%
= Total Qualified/Turnover Owner Households	1,849	1,638	3,107	1,884	8,478
x Estimated Active Market 9/	22.4%	22.4%	22.4%	22.4%	22.4%
	------	------	------	------	------
Total Annual Demand From Owner Preference	415	367	697	423	1,902
Net Annual Estimated Demand	822	587	1,034	606	3,049

1 / Includes Primary Market Area (Central Oahu and Ewa planning areas as shown in EXHIBIT 1 map).
2 / Based upon market area surveys; March 1990 dollars.
3 / Assumes 10% interest on a 30-year mortgage and a monthly mortgage payment equivalent to 28% of gross income, with a down payment of 30% for entry level and 50% for all other price ranges.
4 / Based on City and County of Honolulu projections (see EXHIBIT 3).
5 / As determined by Urban Decision Systems and adjusted by RCLCo to reflect real income growth during the projection period.
6 / From U.S. Census,1980 (Metropolitan Housing Characteristics, Tables A-7, B-1, B-4 and B-8).
7 / Based upon Oahu new home vs resale figures, as determined by the relationship between residential building permits and resale activity from the Honolulu Board of Realtors Multiple Listing Service.
8 / Assumes approximately 20% of renter turnover will purchase homes of which 37.4% will buy a new home.
9 / Assumes that existing home owners have a 40% higher propensity than new households to buy an existing home.

Source: Urban Decision Systems, Incorporated, U.S. Bureau of the Census and Robert Charles Lesser & Co.

EXHIBIT 23C

01-2726.05

ESTIMATED ANNUAL DEMAND POTENTIAL FOR OWNER-OCCUPIED UNITS
PRICED FROM $185,000
2000 - 2004
CITY AND COUNTY OF HONOLULU 1/
April 1990

DEMAND SOURCE	Entry Level	1st Time Move-Up	2nd Time Move-Up	Upgrade Luxury	TOTAL
Home Price: 2/	$185,000 $269,999	$260,000 $369,999	$370,000 $530,000	$530,000 +	
Income: 3/	$50,000 $59,999	$60,000 $69,999	$70,000 $99,999	$100,000 +	
Down Payment:	30%	50%	50%	50%	
New Household Growth					
Total Annual New Households 4/	6,007	6,007	6,007	6,007	6,007
x Percentage Income Qualified 5/	9.6%	6.6%	11.6%	7.4%	35.2%
= Income Qualified	577	396	697	445	2,114
x Demonstrated Owner Propensity 6/	60.0%	76.5%	83.3%	66.7%	76.4%
= Total Potential New Owner Households	346	303	580	385	1,615
x Estimated Active Market 7/	37.4%	37.4%	37.4%	37.4%	37.4%
	------	------	------	------	------
Total Annual Demand From New Households	129	113	217	144	604
Renter Turnover					
Total Households	337,998	337,998	337,998	337,998	337,998
x Percentage Income Qualified 5/	9.6%	6.6%	11.6%	7.4%	35.2%
= Income Qualified	32,448	22,308	39,208	25,012	118,975
x Estimated Renter Propensity	40.0%	23.5%	16.7%	13.3%	23.6%
= Total Estimated Renter Households	12,979	5,242	6,548	3,327	28,096
x Average Annual Turnover Factor 6/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households	4,335	1,751	2,187	1,111	9,384
x Estimated Active Market 8/	7.5%	7.5%	7.5%	7.5%	7.5%
	------	------	------	------	------
Total Annual Demand from Renter Upgrading	324	131	164	83	702
Owner Preference					
Total Households	337,998	337,998	337,998	337,998	337,998
x Percentage Income Qualified 5/	9.6%	6.6%	11.6%	7.4%	35.2%
= Total Income Qualified Households	32,448	22,308	39,208	25,012	118,975
x Estimated Owner Propensity	60.0%	76.5%	83.3%	86.7%	76.4%
= Total Estimated Owner Households	19,469	17,066	32,660	21,685	90,880
x Average Annual Turnover Factor 6/	10.4%	10.4%	10.4%	10.4%	10.4%
= Total Qualified/Turnover Owner Households	2,025	1,775	3,397	2,255	9,451
x Estimated Active Market 9/	22.4%	22.4%	22.4%	22.4%	22.4%
	------	------	------	------	------
Total Annual Demand From Owner Preference	454	398	762	506	2,121
Net Annual Estimated Demand	908	643	1,143	734	3,427

1 / Includes Primary Market Area (Central Oahu and Ewa planning areas as shown in EXHIBIT 1 map).
2 / Based upon market area surveys; March 1990 dollars.
3 / Assumes 10% interest on a 30-year mortgage and a monthly mortgage payment equivalent to 28% of gross income, with a down payment of 30% for entry level and 50% for all other price ranges.
4 / Based on City and County of Honolulu projections (see EXHIBIT 3).
5 / As determined by Urban Decision Systems and adjusted by RCLCo to reflect real income growth during the projection period.
6 / From U.S. Census,1980 (Metropolitan Housing Characteristics, Tables A-7, B-1, B-4 and B-8).
7 / Based upon Oahu new home vs resale figures, as determined by the relationship between residential building permits and resale activity from the Honolulu Board of Realtors Multiple Listing Service.
8 / Assumes approximately 20% of renter turnover will purchase homes of which 37.4% will buy a new home.
9 / Assumes that existing home owners have a 40% higher propensity than new households to buy an existing home.

Source: Urban Decision Systems, Incorporated, U.S. Bureau of the Census and Robert Charles Lesser & Co.

EXHIBIT 23D

01-2726.05

ESTIMATED ANNUAL DEMAND POTENTIAL FOR OWNER-OCCUPIED UNITS
PRICED FROM $185,000
2005 - 2010
CITY AND COUNTY OF HONOLULU 1/
April 1990

DEMAND SOURCE		Entry Level	1st Time Move-Up	2nd Time Move-Up	Upgrade Luxury	TOTAL
	Home Price: 2/	$185,000 $259,999	$260,000 $369,999	$370,000 $530,000	$530,000 +	
	Income: 3/	$50,000 $59,999	$60,000 $69,999	$70,000 $99,999	$100,000 +	
	Down Payment:	30%	50%	50%	50%	
New Household Growth						
Total Annual New Households 4/		6,998	6,998	6,998	6,998	6,998
x Percentage Income Qualified 5/		9.7%	6.5%	11.8%	8.1%	36.1%
= Income Qualified		679	457	823	567	2,526
x Demonstrated Owner Propensity 6/		60.0%	76.5%	83.3%	86.7%	76.6%
= Total Potential New Owner Households		407	350	686	491	1,934
x Estimated Active Market 7/		37.4%	37.4%	37.4%	37.4%	37.4%
		------	------	------	------	------
Total Annual Demand From New Households		152	131	257	184	723
Renter Turnover						
Total Households		368,032	368,032	368,032	368,032	368,032
x Percentage Income Qualified 5/		9.7%	6.5%	11.8%	8.1%	36.1%
= Income Qualified		35,699	24,045	43,305	29,811	132,860
x Estimated Renter Propensity		40.0%	23.5%	16.7%	13.3%	23.4%
= Total Estimated Renter Households		14,280	5,651	7,232	3,965	31,127
x Average Annual Turnover Factor 6/		33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households		4,769	1,887	2,415	1,324	10,396
x Estimated Active Market 8/		7.5%	7.5%	7.5%	7.5%	7.5%
		------	------	------	------	------
Total Annual Demand from Renter Upgrading		357	141	181	99	778
Owner Preference						
Total Households		368,032	368,032	368,032	368,032	368,032
x Percentage Income Qualified 5/		9.7%	6.5%	11.8%	8.1%	36.1%
= Total Income Qualified Households		35,699	24,045	43,305	29,811	132,860
x Estimated Owner Propensity		60.0%	76.5%	83.3%	86.7%	76.6%
= Total Estimated Owner Households		21,419	18,394	36,073	25,846	101,733
x Average Annual Turnover Factor 6/		10.4%	10.4%	10.4%	10.4%	10.4%
= Total Qualified/Turnover Owner Households		2,228	1,913	3,752	2,688	10,580
x Estimated Active Market 9/		22.4%	22.4%	22.4%	22.4%	22.4%
		------	------	------	------	------
Total Annual Demand From Owner Preference		500	429	842	603	2,374
Net Annual Estimated Demand		1,009	701	1,279	886	3,876

1 / Includes Primary Market Area (Central Oahu and Ewa planning areas as shown in EXHIBIT 1 map).
2 / Based upon market area surveys; March 1990 dollars.
3 / Assumes 10% interest on a 30-year mortgage and a monthly mortgage payment equivalent to 28% of gross income, with a down payment of 30% for entry level and 50% for all other price ranges.
4 / Based on City and County of Honolulu projections (see EXHIBIT 3).
5 / As determined by Urban Decision Systems and adjusted by RCLCo to reflect real income growth during the projection period.
6 / From U.S. Census,1980 (Metropolitan Housing Characteristics, Tables A-7, B-1, B-4 and B-8).
7 / Based upon Oahu new home vs resale figures, as determined by the relationship between residential building permits and resale activity from the Honolulu Board of Realtors Multiple Listing Service.
8 / Assumes approximately 20% of renter turnover will purchase homes of which 37.4% will buy a new home.
9 / Assumes that existing home owners have a 40% higher propensity than new households to buy an existing home.

Source: Urban Decision Systems, Incorporated, U.S. Bureau of the Census and Robert Charles Lesser & Co.

01-2728.05

EXHIBIT 24A

ESTIMATED ANNUAL DEMAND POTENTIAL FOR RENTAL UNITS

1990 - 1994
CITY AND COUNTY OF HONOLULU 1/
April 1990

	Moderate	Mid	High	Luxury	TOTAL
Rents: 2/	$500 $750	$750 $1,000	$1,000 $1,500	$1,500 +	
Income:	$20,000 $29,999	$30,000 $39,999	$40,000 $59,999	$60,000 +	
DEMAND SOURCE					
New Household Growth					
Total Annual New Households 3/	4,595	4,595	4,595	4,595	4,595
x Percentage Income Qualified 4/	14.8%	12.4%	20.2%	24.1%	71.5%
= Income Qualified	680	570	928	1,107	3,285
x Demonstrated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	43.4%
= Total Potential New Renter Households	481	353	388	204	1,426
x Estimated Active Market 6/	7.3%	7.3%	7.3%	7.3%	7.3%
	------	------	------	------	------
Total Annual Demand From New Households	35	26	28	15	105
Renter Turnover					
Total Households	288,907	288,907	288,907	288,907	288,907
x Percentage Income Qualified 4/	14.8%	12.4%	20.2%	24.1%	71.5%
= Income Qualified	42,758	35,824	58,359	69,627	206,569
x Estimated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	43.4%
= Total Estimated Renter Households	30,273	22,211	24,394	12,811	89,689
x Average Annual Turnover Factor 5/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households	10,111	7,419	8,148	4,279	29,956
x Estimated Active Market 6/	5.9%	5.9%	5.9%	5.9%	5.9%
	------	------	------	------	------
Total Annual Demand from Renter Turnover	593	435	478	251	1,757
Net Annual Estimated Demand	628	461	506	266	1,862

1 / Includes Primary Market Area (Central Oahu and Ewa planning areas as shown in EXHIBIT 1 map).
2 / Assumes 30% of gross income is attributed to rent.
3 / Based on City and County of Honolulu projections (see EXHIBIT 3).
4 / Urban Decisions Systems, Inc.
5 / U.S. Census information.
6 / RCLCo estimate, and assumes that existing renters will have a 20% higher propensity to rent existing apartments. Adjusted by a division factor of 2.25 relative to the Primary Market Area to compensate for limited availability of new product in areas other than the Primary Market Area.

Source: Robert Charles Lesser & Co.

01-2728.05

EXHIBIT 24B

ESTIMATED ANNUAL DEMAND POTENTIAL FOR RENTAL UNITS

1995 - 1999
CITY AND COUNTY OF HONOLULU 1/
April 1990

	Moderate	Mid	High	Luxury	TOTAL
Rents: 2/	$500 $750	$750 $1,000	$1,000 $1,500	$1,500 +	
Income:	$20,000 $29,999	$30,000 $39,999	$40,000 $59,999	$60,000 +	
DEMAND SOURCE					
New Household Growth					
Total Annual New Households 3/	5,223	5,223	5,223	5,223	5,223
x Percentage Income Qualified 4/	15.0%	12.6%	20.0%	24.8%	72.4%
= Income Qualified	783	658	1,045	1,295	3,781
x Demonstrated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	43.3%
= Total Potential New Renter Households	555	408	437	238	1,638
x Estimated Active Market 6/	7.8%	7.8%	7.8%	7.8%	7.8%
	------	------	------	------	------
Total Annual Demand From New Households	43	32	34	19	127
Renter Turnover					
Total Households	311,884	311,884	311,884	311,884	311,884
x Percentage Income Qualified 4/	15.0%	12.6%	20.0%	24.8%	72.4%
= Income Qualified	46,783	39,297	62,377	77,347	225,804
x Estimated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	43.3%
= Total Estimated Renter Households	33,122	24,364	26,074	14,232	97,792
x Average Annual Turnover Factor 5/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households	11,063	8,138	8,709	4,753	32,662
x Estimated Active Market 6/	6.2%	6.2%	6.2%	6.2%	6.2%
	------	------	------	------	------
Total Annual Demand from Renter Turnover	688	506	542	296	2,032
Net Annual Estimated Demand	731	538	576	314	2,160

1 / Includes Primary Market Area (Central Oahu and Ewa planning areas as shown in EXHIBIT 1 map).
2 / Assumes 30% of gross income is attributed to rent.
3 / Based on City and County of Honolulu projections (see EXHIBIT 3).
4 / Urban Decisions Systems, Inc.
5 / U.S. Census information.
6 / RCLCo estimate, and assumes that existing renters will have a 20% higher propensity to rent existing apartments. Adjusted by a division factor of 2.25 relative to the Primary Market Area to compensate for limited availability of new product in areas other than the Primary Market Area.

Source: Robert Charles Lesser & Co.

01-2728.05

EXHIBIT 24C

ESTIMATED ANNUAL DEMAND POTENTIAL FOR RENTAL UNITS

2000 - 2004
CITY AND COUNTY OF HONOLULU 1/
April 1990

DEMAND SOURCE	Moderate	Mid	High	Luxury	TOTAL
Rents: 2/	$500 $750	$750 $1,000	$1,000 $1,500	$1,500 +	
Income:	$20,000 $29,999	$30,000 $39,999	$40,000 $59,999	$60,000 +	
New Household Growth					
Total Annual New Households 3/	6,007	6,007	6,007	6,007	6,007
x Percentage Income Qualified 4/	15.1%	12.6%	19.7%	25.6%	73.0%
= Income Qualified	907	757	1,183	1,538	4,385
x Demonstrated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	43.1%
= Total Potential New Renter Households	642	469	495	283	1,889
x Estimated Active Market 6/	8.5%	8.5%	8.5%	8.5%	8.5%
	------	------	------	------	------
Total Annual Demand From New Households	55	40	42	24	161
Renter Turnover					
Total Households	337,998	337,998	337,998	337,998	337,998
x Percentage Income Qualified 4/	15.1%	12.6%	19.7%	25.6%	73.0%
= Income Qualified	51,036	42,588	66,586	86,527	246,739
x Estimated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	43.1%
= Total Estimated Renter Households	36,135	26,404	27,833	15,921	106,293
x Average Annual Turnover Factor 5/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households	12,069	8,819	9,296	5,318	35,502
x Estimated Active Market 6/	6.8%	6.8%	6.8%	6.8%	6.8%
	------	------	------	------	------
Total Annual Demand from Renter Turnover	823	602	634	363	2,422
Net Annual Estimated Demand	878	642	676	387	2,583

1 / Includes Primary Market Area (Central Oahu and Ewa planning areas as shown in EXHIBIT 1 map).
2 / Assumes 30% of gross income is attributed to rent.
3 / Based on City and County of Honolulu projections (see EXHIBIT 3).
4 / Urban Decisions Systems, Inc.
5 / U.S. Census information.
6 / RCLCo estimate, and assumes that existing renters will have a 20% higher propensity to rent existing apartments. Adjusted by a division factor of 2.58 relative to the Primary Market Area to compensate for limited availability of new product in areas other than the Primary Market Area.

Source: Robert Charles Lesser & Co.

EXHIBIT 24D

ESTIMATED ANNUAL DEMAND POTENTIAL FOR RENTAL UNITS

2005 - 2010
CITY AND COUNTY OF HONOLULU 1/
April 1990

DEMAND SOURCE	Moderate	Mid	High	Luxury	TOTAL
Rents: 2/	$500 $750	$750 $1,000	$1,000 $1,500	$1,500 +	
Income:	$20,000 $29,999	$30,000 $39,999	$40,000 $59,999	$60,000 +	
New Household Growth					
Total Annual New Households 3/	6,998	6,998	6,998	6,998	6,998
x Percentage Income Qualified 4/	15.3%	12.8%	19.4%	26.4%	73.9%
= Income Qualified	1,071	896	1,358	1,847	5,172
x Demonstrated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	42.9%
= Total Potential New Renter Households	758	555	567	340	2,221
x Estimated Active Market 6/	9.4%	9.4%	9.4%	9.4%	9.4%
	------	------	------	------	------
Total Annual Demand From New Households	71	52	53	32	209
Renter Turnover					
Total Households	368,032	368,032	368,032	368,032	368,032
x Percentage Income Qualified 4/	15.3%	12.8%	19.4%	26.4%	73.9%
= Income Qualified	56,309	47,108	71,398	97,160	271,976
x Estimated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	42.9%
= Total Estimated Renter Households	39,867	29,207	29,844	17,878	116,796
x Average Annual Turnover Factor 5/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households	13,315	9,755	9,968	5,971	39,010
x Estimated Active Market 6/	7.5%	7.5%	7.5%	7.5%	7.5%
	------	------	------	------	------
Total Annual Demand from Renter Turnover	1,001	734	750	449	2,934
Net Annual Estimated Demand	1,073	786	803	481	3,142

1 / Includes Primary Market Area (Central Oahu and Ewa planning areas as shown in EXHIBIT 1 map).
2 / Assumes 30% of gross income is attributed to rent.
3 / Based on City and County of Honolulu projections (see EXHIBIT 3).
4 / Urban Decisions Systems, Inc.
5 / U.S. Census information.
6 / RCLCo estimate, and assumes that existing renters will have a 20% higher propensity to rent existing apartments. Adjusted by a division factor of 2.50 relative to the Primary Market Area to compensate for limited availability of new product in areas other than the Primary Market Area.

Source: Robert Charles Lesser & Co.

EXHIBIT 25

ANNUAL DEMAND SUMMARY
COMPETITIVE HOUSING MARKET 1/
OAHU
1990-2010

SOURCES OF DEMAND	1990-1994 ANUAL DEMAND		1995-1999 ANUAL DEMAND		2000-2004 ANUAL DEMAND		2005-2010 ANUAL DEMAND	
OWNER-OCCUPIED UNITS								
Local	90%	2,737	90%	3,049	90%	3,427	90%	3,876
Second Home	10%	304	10%	339	10%	381	10%	431
	-----	-----	-----	-----	-----	-----	-----	-----
Total Oahu Demand	100%	3,041	100%	3,388	100%	3,808	100%	4,307
RENTER-OCCUPIED UNITS								
Local	90%	1,852	90%	2,160	90%	2,583	90%	3,142
Second Home	10%	207	10%	240	10%	456	10%	554
	-----	-----	-----	-----	-----	-----	-----	-----
Total Oahu Demand	100%	2,059	100%	2,400	100%	3,039	100%	3,696
Total Owner and Renter Demand		5,100		5,788		6,847		8,003
Primary Market Area Capture 2/		41%		49%		55%		60%

1 / Defined as for sale housing at $180,000 and above, rental rates of $500 per month and higher.
2/ Primary Market Area is comprised of the Ewa and Central Oahu plan areas as defined by the City and County of Honolulu Planning Department. Primary market area capture was calculated utilizing primary market area demand from EXHIBIT 28.

SOURCE: Robert Charles Lesser & Co.

01-2728.05

EXHIBIT 26A

ESTIMATED ANNUAL DEMAND POTENTIAL FOR OWNER-OCCUPIED UNITS
PRICED FROM $185,000
1990 - 1994
PRIMARY MARKET AREA 1/
April 1990

DEMAND SOURCE	Entry Level	1st Time Move-Up	2nd Time Move-Up	Upgrade Luxury	TOTAL
Home Price: 2/	$185,000 $269,999	$260,000 $369,999	$370,000 $530,000	$530,000 +	
Income: 3/	$50,000 $59,999	$60,000 $69,999	$70,000 $99,999	$100,000 +	
Down Payment:	30%	50%	50%	50%	
New Household Growth					
Total Annual New Households 4/	1,893	1,893	1,893	1,893	1,893
x Percentage Income Qualified 5/	12.7%	8.7%	13.4%	4.4%	39.2%
= Income Qualified	240	165	253	83	742
x Demonstrated Owner Propensity 6/	60.0%	76.5%	83.3%	86.7%	74.6%
= Total Potential New Owner Households	144	126	211	72	554
x Estimated Active Market 7/	37.4%	37.4%	60.0%	80.0%	51.6%
	------	------	------	------	------
Total Annual Demand From New Households	54	47	126	58	285
Renter Turnover					
Total Households	56,358	59,358	59,358	59,358	59,358
x Percentage Income Qualified 5/	12.7%	8.7%	13.4%	4.4%	39.2%
= Income Qualified	7,538	5,164	7,934	2,612	23,268
x Estimated Renter Propensity	40.0%	23.5%	16.7%	13.3%	25.4%
= Total Estimated Renter Households	3,015	1,218	1,325	347	5,906
x Average Annual Turnover Factor 6/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households	1,007	407	443	116	1,973
x Estimated Active Market 8/	7.5%	7.5%	12.0%	16.0%	9.0%
	------	------	------	------	------
Total Annual Demand from Renter Upgrading	75	30	53	19	177
Owner Preference					
Total Households	59,358	59,358	59,358	59,358	59,358
x Percentage Income Qualified 5/	12.7%	8.7%	13.4%	4.4%	39.2%
= Total Income Qualified Households	7,538	5,184	7,934	2,612	23,268
x Estimated Owner Propensity	60.0%	76.5%	83.3%	86.7%	74.6%
= Total Estimated Owner Households	4,523	3,966	6,609	2,264	17,362
x Average Annual Turnover Factor 6/	10.4%	10.4%	10.4%	10.4%	10.4%
= Total Qualified/Turnover Owner Households	470	412	687	235	1,806
x Estimated Active Market 9/	22.4%	22.4%	48.0%	64.0%	37.6%
	------	------	------	------	------
Total Annual Demand From Owner Preference	106	93	330	151	679
Net Annual Estimated Demand	235	170	510	227	1,142

1 / Primary Market Area is comprised of Central Oahu and Ewa planning areas, as defined by the City and County of Honolulu Planning Department (as shown in EXHIBIT 1 map).
2 / Based upon market area surveys; March 1990 dollars.
3 / Assumes 10% interest on a 30-year mortgage and a monthly mortgage payment equivalent to 28% of gross income, with a down payment of 30% for entry level and 50% for all other price ranges.
4 / Based on City and County of Honolulu projections (see EXHIBIT 3).
5 / As determined by Urban Decision Systems and adjusted by RCLCo to reflect real income growth during the projection period.
6 / From U.S. Census,1980 (Metropolitan Housing Characteristics, Tables A-7, B-1, B-4 and B-8).
7 / Based upon Oahu new home vs resale figures, as determined by the relationship between residential building permits and resale activity from the Honolulu Board of Realtors Multiple Listing Service. Percentage was adjusted upward in the second-time move-up and luxury categories due to absence of existing product in the market within those price ranges.
8 / Assumes approximately 20% of renter turnover will purchase homes of which 37.4% will buy a new home, except in second-time move-up and luxury categories, with greater propensities due to absence of new product.
9 / Assumes that existing home owners have a 40% higher propensity than new households to buy an existing home, except in the second-time move-up and luxury categories which currently have a limited supply of existing product.

Source: Urban Decision Systems, Incorporated, U.S. Bureau of the Census and Robert Charles Lesser & Co.

EXHIBIT 26B

01-2728.05

ESTIMATED ANNUAL DEMAND POTENTIAL FOR OWNER-OCCUPIED UNITS
PRICED FROM $185,000
1995 - 1999
PRIMARY MARKET AREA 1/
April 1990

	Entry Level	1st Time Move-Up	2nd Time Move-Up	Upgrade Luxury	TOTAL
Home Price: 2/	$185,000 $269,999	$260,000 $369,999	$370,000 $530,000	$530,000 +	
Income: 3/	$50,000 $59,999	$60,000 $69,999	$70,000 $99,999	$100,000 +	
Down Payment:	30%	50%	50%	50%	
DEMAND SOURCE					
New Household Growth					
Total Annual New Households 4/	2,354	2,354	2,354	2,354	2,354
x Percentage Income Qualified 5/	12.8%	8.7%	13.7%	5.2%	40.4%
= Income Qualified	301	206	322	122	951
x Demonstrated Owner Propensity 6/	60.0%	76.5%	83.3%	86.7%	74.9%
= Total Potential New Owner Households	181	157	268	106	712
x Estimated Active Market 7/	37.4%	37.4%	60.0%	80.0%	52.3%
	------	------	------	------	------
Total Annual Demand From New Households	68	59	161	85	372
Renter Turnover					
Total Households	68,822	68,822	68,822	68,822	68,822
x Percentage Income Qualified 5/	12.8%	8.7%	13.7%	5.2%	40.4%
= Income Qualified	8,809	6,010	9,406	3,579	27,804
x Estimated Renter Propensity	40.0%	23.5%	16.7%	13.3%	25.1%
= Total Estimated Renter Households	3,524	1,412	1,571	476	6,983
x Average Annual Turnover Factor 6/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households	1,177	472	525	159	2,332
x Estimated Active Market 8/	7.5%	7.5%	12.0%	16.0%	9.1%
	------	------	------	------	------
Total Annual Demand from Renter Upgrading	88	35	63	25	212
Owner Preference					
Total Households	68,822	68,822	68,822	68,822	68,822
x Percentage Income Qualified 5/	12.8%	8.7%	13.7%	5.2%	40.4%
= Total Income Qualified Households	8,809	6,010	9,406	3,579	27,804
x Estimated Owner Propensity	60.0%	76.5%	83.3%	86.7%	74.9%
= Total Estimated Owner Households	5,286	4,598	7,835	3,103	20,821
x Average Annual Turnover Factor 6/	10.4%	10.4%	10.4%	10.4%	10.4%
= Total Qualified/Turnover Owner Households	550	478	815	323	2,165
x Estimated Active Market 9/	22.4%	22.4%	48.0%	64.0%	38.3%
	------	------	------	------	------
Total Annual Demand From Owner Preference	123	107	391	207	828
Net Annual Estimated Demand	279	201	615	317	1,412

1 / Primary Market Area is comprised of Central Oahu and Ewa planning areas, as defined by the City and County of Honolulu Planning Department (as shown in EXHIBIT 1 map).
2 / Based upon market area surveys; March 1990 dollars.
3 / Assumes 10% interest on a 30-year mortgage and a monthly mortgage payment equivalent to 28% of gross income, with a down payment of 30% for entry level and 50% for all other price ranges.
4 / Based on City and County of Honolulu projections (see EXHIBIT 3).
5 / As determined by Urban Decision Systems and adjusted by RCLCo to reflect real income growth during the projection period.
6 / From U.S. Census,1980 (Metropolitan Housing Characteristics, Tables A-7, B-1, B-4 and B-8).
7 / Based upon Oahu new home vs resale figures, as determined by the relationship between residential building permits and resale activity from the Honolulu Board of Realtors Multiple Listing Service. Percentage was adjusted upward in the second-time move-up and luxury categories due to absence of existing product in the market within those price ranges.
8 / Assumes approximately 20% of renter turnover will purchase homes of which 37.4% will buy a new home, except in second-time move-up and luxury categories, with greater propensities due to absence of new product.
9 / Assumes that existing home owners have a 40% higher propensity than new households to buy an existing home, except in the second-time move-up and luxury categories which currently have a limited supply of existing product.

