APPENDIX A

Noise Study:
Darby & Associates, Acoustical Consultants

DARBY & ASSOCIATES
ACOUSTICAL CONSULTANTS

Job #87-21
September 10, 1987

Hawaiian Housing Authority
1002 North School Street
Honolulu, Hawaii 96817

Attention: Mr. Lloyd Haraguchi

Subject: Response to DOT's Comments on Report "Aircraft Noise Impact Evaluation on Proposed Resort Development in Honouliuli, Ewa, Oahu, Hawaii" dated December 30, 1986 - Now Kapolei Village.

Dear Mr. Haraguchi:

On August 12, 1987, I received a copy of a letter to R. Fukumoto (attentioned to you) from O. Miyamoto dated August 6, 1987. The letter comments on the subject report dated December 30, 1986. Between August 17 and 20th, I had phone conversations with Mr. Dean Nakagawa, Airports Division, DOT, and now have the following understanding:

1. DOT played a "devil's advocate's" role in evaluating the subject report and did not realize that it represented a very short study completed within a two-and-one-half week period based upon the two AICUZ documents and any additional supporting data provided by Campbell Estate within that time period. It is to be noted that the report is dated December 30, 1986 and the opening sentence references a proposal dated December 12, 1986. Also, it was explained that our agreement was that I would provide "no opinions on the various legal issues involved" and that no aircraft noise measurements would be made and that no new noise contours would be developed (reference 1).

2. DOT would like to see a thorough evaluation of the combined HIA and BPNAS noise impact, but DOT does not intend to perform such a study because of the current litigation between Campbell Estate and the Navy.

3. That we can use preliminary data being developed in the FAA Part 150 Noise Compatibility Study for HIA to evaluate the Kapolei situation in greater detail.

With this understanding, I respond to the comments as follows:

A. Comment 3; page 2:

"3. In studies of this type, where significant policy or land use decisions could be formulated from the conclusions of the study, a greater reliance should be placed on measured sound exposure data rather than published, generic, or assumed data (or aircraft power settings). This is particularly true if conclusions are to be made within 2.3 Ldn tolerance of the 60 Ldn planning threshold. The use of measured sound exposure data should have been used to support the study purposes "to objectively review and comment on" the 1984 AICUZ and the Parnell Associates, Inc. report."

Response - As mentioned above, noise level measurements were not within the scope of the short study. I concur that SEL measurements should be obtained for fine tuning a computer model, but common sense and engineering judgement should also be used in cases where large discrepancies exist in different computer studies based upon the same input data. Furthermore, even if there was a large bank of measured SEL's along with their statistical parameters, there are still basic problems (that were addressed in the report, but not commented upon) in averaging together the sporadic events dominating the military flight operations at BPNAS along with the relatively steady stream of operations into HIA. The persons making final decisions concerning land use may not wish to base their decisions on fine-line contours representing complexly averaged day-night noise levels compared to an L_{dn} threshold; but may consider the fact that more than one-half of the F-4 operations in 1982 apparently occurred within a single period of less than one month; that one F-4 afterburner overflight can equal 832 P-3 overflights in noise dose; and that the BPNAS operations typically do not occur on week-ends when most people are home enjoying their outdoor style of Hawaiian living, etc.

B. Comments 4 and 5, page 3:

"4. The source of Darby's information regarding the civil aircraft source noise, or "SEL value reportedly used in the AICUZ" should be disclosed because of the apparent significance of the assumptions on his results. Was the source a personal, first-hand examination of the 1984 AICUZ computer model input listing, information provided by the Navy or its representatives, or Campbell Estate or its representatives?

5. Similar disclosure by Darby should be made of the method in which the 100% F-4 aircraft and P-3 power settings were confirmed to have been used in the 1984 AICUZ ("Similar power settings and SEL's were apparently used in the 1984 AICUZ," para. 4, page 4). If the source of the information was Campbell Estate as indicated in TABLE I (Reference 4) of the Darby report, then the conclusions may not be Darby's but a restatement of Campbell Estates' conclusions by Darby."

Response - As mentioned above, the subject report was to evaluate the two AICUZ documents and any supporting information provided by Campbell Estate essentially within a one-week period at the beginning of the study. I obviously was aware of the fact that I couldn't substantiate the validity of the data and entitled it "as Reportedly in the 1984 AICUZ Document". The data was basically in a handout packet entitled "Campbell Estate - Navy Lawsuit Discussion Summary" dated December 15, 1986. It also included four worksheets showing Tracks 02 and 07 with P3, C130, helicopters and U4B aircraft with power setting distances, SEL values, etc. apparently done by a knowledgeable consultant. No "first-hand examination of the 1984 AICUZ computer model input listing" was provided. On December 23, 1986, Mr. Clint Churchill also provided me in a phone conversation with SEL data associated with F-4, A-4, and T-33 aircraft at various generic aircraft operational modes. In the report, this compendium of information was called reference 4 -"Miscellaneous documents and data provided by Campbell Estate in December 1986."

In response to the comment that the conclusions may not be mine, "but a restatement of Campbell Estate's conclusions by Darby"; I can only respond as a technical specialist in that if the flight tracks are fixed; the aircraft types and number of operations are fixed; the altitude is fixed; how can relatively high L_{dn} values emerge unless there are relatively high SEL values, and therefore high thrust values, etc.? As mentioned above, the report was not to get involved with legal issues; but these non-technical legalistic comments by a party who publically is on-record to stay out of the litigation are confusing.

C. Comments 1 and 2, page 2:

"1. All of the aircraft flight tracks and noise contributors modeled by the 1984 AICUZ were not considered in the Darby study. Specifically, these

tracks which were included in the 1984 AICUZ, but not in the Darby study, are Tracks 25, 34, 39 (HIA), and all jet departure noise contributions from NAS, BP RWY 04R. The Darby study did not include "the same inputs as reported in the 1984 AICUZ" or supporting calculations to substantiate the insignificance of the track omissions on the computed Ldn values at Location A. Unless this degree of thoroughness is undertaken to include all significant noise contributors into the cumulative Ldn computations on the project site, the Darby study cannot be interpreted as providing "the worst case Ldn values in the project site."

2. Because only a single Location A was evaluated in the Darby study, and because the combined aircraft noise exposure from NAS, BP, and HIA aircraft may be greatest along the southern boundary of the project, the conclusion "that no Ldn 60 or Ldn 65 'arm' would extend over the project and therefore the project site should be exposed to less than Ldn 60" has not been demonstrated in the Darby study. The necessity for inclusion of HIA ILS Track 39 and NAS, BP departure tracks from RWY 04R, as was done in the 1984 AICUZ, is more obvious along the southern boundary of the project than at Location A."

Response - In my opinion, the short study included enough significant noise contributors in the cumulative L_{dn} computations on the project site to make a rational judgement. It did not include Tracks 25, 34, and all jet departures from 04R nor did it include the HIA ILS track. What is the basis that these aircraft operations are significant? Why didn't DOT demonstrate a "degree of thoroughness" and provide typical L_{dn} contributions from these tracks? Are the commenters willing to assume that insignificant contributions arise from any other airport operations at BPNAS and HIA?

The worst case L_{dn} values on the project site obviously occur where the highest L_{dn} values exist, e.g. greater than 65 L_{dn} and where two major tracks intersect which generate the high L_{dn} values. This is where location "A" was chosen for exercising the simplified technique. What is the basis for stating that the inclusion of the HIA ILS, BPNAS departures from Runway 04R is more obvious along the southern boundary of the project than at location "A"?

In the spirit