Source: Urban Decision Systems, Incorporated, U.S. Bureau of the Census and Robert Charles Lesser & Co.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

01-2728.05

EXHIBIT 26A

ESTIMATED ANNUAL DEMAND POTENTIAL FOR OWNER-OCCUPIED UNITS
PRICED FROM $185,000
1990 - 1994
PRIMARY MARKET AREA 1/
April 1990

DEMAND SOURCE		Entry Level	1st Time Move-Up	2nd Time Move-Up	Upgrade Luxury	TOTAL
Home Price:	2/	$185,000 $269,999	$260,000 $369,999	$370,000 $530,000	$530,000 +	
Income:	3/	$50,000 $59,999	$60,000 $69,999	$70,000 $99,999	$100,000 +	
Down Payment:		30%	50%	50%	50%	
New Household Growth						
Total Annual New Households 4/		1,893	1,893	1,893	1,893	1,893
x Percentage Income Qualified 5/		12.7%	8.7%	13.4%	4.4%	39.2%
= Income Qualified		240	165	253	83	742
x Demonstrated Owner Propensity 6/		60.0%	76.5%	83.3%	86.7%	74.6%
= *Total Potential New Owner Households*		144	126	211	72	554
x Estimated Active Market 7/		37.4%	37.4%	60.0%	80.0%	51.6%
		------	------	------	------	------
Total Annual Demand From New Households		54	47	126	58	285
Renter Turnover						
Total Households		59,358	59,358	59,358	59,358	59,358
x Percentage Income Qualified 5/		12.7%	8.7%	13.4%	4.4%	39.2%
= Income Qualified		7,538	5,184	7,934	2,612	23,268
x Estimated Renter Propensity		40.0%	23.5%	16.7%	13.3%	25.4%
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= Total Qualified Renter Turnover Households		1,007	407	443	116	1,973
x Estimated Active Market 8/		7.5%	7.5%	12.0%	16.0%	9.0%
		------	------	------	------	------
Total Annual Demand from Renter Upgrading		75	30	53	19	177
Owner Preference						
Total Households		59,358	59,358	59,358	59,358	59,358
x Percentage Income Qualified 5/		12.7%	8.7%	13.4%	4.4%	39.2%
= Total Income Qualified Households		7,538	5,184	7,934	2,612	23,268
x Estimated Owner Propensity		60.0%	76.5%	83.3%	86.7%	74.6%
= Total Estimated Owner Households		4,523	3,966	6,609	2,264	17,362
x Average Annual Turnover Factor 6/		10.4%	10.4%	10.4%	10.4%	10.4%
= Total Qualified/Turnover Owner Households		470	412	687	235	1,806
x Estimated Active Market 9/		22.4%	22.4%	48.0%	64.0%	37.6%
		------	------	------	------	------
Total Annual Demand From Owner Preference		106	93	330	151	679
Net Annual Estimated Demand		235	170	510	227	1,142

1 / Primary Market Area is comprised of Central Oahu and Ewa planning areas, as defined by the City and County of Honolulu Planning Department (as shown in EXHIBIT 1 map).
2 / Based upon market area surveys; March 1990 dollars.
3 / Assumes 10% interest on a 30-year mortgage and a monthly mortgage payment equivalent to 28% of gross income, with a down payment of 30% for entry level and 50% for all other price ranges.
4 / Based on City and County of Honolulu projections (see EXHIBIT 3).
5 / As determined by Urban Decision Systems and adjusted by RCLCo to reflect real income growth during the projection period.
6 / From U.S. Census,1980 (Metropolitan Housing Characteristics, Tables A-7, B-1, B-4 and B-6).
7 / Based upon Oahu new home vs resale figures, as determined by the relationship between residential building permits and resale activity from the Honolulu Board of Realtors Multiple Listing Service. Percentage was adjusted upward in the second-time move-up and luxury categories due to absence of existing product in the market within those price ranges.
8 / Assumes approximately 20% of renter turnover will purchase homes of which 37.4% will buy a new home, except in second-time move-up and luxury categories, with greater propensities due to absence of new product.
9 / Assumes that existing home owners have a 40% higher propensity than new households to buy an existing home, except in the second-time move-up and luxury categories which currently have a limited supply of existing product.

Source: Urban Decision Systems, Incorporated, U.S. Bureau of the Census and Robert Charles Lesser & Co.

EXHIBIT 26B

01-2728.05

ESTIMATED ANNUAL DEMAND POTENTIAL FOR OWNER-OCCUPIED UNITS
PRICED FROM $185,000
1995 - 1999
PRIMARY MARKET AREA 1/
April 1990

DEMAND SOURCE	Entry Level	1st Time Move-Up	2nd Time Move-Up	Upgrade Luxury	TOTAL
Home Price: 2/	$185,000 $269,999	$260,000 $369,999	$370,000 $530,000	$530,000 +	
Income: 3/	$50,000 $59,999	$60,000 $69,999	$70,000 $99,999	$100,000 +	
Down Payment:	30%	50%	50%	50%	
New Household Growth					
Total Annual New Households 4/	2,354	2,354	2,354	2,354	2,354
x Percentage Income Qualified 5/	12.8%	8.7%	13.7%	5.2%	40.4%
= Income Qualified	301	206	322	122	951
x Demonstrated Owner Propensity 6/	60.0%	76.5%	83.3%	86.7%	74.9%
= Total Potential New Owner Households	181	157	268	106	712
x Estimated Active Market 7/	37.4%	37.4%	60.0%	80.0%	52.3%
	------	------	------	------	------
Total Annual Demand From New Households	68	59	161	85	372
Renter Turnover					
Total Households	68,822	68,822	68,822	68,822	68,822
x Percentage Income Qualified 5/	12.8%	8.7%	13.7%	5.2%	40.4%
= Income Qualified	8,809	6,010	9,406	3,579	27,804
x Estimated Renter Propensity	40.0%	23.5%	16.7%	13.3%	25.1%
= Total Estimated Renter Households	3,524	1,412	1,571	476	6,983
x Average Annual Turnover Factor 6/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households	1,177	472	525	159	2,332
x Estimated Active Market 8/	7.5%	7.5%	12.0%	16.0%	9.1%
	------	------	------	------	------
Total Annual Demand from Renter Upgrading	88	35	63	25	212
Owner Preference					
Total Households	68,822	68,822	68,822	68,822	68,822
x Percentage Income Qualified 5/	12.8%	8.7%	13.7%	5.2%	40.4%
= Total Income Qualified Households	8,809	6,010	9,406	3,579	27,804
x Estimated Owner Propensity	60.0%	76.5%	83.3%	86.7%	74.9%
= Total Estimated Owner Households	5,286	4,598	7,835	3,103	20,821
x Average Annual Turnover Factor 6/	10.4%	10.4%	10.4%	10.4%	10.4%
= Total Qualified/Turnover Owner Households	550	478	815	323	2,165
x Estimated Active Market 9/	22.4%	22.4%	48.0%	64.0%	38.3%
	------	------	------	------	------
Total Annual Demand From Owner Preference	123	107	391	207	828
Net Annual Estimated Demand	279	201	615	317	1,412

1 / Primary Market Area is comprised of Central Oahu and Ewa planning areas, as defined by the City and County of Honolulu Planning Department (as shown in EXHIBIT 1 map).
2 / Based upon market area surveys; March 1990 dollars.
3 / Assumes 10% interest on a 30-year mortgage and a monthly mortgage payment equivalent to 28% of gross income, with a down payment of 30% for entry level and 50% for all other price ranges.
4 / Based on City and County of Honolulu projections (see EXHIBIT 3).
5 / As determined by Urban Decision Systems and adjusted by RCLCo to reflect real income growth during the projection period.
6 / From U.S. Census,1980 (Metropolitan Housing Characteristics, Tables A-7, B-1, B-4 and B-8).
7 / Based upon Oahu new home vs resale figures, as determined by the relationship between residential building permits and resale activity from the Honolulu Board of Realtors Multiple Listing Service. Percentage was adjusted upward in the second-time move-up and luxury categories due to absence of existing product in the market within those price ranges.
8 / Assumes approximately 20% of renter turnover will purchase homes of which 37.4% will buy a new home, except in second-time move-up and luxury categories, with greater propensities due to absence of new product.
9 / Assumes that existing home owners have a 40% higher propensity than new households to buy an existing home, except in the second-time move-up and luxury categories which currently have a limited supply of existing product.

Source: Urban Decision Systems, Incorporated, U.S. Bureau of the Census and Robert Charles Lesser & Co.

01-2728.05

EXHIBIT 26C

ESTIMATED ANNUAL DEMAND POTENTIAL FOR OWNER-OCCUPIED UNITS
PRICED FROM $185,000
2000 - 2004
PRIMARY MARKET AREA 1/
April 1990

DEMAND SOURCE	Entry Level	1st Time Move-Up	2nd Time Move-Up	Upgrade Luxury	TOTAL
Home Price: 2/	$185,000 $269,999	$260,000 $369,999	$370,000 $530,000	$530,000 +	
Income: 3/	$50,000 $59,999	$60,000 $69,999	$70,000 $99,999	$100,000 +	
Down Payment:	30%	50%	50%	50%	
New Household Growth					
Total Annual New Households 4/	2,962	2,962	2,962	2,962	2,962
x Percentage Income Qualified 5/	12.9%	8.7%	14.0%	6.0%	41.6%
= Income Qualified	382	257	416	178	1,232
x Demonstrated Owner Propensity 6/	60.0%	76.5%	83.3%	86.7%	75.1%
= Total Potential New Owner Households	229	196	346	154	926
x Estimated Active Market 7/	37.4%	37.4%	45.0%	60.0%	44.0%
	------	------	------	------	------
Total Annual Demand From New Households	86	73	156	92	407
Renter Turnover					
Total Households	80,594	80,594	80,594	80,594	80,594
x Percentage Income Qualified 5/	12.9%	8.7%	14.0%	6.0%	41.6%
= Income Qualified	10,397	6,985	11,310	4,836	33,527
x Estimated Renter Propensity	40.0%	23.5%	16.7%	13.3%	24.9%
= Total Estimated Renter Households	4,159	1,641	1,889	643	8,332
x Average Annual Turnover Factor 6/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households	1,389	548	631	215	2,783
x Estimated Active Market 8/	7.5%	7.5%	9.0%	12.0%	8.2%
	------	------	------	------	------
Total Annual Demand from Renter Upgrading	104	41	57	26	227
Owner Preference					
Total Households	80,594	80,594	80,594	80,594	80,594
x Percentage Income Qualified 5/	12.9%	8.7%	14.0%	6.0%	41.6%
= Total Income Qualified Households	10,397	6,985	11,310	4,836	33,527
x Estimated Owner Propensity	60.0%	76.5%	83.3%	86.7%	75.1%
= Total Estimated Owner Households	6,238	5,343	9,421	4,192	25,195
x Average Annual Turnover Factor 6/	10.4%	10.4%	10.4%	10.4%	10.4%
= Total Qualified/Turnover Owner Households	649	556	980	436	2,620
x Estimated Active Market 9/	22.4%	22.4%	36.0%	48.0%	31.8%
	------	------	------	------	------
Total Annual Demand From Owner Preference	146	125	353	209	832
Net Annual Estimated Demand	335	239	565	328	1,467

1 / Primary Market Area is comprised of Central Oahu and Ewa planning areas, as defined by the City and County of Honolulu Planning Department (as shown in EXHIBIT 1 map).
2 / Based upon market area surveys; March 1990 dollars.
3 / Assumes 10% interest on a 30-year mortgage and a monthly mortgage payment equivalent to 28% of gross income, with a down payment of 30% for entry level and 50% for all other price ranges.
4 / Based on City and County of Honolulu projections (see EXHIBIT 3).
5 / As determined by Urban Decision Systems and adjusted by RCLCo to reflect real income growth during the projection period.
6 / From U.S. Census,1980 (Metropolitan Housing Characteristics, Tables A-7, B-1, B-4 and B-8).
7 / Based upon Oahu new home vs resale figures, as determined by the relationship between residential building permits and resale activity from the Honolulu Board of Realtors Multiple Listing Service.
8 / Assumes approximately 20% of renter turnover will purchase homes of which 37.4% will buy a new home.
9 / Assumes that existing home owners have a 40% higher propensity than new households to buy an existing home.

Source: Urban Decision Systems, Incorporated, U.S. Bureau of the Census and Robert Charles Lesser & Co.

01-2728.05

EXHIBIT 26D

ESTIMATED ANNUAL DEMAND POTENTIAL FOR OWNER-OCCUPIED UNITS
PRICED FROM $185,000
2005 - 2010
PRIMARY MARKET AREA 1/
April 1990

DEMAND SOURCE		Entry Level	1st Time Move-Up	2nd Time Move-Up	Upgrade Luxury	TOTAL
Home Price:	2/	$185,000 $269,999	$260,000 $369,999	$370,000 $530,000	$530,000 +	
Income:	3/	$50,000 $59,999	$60,000 $69,999	$70,000 $99,999	$100,000 +	
Down Payment:		30%	50%	50%	50%	
New Household Growth						
Total Annual New Households 4/		3,766	3,766	3,766	3,766	3,766
x Percentage Income Qualified 5/		13.0%	8.7%	14.4%	6.8%	42.9%
= Income Qualified		490	326	544	256	1,616
x Demonstrated Owner Propensity 6/		60.0%	76.5%	83.3%	86.7%	75.4%
= Total Potential New Owner Households		294	250	453	222	1,218
x Estimated Active Market 7/		37.4%	37.4%	37.4%	50.0%	39.7%
		......	......	......	......	......
Total Annual Demand From New Households		110	93	169	111	484
Renter Turnover						
Total Households		95,404	95,404	95,404	95,404	95,404
x Percentage Income Qualified 5/		13.0%	8.7%	14.4%	6.8%	42.9%
= Income Qualified		12,403	8,268	13,770	6,487	40,928
x Estimated Renter Propensity		40.0%	23.5%	16.7%	13.3%	24.6%
= Total Estimated Renter Households		4,961	1,943	2,300	863	10,066
x Average Annual Turnover Factor 6/		33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households		1,657	649	768	288	3,362
x Estimated Active Market 8/		7.5%	7.5%	7.5%	7.5%	7.5%
		......	......	......	......	......
Total Annual Demand from Renter Upgrading		124	49	57	22	252
Owner Preference						
Total Households		95,404	95,404	95,404	95,404	95,404
x Percentage Income Qualified 5/		13.0%	8.7%	14.4%	6.8%	42.9%
= Total Income Qualified Households		12,403	8,268	13,770	6,487	40,928
x Estimated Owner Propensity		60.0%	76.5%	83.3%	86.7%	75.4%
= Total Estimated Owner Households		7,442	6,325	11,470	5,625	30,862
x Average Annual Turnover Factor 6/		10.4%	10.4%	10.4%	10.4%	10.4%
= Total Qualified/Turnover Owner Households		774	658	1,193	585	3,210
x Estimated Active Market 9/		22.4%	22.4%	22.4%	40.0%	25.6%
		......	......	......	......	......
Total Annual Demand From Owner Preference		174	148	268	234	823
Net Annual Estimated Demand		407	290	494	367	1,558

1 / Primary Market Area is comprised of Central Oahu and Ewa planning areas, as defined by the City and County of Honolulu Planning Department (as shown in EXHIBIT 1 map).
2 / Based upon market area surveys; March 1990 dollars.
3 / Assumes 10% interest on a 30-year mortgage and a monthly mortgage payment equivalent to 28% of gross income, with a down payment of 30% for entry level and 50% for all other price ranges.
4 / Based on City and County of Honolulu projections (see EXHIBIT 3).
5 / As determined by Urban Decision Systems and adjusted by RCLCo to reflect real income growth during the projection period.
6 / From U.S. Census,1980 (Metropolitan Housing Characteristics, Tables A-7, B-1, B-4 and B-6).
7 / Based upon Oahu new home vs resale figures, as determined by the relationship between residential building permits and resale activity from the Honolulu Board of Realtors Multiple Listing Service.
8 / Assumes approximately 20% of renter turnover will purchase homes of which 37.4% will buy a new home.
9 / Assumes that existing home owners have a 40% higher propensity than new households to buy an existing home.

Source: Urban Decision Systems, Incorporated, U.S. Bureau of the Census and Robert Charles Lesser & Co.

01-2728.05

EXHIBIT 27A

ESTIMATED ANNUAL DEMAND POTENTIAL FOR RENTAL UNITS

1990 - 1994
PRIMARY MARKET AREA 1/
April, 1990

	Moderate	Mid	High	Luxury	TOTAL
Rents: 2/	$500 $750	$750 $1,000	$1,000 $1,500	$1,500 +	
Income:	$20,000 $29,999	$30,000 $39,999	$40,000 $59,999	$60,000 +	
DEMAND SOURCE					
New Household Growth					
Total Annual New Households 3/	1,893	1,893	1,893	1,893	1,893
x Percentage Income Qualified 4/	13.9%	13.1%	26.2%	26.5%	79.7%
= Income Qualified	263	248	496	502	1,509
x Demonstrated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	42.4%
= Total Potential New Renter Households	186	154	207	92	640
x Estimated Active Market 6/	12.5%	12.5%	12.5%	12.5%	12.5%
	------	------	------	------	------
Total Annual Demand From New Households	23	19	26	12	80
Renter Turnover					
Total Households	59,358	59,358	59,358	59,358	59,358
x Percentage Income Qualified 4/	13.9%	13.1%	26.2%	26.5%	79.7%
= Income Qualified	8,251	7,776	15,552	15,730	47,308
x Estimated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	42.4%
= Total Estimated Renter Households	5,842	4,821	6,501	2,894	20,058
x Average Annual Turnover Factor 5/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households	1,951	1,610	2,171	967	6,699
x Estimated Active Market 6/	10.0%	10.0%	10.0%	10.0%	10.0%
	------	------	------	------	------
Total Annual Demand from Renter Turnover	195	161	217	97	670
Net Annual Estimated Demand	218	180	243	108	750

1 / Primary Market Area is comprised of Central Oahu and Ewa planning areas, as defined by the City and County of Honolulu Planning Department (as shown in EXHIBIT 1 map).
2 / Assumes 30% of gross income is attributed to rent.
3 / Based on City and County of Honolulu projections (see EXHIBIT 3).
4 / Urban Decisions Systems, Inc.
5 / U.S. Census information.
6 / RCLCo estimate, and assumes that existing renters will have a 20% higher propensity to rent existing apartments.

Source: Robert Charles Lesser & Co.

01-2728.05

EXHIBIT 27B

ESTIMATED ANNUAL DEMAND POTENTIAL FOR RENTAL UNITS

1995 - 1999
PRIMARY MARKET AREA 1/
April, 1990

	Moderate	Mid	High	Luxury	TOTAL
Rents: 2/	$500 $750	$750 $1,000	$1,000 $1,500	$1,500 +	
Income:	$20,000 $29,999	$30,000 $39,999	$40,000 $59,999	$60,000 +	
DEMAND SOURCE					
New Household Growth					
Total Annual New Households 3/	2,354	2,354	2,354	2,354	2,354
x Percentage Income Qualified 4/	14.0%	13.2%	25.7%	27.6%	80.5%
= Income Qualified	330	311	605	650	1,895
x Demonstrated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	42.1%
= Total Potential New Renter Households	233	193	253	120	798
x Estimated Active Market 6/	13.5%	13.5%	13.5%	13.5%	13.5%
Total Annual Demand From New Households	31	26	34	16	108
Renter Turnover					
Total Households	68,822	68,822	68,822	68,822	68,822
x Percentage Income Qualified 4/	14.0%	13.2%	25.7%	27.6%	80.5%
= Income Qualified	9,635	9,085	17,687	18,995	55,402
x Estimated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	42.1%
= Total Estimated Renter Households	6,822	5,632	7,393	3,495	23,342
x Average Annual Turnover Factor 5/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households	2,278	1,881	2,469	1,167	7,796
x Estimated Active Market 6/	10.8%	10.8%	10.8%	10.8%	10.8%
Total Annual Demand from Renter Turnover	246	203	267	126	842
Net Annual Estimated Demand	278	229	301	142	950

1 / Primary Market Area is comprised of Central Oahu and Ewa planning areas, as defined by the City and County of Honolulu Planning Department (as shown in EXHIBIT 1 map).
2 / Assumes 30% of gross income is attributed to rent.
3 / Based on City and County of Honolulu projections (see EXHIBIT 3).
4 / Urban Decisions Systems, Inc.
5 / U.S. Census information.
6 / RCLCo estimate, and assumes that existing renters will have a 20% higher propensity to rent existing apartments.

Source: Robert Charles Lesser & Co.

01-2728.05

EXHIBIT 27C

ESTIMATED ANNUAL DEMAND POTENTIAL FOR RENTAL UNITS

2000 - 2004
PRIMARY MARKET AREA 1/
April, 1990

DEMAND SOURCE	Moderate	Mid	High	Luxury	TOTAL
Rents: 2/	$500 $750	$750 $1,000	$1,000 $1,500	$1,500 +	
Income:	$20,000 $29,999	$30,000 $39,999	$40,000 $59,999	$60,000 +	
New Household Growth					
Total Annual New Households 3/	2,962	2,962	2,962	2,962	2,962
x Percentage Income Qualified 4/	14.0%	13.2%	25.1%	28.7%	81.0%
= Income Qualified	415	391	743	850	2,399
x Demonstrated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	41.8%
= Total Potential New Renter Households	294	242	311	156	1,003
x Estimated Active Market 6/	19.0%	19.0%	19.0%	19.0%	19.0%
	------	------	------	------	------
Total Annual Demand From New Households	56	46	59	30	191
Renter Turnover					
Total Households	80,594	80,594	80,594	80,594	80,594
x Percentage Income Qualified 4/	14.0%	13.2%	25.1%	28.7%	81.0%
= Income Qualified	11,283	10,638	20,229	23,130	65,281
x Estimated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	41.8%
= Total Estimated Renter Households	7,988	6,596	8,456	4,256	27,296
x Average Annual Turnover Factor 5/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households	2,668	2,203	2,824	1,422	9,117
x Estimated Active Market 6/	15.0%	15.0%	15.0%	15.0%	15.0%
	------	------	------	------	------
Total Annual Demand from Renter Turnover	400	330	424	213	1,368
Net Annual Estimated Demand	456	377	483	243	1,558

1 / Primary Market Area is comprised of Central Oahu and Ewa planning areas, as defined by the City and County of Honolulu Planning Department (as shown in EXHIBIT 1 map).
2 / Assumes 30% of gross income is attributed to rent.
3 / Based on City and County of Honolulu projections (see EXHIBIT 3).
4 / Urban Decisions Systems, Inc.
5 / U.S. Census information.
6 / RCLCo estimate, and assumes that existing renters will have a 20% higher propensity to rent existing apartments.

Source: Robert Charles Lesser & Co.

01-2728.05

EXHIBIT 27D

ESTIMATED ANNUAL DEMAND POTENTIAL FOR RENTAL UNITS

2005 - 2010
PRIMARY MARKET AREA 1/
April, 1990

	Moderate	Mid	High	Luxury	TOTAL
Rents: 2/	$500 $750	$750 $1,000	$1,000 $1,500	$1,500 +	
Income:	$20,000 $29,999	$30,000 $39,999	$40,000 $59,999	$60,000 +	
DEMAND SOURCE					
New Household Growth					
Total Annual New Households 3/	3,766	3,766	3,766	3,766	3,766
x Percentage Income Qualified 4/	14.0%	13.3%	24.5%	29.9%	81.7%
= Income Qualified	527	501	923	1,126	3,077
x Demonstrated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	41.5%
= Total Potential New Renter Households	373	311	386	207	1,277
x Estimated Active Market 6/	22.5%	22.5%	22.5%	22.5%	22.5%
Total Annual Demand From New Households	84	70	87	47	287
Renter Turnover					
Total Households	95,404	95,404	95,404	95,404	95,404
x Percentage Income Qualified 4/	14.0%	13.3%	24.5%	29.9%	81.7%
= Income Qualified	13,357	12,689	23,374	28,526	77,945
x Estimated Renter Propensity 5/	70.8%	62.0%	41.8%	18.4%	41.5%
= Total Estimated Renter Households	9,456	7,867	9,770	5,249	32,343
x Average Annual Turnover Factor 5/	33.4%	33.4%	33.4%	33.4%	33.4%
= Total Qualified Renter Turnover Households	3,158	2,628	3,263	1,753	10,802
x Estimated Active Market 6/	18.0%	18.0%	18.0%	18.0%	18.0%
Total Annual Demand from Renter Turnover	569	473	587	316	1,944
Net Annual Estimated Demand	653	543	674	362	2,232

1 / Primary Market Area is comprised of Central Oahu and Ewa planning areas, as defined by the City and County of Honolulu Planning Department (as shown in EXHIBIT 1 map).
2 / Assumes 30% of gross income is attributed to rent.
3 / Based on City and County of Honolulu projections (see EXHIBIT 3).
4 / Urban Decisions Systems, Inc.
5 / U.S. Census information.
6 / RCLCo estimate, and assumes that existing renters will have a 20% higher propensity to rent existing apartments.

Source: Robert Charles Lesser & Co.

EXHIBIT 28a

ANNUAL TOTAL DEMAND SUMMARY
COMPETITIVE HOUSING MARKET 1/
PRIMARY MARKET AREA 2/
1990-2010

SOURCES OF DEMAND	1990-1994 ANNUAL DEMAND		1995-1999 ANNUAL DEMAND		2000-2004 ANNUAL DEMAND		2005-2010 ANNUAL DEMAND	
OWNER-OCCUPIED UNITS								
Local	90%	1,142	80%	1,412	70%	1,467	70%	1,558
Second Home	10%	127	20%	353	30%	629	30%	668
Total Primary Market Area Demand	100%	1,269	100%	1,765	100%	2,096	100%	2,226
RENTER-OCCUPIED UNITS								
Local	90%	750	90%	950	85%	1,558	85%	2,232
Second Home	10%	83	10%	106	15%	275	15%	394
Total Primary Market Area Demand	100%	833	100%	1,056	100%	1,833	100%	2,626
Total Owner and Renter Demand, PMA		2,102		2,821		3,929		4,852

1/ Defined as for sale housing at $180,000 and above, rental rates of $500 per month and higher.
2/ Primary Market Area is comprised of the Ewa and Central Oahu plan areas as defined by the City and County of Honolulu Planning Department.

SOURCE: Robert Charles Lesser & Co.

EXHIBIT 28b

ANNUAL SEGMENTED DEMAND SUMMARY
OWNER-OCCUPIED UNITS PRICED FROM $370,000
RENTER-OCCUPIED UNITS PRICED FROM $1,000 PER MONTH
PRIMARY MARKET AREA 1/
1990-2010

SOURCES OF DEMAND	1990-1994 ANNUAL DEMAND		1995-1999 ANNUAL DEMAND		2000-2004 ANNUAL DEMAND		2005-2010 ANNUAL DEMAND	
OWNER-OCCUPIED UNITS ($370,000 plus)								
Local	90%	737	80%	932	70%	893	70%	861
Second Home	10%	82	20%	233	30%	383	30%	369
Total Primary Market Area Demand	100%	819	100%	1,165	100%	1,276	100%	1,230
RENTER-OCCUPIED UNITS ($1,000 per month plus)								
Local	90%	351	90%	443	85%	726	85%	1,036
Second Home	10%	39	10%	49	15%	128	15%	183
Total Primary Market Area Demand	100%	390	100%	492	100%	854	100%	1,219
Total Price Qualified Owner and Renter Demand, PMA		1,209		1,657		2,130		2,449
Makaiwa Hills Capture 2/	10% -	15%	10% -	15%	10% -	15%	10% -	15%
Makaiwa Hills Demand	121 -	181	166 -	249	213 -	319	245 -	367

1 / Primary Market Area is comprised of the Ewa and Central Plan Areas as defined by the City and County of Honolulu Planning Department.
2 / Based upon planned and proposed residential construction in Ewa and Central Oahu, Makaiwa Hills is expected to capture two to three times its fair share (5%) given its hillside location and amenity-orientation.

SOURCE: Robert Charles Lesser & Co.

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EXHIBIT 29

PLANNED AND PROPOSED RESIDENTIAL DEVELOPMENT
AFFORDABLE AND MARKET RATE HOUSING
PRIMARY MARKET AREA 1/

PROJECT NAME	TOTAL UNITS	UNITS COMPLETED	UNITS TO BE BUILT	AFFORDABLE		MARKET-RATE		COMMENTS
				COMPLETED	TO BE BUILT	COMPLETED	TO BE BUILT	
Ewa Marina	5,228	0	5,228	0	523	0	4,705	Affordable units comprise 10% of first phase development and 60% for later phases Phase II may include a golf course.
Kapolei Knolls	500	0	500	0	250	0	250	Affordable units comprise 50% of total. Site and design planning in process.
Makakilo	5,100	3,028	2,072	303	1,243	2,725	829	Affordable units comprise 10% of first phase development and 60% of later phases. Development will include golf course.
West Hills	3,250	0	3,250	0	1,950	0	1,300	Very preliminary at this time. Will include an 18-hole golf course.
West Loch	1,447	593	854	356	451	237	403	Affordable units comprise 60% of total Government sponsored project. First phase of 593 units is built and sold. The development also includes a municipal golf course.
Villages of Kapolei	4,900	150	4,750	97	2,850	53	1,900	Affordable units comprise 60% of total. Development will include an 18-hole municipal golf course.
Ewa Gentry	7,150	725	6,425	0	3,855	725	2,570	Affordable units comprise 10% of first phase development and 60% in later phases. Adjacent to proposed golf course.
Ko Olina	9,500	0	9,500	0	0	0	9,500	Affordable units comprise 10% and will be built in another project Development will also include two 18-hole golf courses and 4,000 resort units.
Royal Kunia	2,450	274	2,178	0	1,150	274	1,028	Waiting for approval, will probably build rental apartments to satisfy affordable housing requirement. This project is a further expansion of Village Park. Will include two 18-hole golf courses.
Mililani Town	10,235	8,000	2,235	800	1,341	7,200	894	Affordable units estimated at 60%.
Mililani Mauka	6,600	0	6,600	0	3960	0	2640	Across freeway from Mililani Town. Affordable housing requirement uncertain, estimated at 60%.
Makaiwa Hills	3,000	0	3,000	0	1,200	0	1,800	In preliminary planning stage. Affordable units estimated at 40%. Development may include an 18-hole golf course.
Waiawa Gentry	7,900	0	7,900	0	4,740	0	3,160	Still working on approvals. Affordable requirement estimated at 60% Development will include two 18 golf courses.
Waikele	2,700	0	2,700	0	1,620	0	1,080	Affordable units comprise approximately 60% of total Development will include an 18-hole golf course.
Miscellaneous 2/	3,500	150	3,350	0	2,010	150	1,340	Affordable units estimated at 60% of total.
	......	......	......	......	......	......	......	
TOTAL	73,480	12,820	60,540	1,556	27,143	11,364	33,397	
Makaiwa Hills Pct. of Total	4%	0%	5%	0%	4%	0%	5%	

Note: Totals do not include Hale Ola (potential 8,714 units), Kipapa Ridge Estates (potential 1,687 units), or Ewa Villages (potential 2,811 units) These projects are government sponsored and will market mostly affordable units.

1/ Comprised of Ewa and Central Oahu Plan Areas as defined by the City and County of Honolulu DEPARTMENT OF GENERAL PLANNING
2/ Includes Halekua, Melemanu Woodlands III, Puuloa Estates.
SOURCE: City and County of Honolulu Department of General Planning; and Robert Charles Lesser & Co.

EXHIBIT 30

SUMMARY CHARACTERISTICS OF SURVEYED PROJECTS
ISLAND OF OAHU
APRIL 1990

PROJECT/ LOCATION/ DEVELOPER	PRODUCT TYPE/ TENURE 2/	CONFIGU-RATION/ DENSITY	LOT SIZE (IF APP)	TOTAL UNITS	UNITS BUILT	UNITS SOLD	DATE BEGAN SELLING	MONTHLY ABSORPTION/ OCCUPANCY 3/	UNIT TYPE	UNIT MIX	UNIT SIZE	UNIT PRICE FROM	VALUE RATIO ($/SQ FT.)	ADDITIONAL COMMENTS
SINGLE-FAMILY DETACHED														
CENTRAL OAHU														
KUMU IKI Villages of Kapolei Oceanic Properties	SFD Fee	7.3	3,000 A 4,000 A 4,300 M 5,700 M	519 311 A 208 M	150 87 A 53 M	150	Sep-89	Sold out immediately upon opening	2B/2b - 3B/2b	56%	950 - 1,250	$96,000 $118,000	$101 - $94	September 1989 sellout prices.
									2B/2b - 3B/2b	19%	1,000 - 1,500	$120,000 $210,000	$120 - $140	
									3B/2b - 4B/2.5b	25%	1,295 - 1,930	$225,000 $270,000	$174 - $140	
									3B/2b 3B/2b		1,295 - 1,500	$335,000 $335,000	$258 - $223	Recent resale. Recent resale.
WEST LOCH ESTATES Kapolei City Westloch, Inc.	SFD Fee	6.4	4,000 M 5,000 M	1,447 807 A 640 M	593 356 A 237 M	593	Sep-88	Sold out immediately upon opening	3B/2b 3B/2.5b 3B/2b 3B/2b 4B/2.5b	20% 20% 20% 20% 20%	1,420 1,507 1,608 1,657 1,758	$330,000 to $375,000	$232 to $214	Current resales. Demand was too strong to notice trends in buying patterns.
THE RIDGE Mililani Town Islander Homes	SFD Fee	Cluster, long narrow lots	3,500 - 5,000 2 at 12,000	348	348	348	Mar-89	sold project from plans	2B/1b 3B/2b 4B/2.5b 3B/2b 3B/2.5b 4B/2.5b	-- -- -- -- -- --	765 965 1,295 1,380 1,525 1,745	$170,000 $180,000 $220,000 $255,000 $270,000 $290,000	$222 $187 $170 $185 $177 $166	December 1989 closing prices. Current resales= two 865 s.f. units at $237,000 and $240,000. The current resale range is $240,000 to $360,000.
AEA RIDGE 99-120 Inea Place Aiea I.N.V. Corporation	SFD Fee	28 6.0	5,500 avg	21	21	21	Jul-88	two-month sellout	3B/2.5b 3B/2.5b 3B/2.5b	24% 29% 48%	1,502 1,504 1,553	$269,900 - $299,900 $284,900 - $296,900 $290,900 - $299,900	$180 - $200 $189 - $197 $187 - $193	Prices shown are reservation prices from 1988, resales currently sell for $450,000 and more. Lot range is 4,010 to 15,000 square feet, but pad is only 4,000 s.f. for most lots. Reservations sold out within a couple months, construction was completed last month
CREST AT WAILUNA Kaahumanu Street Ewa/Central Oahu	SFD Lease	1-28 11.0	3,500	170	170	170	Sep-87	7.1	3B/2b 3B/2.5b 4B/3b	14% 35% 51%	850 1,022 1,174	NA $318,000 $365,000	NA $311 $311	Prices one year ago were $156,000 to $237,000. Prices shown are current without premiums.
SODA CREEK Ewa Gentry Gentry Homes, Ltd	SFD Fee	NA NA	3,200 40 x 80	389	389	389	Mar-88	one-week sellout	2B/2b 3B/2b 4B/2.5b	13% 67% 20%	802 - 945 1,045 - 1,189 1,368 - 1,530	$250,000 to $310,000	$312 to $203	Current resales. No affordable units (requirement satisfied by building rental units)
ROYAL KUNIA SUBDIVISION Honta Homes	SFD Fee		5,000 - 5,400	288	274	274	Sep-88	Immediate	3B/2b 3B/2b 4B/3b 3B/3b		1,064 1,344 1,523 1,556	$166,000 to $204,000	$156 to $131	Prices shown are Sept-88 sellout prices. One year restriction on resales is only beginning to run out now and has not allowed for any resale activity yet.

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EXHIBIT 30

SUMMARY CHARACTERISTICS OF SURVEYED PROJECTS
ISLAND OF OAHU
APRIL 1990

PROJECT/ LOCATION/ DEVELOPER	PRODUCT TYPE/ TENURE 2/	CONFIGU-RATION/ DENSITY	LOT SIZE (SF APP)	TOTAL UNITS	UNITS BUILT	UNITS SOLD	DATE BEGAN SELLING	MONTHLY ABSORPTION/ OCCUPANCY 3/	UNIT TYPE	UNIT MIX	UNIT SIZE	UNIT PRICE FROM	VALUE RATIO ($/SQ FT.)	ADDITIONAL COMMENTS
HAWAII KAI-KAHALA									4B/2.5b		1,830	$280,000	$145	
HAWAII LOA RIDGE	Lots	NA		550	550	540			Standard view/interior		7,600 -	$550,000 -	$72 -	Home prices from $1.65 million to
Hawaii Kai	Fee										12,000	$650,000	$54	$3.5 million on 10,000 to 20,000
HMF, Inc														square foot lots. Homes are typically
									Great view/am		9,000 -	$800,000 -	$89 -	4,000 square feet and greater.
											25,000	$1,850,000	$74	
WAIALAE IKI	Lots		8,500 -	84	84	60	Dec-88	5.0	Standard		8,500 -	$440,000 -	$52 -	Current pricing
Hawaii Kai	Fee	1.9	12,000								12,000	$625,000	$52	
									View		8,500 -	$570,000 -	$67 -	
											12,000	$700,000	$58	
									Best View		12,000	$780,000 -	$65 -	
											12,000	$850,000	$71	
KAHALA KUA	Lots	0.5	28,225 -	40	40	4	Mar-90	6.0	Standard		28,225 -	$1,300,000	$46 -	Homes are $1.3M to $3.9 M.
Kahala	Fee		97,808						Standard		97,808	$2,500,000	$26	
BC Dev Co									View		30,000 -	$2,300,000 -	$77 -	
									View		55,000	$3,900,000	$71	
LAULIMA O HAWAII KAI	SFD	Cluster	3,500 -	104	104	104	Sep-86	8.7	2B/2b		1,600 -	$440,000 -	$275 -	Current resale prices
Hawaii Kai	Lease		5,000						3B/3b		2,100	$480,000	$229	Price range at sellout (March 1988) was
Kaiser Development Co.			4K avg											$195,000 to $260,000
									3B/2.5b		1,790	$515,000	$288 -->	Golf course unit recent resale
									3B/2.5b		1,800	$495,000	$275 -->	Golf course unit recent resale
											1,800	$459,000	$255 -->	Recent resale.
QUEEN'S GATE	SFD		6,240 -	NA	All	All	1978	NA	3B/2b		1,814	$575,000	$300	Current listings
Kalohelani Place	Lease	5.0	8,175						3B/2b		1,985	$449,000	$227	$533K listing is fee simple
Hawaii Kai									4B/2b		2,001	$490,000	$245	Interior units are typically in low $500,000's
									3B/2b		2,033	$535,000	$263	Golf course units are typically about $600,000
									4B/3b		2,143	$450,000	$210	
TOWNHOMES														
....														
CENTRAL OAHU														
MILILANI PINNACLE	TH	Four-plex	NA	90	90	90	Aug-88	60.0	2B/1.5b		1,200	$192,000	$160	Current resale prices
Ualalehu/Ahiku St	Fee	Six-plex							2B/2.5b		1,500	to	to	Original prices $130,000 to $220,000.
Mililani		9.0							3B/2.5b		1,500	$264,000	$176	Luxury townhomes.
MILILANI POINT	TH	Duplex (12)	NA	20	20	20	Mar-89	Immediate	2B/2b	10%	1,408	$231,900	$165 -->	Recent listing
95-349 Kuahelani Ave.	Fee	Fourplex (8)										$239,000	$170 -->	Recent listing
Mililani Point Ventures		11.9							3B/3b	15%	1,758	$220,000	$125	Current resale range for specified units.
									4B/3b	60%	1,878	to	to	One of the only duplex projects on Oahu.
									4B/3b	15%	1,921	$260,000	$135	

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EXHIBIT 30

SUMMARY CHARACTERISTICS OF SURVEYED PROJECTS
ISLAND OF OAHU
APRIL 1990

PROJECT/ LOCATION/ DEVELOPER	PRODUCT TYPE/ TENURE 2/	CONFIGU-RATION/ DENSITY	LOT SIZE (IF APP)	TOTAL UNITS	UNITS BUILT	UNITS SOLD	DATE BEGAN SELLING	MONTHLY ABSORPTION/ OCCUPANCY 3/	UNIT TYPE	UNIT MIX	UNIT SIZE	UNIT PRICE FROM	VALUE RATIO ($/SQ.FT.)	ADDITIONAL COMMENTS
HAWAII KAI-KAHALA														
GATEWAY PENINSULA Kawaihae Street Hawaii Kai	TH Lease	Sixplex Nineplex 10.2	NA	38	38	38	Jun-72	NA	4B/2.5b 3B/2.5b 4B/2.5b	26% 44% 31%	1,632 1,752 1,850	$370,000 + $400,000 +	$211 + $216 +	Current resales. $530,000 to $695,000 for units with marina frontage
THE MOORINGS 6370 Hawaii Kai Dr. Hawaii Kai Kaiser Hawaii Kai	TH Lease	2-story 11.8	NA	64	64	64	Oct-88	NA	3B/2.5b	100%	1,332	$354,000 $380,000	$266 --> $285 -->	Recent resale without premium. Recent resale with water.
KOKO ISLE Anapalau St. Hawaii Kai	TH Lease	Sixplex 9.0	NA	124	124	124	Nov-87	NA	2B/2b 3B/2.5b 3B/3b	9% 67% 24%	1,268 - 1,398 1,400 - 1,538 1,670 - 1,700	$310,000 - $335,000 $350,000 - $380,000 $385,000 - $400,000	$244 - $240 $250 - $247 $231 - $235	Current resale prices.
KAHUKU														
KUILIMA ESTATES Kamehameha HY Kahuku Inscon Development Co.	TH Lease	28 11.3	NA	368	368	368	Sep-72	NA	Studio 1B/1b 2B/2b 3B/2b	9% 68% 19% 4%	500 658 1,072 1,394	$140,000 $170,000 - $195,000 $250,000 - $289,000 $375,000 - $425,000	$280 $258 - $296 $233 - $270 $269 - $305	Current resale prices.
LOW-MID-RISE CONDOMINIUMS														
CENTRAL OAHU														
MILILANI PARKWAY 94-718 Mehuala Pkwy. Mililani	Condo Fee	Stacked 22.0	NA	240	240	240	Dec-89	Immediate	2B/1b	100%	762	$78,000	$102	Dec-89 affordable price.
PALM COURT Ewa Gentry Gentry Homes	Condo Fee	Eight-plex 4/4 18.0	NA	408	72	72	Sep-88	Sold in one day	2B/2b 2B/2b	50% 50%	810 874	$175,000 $185,000	$216 $212	Prices shown are current for escrow fall-outs. First closings were in Dec-89. Sept-88 prices were $110,000 to $115,000
PALM VILLAS Ewa Gentry Gentry Homes	Condo Fee	Eight-Plex 4/4	NA	240	240	240	May-89	Sold in two days	2B/2b	100%	716	$155,000	$216	Price shown is current for escrow fall-outs. Closings were Jul-89 thru Mar-90.
KUAHI HILLSIDE Waipio Gentry Homes	Condo Fee	Eight-Plex 4/4	NA	58	58	58	Jan-90	One day sell-out	2B/2b 2B/2b	50% 50%	810 874	$190,000 $215,000	$235 $246	Base prices for homes at sell-out

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

EXHIBIT 30

SUMMARY CHARACTERISTICS OF SURVEYED PROJECTS
ISLAND OF OAHU
APRIL 1990

PROJECT/ LOCATION/ DEVELOPER	PRODUCT TYPE/ TENURE 2/	CONFIGURATION/ DENSITY	LOT SIZE (IF APP)	TOTAL UNITS	UNITS BUILT	UNITS SOLD	DATE BEGAN SELLING	MONTHLY ABSORPTION/ OCCUPANCY 3/	UNIT TYPE	UNIT MIX	UNIT SIZE	UNIT PRICE FROM	VALUE RATIO ($/SQ.FT.)	ADDITIONAL COMMENTS
HAWAII KAI-KAHALA														
GATEWAY PENINSULA	TH	Sixplex	NA	38	38	38	Jun-72	NA	4B/2.5b	26%	1,632			Current resales.
Kawaihae Street	Lease	Nineplex							3B/2.5b	44%	1,752	$370,000 +	$211 +	$530,000 to $695,000 for units with
Hawaii Kai		10.2							4B/2.5b	31%	1,850	$400,000 +	$216 +	marina frontage
THE MOORINGS	TH	2-story	NA	64	64	64	Oct-88	NA	3B/2.5b	100%	1,332	$354,000	$266 -->	Recent resale without premium.
6370 Hawaii Kai Dr.	Lease	11.8										$380,000	$285 -->	Recent resale with water.
Hawaii Kai														
Kaiser Hawaii Kai														
KOKO ISLE	TH	Sixplex	NA	124	124	124	Nov-87	NA	2B/2b	9%	1,268 -	$310,000 -	$244 -	Current resale prices.
Anapalau St.	Lease	9.0									1,398	$335,000	$240	
Hawaii Kai									3B/2.5b	67%	1,400 -	$350,000 -	$250 -	
											1,538	$380,000	$247	
									3B/3b	24%	1,670 -	$385,000 -	$231 -	
											1,700	$400,000	$235	
KAHUKU														
KUILIMA ESTATES	TH	28	NA	368	368	368	Sep-72	NA	Studio	9%	500	$140,000	$280	Current resale prices.
Kamehameha HY	Lease	11.3							1B/1b	68%	658	$170,000 -	$258 -	
Kahuku												$195,000	$296	
Inecon Development Co.									2B/2b	19%	1,072	$250,000 -	$233 -	
												$289,000	$270	
									3B/2b	4%	1,394	$375,000 -	$269 -	
												$425,000	$305	
LOW-MID-RISE CONDOMINIUMS														
CENTRAL OAHU														
MILILANI PARKWAY	Condo	Stacked	NA	240	240	240	Dec-89	Immediate	2B/1b	100%	762	$78,000	$102	Dec-89 affordable price.
94-718 Meheula Pkwy.	Fee	22.0												
Mililani														
PALM COURT	Condo	Eight-plex 4/4	NA	408	72	72	Sep-88	Sold in one day	2B/2b	50%	810	$175,000	$216	Prices shown are current for escrow
Ewa Gentry	Fee	18.0							2B/2b	50%	874	$185,000	$212	fall-outs. First closings were in Dec-89.
Gentry Homes														Sept-88 prices were $110,000 to $115,000
PALM VILLAS	Condo	Eight-Plex 4/4	NA	240	240	240	May-89	Sold in two days	2B/2b	100%	718	$155,000	$216	Price shown is current for escrow
Ewa Gentry	Fee													fall-outs. Closings were Jul-89 thru
Gentry Homes														Mar-90.
KUANI HILLSIDE	Condo	Eight-Plex 4/4	NA	56	56	56	Jan-90	One day sell-out	2B/2b	50%	810	$190,000	$235	Base prices for homes at sell-out.
Waipio	Fee								2B/2b	50%	874	$215,000	$246	
Gentry Homes														

EXHIBIT 30

SUMMARY CHARACTERISTICS OF SURVEYED PROJECTS
ISLAND OF OAHU
APRIL 1990

PROJECT/ LOCATION/ DEVELOPER	PRODUCT TYPE/ TENURE 2/	CONFIGU-RATION/ DENSITY	LOT SIZE (IF APP)	TOTAL UNITS	UNITS BUILT	UNITS SOLD	DATE BEGAN SELLING	MONTHLY ABSORPTION/ OCCUPANCY 3/	UNIT TYPE	UNIT MIX	UNIT SIZE	UNIT PRICE FROM	VALUE RATIO ($/SQ.FT.)	ADDITIONAL COMMENTS
HAWAII KAI-KAHALA														
ESPLANADE	Condo	3/8-story	NA	208	208	208	Mar-73	NA	1B/1b	23%	762			Average unit price was about $200,0000
500 Lunalilo Home Rd	Lease	44 0							1B/1b	2%	790			six to eight months ago
Hawaii Kai									2B/2b	65%	1,083	$295,000	$272 -->	Recent resale
									3B/3b PH	11%	1,657	$425,000	$256 -->	Recent resale
									3B/3b PH	11%	1,657	$495,000	$299 -->	Listing, didn't sell
NANIWA GARDENS	Condo	15-story	NA	111	111	111	Jan-74	NA	1B/1B	50%	859	$240,000	$279	Current resale prices
6750 Hawaii Kai Dr.	Lease	52 5							2B/2B	50%	1,232	$345,000	$280	
Hawaii Kai														
MAWAENA KAI, THE LANDING	Condo	twelve-plex	NA	104	104	104	Sep-87	One day sell-out	2B/2b	21%	1,012			Current resale prices
7007 Hawaii Kai Drive	Lease	12.3							2B/2b	21%	1,148	$369,000	$322	
Kaiser Hawaii Kai Dev.									3B/2b	8%	1,234			
									3B/2b	42%	1,298	$425,000	$328	
									3B/2b	8%	1,408			
THE PLAZA (Imperial Plaza)	Condo	Eight-Story		33	33	33	Sep-89	11.0	2B/2 5b		1,240 -	$605,000 -	$488 -	Current escrow prices
Cooke St. & Kapiolani Bl.	Fee										1,350	$740,000	$548	Referred to as the "townhome" component of
Honolulu (Kaka'ako)									3B/2 5b		2,030 -	$750,000 -	$369 -	the Imperial project, an attempt to integrate
Business Investment, Ltd.											2,225	$795,000	$357	the space of a townhome product in the midst
														of a downtown area. The concept has met with
														some reluctance because it is unique
WINDWARD OAHU														
POHAKEA POINT	Condo	Stacked	NA	550	550	428	Jan-82	4 4	2B/2b	50%	1,100 -	$235,000 -	$214 -	Current phase (Ph III, Incr 4) has 124
Lilipuna Road	Lease	17.7							3B/2b	50%	1,200	$303,000	$253	units, with 31 reservations sold since
Kaneohe														October 1988. Absorption shown is
Swire Properties Ltd.														for life of project; current absorption
														is much higher than in early 1980's.
WINDWARD HARBOUR	Condo	4-story	NA	85	85	85	Jan-78	NA	1B/1b	29%	865 -	$165,000 -	$191 -	Current resale prices
1030 Aoloa Place	Lease	25 8									920	$170,000	$185	
Kailua									3B/2b	48%	1,200	$250,000	$208	
									3B/2b	23%	1,670	$290,000	$174	
WINDWARD COVE	Condo	4-story	NA	88	88	88	Dec-78	NA	3B/2b		1,200 -	$239,000 -	$199 -	Current resale prices
1000 Aoloa Place	Lease	26.8							3B/2b		1,375	$270,000	$196	
Kailua														
MAKANI KAI MARINA	TH	1-, 2-story	NA	78	78	78	Jul-75	NA	2B/2b -	24%	1,600 -	$340,000 -	$213 -	Current resale prices
45-995 Wailele Rd.	Lease	5 7							3B/2b	76%	2,000	$400,000	$200	
Kaneohe														
HOKULANI IN KAILUA	Condo	Eight-plex 4/4	NA	144	144	144	Sep-87	4.8	2B/2b	27%	811	$194,900	$240	Current price for units out of
355 A-D Aoloa St	Lease	6 5							2B/2b	73%	814	$215,900	$265	escrow.
Kailua														

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SUMMARY CHARACTERISTICS OF SURVEYED PROJECTS
ISLAND OF OAHU
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PROJECT/ LOCATION/ DEVELOPER	PRODUCT TYPE/ TENURE 2/	CONFIGU-RATION/ DENSITY	LOT SIZE (IF APP)	TOTAL UNITS	UNITS BUILT	UNITS SOLD	DATE BEGAN SELLING	MONTHLY ABSORPTION/ OCCUPANCY 3/	UNIT TYPE	UNIT MIX	UNIT SIZE	UNIT PRICE FROM	VALUE RATIO ($/SQ FT.)	ADDITIONAL COMMENTS
HIGH-RISE CONDOMINIUMS														
CENTRAL OAHU														
THE IMPERIAL (Imperial Plaza) Cooke St. & Kapiolani Bl Honolulu (Kaka'ako) Business Investment, Ltd.	Condo Fee	40-Story		173	173	167	Sep-89	55.7	2B/2b	42%	1,035 - 1,071	$390,000 - $545,000	$377 - $509	Current prices of units in escrow
									2B/2b	17%	1,222 - 1,440	$650,000 - $905,000	$532 - $628	Unit prices increase by floor. Ocean and three-bedroom units
									3B/2b	18%	1,384	$460,000 - $855,000	$332 - $618	underpriced, according to broker
									PH (2B/2.5b)	9%	2,120 - 2,260	$2,500,000 - $3,000,000	$1,179 - $1,327	
MAUKA TOWER (One Waterfront Towers) 425 South Street Honolulu Stark Properties Ltd	Condo Lease	Tower 45 stories	--	151	0	151	Sep-89		1B/1b	40%	804	$285,000 - $355,000	$354 - $442	Construction will be completed by end of March. Project is sold out, with
									2B/2b	54%	1,195 - 1,732	$595,000 - $950,000	$498 - $548	only resales available. Prices shown are opening prices.
									PH 2B/2b	5%	1,288 - 2,082			
									PH LOFT	1%	4,475			
									Current Resales					
									1B/1b	resale	804	$550,000	$684	29th Floor
									1B/1b	resale	804	$425,000	$529	10th Floor
									2B/2b	resale	1,615	$1,400,000	$867	38th Floor
									2B/2b	resale	1,470	$930,000	$633	29th Floor
MAKAI TOWER (One Waterfront Towers) 415 South Street Honolulu Stark Properties Ltd.	Condo Lease	Tower 45 stories	--	155	0	155	Sep-89		1B/1b	40%	804	$350,000 - $750,000	$435 - $933	Construction will be completed by end of March. Project is sold out, with only resales available.
									1B/1.5b	3%	1,270			
									2B/2b	51%	1,188 - 1,732	$850,000 - $1,100,000	$715 - $635	Prices shown are opening prices.
									PH 2B/2b	5%	1,288 - 2,082			
									PH LOFT	1%	4,475			
									Current Resales					
									2B/2b	resale	1,470 -	$825,000	$561	19th Floor
									PH LOFT	resale	4,475	$4,500,000	$1,006	45th Floor
PLAZA HAWAII KAI 6770 Hawaii Kai Dr. Hawaii Kai	Condo Lease	14-story 50.7	NA	148	148	148	Apr-73	NA	1B/1b	17%	733 - 813	$144,000 - $177,000	$196 - $218	Current resale prices
									2B/2b	65%	1,030 - 1,402	$180,000 - $235,000	$175 - $168	
									2B/2b	18%	1,478 - 1,826	$400,000 - $500,000	$271 - $308	
HERITAGE HOUSE 6710 Hawaii Kai Drive Honolulu	Condo Lease	17-story 54.0	NA	135	135	135	Apr-73	NA	1B/1b	13%	706	$138,000	$197	$139,000 sale occurred nine months ago.
									1B/1b		706	$152,000	$215	$152,000 six months ago. Rest are
									1B/1b		706	$172,500	$244	recent resales.
									2B/2b	62%	935	$310,000	$332	Japanese extremely active in Hawaii Kai,
									2B/2b		935	$425,000	$455	according to manager-all cash buyers/
									2B/2b	13%	1,035	NA	NA	investors are Japanese, locals use
									2B/2b	13%	1,208	NA	NA	conventional financing

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SUMMARY CHARACTERISTICS OF SURVEYED PROJECTS
ISLAND OF OAHU
APRIL 1990

PROJECT/ LOCATION/ DEVELOPER	PRODUCT TYPE/ TENURE 2/	CONFIGU-RATION/ DENSITY	LOT SIZE (SF APP)	TOTAL UNITS	UNITS BUILT	UNITS SOLD	DATE BEGAN SELLING	MONTHLY ABSORPTION/ OCCUPANCY 3/	UNIT TYPE	UNIT MIX	UNIT SIZE	UNIT PRICE FROM	VALUE RATIO ($/SQ FT.)	ADDITIONAL COMMENTS
PLANNED PROJECTS														
CENTRAL OAHU														
KAPOLEI KNOLLS Kapolei City Lusk Company	SFD Fee	small lot	3,500 - 5,000	450	0	0	Jan-91	NA	2B/2b - 3B/2b	NA NA	1,000 - 1,800	$130,000 - $290,000	$130 - $161	Still securing zoning, construction is expected to start first quarter 1991. Will be targeted to first-time buyers, with some move-ups as well Prices are from 6-8 months ago.
WAIKELE Waipio AMFAC/JMB	SFD Fee	cluster/ standard lot	4,000 - 6,000	1,600	0	0	Mid-1991	NA	2B/2b		1,200 4K lot 1,200 5-6K lot	$220,000 - $260,000 - $290,000	$183 - $217 - $242	Golf course premium of $50,000 to $100,000 for 5,000 to 6,000 square foot lots. Project will include 18-hole golf course and 56 acres of commercial retail and office space. Affordable units comprise 50% of total.
	SFD Fee	cluster/ standard lot	4,000 - 6,000	1,600	0	0	Mid-1991	NA	2B/2b		1,200	$250,000 - $290,000	$208 - $242	Golf course premium of $50,000 to $100,000 on 5,000 to 6,000 square foot lots. Project will include 18-hole golf course and 56 acres of commercial retail and office space Affordable units comprise 50% of total (MF and SFD)
	TH Fee		NA	800	0	0	Mid-1991	NA	2B/2b		1,200 1,200	$85,000 - $170,000 $170,000 - $210,000	$70 - $142 $142 - $175	Very few market rate units, mostly affordable First price range is affordable, second is market rate Project will include 18-hole golf course and 56 acres of commercial retail and office space.
WATT HAWAII COMMUNITY Villages of Kapolei Watt Hawaii	SFD Fee		4,000 - 6,000	818	0	0	Jan-91	NA	2B 3B 2B 3B	60% affordable 40% market	950 - 1,250 1,500 - 2,000	$85,000 $120,000 $275,000 $300,000	$89 - $96 $183 - $150	First price range is affordable, second is market rate. Market rate units include golf course premium. 75% of units will be on the golf course.
WEST CLIFF Makakilo Heights Finance Realty	SFD Fee		5,000 - 9,000	500	0	0	Oct-90	NA	2B/2b - 3B/2b		1,450 - 2,200	$300,000 - $440,000	$207 - $200	First increment of 100 units at end of this year, four or five increments; exec homes No affordable units, requirement satisfied by building rentals. Average price= $340,000. Current resales in area are $340,000 to $350,000. Broker commented that exceptional product necessary to break $325,000-$330,000 price barrier.
HAWAII KAI-KAHALA														
MARINA 11A Hawaii Kai Bedford Properties	TH/Condo Lease	NA	NA	260	0	0	Jan-91	NA	2B 2B 3B 3B	67% condo 33% townhome	1,400 - 1,600 1,700 - 2,100	$400,000 $400,000 $510,000 $510,000	$286 - $250 $300 - $243	$20/s.f. premium for waterfront $40-$45/s.f. premium for end units-upper level. Highest prices will be for top floor units, priced from $380 to $400/s.f. Fee premium, if available, would be 15-20%. Only 10 townhomes on water.

EXHIBIT 30

SUMMARY CHARACTERISTICS OF SURVEYED PROJECTS
ISLAND OF OAHU
APRIL 1990

PROJECT/ LOCATION/ DEVELOPER	PRODUCT TYPE/ TENURE 2/	CONFIGU- RATION/ DENSITY	LOT SIZE (SF APP)	TOTAL UNITS	UNITS BUILT	UNITS SOLD	DATE BEGAN SELLING	MONTHLY ABSORPTION/ OCCUPANCY 3/	UNIT TYPE	UNIT MIX	UNIT SIZE	UNIT PRICE FROM	VALUE RATIO ($/SQ.FT.)	ADDITIONAL COMMENTS
CASDEN PROJECT	SFD/TH/Condo		4,000	556	0	0	Jan-91	NA	2B	42%	2,025 -	$600,000	$296 -	Dock privileges for all units, regardless of
Hawaii Kai		12.6	average						3B	SFD	2,700	$700,000	$250	product type.
Casden Group									2B	32%	1,280 -	$370,000	$289 -	Casden calls SFD component a "double zero-lot-
									3B	townhome	1,800	$450,000	$250	line" product.
									2B	26%	1,200 -	$300,000	$250 -	Base prices before premiums.
									3B	condo	1,550	$350,000	$226	

SF= Stacked flat; TH= Townhome; SFD= Single-family detached; S= Story.
Data as of March 1990. Unless specific date is known, assumes projects began selling on the first day of the opening month.

SOURCE: Hawaii TMK Service and Robert Charles Lesser & Co.

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EXHIBIT 31

ADDITIONAL CHARACTERISTICS OF SURVEYED PROJECTS
ISLAND OF OAHU
APRIL 1990

PROJECT/ LOCATION/ DEVELOPER	BEST SELLING UNITS/COMMENTS	VIEW ORIENTATION	PREMIUM SCHEDULE	AMENITIES/SERVICES	BUYER/TENANT PROFILE
SINGLE-FAMILY DETACHED					
CENTRAL OAHU					
KUMU IKI Villages of Kapolei Oceanic Properties	All	None	None	Schools, churches, parks, recreation centers, a golf course and two retail shopping centers.	Smallest home series is marketed to 80-120 percent median income buyers, other series' are market rate 90% primary home buyers, 30- to 50-year age groups most prominent. Mostly established families and some empty nest (50% of each group). Down payments of 40% to 100% of price (equity from previous home a major source of down payment)
WEST LOCH ESTATES Kapolei City Westloch, Inc.	All	Diamondhead West Loch GC	$25,000 to $50,000 for view of Diamondhead/ golf frontage	Small lot lot; located adjacent to municipal golf course.	Some Japanese in resales, but less than 1%. Market units are 85% primary ownership, 95% of buyers are local. Majority of buyers are families, with head of household from 20 to 40 years old. Some older buyers.
THE RIDGE Mililani Town Islander Homes	865 and 1295, because there were more of them.	NA	Perimeter lots= $20,0000 to $40,000.	Mililani services and recreational facilities	No Japanese buyers, 100% primary buyers, 35 years was median age previously, is moving toward 40. Mostly established families, no empty nesters yet Down payments of $20,000 to $100,000
AIEA RIDGE 99-120 Inea Place Aiea I.H.V. Corporation	1,504 s.f. plan, but all sold well.	All units have view of Pearl Harbor.	Indeterminable	Private entryway with security gate, recreation area, homeowners assoc.	Only one Japanese buyer in project. All but that unit were purchased as primary residences. Age groups were 40s. Empty nesters and childless couples, all working professional
CREST AT WAILUNA Kaahumanu Street Ewa/Central Oahu	All units sold well	Some units have Pearl Harbor view.	$15,000 to $20,000 for view of Pearl Harbor.	Membership in Wailuna Recreation Association required (fee). Provides passive park, two swimming pools, two rec centers, tennis courts and playground.	All units purchased as primary residences. Most buyers were their thirties. Mostly local, some mainland (military) but were already relocated to island before buying at The Crest. Major of buyers did not have families, some had young family. No Japanese buyers - broker notes that Japanese buy mostly from realtors, and developer did not sell cooperatively. In addition, broker notes that Japanese are most attracted to an
SODA CREEK Ewa Gentry Gentry Homes, Ltd	All	None	$2,500 for a corner lot	None	Mostly locals, some foreign buyers All age groups. Families are primary buyer group Primary buyers comprise 80%
ROYAL KUNIA SUBDIVISION Honta Homes	Four-bedroom	Ocean Diamondhead	$15,000 to $20,000 for view	None	Mostly move-up families. 20-30% purchased by local investor Mostly buyers from leeward side, some from condos downtowı

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EXHIBIT 31

ADDITIONAL CHARACTERISTICS OF SURVEYED PROJECTS
ISLAND OF OAHU
APRIL 1990

PROJECT/ LOCATION/ DEVELOPER	BEST SELLING UNITS/COMMENTS	VIEW ORIENTATION	PREMIUM SCHEDULE	AMENITIES/SERVICES	BUYER/TENANT PROFILE
HAWAII KAI-KAHALA					
HAWAII LOA RIDGE Hawaii Kai HMF, Inc	Best views go first 80% of the time.	Ocean (80-90%)	50%+ for ocean views.	None	Japanese were 80% of buyers in 1987, 40% in 1988, 20% in 1989 and 10% in 1990. Most buyers were primary home buyers All age categories, many families Cash buyers comprised 80% of total
WAIALAE IKI Hawaii Kai	Cheapest lots with no views ($350K at time of sale).	Diamondhead Koko Head	$100,000 for view (typical) $200,000+ for best lots (2 or 3)	None	Primary home buyers. Mid-40's to mid-50's, primarily professional people with families. Home construction is scheduled or in progress on about 20 lots
KAHALA KUA Kahala EIC Dev Co	NA	Ocean Diamondhead Koko Head	One million dollars for panorama from DH to Koko Head.	Gated community.	One Japanese buyer, other three lots to developer, all sales were for cash.
LAULIMA O HAWAII KAI Hawaii Kai Kaiser Development Co.	Golf course units	Golf course Ocean	$50,000 to $80,000 for exterior units (golf course frontage). $100,000 for best ocean views.	Golf course Beach within walking distance	Japanese buyers of golf course units (less than 10%) Primary buyers comprise 100% Rentals comprise 25% of units Age groups= mostly in 40's and 50's Many retirees from mainland, as well as empty nesters and pre-empty nesters from local market. Locals bought mostly interior units, couldn't afford golf course frontage.
QUEEN'S GATE Kalohelani Place Hawaii Kai	NA	Ocean view golf course	Fee= $50,000 to $70,000. Golf course= $50,000 to $75,000	Gated community.	
TOWNHOMES .... **CENTRAL OAHU**					
MILILANI PINNACLE Ualalehu/Ahiku St Mililani	All	Golf course	$40,000 to $80,000 for golf course.	Bordered by Mililani Golf Course and the Waikakalaua ravine area. Yards, low density.	Local buyers from Mililani area Primary buyers comprise 100% of total Age categories= mid-30's to 60's, mostly professional couples with no kids and empty nesters. Equity is major source of down payment (40%-50% down)
MILILANI POINT 95-349 Kuahelani Ave. Mililani Point Ventures	All	None	None	None	Local buyers comprise 100% of total, of which 80% are investors; typical financing is 20% down conventional Typical residents are 30 to 40 years of age, mostly young professional couples

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EXHIBIT 31

ADDITIONAL CHARACTERISTICS OF SURVEYED PROJECTS
ISLAND OF OAHU
APRIL 1996

PROJECT/ LOCATION/ DEVELOPER	BEST SELLING UNITS/COMMENTS	VIEW ORIENTATION	PREMIUM SCHEDULE	AMENITIES/SERVICES	BUYER/TENANT PROFILE
HAWAII KAI-KAHALA					
GATEWAY PENINSULA Kawaihae Street Hawaii Kai	NA	Marina Ocean	Marina frontage= $150,000 to $250,000.	Marina, boat space for each unit	Japanese have been buying resales in project, estimated to own about 10% of units. Owners comprise 90% to 95% of current residents, with good mix of age categories and family types. Japanese buy marina frontage units only
THE MOORINGS 6370 Hawaii Kai Dr. Hawaii Kai Kaiser Hawaii Kai		Ocean			
KOKO ISLE Anapalau St. Hawaii Kai	NA	Ocean	$75,000 for waterfront units.	Boat dock, rec area, pool.	70% owner occupied. Mostly empty nesters and retirees
KAHUKU					
KUILIMA ESTATES Kamehameha HY Kahuku Inacon Development Co.	Largest units	Ocean views Golf course	$50,000+ for golf course.	Golf course, rec area, tennis court.	One-third of units are owner occupied (50% work, 50% retired). One-third of units are rented or not used, one-third are in vacation rental pool. Japanese buyers not common in Kuilima, but may increase wit building of new hotel.
LOW-AND-RISE CONDOMINIUMS					
CENTRAL OAHU					
MILILANI PARKWAY 94-710 Meheula Pkwy. Mililani	Only one type	None	None	Tot lot.	Affordable product, sold out as available Buyers moved mostly from other Leeward areas of the island
PALM COURT Ewa Gentry Gentry Homes	Both	None	None	Rec center.	All local, primary buyers (restriction on rental for one year) Mostly couples in their 20's and 30's, first-time buyers Few couples.
PALM VILLAS Ewa Gentry Gentry Homes	All	None	None	None	All local, primary buyers (restriction on rental for one year). Mostly couples in their 20's and 30's, first-time buyers. Few couples.

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EXHIBIT 31

ADDITIONAL CHARACTERISTICS OF SURVEYED PROJECTS
ISLAND OF OAHU
APRIL 1990

PROJECT/ LOCATION/ DEVELOPER	BEST SELLING UNITS/COMMENTS	VIEW ORIENTATION	PREMIUM SCHEDULE	AMENITIES/SERVICES	BUYER/TENANT PROFILE
KUANI HILLSIDE Waipio Gentry Homes	All	Diamondhead	$20,000 to $25,000 for Diamonhead view	None	All local, primary buyers. Few families, mostly professional couples and empty nesters. Mostly move-up buyers from with Waipio.
HAWAII KAI-KAHALA					
ESPLANADE 500 Lunalilo Home Rd. Hawaii Kai	2B and 3B	Diamondhead Ocean Mountains	$20,000 to $30,000 for Diamondhead view. Only 2B and 3B units have direct water frontage and view.	Pool, rec area, tennis courts, steam room, whirlpool.	Japanese and Chinese investors. Majority of buyers are primary users. Ages from 30's to 60's, many part-time retirees (Oahu/mainland). Other buyer groups include young couples and empty nesters, few children. Many move-downs from downtown and Hawaii Kai.
NANIWA GARDENS 6750 Hawaii Kai Dr. Hawaii Kai	NA	Ocean	Ocean view=$20,000	Rec area, pool	All owner-occupied are primary buyers. Rentals comprise 35% of total. Most buyers are in 40's through 60's. Mostly retirees and empty nesters. Most sales are 50% to 100% down, with equity as a major source of equity. Of owners, two are from Japan, two from New Zealand, some from mainland and Waiala
MAWAENA KAI, THE LANDING 7007 Hawaii Kai Drive Kaiser Hawaii Kai Dev.	Three-bedroom end units.	Marina	$5,000 for boat mooring	Marina access	All local buyers, 100% owner-occupied. Buyer ages and previous locations mixed. Some retired, some mainland, some singles.
THE PLAZA (Imperial Plaza) Cooke St. & Kapiolani Bl. Honolulu (Kaka'ako) Business Investment, Ltd.	Hard to sell as TH project in downtown, unusual concept	Ocean	None	Pool, spas, saunas and a party pavilion. Water fountain and atrium. Valet service, concierge, 24-hour security guards and TV monitors in each unit.	70% local buyers, 20% Japanese, 10% mainland. Primary home buyers comprise 80%, many moving up from other condo projects on Oahu. Foreigners buy mostly for cash. 5-10% cash sales. Local buyers made cash down payments, will pay rest with equity when they sell current home, many waiting for children to leave home before selling current hom
WINDWARD OAHU					
POHAKEA POINT Lilipuna Road Kaneohe Swire Properties Ltd.	All units sell equally well.	All units have ocean view.	Indeterminable	Carpet, tile, pool, rec area, tennis court, meeting rooms, master TV, BBQ.	Prices shown are current phase. Mostly professional couples, empty nesters. Japanese influence is minimal; 75-80% of sales have been to primary home buyers; during last two years, 30-35% of buyers have been from mainland, rest local, with very few Japanese. In the early 1980's, about 50% of buyers came from mainland.
WINDWARD HARBOUR 1030 Aoloa Place Kailua	NA	Ocean	NA	Gated with security guard	Very few investors, some from mainland, Australia and Canad
WINDWARD COVE 1000 Aoloa Place Kailua	NA	Ocean	$15,000 for lagoon frontage	Tennis court, pool, rec area	Owner occupancy is 55%. Renters are mostly young. Very few investors.
MAKANI KAI MARINA 45-995 Wailele Rd Kaneohe	NA	Ocean	Fee premium= $30,000 to $50,000. Marina frontage= $20,000 to $30,000.	Tennis court, pool, rec area.	Local owners comprise 100%. Owner occupancy is 67%. Mostly retirees and young families, a few couples.

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EXHIBIT 31

ADDITIONAL CHARACTERISTICS OF SURVEYED PROJECTS
ISLAND OF OAHU
APRIL 1990

PROJECT/ LOCATION/ DEVELOPER	BEST SELLING UNITS/COMMENTS	VIEW ORIENTATION	PREMIUM SCHEDULE	AMENITIES/SERVICES	BUYER/TENANT PROFILE
HOKULANI IN KAILUA 355 A-D Aoloa St. Kailua	All	None	$25,000 more if project was fee simple	None	No Japanese, mostly locals, lot of Chinese buyers. 80-85% primary buyers in late 20's through 30's, 25% retired persons, 75% young couples with established careers
HIGH-RISE CONDOMINIUMS					
CENTRAL OAHU					
THE IMPERIAL (Imperial Plaza) Cooke St. & Kapiolani Bl. Honolulu (Kakaako) Business Investment, Ltd.	Two- and three-bedroom units facing Diamondhead sold out immediately, penthouses have sold most slowly.	Diamondhead Ocean Mountains	$10,000/floor	Pool, spas, saunas and a party pavilion. Water fountain and atrium. Valet service, concierge, 24-hour security guards and TV monitors in each unit.	70% local buyers, 20% Japanese, 10% mainland. Primary home buyers comprise 80%, many moving up from other condo projects on Oahu. Foreigners buy mostly for cash. 5-10% cash sales. Local buyers made cash down payments, will pay rest with equity when they sell current home, many waiting for children to leave home before selling current home
PLAZA HAWAII KAI 6770 Hawaii Kai Dr. Hawaii Kai	NA	Ocean	NA	Rec area, pool.	
HERITAGE HOUSE 6710 Hawaii Kai Drive Honolulu	Two-bedroom units for resale value and size advantages.	Ocean	$1,000/floor	Pool, recreation area	10% of tenants are Japanese, 40% of units are owned by investors. Canadians were first investors, then Japanese. 30%-40% retirees, rest of owners are in their 40's, commute to Honolulu to work.
PLANNED PROJECTS					
CENTRAL OAHU					
WEST CLIFF Makakilo Heights Finance Realty	NA	Ocean Diamondhead	Less than $25,000	NA	Targeted to equity transfers in immediate area, many potential buyers are already discussing resale of their current home in order to buy in project. Also targeting move-ups from out of area moving to their last home. No Japanese buyers expected.

SOURCE: Hawaii TMK Service and Robert Charles Lesser & Co.

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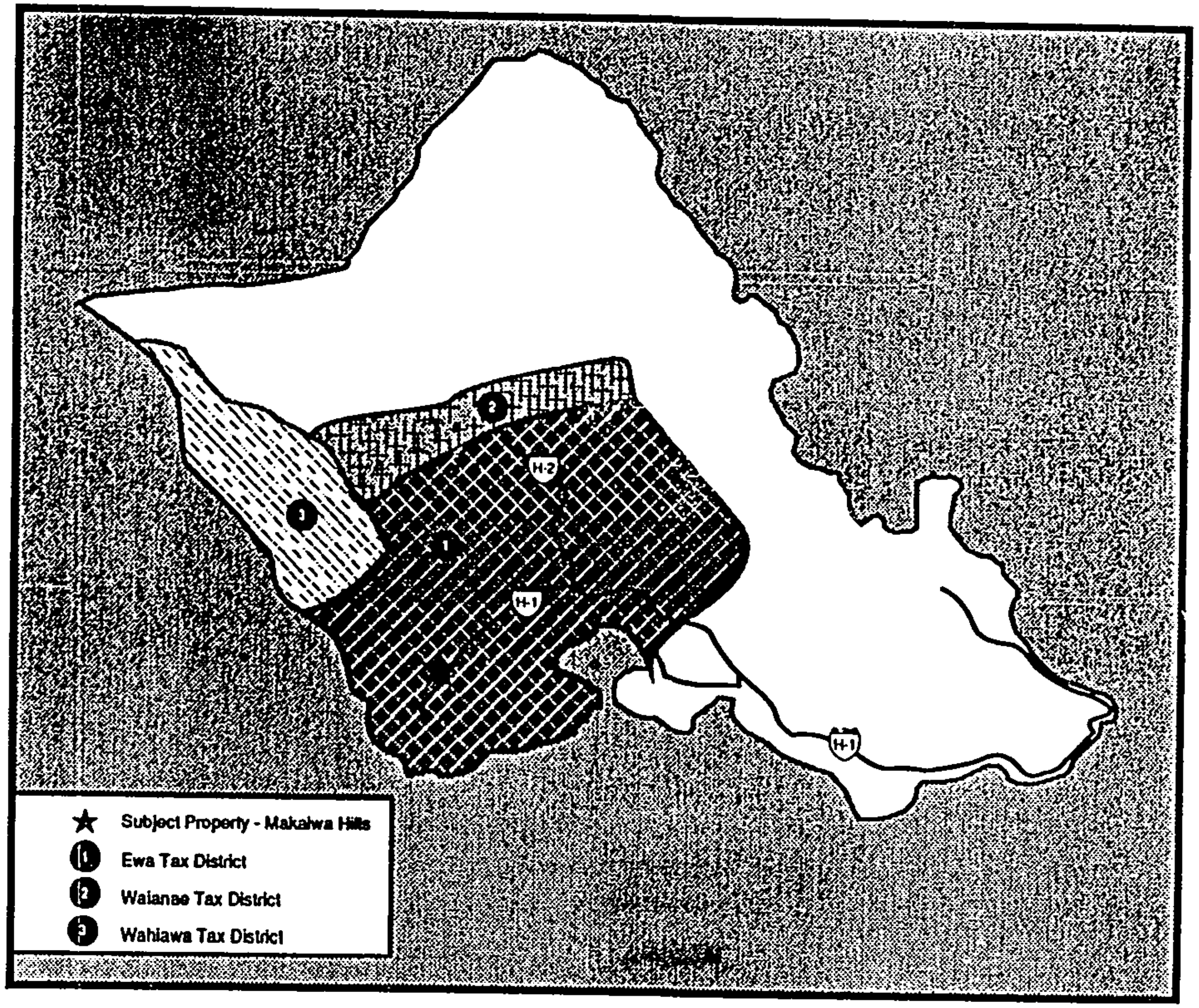
EXHIBIT 32

ISLAND OF OAHU



SOURCE: Robert Charles Lesser & Co.

EXHIBIT 33

01-2728.05(T4)

SELECTED SURVEY OF COMPARABLE REGIONAL SHOPPING CENTERS
OAHU

	PROJECT/LOCATION	DATE BUILT	ACRES	PARKING SPACES	GROSS LEASABLE AREA	PARKING RATIO (per 1,000 s.f.)	NUMBER OF STORES	ANCHOR TENANTS		ANCHORS AS% OF TOTAL GLA	TYPICAL IN-LINE STORE LEASE RATES Oct, 1989
1	Ala Moana Shopping Cent	1959	50	7,500	1,500,000	5	180	J.C. Penny's	182,350	56%	$3.00 to $5.00
	1450 Ala Moana Blvd.							Liberty House	310,320		(NNN)
	Honolulu							Sears	340,000		No TI's
								Total:	832,670		
2	Pearlridge Mall	1975/1984	NA	4,915	1,200,000	4	185	J.C. Penny's	130,000	36%	$2.00 to $2.50
	98-1005 Moanalua Road							Liberty House	100,000		(NNN)
	Aiea/Pearl City							Sears	150,000		
								Longs Drugs	26,500		
								Shirokiya	19,500		
								Total:	426,000		
3	Windward Mall	1982	30	2,300	530,000	4	103	J.C. Penny's	87,585	33%	$1.25 to $2.25
	Likelike & Kam Hwy.							Liberty House	87,397		(NNN)
	Kanohoe							Sears	1,277		No TI's
								Total:	176,259		
4	Kahala Mall	1970	26	1,700	36[illegible],000	5	75	Liberty House	91,000	45%	$2.00 to $2.50
	4211 Waialae Avenue							Star Market	28,066		(NNN)
	Honolulu							Carol & Mary	46,000		No TI's
								Total:	165,066		
				------	-----------	---------			-----	---------	
	TOTAL/AVERAGE:			16,415	3,595,000	5			1,599,995	45%	

Source: 1989 Shopping Center Directory; survey of center leasing agents and managers; and Robert Charles Lesser & Co.

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EXHIBIT 34

EXISTING COMPETITIVE REGIONAL SHOPPING CENTERS 1/
CITY AND COUNTY OF HONOLULU

CENTER/ DEPARTMENT STORE	SQUARE FOOTAGE	APPROXIMATE DISTANCE FROM SITE	ESTIMATED TRADE AREA RADIUS 2/	% OVERLAP	ESTIMATED COMPETITIVE G.L.A.
ALA MOANA SHOPPING CENTER					
JC Penney	182,350	9 miles	Oahu	40%	333,068
Liberty House	310,320				
Sears	340,000				
	832,670				
PEARLRIDGE SHOPPING CENTER					
Liberty House	100,000	4 miles	10 miles	75%	285,000
Sears	150,000				
JC Penney	130,000				
	380,000				

1/ Centers which are considered competitive with the subject site.

SOURCE: Robert Charles Lesser & Co.

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EXHIBIT 35

ESTIMATED DEMAND FOR ALL DEPARTMENT STORES
PRIMARY TRADE AREA
1990 - 2010

	1990	1995	2000	2005	2010
DEPARTMENT STORE DEMAND POTENTIAL					
Demand Potential, Residents					
Population 1/	304,573	358,864	398,783	438,071	478,327
Per Capita Dept. Store Purchase Potential 2/	$426	$460	$512	$562	$614
= Dept. Store Sales Potential	$129,626,269	$165,231,473	$204,035,746	$246,219,246	$293,550,470
Less Estimated 20% Leakage 3/	$25,925,254	$33,046,295	$40,807,149	$49,243,849	$58,710,094
= Net Dept. Store Sales Potential	$103,701,015	$132,185,179	$163,228,597	$196,975,397	$234,840,376
Subtotal, Net Dept. Store Sales Potential	$103,701,015	$132,185,179	$163,228,597	$196,975,397	$234,840,376
Demand Potential, Tourists					
Estimated Annual Tourist Population 4/	204,400	408,800	613,200	817,600	817,600
x Estimated Tourist Expenditures 5/	$3,607,660	$7,215,320	$10,822,980	$14,430,640	$14,430,640
x Potential Capture 6/	15%	15%	15%	15%	15%
Estimated Tourist Market Sales Potential	$541,149	$1,082,298	$1,623,447	$2,164,596	$2,164,596
Total Net Dept. Store Sales Potential	$104,242,164	$133,267,477	$164,852,044	$199,139,993	$237,004,972
EXISTING SUPPLY					
Total Dept. Store Square Footage 7/	0	0	0	0	0
Total Dept. Store Sales 8/	$0	$0	$0	$0	$0
NET MARKET SUPPORT					
Potential Sales Minus Existing Sales	$104,242,164	$133,267,477	$164,852,044	$199,139,993	$237,004,972
Supportable New Dept. Store Square Feet 8/	416,969	533,070	659,408	796,560	948,020
Supportable New Dept.Stores 9/	2.8	3.6	4.4	5.3	6.3

1/ Includes Ewa, Waianae and Wahiawa Tax Districts estimated real growth in incomes.
2/ Derived from UDS estimates and increased annually based on forecasted growth in real income.
3/ Assuming that 20% of the potential demand will not be captured within the market area.
4/ Based on forecasted resort population growth in primary market area.
5/ Hawaii DBED. Assumes per capita daily expenditures of $8.70 on apparel and $8.95 on gifts.
6/ Assumes that only 15% of tourist demand will be captured, with the rest lost to resort retail.
7/ Based on EXHIBIT 34.
8/ Assuming average sales per square foot of $250.
9/ Assuming 150,000 square feet per department store.

SOURCE: Robert Charles Lesser & Co.

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EXHIBIT 36

PRELIMINARY ESTIMATED DEMAND FOR UPSCALE FASHION DEPARTMENT STORES
PRIMARY TRADE AREA
1990 - 2010

	1990	1995	2000	2005	2010
DEMAND POTENTIAL, RESIDENTS					
$50,000+ Households					
Population in $50,000+ Households 1/	77,812	95,402	108,853	122,720	137,467
x Per Capita Dept. Store Purchase Potential 2/	$532	$576	$611	$647	$686
= Dept. Store Sales Potential	$41,395,753	$54,907,144	$66,487,366	$79,459,749	$94,250,551
x % of Sales Potential in Upscale Dept. Stores 3	80.0%	80.0%	80.0%	80.0%	80.0%
= Upscale/High Fashion Sales Potential	$33,116,602	$43,925,715	$53,189,892	$63,567,799	$75,400,441
$35,000+ Households					
Population in $35,000 - $50,000 Households 1	42,650	48,492	52,030	54,986	57,474
x Per Capita Dept. Store Purchase Potential 2/	$426	$460	$489	$518	$548
= Dept. Store Sales Potential	$18,151,988	$22,327,043	$25,423,882	$28,482,379	$31,524,128
x % of Sales Potential in Upscale Dept. Stores 3	40.0%	40.0%	40.0%	40.0%	40.0%
= Upscale/High Fashion Sales Potential	$7,260,795	$8,930,817	$10,169,553	$11,392,951	$12,609,651
$15,000+ Households					
Population in <$35,000 Households 1/	184,111	214,971	237,900	260,365	283,386
x Per Capita Dept. Store Purchase Potential 2/	$356	$384	$407	$432	$457
= Dept. Store Sales Potential	$65,298,065	$82,462,262	$96,872,580	$112,389,014	$129,530,716
x % of Sales Potential in Upscale Dept. Stores 3	10.0%	10.0%	10.0%	10.0%	10.0%
= Upscale/High Fashion Sales Potential	$6,529,807	$8,248,226	$9,687,258	$11,238,901	$12,953,072
Primary Upscale/High Fashion Sales Potential	$46,907,204	$61,104,759	$73,046,703	$86,199,652	$100,963,164
Estimated Secondary Market Potential 4/	$21,108,242	$27,497,141	$32,871,016	$38,789,843	$45,433,424
Subtotal Upscale/High Fashion Sales Potential	$68,015,446	$88,601,900	$105,917,720	$124,989,496	$146,396,587
Demand Potential, Tourists					
Estimated Annual Tourist Population 5/	204,400	408,800	613,200	817,600	817,600
x Estimated Tourist Expenditures 6/	$3,607,660	$7,215,320	$10,822,980	$14,430,640	$14,430,640
x Potential Capture	25%	25%	25%	25%	25%
Estimated Tourist Market Sales Potential	$901,915	$1,803,830	$2,705,745	$3,607,660	$3,607,660
Total Upscale/High Fashion Sales Potential	$68,917,361	$90,405,730	$108,623,465	$128,597,156	$150,004,247
EXISTING SUPPLY					
Total Upscale Dept. Store Square Footage 7/	0	0	0	0	0
Total Upscale Dept. Store Sales 8/	$0	$0	$0	$0	$0
NET MARKET SUPPORT					
Potential Sales Minus Existing Sales	$68,917,361	$90,405,730	$108,623,465	$128,597,156	$150,004,247
Supportable New Upscale/High Fashion Square Feet 8/	196,907	258,302	310,353	367,420	428,584
Supportable New Upscale/High Fashion Dept.Stores 9/	1.3	1.7	2.1	2.4	2.9

1/ Includes Ewa, Waianae and Wahiawa Tax Districts Qualified households based on forcasted real income and household growth estimates per County of Honolulu.
2/ Derived from UDS estimates and increased annually based on forecasted real income growth.
3/ Based on discussions with national retail professionals.
4/ Assuming 35% of the market demand will be derived from outside the primary market area.
5/ Based on forecasted resort population growth in primary market area.
6/ Hawaii DBED. Assumes per capita daily expenditures of $6.70 on apparel and $8.95 on gifts.
7/ EXHIBIT 34. Takes into account lack of existing upscale product on Oahu.
8/ Assuming average sales per square foot of $350.
9/ Assuming 150,000 square feet per department store.

ROBERT CHARLES LESSER & CO.

The real estate industry has entered its most dynamic period of change in the 1990's. The challenges and opportunities are arising from global financial markets, major restructuring of the corporate real estate environment, the continued emergence of major national and international players, and fundamental shifts in the size and nature of demand for real estate product.

Since our founding in 1966, RCLCo has responded to the ever evolving real estate industry by expanding and improving the services that we offer to our clients. We have always strived to add value and provide a competitive advantage to our clients' real estate activities. We have and will continue to accomplish this goal by helping our clients stay at the cutting edge of new and emerging trends and markets.

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Development Advisory Services
Investment Advisory Services
Valuation Services
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Developers
Corporations
Financial Institutions
Institutional Investors
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The hallmark of RCLCo action-oriented professionals is that we provide our clients with clear and definitive recommendations which can be readily implemented. Our recommendations are driven by and based upon grounded creativity regarding market, economic, physical, and political realities influencing the asset or the portfolio.

DEVELOPERS

A.G. SPANOS CONSTRUCTION, INC.
AHMANSON DEVELOPMENT
AMERICAN NEVADA CORPORATION
ARVIDA/JMB PARTNERS
AYRSHIRE CORPORATION
BCE DEVELOPMENT PROPERTIES, INC.
THE BERGHEER COMPANY
THE CALIBRE COMPANY OF VIRGINIA, INC.
CHATHAM PROPERTIES
CHRISTOPHER MASON COMPANY
CLUB CORP
COLEMAN HOMES
COSMO WORLD CORPORATION OF NEVADA, INC.
COSTAIN HOMES
EAST-WEST PARTNERS
EL DORADO HILLS COMMUNITIES
FEDERATED DEVELOPMENT COMPANY
GENSTAR SOUTHERN DEVELOPMENT
GSL PROPERTIES, INC.
HOMART DEVELOPMENT COMPANY
IDM DEVELOPMENT CORPORATION
INTRAWEST CORPORATION
IRIS ARC CRYSTAL
JANSS CORPORATION
JOHN BUCK COMPANY
JOHN LAWRENCE (NEVADA), INC.
KATELL PROPERTIES, INC.
KAUFMAN AND BROAD HOME CORPORATION
KETTLER BROTHERS, INC.
LATIGO REALTY CORPORATION
LERNER CORPORATION
THE LINPRO COMPANY
LOWE ASSOCIATES, INC.
LYON DEVELOPMENT COMPANY
MARKLAND PROPERTIES, INC.
MCKELLAR DEVELOPMENT
MJ BROCK & SONS
MOBIL LAND DEVELOPMENT CORPORATION
MSG ENTERPRISES, INC.
NATIONAL CORPORATION FOR HOUSING PARTNERSHIPS
NEWHALL LAND & FARMING
PACIFIC PROPERTIES CORP.
PEACHTREE CITY DEVELOPMENT CORPORATION
PORTMAN PROPERTIES
POTOMAC INVESTMENTS ASSOCIATES
PRESLEY HOMES
RATKOVICH COMPANY
THE RELATED COMPANIES, INC.
SAUNDERS DEVELOPMENT CORP.
SHERWOOD VALLEY
SKINNER CORPORATION
SNYDER HUNT
SOUTHEAST VENTURES COMPANIES
SPANISH TRAIL ASSOCIATES
SPAULDING & SLYE
STANFORD RANCH, INC.
STONEGATE DEVELOPMENT, INC.
TODA DEVELOPMENT, INC.
TRAMMELL CROW COMPANY
TRAMMELL CROW RESIDENTIAL
U.S. HOME CORPORATION
THE VALUE GROUP
WATT INDUSTRIES, INC.
ZECKENDORF CO., INC.

CORPORATE REAL ESTATE

ALLIED SIGNAL AEROSPACE CO.
BALTIMORE ORIOLES
CHAMPION REALTY CORPORATION
COLLIER ENTERPRISES
CSX CORPORATION
DISNEY DEVELOPMENT COMPANY
DOMINION LAND, INC.
THE ESTATE OF JAMES CAMPBELL
GULFSTREAM LAND DEVELOPMENT CORP.
GUNNELL PROPERTIES
HUNTER FAN
THE LOCKHEED CORPORATION
LUKENS, INC.
MOBIL LAND DEVELOPMENT CORPORATION
NEWHALL LAND & FARMING
OCEANIC PROPERTIES, INC.
RALSTON PURINA COMPANY
SANTA CATALINA ISLAND COMPANY
SUMMA VENTURES, LTD.
SUNCOR DEVELOPMENT COMPANY

FINANCIAL INSTITUTIONS

BENJFRAN DEVELOPMENT CO.
CHANCELLOR LAND CORPORATION
COLUMBIA SAVINGS
FIRST FINANCIAL GROUP
FIRST INTERSTATE BANK OF CALIFORNIA
GIBRALTER LAND, INC.
GLENFED DEVELOPMENT CORP.
HAMILTON CORPORATION
HELLER FINANCIAL, INC.
HERON INTERNATIONAL
HOME SAVINGS OF AMERICA
HONOFED
METROPOLITAN FEDERAL BANK
MILWAUKEE INSURANCE
NATIONAL BANK OF CANADA

INSTITUTIONAL INVESTORS

AMERICAN GENERAL INVESTMENT CORPORATION
ARVIDA/JMB PARTNERS
BARRINGTON PLAZA, LTD.
CLAREMONT FACILITIES CORPORATION
CREDIT AMERICA
INVESTORS MANAGEMENT GROUP, LTD.
L.G. SCHAFRAN & PARTNERS
MERRILL, LYNCH, HUBBARD, INC.
MORGAN STANLEY & CO. INCORPORATED
MOSBACHER JACOBS PROPERTIES
PACTEL PROPERTIES
PRUDENTIAL ACQUISITIONS AND SALES GROUP
PUBLIC STORAGE, INC.
RANCON FINANCIAL CORPORATION
SALOMON BROTHERS, INC.
SHAMROCK HOLDINGS, INC.
SKYLINE FINANCIAL SERVICES
TRANSAMERICA REALTY SERVICES, INC.
VMS REALTY PARTNERS
WESTINGHOUSE CREDIT CORPORATION
WEYERHAUSER MORTGAGE COMPANY

INTERNATIONAL CLIENTS

BPT (THE BURTON GROUP PLC)
BURNS INTERNATIONAL
BURNS, ROSEHAUGH, MOUNTLEIGH PARTNERSHIP
B.V.I. FINANCIAL CORPORATION
CHARLES DUNN COMPANY
C. ITOH & CO.
HASEKO (GEORGIA), INC.
HASEKO (HAWAII), INC.
JENNINGS
KAKU ASSOCIATES
MARUFUJI AMERICA, INC.
MITSUBISHI INTERNATIONAL CORPORATION
PACIFIC ATLAS CORPORATION
REAL PROM DEVELOPMENT, INC.
SEINO AMERICA, INC.

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CITY OF ANAHEIM, CALIFORNIA
CITY OF BEAVERTON, OREGON
CITY OF LAKEWOOD, CALIFORNIA
CITY OF LOS ANGELES, CALIFORNIA
CITY OF MONROVIA, CALIFORNIA
CITY OF NORWALK, CALIFORNIA
CITY OF PASCO, WASHINGTON
CITY OF SANTA ANA, CALIFORNIA
CITY OF SANTA FE, NEW MEXICO
CITY OF TIGARD, OREGON
CORE NORTH PARTNERS
COUNTY OF LOS ANGELES, CALIFORNIA
HUNTINGTON BEACH, CALIFORNIA
PORTLAND DEVELOPMENT COMMISSION
PORT OF HOOD RIVER
PORT OF NEWPORT
STATE OF OREGON

LITIGATION SUPPORT

BALL, JANIK & NOVACK
DEWEY, BALLANTINE, BUSHEY, PALMER & WOOD
GIBSON, DUNN & CRUTCHER
GRAHAM & JAMES
GROSS ENTERPRISES
HUFSTEDLER, MILLER, KAUS & BEARDSLEY
MESERVE, MUMPER & HUGHES
MUNGER, TOLLES, OLSEN LAW FIRM

STRATEGIC PLANNING

THE ARTERY ORGANIZATION, INC.
THE BENKENDORF ASSOCIATES
BISKIND DEVELOPMENT COMPANY
BIRTCHER
THE C.P. MORGAN CO., INC.
EMPIRE WEST COMPANIES, INC.
FAISON ASSOCIATES
NOTTINGHAM PROPERTIES, INC.
ROUSE & ASSOCIATES
SOUTHEASTERN INVESTMENT PROPERTIES, INC.
SOUTHEAST VENTURE COMPANIES
TRAMMELL CROW COMPANY
TRAMMELL CROW RESIDENTIAL

Appendix O.

Makaiwa Hills Golf Alternative, A Market Assessment

John Zapotocky

Makaiwa Hills Golf Alternative

A Market Assessment

Prepared for
THE ESTATE OF JAMES CAMPBELL

Prepared by
John Zapotocky

December 1990

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Executive Summary

The Makaiwa Hills development project is in the early stages of the planning process. One of the more attractive features of the development is the readily accessible recreational facilities. These amenities include a tennis and swim club. In an effort to provide an even greater assortment of recreational amenities and to explore alternate land uses, John Zapotocky, Consultant, was commissioned to prepare a market assessment for a golf course. The purpose of this report is to identify and assess the potential need for a golf course from a market point of view, i.e., what is the estimated demand for the course?

The proposed course development would consist of an 18 hole, daily fee, championship golf course, including a golf clubhouse, parking lot, and maintenance facilities. The course would be alternate use for 180 acres now requested for preservation. The course would complement the residential housing development of about 2,100 units. If built, the golf course would be ready for play sometime in 1995.

The enhancement of residential developments with golf courses is a documented way to increase the value of a project, which in turn often helps to offset the construction and operational costs of the course. Increased premiums for homes with golf course frontage are noted to be as high at 50-60% in the southwestern United States, according to a recent Leventhal study.

Nationally, the outlook for golf participation through the year 2000 is very positive. This optimism is based on the following: expected higher incomes, an aging population, early retirement, and more leisure and flex time (flexible working hours), among other factors. According to recent studies by the National Golf Foundation, there were some 24.7 million golfers in 1989, up about 8% per annum from 17.5 million golfers in 1985. If similar trends continue, it is estimated that there may be between 30-40 million U.S.-resident golfers by the year 2000. This projected growth, when analyzed from the point of view of the need for additional golf courses, shows potential demand for between 1,400 to 7,900 golf courses by the year 2000, assuming *only* 0% and 3% rates of growth in participation.

The prospects for increased golf participation in the State of Hawaii echo, and in some cases, amplifies, those of the national trends. The growth of golf participation in the State is tied to the growth of in the resident population and tourism, as well as the annual growth in the participation of golf within each group.

A survey conducted by the Consultant within the past two years showed that approximately 1.5 million rounds were played on Oahu's 19 non-military golf courses in 1988. Of these rounds, approximately 1.24 million or 79% were played by residents and .27 million or 21% were played by visitors. Based on this information the average annual rounds played in 1988 by Oahu's average resident (non-military) and visitor population was 1.81 and 3.58 rounds, respectively. Using the 1988 figures and the projected growth rates for resident and visitor population as projected by State planners, alternative demand scenarios were generated by incorporating growth rates of 0%, 2%, and 5%. Use of these assumptions indicated a demand on Oahu for additional golf courses of three, eight and 18, respectively.

Characteristics which describe Oahu's unmet golf demand include: courses which operate at maximum or over capacity; escalating green fees, and a telephone-lottery system for municipal course starting times.

There are currently (December 1990) 5 golf courses under construction on Oahu with an additional 35 courses in various stages of planning. However, based on a number of considerations, including the ability to achieve needed governmental approvals, the physical constraints of the sites under consideration, the ability of potential developers to obtain financing and the economics of development in an environment of potential oversupply, the Consultant estimates that less that half, or about 20 of these planned courses could be developed by the year 2000.

Summarizing the future demand and supply of Oahu golf courses, the consultant estimates a shortfall of between 3 and 12 courses by the year 2000 with a mid range estimate of 7.5 courses. This assumes an existing shortfall ranging from 5 to 14 courses, additional demand by the year 2000 ranging from 3 to 18 courses and an estimated supply ranging from 5 to 20 courses.

The Ewa, Central Oahu and Waianae Development Plan areas are expected to account for the bulk of the residential development and visitor plant expansion thru the year 2010. Growth in golf demand from the residential and visitor population in the Primary Urban Center (PUC) and any growth in golf demand from the PUC will have to be met outside of the PUC. Given their convenient location and excellent transportation infrastructure, the Ewa and Central Oahu areas are likely to attract the bulk of the increased golf demand from the PUC. The consultant estimates that the Ewa Central Oahu and Waianae DP areas could attract 75% to 80% of the islandwide growth in golf demand thru the year 2000.

Demand for golf at Makaiwa should be assured due to three factors: Location within the high golf growth Ewa area; the target market for the homes within the Makaiwa Residential Community is likely to attract buyers whose demographic profile matches that of high frequency golfers; and the location of the development adjacent to the Ko Olina Resort Residential Community.

The consultant estimates that the Makaiwa Residential Community is likely to supply 21,000 rounds annually at buildout. This is based on the community's likely demographic makeup which increases its likelihood of attracting high frequency golfers. In addition, other resident play is estimated at approximately 16,600 rounds annually composed primarily of play from the local network of public-links golf clubs. Resort demand has been estimated at approximately 33,400 rounds based on overflow demand from the Ko Olina Resort Residential Community.

A golf courses at Makaiwa will have advantages over other golf courses on Oahu and in the Ewa area. These advantages include: proximity to resort development at Ko Olina; proximity to the "executive home" development at Makaiwa Hills; a high degree of visibility from the H-1 freeway and topography that allows for ocean views.

The golf course alternate being considered for Makaiwa Hills is strongly supported from the standpoint of the existing and future demand for golf courses on Oahu. Development of a golf course at Makaiwa will enhance the residential product being proposed by providing additional recreational opportunities as well as aesthetic benefits to the surrounding residential development. Thus from a market standpoint, the golf course alternative should be adopted.

Market Assessment For MAKAIWA HILLS

I. INTRODUCTION

Makaiwa Hills consists of a 1,915 acre parcel located on the north side of Farrington Highway in Ewa; directly adjacent to the Ko Olina Resort. Proposed land uses include residential, commercial and preservation, among others, on this hilly site. One of the Development's strongest features is the way in which it is planned to take environmentally sound advantage of the existing natural resources and features, thus creating an atmosphere of comfort for its residents. Another positive attribute of the Project is its dedication to the health and recreational needs of its residents. Current planned recreational amenities include a tennis and swim club. However, in an effort to provide an even greater assortment of recreational amenities and to explore alternate land uses, John Zapotocky, Consultant, was commissioned to prepare a market assessment for a golf course. The purpose of this report is to identify and assess the potential need for a golf course from a marketing point of view, i.e., what is the anticipated demand for the course?

The proposed course development would be an 18 hole, daily fee, championship golf course, including a golf clubhouse, parking lot, and maintenance facilities. The course would be an alternate use for 180 acres now requested for preservation. The course would complement the residential housing development of about 2,100 units (*Exhibit 1*). If built, the golf course would be ready for play sometime in 1995.

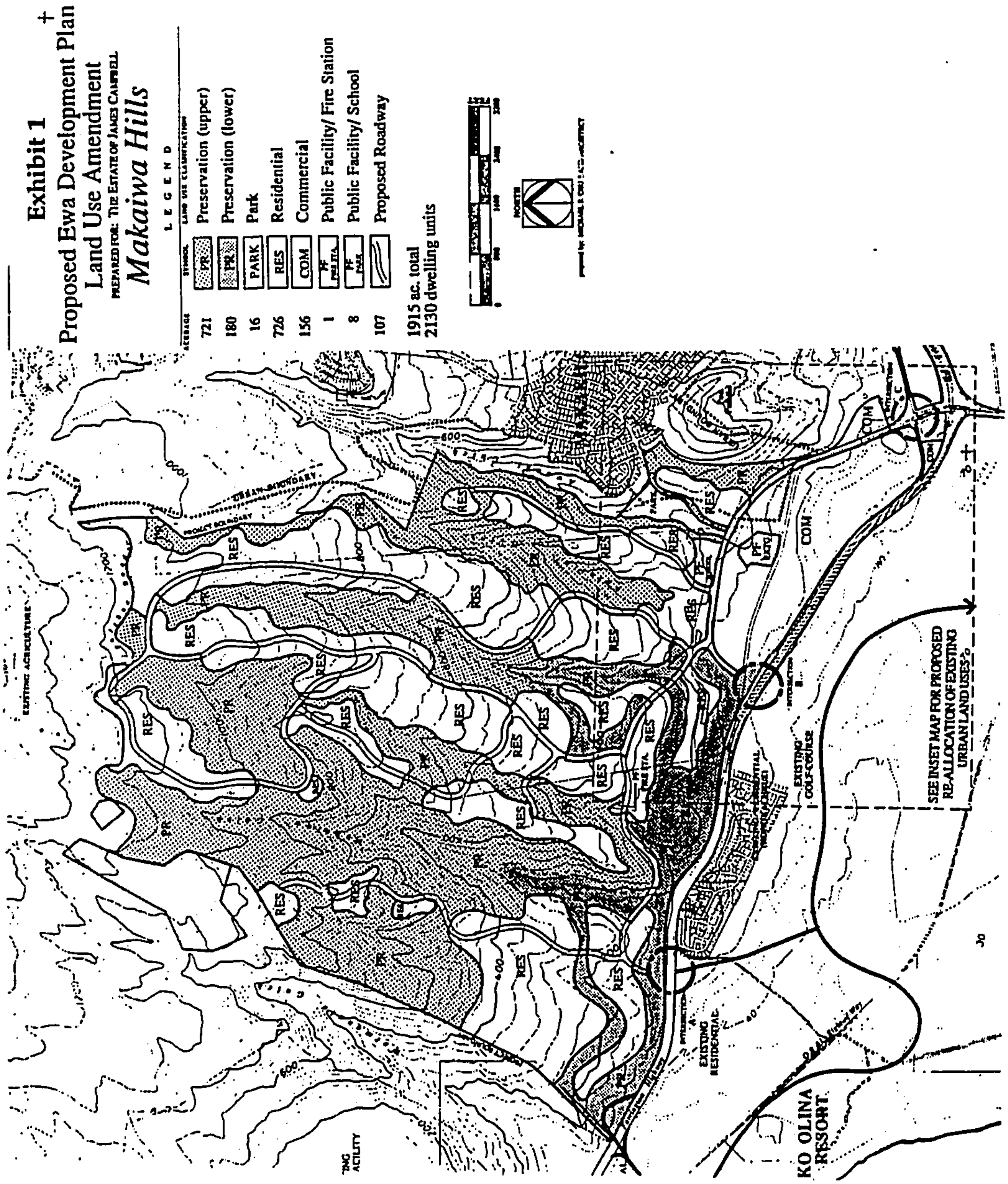


Exhibit 1
Proposed Ewa Development Plan
Land Use Amendment
PREPARED FOR: THE ESTATE OF JAMES CAMPBELL
Makaiwa Hills
LEGEND
721 PR Preservation (upper)
180 PR Preservation (lower)
16 PARK Park
726 RES Residential
156 COM Commercial
1 PF Public Facility/ Fire Station
8 PF Public Facility/ School
107 Proposed Roadway
1915 ac. total
2130 dwelling units
NORTH
EXISTING AGRICULTURE
EXISTING GOLF COURSE
SEE INSET MAP FOR PROPOSED RE-ALLOCATION OF EXISTING URBAN LAND USES
KO OLINA RESORT

II. PROJECT DESCRIPTION

A. Golf Course

The golf development consists of a daily-fee, championship length 18 hole course on 180 acres with a clubhouse, parking lot, and maintenance area. Grading and landscaping will provide water features, tree massing, bunkers, and earth berms and mounds. The golf courses will be irrigated using non-potable water.

The golf course is intended primarily to benefit the Makaiwa development in two ways: (1) By providing an enhanced residential environment due to the asthetic attributes of a golf course; and (2) By providing enhanced recreational opportunities for Makaiwa residents.

III. GOLF - DEMAND

A. Background

According to the State Data Book as of January 1990, there were 61 golf courses in operation in the State of Hawaii (*Exhibit 2*). These courses are further broken down by type; seven municipal; nine military and forty-five privately owned. By the end of 1990, three additional courses had opened–one municipal and two privately owned–bringing the total to 64 courses. During the past ten years almost all of the golf course development has taken place as an integral part of land development projects. This situation closely follows the national experience.

Exhibit 2
GOLF COURSES, BY NUMBER OF HOLES, OWNERSHIP, AND ISLANDS: JANUARY 1990

Island	Ownership	Number of Golf Courses				Number of Holes
		Total	9-hole	18-hole	27-hole	
State Total		61	11	48	2	1,017
Hawaii		12	2	9	1	207
	Municipal	1	-	1	-	18
	Private	11	2	8	1	189
Maui		10	1	9	-	171
	Municipal	1	-	1	-	18
	Private	9	1	8	-	153
Lanai		1	1	-	-	9
	Private	1	1	-	-	9
Molokai		2	1	1	-	27
	Private	2	1	1	-	27
Oahu		29	5	24	-	477
	Military	9	3	6	-	135
	Municipal	4	1	3	-	63
	Private	16	1	15	-	279
Kauai		7	1	5	1	126
	Municipal	1	-	1	-	18
	Private	6	1	4	1	108

Source: Compiled by Hawaii State Department of Business and Economic Development from county departments of parks and recreation.

The City and County of Honolulu which, for all practical purposes, encompasses the Island of Oahu, contains 30 golf courses consisting of: five municipal, nine military and 16 privately owned. Thus Oahu, which accounts for approximately 80% of the State's population, contains less than half of the State's golf courses. (Note: West Loch Municipal course opened in September 1990, thus increasing Oahu total to 30 and municipal total to 5.)

At the present time, municipal golf courses on Oahu are operating at capacity, the private country clubs have waiting lists, the military courses are said to be at capacity, and the public daily fee courses are at capacity with continuing fee increases anticipated. Interviews with managements of the Ko Olina and West Loch Golf Courses indicate that they are at or exceeding start up projections.

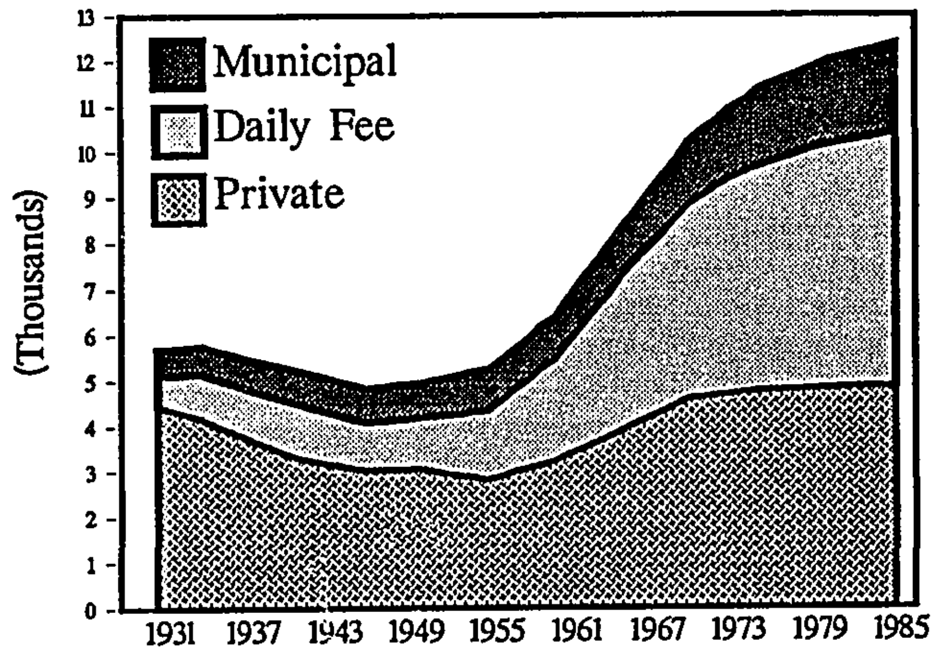
While a number of new courses have been proposed, only the Minami (Kaneohe, 18 holes, private) is likely to open in 1991.

Despite the openings of the West Loch and the Ko Olina, recent interviews with golf course staffs at established courses in the area indicate that there has been no drop in the demand at their courses. In fact, Makaha West Golf course noted an increase in play during 1990 and the need to curtail growth in the numbers of rounds played on their course to ensure a quality golf game. Thus they welcomed new courses to relieve the pressure on their course. Only the Turtle Bay Course has indicated a reduction in demand. The consultant believes this is primarily the result of the construction and renovation program under way at Turtle Bay.

B. National Golf Trends

Statistics provided in the National Golf Foundation's (NFG), publication Golf Facilities in the United States, 1985, attest to the growth of golf in the United States over the past 30 years. Between 1955 and 1985 the number of golf facilities in the country grew from 5,218 to 12,346, a 136% increase. At the same time, population grew from 164 million to 237 million, a gain of only 44%. From 1985 to 1989 an additional 274 facilities have been added. While the overall trend in course development is positive, the number of private facilities has decreased from approximately 54% to 39%. This decrease indicates a broadening of the participation in the sport to include a wider spectrum of the American population (*Exhibit 3*).

Exhibit 3
Growth in Facilities
Number of Golf Facilities Nationwide

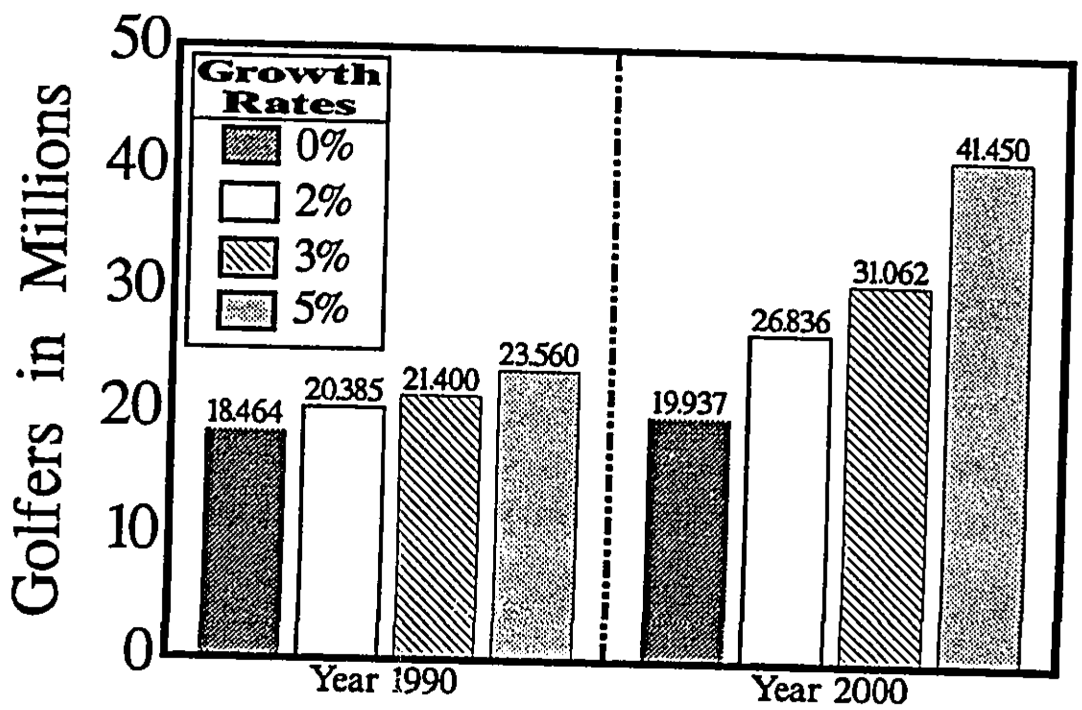


Source: National Golf Foundation *Golf Facilities in the United States*
Graphics by John Zapotocky

At a 1986 symposium sponsored by the National Golf Foundation, Dr. John F. Rooney of Oklahoma State University presented a paper on the Demand for Golf in the Year 2000. The paper presented historical data on the growth of golf in the United States and those factors which would be predictive of future growth. Dr. Rooney estimated that in 1986 there were 17.5 million golfers being accommodated by 12,500 golf facilities.

Rooney said that golf participation nationwide is expected to increase due to the following growth generators: higher incomes; an aging population; early retirement; more leisure time, flex time and residential mobility. Using alternate growth rates for golf participation ranging from 0% to 5% and including only the known demographic changes in the population, Rooney estimated that there would be a range of between 20 to 41 million golfers by the year 2000 (*Exhibit 4*). Thus in the short time, between now and the year 2000, golf demand nationally could rise between 10% and 100%+.

Exhibit 4
Potential Growth in Golf Participation



Source: National Golf Foundation *Golf Projections 2000: Golf Summit '88 Research Presentation*
Graphics by John Zapotocky

At the same symposium in a paper titled The Crisis in Public Golf Course Development, Dr. Robert Adams of the University of New Hampshire attempted to quantify the demand for new golf facilities. Dr. Adams' research indicated that golf facilities nationwide are in tight supply (thus frustrating the desire for golf among the "wider spectrum" of golfers identified previously) and that the availability of public golf facilities declined in 23 of 50 states (including Hawaii) during the time of his research (*Exhibit 5*). Dr. Adams, using the same alternate scenarios cited in Dr. Rooney's paper, but eliminating the 5% scenario, developed projected increases in golf facilities to maintain present levels of course availability. The results of his analysis showed the need for a range of between 1,400 to 7,900 new courses by the year 2000 if growth rates of 0% and 3% were assumed, respectively (See *Exhibit 6*). Annualized, these projections would result in an increased golf course inventory of 100 to 560 courses per year. Need for additional facilities is expected to be the greatest in the south and the west, where population growth has outstripped new golf facilities in recent years.

Exhibit 5
States that Declines In Availability of Public Golf Facilities: 1975 - 1985

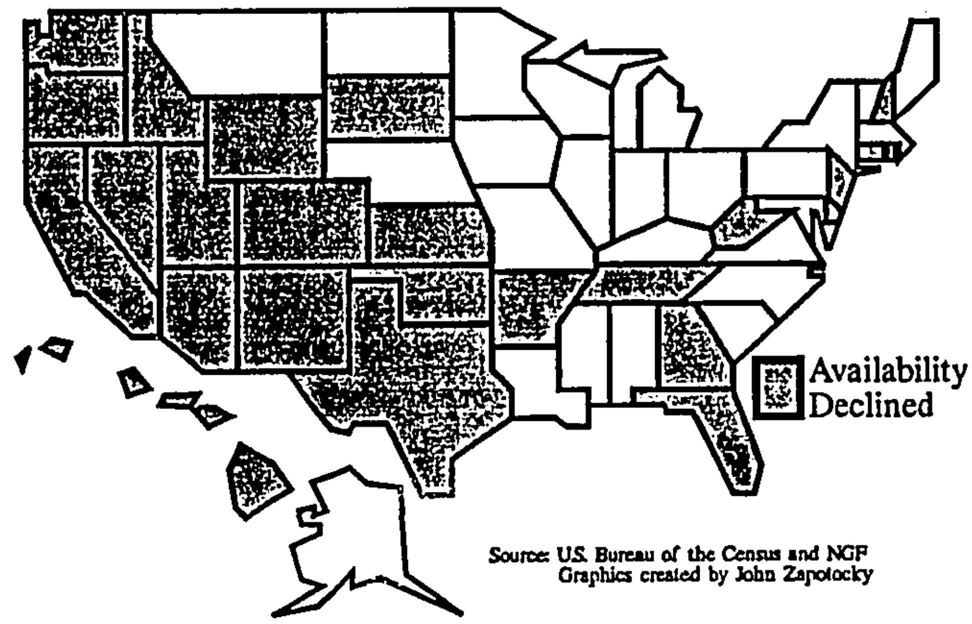


Exhibit 6
COURSE DEVELOPMENT REQUIRED TO MEET POTENTIAL GROWTH

Year:	Today	2000	2000	2000
% Growth in Golf Population		@ 0% Growth	@ 2% Growth	@ 3% Growth
Number of Golfers	17,500,000	19,900,000	26,800,000	31,100,000
Number of Courses[1] That must be added to Maintain Current Availability[2]	0	1,399	5,420	7,926
Required Average Yearly Increase in Number of Courses to 2000[3]	--	100/year	387/year	566/year

SOURCE: Market Facts, Inc. and NGF

1 - Course = 18-Hole Equivalents
2 - Current Availability = 58 Courses/100,000 Golfers
3 - Average Yearly Growth 1983-1985 = 116 Courses/Year (Not 18-Hole Equivalents)

A research summary published by the National Golf Foundation in May 1990 indicated both participation and the number of rounds increased between 1986 and 1989. Participation increased by 7% annually and rounds by 4% annually. This report was one of the first opportunities to measure the validity of the initial growth projections contained in the two aforementioned studies. It appears, however, that growth in golf is tracking the upper end of the projected ranges.

Similar projections have been made by others. The following quote from an article in the January 1987 issue of Urban Land Magazine illustrates the point.

"Golf will be a major beneficiary of the aging of the population. A disinterested baby boom generation slowed golf play growth considerably in the 1970s. However, as this generation moves into the 35- to 54-year-old age bracket group with the highest golf participation rate _ and as growth accelerates in the 65-and-over population _ the group exhibiting the highest per capita play _ golf will benefit greatly. Today there are approximately 6 million golfers in the 35- to 54-year-old age bracket. By 1990, there will be approximately 7.2 million, and by 2000, golfers in that age group will swell to over 9 million, a 50 percent increase in 15 years. In addition, golf is becoming increasingly popular with women."

Thus, the number of golfers is expected to increase significantly by 1995 (*Exhibit 7*). And, because of the aging population, golf demand (number of rounds) will rise at an even faster rate. Moreover, with a growing retirement population, golf demand during mid-week periods should accelerate, a major factor in improving the profitability of golf course operations.

Exhibit 7
GROWTH IN GOLF PLAY

Year	Number (Millions)	Percent Increase	Number of Rounds (Millions)	Percent Increase
1985	18.1	--	440	--
1990	19.1	5.5	466	5.9
1995	19.9	4.2	491	5.4

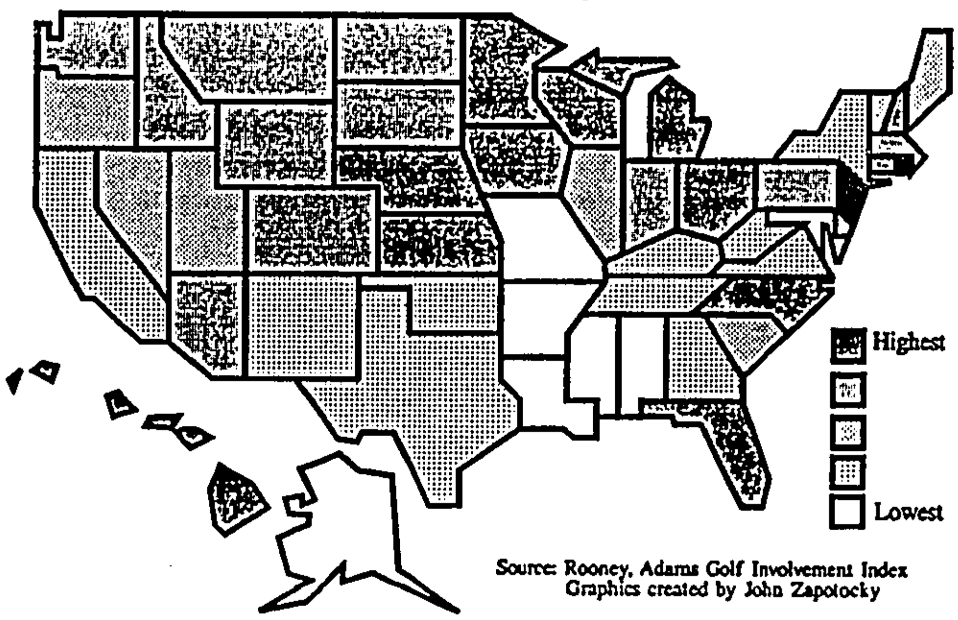
Source: Economics Research Associates

The awareness of golf has grown, in part, due to its prime time weekend television exposure supported by major sponsors who target their message at the middle income and affluent market. Awareness has also increased due to expanded coverage of preliminary rounds by cable channels such as ESPN. Further, the development of a strong seniors and womens tour has also brought golf into the public's awareness. Golf awareness has also grown due to an increase in junior golf programs and the emergence of golfers as sports heroes.

C. Golf Trends In The State Of Hawaii

Golf in the State of Hawaii has also exhibited strong growth for many of the same reasons identified as golf generators nationally. Hawaii has been identified as one of the states in the nation with a high golf intensity *(Exhibit 8)*. The most explosive growth in golf in Hawaii during the past 20 years has been in the development of the residential community and resort golf industries. This trend is expected to continue with more rounds per individual per annum also being a driving factor in golf growth.

Exhibit 8
Golf Intensity



Source: Rooney, Adams Golf Involvement Index
Graphics created by John Zapotocky

1. Resident Golf

Statewide resident golfers play the majority of the rounds played. On Oahu, residents play approximately 80% of all rounds while on Maui, residents play 35% of the rounds. Golf play on Hawaii and Kauai is estimated to be similar to that on Maui. On the other hand, Maui residents play 2.79 rounds per capita versus 1.81 per capital on Oahu or 54% more rounds on the average per capita. Demand for golf by residents is expected to grow at rates consistent with national trends. Based on the State Department of Business and Economic Development's M-K Series projections, the median age of Hawaii's population is expected to increase from 30.5 in 1985 to 35.3 in the year 2010 with the 35-54 year old population group increasing by 52% and the over 65 population group by 90%. The aging of the population follows national trends. As the population ages, people have a much higher propensity to golf. This is due to a number of factors including: the search for less demanding forms of exercise; the ability to set aside large blocks of time for recreation; and, increased disposable income.

2. Resort Golf

Demand for golf by tourists is expected to continue to increase with the growth of the visitor industry and may accelerate as the mix of Hawaii's visitors shift towards the up-scale market.

The growth in golf as a leisure time activity has translated into the growth of golf as an activity for tourists. In 1955, none of the golf courses in the State of Hawaii could be classified as being resort courses; in 1965 only the Mauna Kea (Hawaii County) and the Kaanapali Golf (Maui County) Facilities could be classified as resort courses; by 1985 there were 20 golf courses in the state classified as resort golf courses.

An examination of golf courses by island indicated that resort courses have developed on the neighbor islands to a greater degree than on Oahu when measured against average visitor census or visitor expenditures by county (*Exhibits 9* and *10*). This can probably be explained by the fact that growth of the neighbor island visitor industry has taken place more recently and, to a large degree has focused around destination resorts. Proposed additions to Oahu's visitor plant such as Ko Olina and the Kuilima Expansion include golf facilities as prominent features of the proposed resort development plans. A study[1] commissioned by the State Legislature stated that Hawaii

[1] - Coopers & Lybrand, *A Master Plan for the Continued Development of Hawaii as a Sports Center*, February 1987.

attracted approximately 200,000 golfers in 1985 and that they expended $30,000,000 at the state's resort golf courses.

Exhibit 9
AVERAGE VISITOR CENSUS, BY COUNTIES AND ISLANDS: 1986 TO 1989

[Before 1989, all eastbound and northbound visitor-days were allocated to Oahu]

County or Island	1986	1987	1988	Total	West-bound	Other[1]
State total	132,910	134,270	141,410	169,670	135,480	34,190
Oahu	73,870	74,660	80,450	88,750	61,480	27,270
Hawaii County	9,870	10,210	10,690	17,760	15,560	2,200
Kauai County	14,840	15,510	16,400	19,140	18,090	1,050
Maui County	34,330	33,890	33,870	44,020	40,350	3,670
Lanai	(NA)	(NA)	(NA)	240	210	30
Maui	(NA)	(NA)	(NA)	42,690	39,240	3,450
Molokai	(NA)	(NA)	(NA)	1,090	900	190

NA Not available.

Source: Hawaii Visitors Bureau, Westbound Visitors to Hawaii (annual), release data March 1989, and records.

The development of destination resorts in Hawaii, starting with the development of Kaanapali on Maui over 25 years ago, have followed a more or less standard formula for success. In general, resorts have been sited in coastal areas with prevailing good weather and provided a variety of self-contained recreational amenities, including ocean activities, golf course(s), tennis facilities, shopping and various other amenities. In the early years golf and other recreational facilities were considered to be necessary cost centers for the resort development. Development costs for these amenities were generally allocated to parcels for sale or lease and were recovered by sales of developable land within the resort. The basic reason for this assumption was that golf course fees and demand was relatively low in comparison to golf course

[1] - Eastbound and northbound. Distribution by island based on data for fourth quarter.

operating and capital costs. During the past five years there has been an unprecedented increase in the level of demand, and fees have been increased to allocate scarce playing times on an economic basis. Golf course operations have become self-supporting and, in most cases, profitable. This change in demand at Hawaiian resort courses is the result of maturation of the Hawaiian destination resort industry.

Exhibit 10
ESTIMATED EXPENDITURES BY VISITORS TO HAWAII, BY COUNTIES: 1970 TO 1989

[Millions of dollars. Interisland air fares have been distributed on a prorata basis. Before 1989, all expenditures by eastbound visitors were included with the City and County of Honolulu. Excludes expenditures by Hawaii residents]

Year	State Total	City and County of Honolulu	Other Counties Total	Hawaii	Kauai	Maui
1970	595	442.0	153.0	53.4	45.1	54.5
1971	705	507.0	198.0	67.7	56.1	74.2
1972	840	609.0	231.0	77.0	61.9	92.1
1973	1,020	777.0	243.0	81.9	63.2	97.9
1974	1,225	927.5	297.5	99.3	73.9	124.3
1975	1,360	1,004.1	355.9	114.6	87.2	154.1
1976	1,640	1,212.8	427.2	126.8	101.8	198.6
1977	1,845	1,376.5	468.5	131.2	109.9	227.4
1978	2,146	1,569.0	577.0	152.9	137.9	286.9
1979	2,537	1,867.2	669.8	162.0	159.1	348.7
1980	2,875	2,097.5	777.5	187.6	189.3	400.6
1981	3,200	2,394.1	805.9	179.2	197.3	429.4
1982	3,700	2,748.2	951.8	200.9	210.6	540.3
1983	3,974	2,653.1	1,320.9	277.2	250.8	792.9
1984	4,582	2,895.4	1,686.6	248.9	359.4	1,078.3
1985	4,884	3,084.5	1,799.5	285.9	407.9	1,105.7
1986	5,500	3,443.8	2,056.2	343.8	516.9	1,195.5
1987	6,600	4,370.4	2,229.6	381.8	580.1	1,267.7
1988	9,200	6,552.7	2,647.3	464.2	712.1	1,471.0
1989 [1]	10,907	6,635.6	4,271.0	1,004.8	952.3	2,313.9

Source: Hawaii Visitors Bureau, *Neighbor Island Statistics*, tabular releases dated May 1989 and 1990.

[1] - Data reflect improved allocation of eastbound visitor expenditures, previously included with Oahu, and thus are not comparable to estimates for earlier years.

As destination resorts have matured, the number of resort accommodations providing potential golf users has increased. An upscaling of accommodations generally at planned resorts has resulted in a reduction in densities tending to attract groups which traditionally exhibit higher rates of golf participation. These factors have encouraged the growth of the golf playing visitors.

Another factor encouraging the expansion of the golf playing visitor market has been the expansion, availability and marketing of resort golf facilities. The islands of Maui and Hawaii have led the state in the expansion of golf facilities. Twenty-five years ago on Maui, there was a single golf facility at the "infant" Kaanapali Resort. Today there are seven resort golf courses with a number of new facilities under construction and in the planning stages. Unlike a tennis court, each golf course is unique. Avid golfers seek opportunities for experiencing a number of championship facilities, thus encouraging them to return year-after year. This has also resulted in word of mouth advertising upon their return home. Maui has marketed its golf on a national (U.S.) basis under the heading "Maui Golf Coast".

a. Future Prospects

Future prospects for growth in demand for Hawaiian resort golf look extremely bright for the following reasons: i) Continued maturation of the Hawaii destination resort industry; ii) Favorable demographic trends in the United States (primary source of the Hawaiian visitor market).

i. Maturing Industry

While golf course play at selected resorts shown in *Exhibit 11* shows a matching of play with resources, it does not take into account that, with the exception of Kaanapali, the resort developments shown have reached less than 50% of their ultimate size in terms of total units.

Further, Wailea and Kaanapali benefit from the availability of neighboring courses such as Makena and Kapalua, respectively, where development of visitor accommodations (hotels and condos) is, at a very early stage, comprising only 20 to 30% of ultimate development. It should be noted that all of the resort facilities shown in *Exhibit 11* are planning additional golf courses.

EXHIBIT 11

RESORT AND NUMBER OF GOLF COURSES	ACTUAL ROUNDS FY 1989	DESIRED MAXIMUM ROUNDS[1]	TWO TIERED PRICING[2]	ROUNDS RESERVED FOR HOTELS[3]	%ROUNDS FROM RESORT COMPLEXES	COMMENTS
Kaanapali 2 Courses	107,000	108,000	No	No	60%	Additional course is under consideration for North Beach Expansion
Wailea 2 Courses	105,000	110,000	$105/$60	90	70%	Additional course is under construction
Mauna Lani 1 Course	45,000	44,000	$100/$60	No	66%	Additional course is under construction

SOURCE: John Zapotocky, Consultant

ii. Improving Demographics

As the population ages, people have a much higher propensity to golf. This is due to a number of factors including: the search for less demanding forms of exercise; the ability to set aside large blocks of time for recreation; and, increased disposable income.

b. Seasonality of Resort Golf

Maintaining the quality of resort play has been stressed time and again by resort management and development executives. Review of desirable annual levels of play and

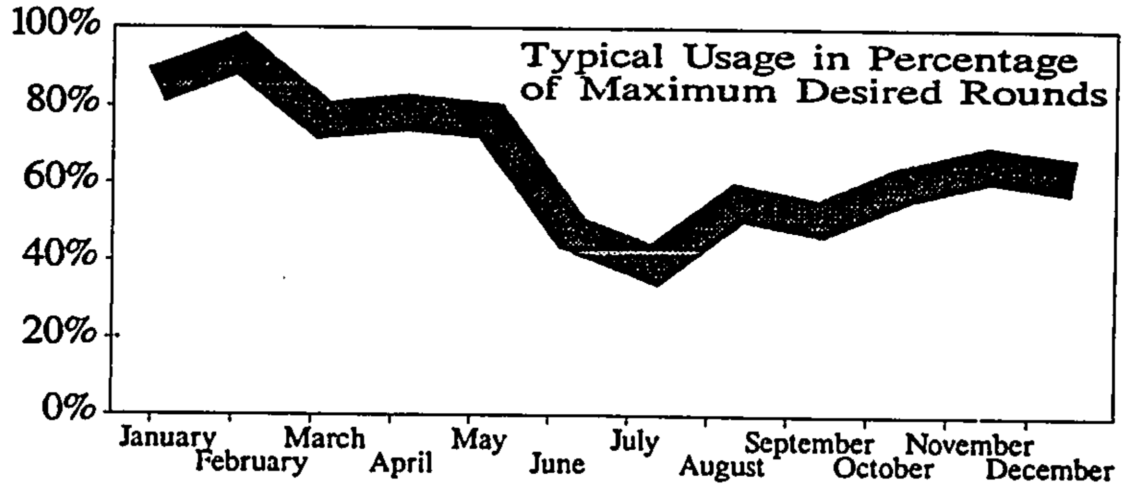
[1] - Desired Maximum Rounds refers to rounds which the operator feels are achievable under current conditions due to seasonality of play. Theoretical maximum capacity is approximately 70,000 rounds per course

[2] - Two tiered Pricing refers to a policy of pricing which discriminates in favor of complex (resort) guests. Resorts have priority reservations policies which give priority to hotels in making reservations for golf play. Operators have seasonal pricing policies. Rates shown are for high season. Kaanapali has not offered low season rates since 1987.

[3] - Wailea and Princeville have guaranteed availability for hotel guests. Kaanapali provides no guarantee but gives reservation priority. Mauna Lani owns both resort and hotel. In 1989, Shinwa (Wailea Resort Owner) acquired the Stoffer Wailea Beach Hotel.

desirable daily levels of play indicate a wide discrepancy between a desirable annual level of play versus the theoretical annual level of play at the stated desired daily level. The reason for this situation is that demand for resort golf is seasonal in nature (See *Exhibit 12*). In fact, it is not unusual at Hawaiian resort developments for January through March to account for in excess of 35% of total annual rounds played. Note: The percentage of rounds played during the high season understates the demand during that time due to the fact that many requests for starting times go unsatisfied during that period. This seasonality has been recognized by resort managers for many years. The competition for high season starting times at many resorts has led to the allocation of these starting times. Many courses have supplemented existing priority of reservation schedules with high and low season rates as well as pricing policies designed to give favorable treatment to guests of the complex. As the marketing strategies have become more sophisticated for the high season times, low season times have been getting extra attention, benefitting local players with lower rates and more starting times. Resort managers have become increasingly aware of the large number of starting times which go unused during the low season and have been attempting to attract both tourist and local play to tap this unused resource.

Exhibit 12
Typical Utilization of Mature Hawaiian Resort Golf Facilities



Source & Graphics: John Zapotocky

c. Number of Rounds Available Per Golf Course

Golf course capacity itself is the product of a number of physical and aesthetic considerations. Resort courses in Hawaii have in general limited play to between 175 and 215 rounds per day. At this level of play, golfers can enjoy the game at a leisurely pace with only a minimum of waiting and with minimum interaction with others playing on the course. Assuming an average of 200 rounds per day and 365 playing days per year, the capacity of resort courses should be at 73,000 rounds annually. Experience has shown that demand for golf from resort guests is strongest during the winter months. *(Exhibit 12)* It should be noted that available starting

Exhibit 13

GOLF DEMAND FOR RESORT HOTEL AND RESORT RESIDENTIAL DEVELOPMENT AT SELECTED DESTINATION RESORTS IN HAWAII

	ANNUAL ROUNDS Per Hotel Room	ANNUAL ROUNDS Per Resort Res. Unit
ISLAND OF HAWAII[1]		
Mauna Kea Beach Hotel	145	
Mauna Lani Bay Hotel	70	
Mauna Lani Resort Res.		36
ISLAND OF MAUI[2]		
Wailea Development Company		
Hotels	30	
Resort Residential		39
ISLAND OF KAUAI[3]		
Princeville Development Company		
Hotels	125	
Resort Res. Owners		31
Resort Res Guests		19

NOTES:

HOTELS: Information presented above shows hotel generated rounds on a daily basis ranging from .4 rounds per room at Mauna Kea to .08 round per room at Wailea.

RESORT RESIDENTIAL: Information presented above shows resort residential units generating between .11 rounds per unit at Wailea and .07 rounds per unit at Princeville.

SOURCE: John Zapotocky, Consultant

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1 - Belt, Collins & Associates, *Final EIS Revised Master Plan for Mauna Lani Resort*, June 1985 and Updated Information from Mauna Lani Planning Staff.

2 - Unpublished Information Wailea Development Co. Operating Plan Assumptions.

3 - Princeville Development Co., *Projection of Golf Rounds at Princeville Due to Phases One and Two Development*, Land Use Commission Filing 1985.

times decline during the winter months due to shorter days and the increased likelihood of rainouts. In addition, demand for golf is also skewed in favor of morning times. Therefore, resort courses are generally operated below capacity during most of the year. A yearly average of 50,000 rounds to 70,000 rounds per year is considered achievable and desirable by resort golf operators.

d. Range of Demand - Hawaiian Resorts

Exhibit 13 indicates the range of demand for selected Hawaiian Island resorts. Based on the information provided in *Exhibit 13*, average rounds of golf generated by resort hotels per day ranges between .08 per room at Wailea and .4 at Mauna Kea. Resort condominiums provide an average between .07 and .11 rounds per day.

IV. Golf Demand and Supply (Island of Oahu)

A. Oahu Golf Survey (excluding military)

The rounds of golf played on Oahu's 19 non-military courses in 1988 were surveyed in March of 1989. The survey included private membership courses, resort courses, privately owned daily fee courses and municipal courses. The purpose of including all types of courses with the exception of military courses was to determine how much golf was played by non-military residents and visitors. Military courses were excluded, because in most cases, civilians are prohibited from obtaining starting times unless guests of military personnel, their dependents or retirees. To the extent that civilian play is actually occurring, the amount is offset by the number of rounds played by military, dependents and retirees on Oahu's resort, municipal, private and daily fee courses. The results of this survey showed that during 1988 approximately 1,500,000 rounds were played on Oahu's non military courses. Of the total approximately 1,240,000 rounds or 79% were played by residents and 270,000 rounds or 21% were played by visitors. (See ***Exhibit 14***) A review of *Exhibit 14* shows that visitor play is concentrated on the private daily fee courses and minimal at municipal and membership courses.

Exhibit 14

Oahu Golf Courses: Total Rounds: 1988

Course/ Location	Type	Yearly Rounds Per Site[1]	Avg Rounds Per Week	Tourist Rounds-Yearly	%	Rounds Yearly	%
Ala Wai Golf Course	Public	188,000	3,615	7,187	4%	180,813	96%
Kahuku Golf Course [2]	Public	48,000	923	2,760	6%	45,240	94%
Pali Golf Course	Public	144,000	2,769	3,038	2%	140,962	98%
Ted Makalena G.C.	Public	165,000	3,173	307	0%	164,693	100%
Bay View Golf Center [2]	Daily Fee	12,000	231	0	0%	12,000	100%
Hawaii Kai Champ	Daily Fee	53,000	1,019	28,500	54%	24,500	46%
Hawaii Kai Exec	Daily Fee	53,000	1,019	28,500	54%	24,500	46%
Honolulu C.C.	Private	70,000	1,346	7,000	10%	63,000	90%
Mid-Pacific Country Club	Private	59,700	1,148	0	0%	59,700	100%
Mililani Golf Club	Daily Fee	94,000	1,808	42,300	45%	51,700	55%
Moanalua Golf Course (est)[2]	Semi-Private [3]	45,000	865	0	0%	45,000	100%
Oahu Country Club (1985)	Private	45,000	865	0	0%	45,000	100%
Olomana Golf Links	Daily Fee	94,000	1,808	5,640	6%	88,360	94%
Pearl Country Club	Daily Fee	80,000	1,538	8,000	10%	72,000	90%
Waialae Country Club	Private	80,000	1,538	0	0%	80,000	100%
Hawaii Country Club	Semi-Private [3]	83,000	1,596	16,600	20%	66,400	80%
Makaha Valley C.C.	Daily Fee	70,000	1,346	24,500	35%	45,500	65%
Sheraton Makaha Resort & C.C.	Resort	58,000	1,115	53,360	92%	4,640	8%
Turtle Bay Hilton & C.C.	Resort	65,000	1,250	42,250	65%	22,750	35%
OVERALL TOTAL		1,506,700	28,975	269,942		1,236,758	
OVERALL AVERAGE		86,097	1,656	15,425	21%	70,672	79%

[1] - City course data from *Proposed Golf Course Number 2* page 15 and from Cipro Golf Consultants.

[2] -Nine hole courses counted as half courses in average calculation.

[3] -Hawaii Country Club (HCC) and Moanalua Golf Course (MGC) have some characteristics of private clubs.

B. Estimate of Number of Rounds Played per Visitor and per Resident in 1988.

Estimates for the non-military resident population and visitor population for 1988 were developed using the same methodology used in the Department of General Planning report *Golf Course Development on Oahu* dated July 1989. The estimates indicated that in 1988 1.81 rounds were played by the average resident and 3.58 rounds were played by the typical visitor. (See *Exhibit 15*) Note: The average rounds figure is based on average daily visitor population and not actual visitors.

Exhibit 15
Oahu Golf Courses: Visitor / Resident Rounds

Population Group	Total Population	Total # of Rounds	Rounds Per Groups
Residents [1]	683,700	1,236,758	1.81
Visitors [2]	75,300	269,942	3.58
Total		1,506,700	

Note: Non-military resident population excludes military personnel, dependents, retirees and their dependents.

C. Estimate of Golf Course Demand thru Year 2000

The Consultant developed demand projections thru 2000 using estimated alternate rates of growth in the demand for golf of 0%, 2% and 5%. Resident and visitor population estimates developed by the State of Hawaii Department of Business and Economic Development in the *Population and Economic Projections for the State of Hawaii to 2010* (Series M-K) dated November 1988 serve as the base assumptions for the Consultant projections. The increased rounds was divided by the average play on the Oahu golf courses surveyed to determine the future demand for golf courses on Oahu. The results of these calculations showed that Oahu would require the following number of new courses by year 2000

1 -From *Golf Course Development on Oahu*, City & County of Honolulu, 1989, page 18.

2 -Extrapolated from data in Department of Business and Economic Development, *Population and Projections for the State of Hawaii to 2010*, November 1988, pages 4 and 18.

under the 0%, 2% and 5% growth scenarios: 2.5, 7.5 and 17.8. (See *Exhibits 16, 17* and *18*) Given the strong growth in demand for golf nationally and the expected growth in the percentage of Hawaii visitors from Japan a reasonable yet conservative estimate of the number of courses needed is expected to range within the 2% and 5% growth factors.

Exhibit 16

Oahu Golf Courses Estimated Demand 1990 - 2000
Assuming 0% Annual Growth Factor
Residents / Visitors Based on Forecast Visitor / Resident Populations
December 1990

Year	Estimated Population [1]		Total Estimated Demand for Rounds [2]		Total Estimated Rounds	Estimated Increase in Rounds	Growth Need [3]	Cumm. Demand
	Resident	Visitor	Resident	Visitor				
1989	693,800	78,600	1,255,028	281,772	1,536,800			
1990	703,900	82,100	1,273,298	294,319	1,567,617	30,817	0.36	0.36
1991	713,660	83,540	1,290,953	299,481	1,590,435	22,817	0.27	0.62
1992	723,420	84,980	1,308,608	304,644	1,613,252	22,817	0.27	0.89
1993	733,180	86,420	1,326,263	309,806	1,636,069	22,817	0.27	1.15
1994	742,940	87,860	1,343,918	314,968	1,658,887	22,817	0.27	1.42
1995	752,900	89,300	1,361,935	320,130	1,682,066	23,179	0.27	1.69
1996	757,180	90,800	1,369,677	325,508	1,695,185	13,120	0.15	1.84
1997	761,660	92,300	1,377,781	330,885	1,708,666	13,481	0.16	2.00
1998	766,140	93,800	1,385,885	336,262	1,722,148	13,481	0.16	2.15
1999	770,620	95,300	1,393,989	341,640	1,735,629	13,481	0.16	2.31
2000	775,100	96,800	1,402,093	347,017	1,749,110	13,481	0.16	2.47

[1] - Department of Business and Economic Development, Population and Economic Projections for the State of Hawaii to 2010, November 1988, pages 4 and 18.

[2] - Calculated by using the average rounds per individual times the estimated population of the group.

[3] - Calculated by taking the projected increase in rounds and dividing it by the average annual rounds played on courses on Oahu.

Exhibit 17

Oahu Golf Courses Estimated Demand 1990 - 2000
Assuming 2% Annual Growth Factor
Residents / Visitors Based on Forecast Visitor / Resident Populations
December 1990

Year	Estimated Population [1]		Total Estimated Demand for Rounds [2]		Total Estimated Rounds	Estimated Increase In Rounds	Growth Need [3]	Cumm. Demand
	Resident	Visitor	Resident	Visitor				
1989	693,800	78,600	1.85	3.66	1,567,536			
1990	703,900	82,100	1.88	3.73	1,630,949	63,413	0.74	0.74
1991	713,660	83,540	1.92	3.80	1,687,782	56,833	0.66	1.40
1992	723,420	84,980	1.96	3.88	1,746,236	58,454	0.68	2.08
1993	733.180	86,420	2.00	3.96	1,806,353	60,117	0.70	2.77
1994	742,940	87,860	2.04	4.04	1,868,176	61,823	0.72	3.49
1995	752,900	89,300	2.08	4.12	1,932,165	63,989	0.74	4.24
1996	757,180	90,800	2.12	4.20	1,986,180	54,015	0.63	4.86
1997	761,860	92,300	2.16	4.28	2,042,015	55,835	0.85	5.51
1998	766,140	93,800	2.21	4.37	2,099,288	57,274	0.67	6.18
1999	770,620	95,300	2.25	4.46	2,158,036	58,748	0.68	6.86
2000	775,100	96,800	2.29	4.55	2,218,295	60,258	0.70	7.56

Exhibit 18

Oahu Golf Courses Estimated Demand 1990 - 2000
Assuming 5% Annual Growth Factor
Residents / Visitors Based on Forecast Visitor / Resident Populations
December 1990

Year	Estimated Population [1]		Total Estimated Demand for Rounds [2]		Total Estimated Rounds	Estimated Increase In Rounds	Growth Need [3]	Cumm. Demand
	Resident	Visitor	Resident	Visitor				
1989	693,800	78,600	1.90	3.76	1,613,640			
1990	703,900	82,100	1.99	3.95	1,728,298	114,658	1.33	1.33
1991	713,660	83,540	2.09	4.15	1,841,127	112,829	1.31	2.64
1992	723,420	84,980	2.20	4.36	1,960,918	119,791	1.39	4.03
1993	733,180	86,420	2.31	4.58	2,088,085	127,167	1.48	5.51
1994	742,940	87,860	2.42	4.80	2,223,067	134,982	1.57	7.08
1995	752,900	89,300	2.55	5.04	2,366,835	143,769	1.67	8.75
1996	757,180	90,800	2.67	5.30	2,504,560	137,725	1.60	10.35
1997	761,660	92,300	2.81	5.56	2,650,702	146,142	1.70	12.05
1998	766,140	93,800	2.95	5.54	2,805,197	154,495	1.79	13.84
1999	770,620	95,300	3.09	6.13	2,968,515	163,317	1.90	15.74
2000	775,100	96,800	3.25	6.44	3,141,151	172,636	2.01	17.74

1 - Department of Business and Economic Development, Population and Economic Projections for the State of Hawaii to 2010, November 1988, pages 4 and 18.

2 - Calculated by the average rounds per individual times estimated population of the group.

3 - Calculated by taking the projected increase in rounds and dividing it by the average annual rounds played on courses on Oahu.

D. Existing Shortfall of Golf Courses on Oahu

A number of factors argue strongly that there is an existing shortfall of golf facilities on Oahu including the following: 1) Existing golf courses operating at maximum capacity; 2) Escalating golf fees; 3) Institution of a telephone lottery system for allocating golf rounds at municipal courses; 4) Much higher levels of play by both residents and visitors in Maui county, the State's second largest visitor market; 5) The flurry of activity among land owners and developers to develop new golf course properties; and, 6) Extrapolation of past trends.

1. Courses Operating at Capacity

Most of the golf courses on Oahu are operating at or near capacity. While there is a large variance in rounds played at various courses, it is primarily due to the type of golf course (9, 18 hole, municipal, resort, private) and the level of service and golfing enjoyment each attempts to provide.

2. Escalating Green Fees

While the recent doubling of fees at municipal courses cannot be attributed exclusively to the shortage of courses, the fact that it was accomplished with a minimal decline in play is an indication of the level of demand and its inelasticity at the lower end of the fee structure. In addition, the daily fee and resort courses have seen escalating revenues in recent years as a result of increased green fees and the institution of tiered pricing policies where visitors are charged higher prices than residents. Nor have private clubs been exempt as both the cost of membership and monthly dues have been escalating. (Note: According to NGF information, the average U.S. golf course did 40,700 rounds annually compared to the average Oahu course which did 86,000 rounds in 1988.)

3. Municipal Telephone Lottery

The city instituted a system under which calls for starting times were picked randomly by computer. This system was instituted due to the percentage of golfers complaining about the difficulty in getting starting times. An analysis of the system, Playing Favorites: An Analysis of the Dial-a-Time Telephone Reservations System for Honolulu's Municipal Golf Courses, November 1989, indicated that on the average Oahu's three 18 hole municipal course receive approximately 38,000 calls daily for approximately 1,300 available times. Since the calls are randomly selected by computer, it is estimated that many of these calls are multiple calls, however, it is considered one indication of excess demand whenever an allocation system must be implemented.

4. Comparison with Maui Play

The Consultant conducted a study of the golf play on the Island of Maui. The results of that study indicated that the average individual in the visitor population played 12.06 rounds while the resident played 2.79 rounds in 1989. (See *Exhibit 19*) Thus, the typical Maui visitor played 3.3 times and resident played 1.5 times more golf than Oahu visitors and residents, respectively. Given that the green fee structure is somewhat comparable between the two counties, the most plausible explanation for this tremendous differential in play is the supply of golf facilities. *Figure 1* estimates a shortfall of 14 courses.

Exhibit 19
Maui Golf Courses (excluding Molokai and Lanai): Visitor / Resident Rounds Based on 1989 Rounds & Visitor / Resident Estimated

Population Group	Total Population	Total # of Rounds [1]	Rounds Per Groups
Residents [2]	89,900	250,423	2.79
Visitors [3]	33,890	408,668	12.06
Total		659,091	

Average Rounds/Course

Total Rounds	Number of Courses[4]	Average Per Rounds
659,091	11.5	57,312

Source: John Zapotocky, Consultant

[1] -Data for 1989 rounds as per Cipro Golf Consultants

[2] -DBED *Population and Economic Projections State of Hawaii to 2010 (Series M-K)* November 1988 p. 4.

[3] - DBED *Population and Economic Projections State of Hawaii to 2010 (Series M-K)* November 1988 p. 18.

[4] -Eighteen hole equivalent

Figure 1

	Oahu Non-Military Population [1] 1989	Rounds / Person Maui [2] 1989	Total Demand	Oahu [3] Average Course Rounds
Resort	683,700	2.79	1,907,523	
Visitor	75,300	12.06	908,114	
Total Demand			2,815,641	
Existing Avg Play for 18-Hole Courses				86,097
Demand for Golf Courses				32.7
Existing Courses (18-Hole Equivalent)				19
Shortfall				13.7

5. Proposed New Golf Facilities

Appendix 2 shows sites where golf courses are currently proposed or mentioned as possible sites for golf Facilities. The fact that so much interest exists is testimony to the existing shortfall of these types of facilities.

6. Extrapolation of Past Trends

The Consultant projected golf course demand based on the relation between population and golf holes between 1950 and 1980. (See *Appendix 1*). Based on this projection, 601 golf holes would be required by 1990 against an existing inventory of 513 holes leaving a shortfall of 88 holes or 4.9 18 hole courses.

7. Summary

Based on the above, a range of 4.9 to 13.7 courses are needed to supply existing demand.

1 - *Exhibit 15*
2 - *Exhibit 19*
3 - *Exhibit 14*

E. Future Supply of Golf Courses on Oahu

Municipal courses on Oahu are some of the busiest in the country and the world. (See *Exhibit 20*) Public pressure has been increasing to construct new municipal courses and several alternative sites are under consideration. There is strong interest in development of private courses with over forty courses under consideration by various developers. (See *Appendix 2*) Others may be under consideration that have not been announced.

Exhibit 20
CITY & COUNTY OF HONOLULU
MUNICIPAL GOLF COURSES
FY 1986 - FY1989

	1986	1987	1988	1989
Ala Wai	197,000	198,000	188,000 [1]	170,000
Pali	144,000	140,000 [2]	144,000	147,000
Makalena	155,000	165,000	165,000	157,000
Kahuku	38,000	42,000	48,000	47,000
TOTAL	**534,000**	**545,000**	**545,000**	**521,000**

NOTES: The West Loch course came on line in September 1990 with an average of 250 rounds per day. The City's golf administrator believes that a total of eight municipal golf courses would be needed to accommodate the current level of demand at municipal golf courses.

SOURCE: Dave Mills, Golf Administrator, City & County of Honolulu

While the potential supply of 40 new courses looks overwhelming in light of the number of existing courses it must be viewed in terms of the likelihood of development and the long term demand for golf on Oahu.

Supply of Golf Courses

A number of factors suggest that not all golf courses proposed will be built including the following:

1 - Ala Wai Course undergoing major renovation in FY 1988 and FY 1989.
2 - Increased rainouts experienced in 1987.

1. <u>Approval Requirements</u>

In 1989 the administration of the City and County of Honolulu expressed concerns relating to the appropriateness of golf courses as an agricultural land use. They recommended to, and were successful in having the City Council pass an ordinance placing a moratorium on golf course approvals until the question could be studied! In February 1990 the City Council approved new requirements for golf courses proposed within the City and County of Honolulu. In November of 1990, a further moratorium was proposed in order to provide the City Council with an opportunity to study the impact of golf course development and to consider the imposition of impact fees.

2. <u>Lifestyle Issues</u>

The recent increase in golf course proposals, particularly in rural areas has raised the public consciousness about golf courses. Community groups have been formed to protest the development of golf courses where lifestyle changes are foreseen. This has been an issue particularly on the Waianae coast where a number of golf course proposals have been made for lands currently in agricultural production as in the case of the Ohikilolo Valley (Cattle Ranch) and the Nakade property in Maile (Lettuce Farm).

3. <u>Environmental Concerns</u>

Increased public concerns relating to the fragility of the environment and recent publicity relating to concerns over Oahu's aquifers have led to concerns about land uses which might potentially impact the Island's aquifers in terms of usage and/or pollution. In addition, recent publicity relating to endangered species and pollution from runoff has led the public and government agencies to express concern for land uses such as golf courses which utilize fertilizers, herbicides and pesticides which might have far ranging impacts. The residents of Koolaupoko have raised issues relating to water usage and the impact on Kaneohe Bay.

4. <u>Infrastructure Requirements</u>

While golf courses are a relatively low intensity land use, they do require a minimum amount of infrastructure development.

Particularly in rural areas, even the low intensity use may create traffic problems or negatively impact sewer and potable water systems already at capacity.

5. Resource Allocation

While the area of land use was addressed earlier, the question of water usage and how it impacts other development is an issue relating to golf course development. State and County water allocation authorities already prohibit the use of potable water for golf course irrigation. There is however a question of allocating scarce non potable water resources for golf course usage.

6. Economic Viability

While the existing shortfall of golf courses is obvious and the economic viability of new courses reasonably assured, each new course which is developed helps to meet the existing and future demand. In addition, the increase in land values generated by demand for golf course, increased costs to mitigate pollution concerns, as well as other approval concerns tend to lower the economic viability on proposed projects.

Based on the above, the Consultant believe that less than half of the courses currently proposed or under consideration as golf course sites will actually be developed prior to 2000.

F. Estimated Potential Shortfall: 1990 - 2000

Based on the preceding, *Exhibit 21* has been developed to show the potential shortfall by the year 2000.

Exhibit 21
Summary Demand and Supply Golf Courses on Oahu
1990 - 2000

	Low	Mid	High
Existing Shortfall	5	9.5	14
Additional Demand Year 2000	3	10.5	18
Total Demand	8	20	32
Supply	5	12.5	20
Estimated Shortfall	**3**	**7.5**	**12**

V. Supply and Demand of Golf Courses in the Ewa, Central Oahu and Waianae Development Plan Areas

The primary market area for a golf course at Makaiwa is the Ewa, Central Oahu and Waianae Development Plan (DP) areas assuming that driving time is the primary factor determining market area. At present these three DP areas contain approximately 24% of the population and 33% of the golf courses in the City and County of Honolulu.

There are ten golf courses in the area. Three of the courses are military and have been excluded from the analysis as they serve military personal and their dependents. Of the seven remaining courses, five are established courses operating at capacity which serve a mix of residential and visitor golfers. With the exception of the Makaha West Golf Course which is an adjunct of the Sheraton Makaha Hotel the orientation of the remaining courses, Makaha East, Hawaii Country Club, Mililani and Ted Makalena is resident golfer with none of these courses having greater than 40% visitor play. Two golf courses have opened within the past year, the Ko Olina Golf Course, a resort golf course, which opened in December of 1989 completed its first year of operation. According to management, traffic at the course has met first year expectations with utilization averaging in excess of 50% of course capacity. Traffic is a mix of visitor and resident play. The West Loch Municipal Course opened for play in September of 1990 and course utilization is at maximum capacity. (Note: For the first year the West Loch Course has been limited to 250 rounds per day)

The General Plan of the City and County of Honolulu calls for over 70% of residential growth between 1989 and 2010 to take place in the Ewa, Central Oahu and Waianae DP areas. In addition, approximately 80% of the growth in visitor units projected for the City and County is expected to take place within the Ko Olina, Ewa Marina and Makaha Resort areas located in the Ewa and Waianae DP areas. Furthermore these development plan areas are expected to the primary beneficiaries of the growth in golf demand within the Primary Urban Center (PUC) which is projected to accommodate an additional 15% of the projected residential growth. Land within the PUC is at a premium, too valuable for use as golf course land. This is confirmed by the fact that of the forty proposed golf courses not a single course was proposed within the PUC.

If the PUC resident population and visitor plant is added to the resident population and the visitor plant of the Ewa, Central Oahu and Waianae

DP areas, it would comprise 77% of the resident population and 95%+ of the visitor plant currently. By the year 2010 resident population in the expanded market area would expand to 79% and visitor plant totaling approximately 90%. However, the geographic population and visitor plant centers would have shifted closer to the Ewa, Central Oahu and Waianae DP areas because of the rapid growth forecast for these areas.

Given the above it is likely that golf courses in the Ewa, Central Oahu and Waianae areas would be capable of attracting 75% to 80% of the future increase in golf course demand for Oahu.

VI. Demand and Supply of Golf at Makaiwa

Demand for golf at Makaiwa is expected to be very strong. There are three primary reasons for this conclusion. First, as indicated previously in the market assessment the Ewa area is expected to be the beneficiary of most of the Islandwide golf demand because of the strong residential population growth planned for the Ewa and Central Oahu areas. Second, the Makaiwa residential community is targeted at the "Executive Home" market. In particular attracting decision makers in the community. This type of individual is likely to possess many of the same qualities which identify likely golf participants, i.e., relatively affluent, well educated, older than the general population and with more flexible schedules. Third, the Makaiwa Golf Course is located directly across the street from the Ko Olina Resort Residential Community. Many of Ko Olina's residents and guests will be able to see the Makaiwa Course from their windows. Given the location of the Ko Olina Freeway Overpass it is highly likely that most of the Ko Olina Visitors and Residents will visually encounter the Makaiwa Golf Course whenever they enter or leave the Ko Olina Community.

The Ko Olina Golf Market Assessment estimates golf demand at approximately four courses based strictly on project generated golf demand. The Ko Olina development proposes to develop only two golf courses. Given the Makaiwa Course's proximity to Ko Olina and its visual connection to Ko Olina, it is highly likely that the Makaiwa course would be an immediate beneficiary of any Ko Olina overflow demand.

A. Makaiwa Golf Course Residential Demand

According to *Golf Participation in the United States 1988 Edition* by the National Golf Foundation, In 1987, the United States had an estimated population of 243,934,000. Of this population a total of 21,700,000 golfers played an estimated 434,000,000 million rounds of golf (approximately 1.8 rounds per resident). A study of the demographic characteristics of golfers indicates that income, age, education and occupation are strong predictors of whether a person will be a golfer or not. However, in determining whether a person will be a frequent golfer (26 or more rounds per year (Note: the average frequent golfer played 65 rounds per year)) or not the most important criteria is age.

This is not surprising given the life cycle of the typical working and personal live of a United States resident. Persons in their twenties and thirties are often preoccupied with their careers or raising a family or both. Persons forty years and older tend to have established themselves having reached mid level or senior positions in their careers. In their personal lives persons in their forties tend to have children in their teens which allows them more independence. Both the career and personal lives of persons forty years and older tend to allow them more freedom to engage in activities which require greater commitments of time, i.e., travel, golf, club activities, volunteer work and hobbies. This age differentiation is important because frequent golfers who make up approximately 22% of all golfers play 73% of the golf rounds. Statistics demonstrate that persons over 40 years of age are 1.75 times more likely to be frequent golfers than the average golfer.

1. Demand Attributable to Makaiwa Residential Community

In the case of the Makaiwa Residential Community, the target market for the residential product is the "decision makers", by definition, the upper income, highly educated, management or professional household. Primary emphasis is also on the buyer trading up. Thus by definition the target market is an older market. In the consultant's opinion, the target market for the residential product at Makaiwa will be almost exclusively in the forty and older head of household age group.

Approximately 36% of the Hawaii population in 1990 will be 40 years or older. If one assumes a household size at Makaiwa of 3.5 and the buyer and spouse are 40 years or older, then 57% of the persons in Makaiwa will be 40 years or older. This translates into a Makaiwa population with 1.6 times more forty or older persons than the general population.

If it is further assumed that the availability of a golf facility within the Makaiwa planned community will attract twice as many frequent golfers as would normally be found. Further if it is assumed that the ratio of medium and low frequency play will be equal to the ratio found in the general population, then the total number of rounds demanded by Makaiwa residents can be estimated as follows:

Exhibit 22
Residential Demand Makaiwa Golf Course From Makaiwa Residential Community

Estimated Frequent Golfers [1]	2%
Estimated Frequent Golfers Makaiwa Adjustment Based on Age [2] (.57 - .36 = .22 * 1.75)	1.157
Adjustment Based on Availability [3]	2.0
Estimated Frequent Golfers Makaiwa (.02 * 1.157 * 2)	4.6%
Estimated Makaiwa Population (2,100 units X 3.5)	7,350
Estimated Frequent Golfers (7,350 x 4.6%)	338
Estimated Rounds Per Frequent Golfer [4]	65 Rounds
Estimated Demand Makaiwa Frequent Golfers (4.6% * 7,350 * 65 rounds)	21,970
Total Demand Makaiwa Residents (21,970/.73) (Incorporates demand from moderate and low fequency golfers).	30,095
Makaiwa Course Capture Rate 70% [5]	21,067
Average Daily Makaiwa Resident Play	58 Rounds

2. Other Residential Demand

Oahu daily fee golf courses typically allocate a portion of their play to the Oahu Public Links Clubs. Generally the clubs are allowed to make starting times up to one year in advance. Club preferences, because they generally are composed of working golfers, are for weekend and holiday times. If it is assumed that Makaiwa Golf Course Management would allow reservations by Public Links Clubs for 100 rounds per weekend day. This would result in approximately 10,400 additional resident rounds. If 10% of the available rounds for the non weekend days are assumed to be utilized by residents other that Makaiwa residents, an additional 5,200 rounds per year would be played by residents.

1 - National Golf Foundation (NGF)
2 - Estimated Age Distribution, Hawaii 1990: DBED. Estimated Age Makaiwa: Consultant
3 - Estimated by Consultant
4 - NGF
5 - Estimated by Consultant

3. Summary of Resident Play

Exhibit 23 contains a summary of the anticipated resident play at the Makaiwa Golf Course.

Exhibit 23
Estimated Resident Play
Makaiwa Golf Course
Year 2000

Demand from Makaiwa Residents	21,000
Demand from Golf Clubs	10,400
Demand from Other Residents	5,200
Total Resident Demand	36,600

B. Estimated Visitor Demand

Visitor demand for the Makaiwa Course is expected to come primarily from the Ko Olina Resort Residential Community located directly across the H-1 freeway from the Makaiwa Golf Course. A study entitled *Market Assessment for Ko Olina Phase II* prepared by Chaney, Brooks & Co., April 1990 estimated the demand for golf at Ko Olina as follows:

Exhibit 24
Ko Olina Demand for Golf
Rounds Demanded & Courses Required
Year 2000

Type of Demand	Units	Rounds / Units	Rounds / Day
Hotel	4,000	1/10	400
Resort Residential	5,200	1/15	347
Residential	3,500	1/75	47
Total Demand			794

	Rounds / Course	Courses Required
Number of Course Required	200	4
Ko Olina Courses Provided		2
Shortfall of Courses		**2**

Thus there is a demand for two additional golf courses from the Ko Olina Resort Residential Community. Assuming that the Makaiwa Course has a capacity of 200 rounds per day then the total rounds available will be approximately 70,000 rounds. Thus after deduction 36,600 rounds for residential demand a total of 33,400 rounds will be available to service the overflow demand from Ko Olina. The 33,400 rounds is approximately 25% of the overflow projected for the Ko Olina resort.

C. Summary of Makaiwa Golf Course Demand

The demand for the Makaiwa Golf Course is estimated to be generated about evenly between residents (52%) and visitors (48%).

D. Absorption of Makaiwa Golf Course

The total demand described above indicates the ultimate demand for golf at the Makaiwa Golf Course. Demand for golf using the above scenario will have to take into account the projected development time table for at the Makaiwa Residential Community, the Ko Olina Resort Residential Community as well as the general growth of the City and County of Honolulu.

The Makaiwa Residential Community would require approximately ten years to develop from date of commencement. The resort portion of the Ko Olina development is expected to be completed by the year 2000 with the entire development completed by 2005. Actual demand from Ko Olina may be understated. The existing Ko Olina Golf Course has been open for one year. With no development either hotel or residential at Ko Olina, the course has generated play utilizing approximately 50% of its ultimate capacity. Thus golf demand from outside of Ko Olina is now utilizing the course. Ko Olina Golf Course Management predicts strong gains in play during 1991. The demand serviced by the Ko Olina Course during the next two years will have to find an alternate supply once the Ko Olina hotel and residential units come on line in 1992.

The consultant has estimated the absorption of rounds at the proposed Makaiwa Hills course in *Exhibit 25*. The exhibit indicated a greater percentage of visitor play in years 1997 through 2005 due to the faster growth anticipated at Ko Olina. However, as residential construction takes place at Makaiwa, demand from the residential sector would be expected to increase to its ultimate utilization.

Exhibit 25
Absorption for Makaiwa Golf Course
1996 thru 2000

Year	Rounds	Resident	Visitor	Utilization
1996	35,000	50%	50%	50%
1997	42,000	45%	55%	60%
1998	54,000	45%	65%	77%
1999	63,000	45%	55%	90%
2000	70,000	45%	55%	100%
2001	70,000	46%	54%	100%
2002	70,000	47%	53%	100%
2003	70,000	48%	52%	100%
2004	70,000	49%	51%	100%
2005	70,000	50%	50%	100%
2006	70,000	51%	49%	100%
2007	70,000	52%	48%	100%

VII. Advantages of Golf Course Development at Makaiwa

The golf course proposed for development at Makaiwa has a number of advantages over other golf courses being proposed on Oahu and over other golf courses proposed in the Ewa area.

1. Proximity to Resort Development

With the exception of the two golf courses planned for the Ko Olina Resort, no other golf course in the Ewa area is as proximate to resort development as the proposed Makaiwa Course.

2. Proximity to Executive Home Development

While most planned communities locate their upscale product on golf frontage property where possible, the Makaiwa Hills development is the only project in which all of the product is targeted at the "executive home" market.

3. Visibility and Access

The Makaiwa Golf Course due to its location alongside the H-1 freeway is highly visible and accessible to resident and visitor golfers. The Kalaeloa Blvd. interchange will provide excellent freeway access.

4. Topography

The site selected for the golf course is relatively level, however, does contain elevations at selected locations which will allow for ocean views.

VIII. Conclusion

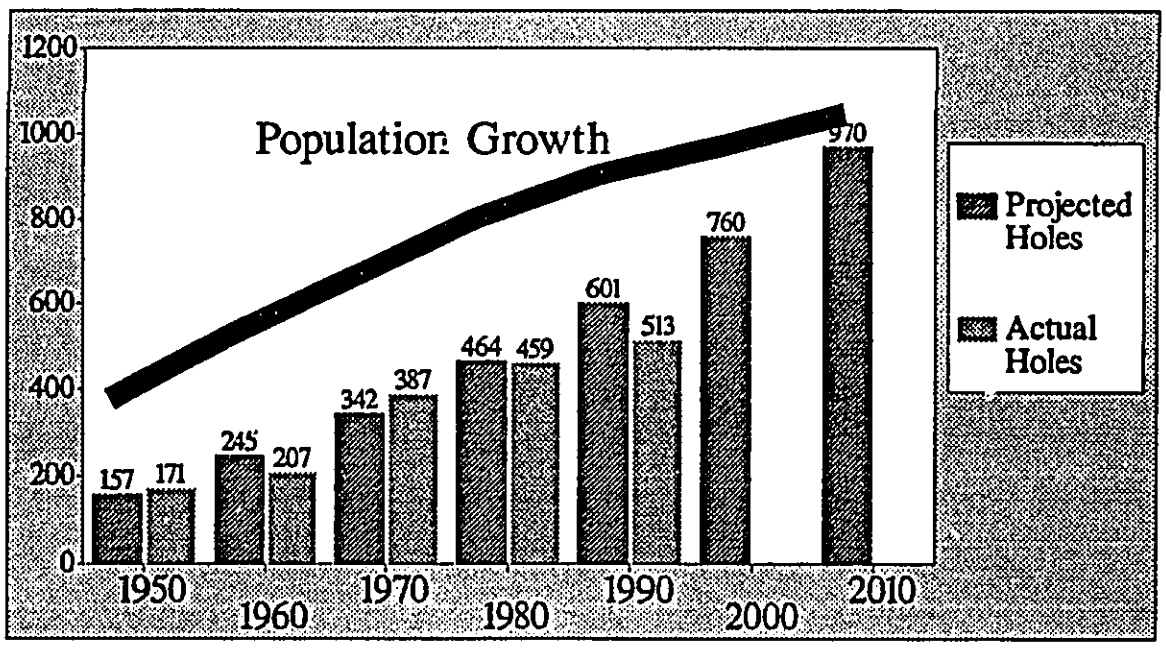
Incorporation of a golf course into the proposed Makaiwa Hills Planned Community is justified from a marketing standpoint.

The golf course, should it be incorporated into the Makaiwa Hills development plan, will enhance the marketability of the community by providing additional recreational opportunities as well as enhanced aesthetics of residential lands surrounding the golf course.

At the same time, the proposed course would enhance the recreational opportunities available to the Ko Olina Resort Recreational Community and to the City and County of Honolulu's golfing public.

Appendix 1
Number of Persons Per Hole
Using a Linear Regression Analysis And Projections

	Persons Per Hole		Golf Holes		
Year	Actual	Projected	Projected	Actual	Population
1950	2,064	2,243	157	171	353,020
1960	2,417	2,043	245	207	500,409
1970	1,629	1,843	342	387	631,600
1980	1,661	1,644	464	459	764,800
1990		1,444	601	513	861,600
2000		1,244	760		932,800
2010		1,044	970		999,500



Appendix 2
Planned or Proposed Golf Courses: City & County of Honolulu

STATUS, GOLF COURSE (DEVELOPER)	HOLES	DISTRICT	DP AREA
Under Construction or Close to Construction			
Minami (Minami Corp.)	18	Windward	Koolaupoko
Myers/Seibu Golf Course (Myers Corp.)	27	Ewa	Ewa
Royal Hawaiian Country Club #1 (Y Y Valley Corp.)	18	Windward	Koolau Poko
Puuloa (H. Horita Realty, Puuloa Homes Inc.)	18	Ewa	Ewa
Turtle Bay Expansion (Kulima Development Co.)	18	Kahuku	Koolauloa
Waikele (Amfac Properties)	18	Waipahu	Central Oahu
Kapolei (State of Hawaii Housing Authority)	18	Ewa	Ewa
Makakilo (Finance Realty)	18	Ewa	Ewa
Needs Substantial Discretionary Approval, Under Review			
Royal Kunia #1 (Halekua Development Co.)	18	Ewa	Central Oahu
Royal Hawaiian Country Club #2 (Y Y Valley Corp.)	18	Windward	Koolaupoko
Ewa Gentry (Gentry Pacific Corp)	18	Ewa	Ewa
Ko'Olina #2 (West Beach Estates)	18	Ewa	Ewa
Royal Kunia #2 (Halekua Development Co.)	18	Ewa	Central Oahu
Waikane (Waikane Development Co.)	27	Windward	Koolaupoko
Kailua Drive-In (Windward Development Co)	18	Windward	Koolaupoko
Lihi Lani Recreational Community (Ohbayashi Hawaii Corp)	36	North Shore	North Shore
Punamano (Campbell Estate)	54	Kahuku	Koolauloa
Malaekahana (Campbell Estate)	18	Kahuku	Koolauloa
Ewa Marina (HASEKO Hawaii)	27	Ewa	Ewa
Waihee Valley (City & County of Honolulu)	18	Windward	Koolaupoko
Waiawa (Gentry Companies)	36	Ewa	Central Oahu
Mokuleia (Mokuleia Land Company)	36	Waakua	North Shore
No Official Pending			
Ohikilolo (Alpha Kai)	18	Waianae	Waianae
Lualuale (Sanjiro Nakode)	18	Waianae	Waianae
Haleiwa (SDZ Land Co.)	9	Waialua	North Shore
Kahuku (City & County of Honolulu)	18	Kahuku	Koolauloa
Waikane (Undetermined)	18	Windward	Koolaupoko
Heeia (Undetermined)	18	Windward	Koolaupoko
Heeia Kea (Nanatome Hawaii, Inc.)	18	Windward	Koolaupoko
Bay View Expansion (Pacific Atlas Hawaii)	18	Windward	Koolaupoko
Malaekahana (Asahi Jyuken)	18	Kahuku	Koolauloa
Application Denied or Withdrawn			
Maili Kai (Kaiser Cement Co)	18	Waianae	Waianae
Waianae Kai (H. Horita Investment Inc)	27	Waianae	Waianae
Kipapa Ridge Estates (C&C Honolulu)	18	Ewa	Central Oahu
Waialua (Oceanic Properties, Inc)	18	Waialua	North Shore

SOURCE: Decision Analysts Hawaii, Inc. Dec. 1989

Updated by John Zapotocky, Consultant, Dec. 1990

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JOHN ZAPOTOCKY, CONSULTANT, Honolulu, Hawaii **1984 - Present**

Consultant. Independent consultant specializing in real estate related assignments. Services provided include financial analysis, market assessments, real estate related environmental assessments and environmental impact statements and specific research assignments. Representative clients and assignments include:

MARKET ASSESSMENTS

The Gentry Companies........ Waiawa Planned Community
Halekua Development Company........ Royal Kunia Phase II Planned Community
Estate of James Campbell........ Country Courses at Kahuku
Estate of James Campbell........ Kapolei Business/Industrial Park
Halekua Development Company........ Village Park Shopping Center
Hawaii States Properties, Inc........ Ultra Luxury Condominium
Takahashi Building Corporation........ Honolulu Office Assessment
Baron Enterprises, Inc........ Ko Olina Site 43
Yoto U.S.A. Company, Ltd........ Ko Olina Site 47
Chiemori Kogyo, Co., Ltd........ Ko Olina Site 43
Waitec Development Company........ Village Park Expansion
West Beach Estates........ Ko Olina Phase II
ANA Hotels Hawaii, Inc........ Makaha Expansion Report
Estate of James Campbell........ Kahuku Master Plan
Hawaii States Properties, Inc........ Makena Surf Expansion
City Dept. of Housing & Community Development........ Waiola Planned Community

ECONOMIC MODELING & FEASIBILITY ANALYSIS

VMS Realty Partners........ Resort/ Residential Community
K. G. Hawaii. Inc........ Ko Olina Phase II Residential Resort Community
Haseko (Hawaii), Inc........ Keaeamoku Superblock Commercial Redevelopment
West Beach Estates........ Ko Olina Feasibility Study

ENVIRONMENTAL ASSESSMENTS AND IMPACT STATEMENTS

Waitec Development Company........ Village Park Expansion
Mokuleia Land Company........ Mokuleia Resort EIS Environmental Impact Assessment
Duty Free Limited Partnership........ Waikiki Duty Free Store Expansion

OTHER CONSULTING ASSIGNMENTS

Interpacific Group .... Waikiki Retail Valuation Assignment
Hawaiian Riviera Resort .... Support Housing/Hawaiian Riviera, Phase I
West Beach Estates .... Affordable Housing Analysis
West Beach Estates .... Consulting Report West Beach Community Associations
Castle & Cooke, Inc. .... Waialua Consulting Report for Castle & Cooke, Inc.

EMPLOYMENT HISTORY

MOKULEIA HOMESTEADS, Honolulu, Hawaii **1979 - 1984**

General Manager. Managed development activities for the 3,000 acre proposed agricultural/residential community on the site of the former Dillingham Ranch in Mokuleia.

WAILEA DEVELOPMENT COMPANY, Kihei, Maui **1975 - 1979**

Project Coordinator. Coordinated development of the Wailea Ekolu project, a 150-unit luxury condominium within the 1,200 acre Wailea Resort Community.

Director of Planning and Budget Analysis. Prepared annual and long-range plans. Performed variance analysis on financial reports.

KAISER AETNA (KACOR), Honolulu, Hawaii **1973 - 1975**

Manager, Administration & Contract Control. Responsibilities included: escrow, contract administration, architectural control and office management.

Manager, Hawaii Kai Golf Courses. Directly responsible for all golf operations.

EDUCATION

College of Arts & Sciences	1969: B.A. in Economics
University of Hawaii	
College of Business Administration	1973: M.B.A.
University of Hawaii	1974: Postgraduate work in Finance

PROFESSIONAL AND VOLUNTEER ORGANIZATIONS

Wahiawa Lions Club, President 1990
Hawaii Society of Corporate Planners, President 1983
UH MBA Alumni Group
Iliahi School PTA, Treasurer 1989

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PA-3 8½″x11″ PAPER PRINTED GENERAL TARGET

DENSITY TARGET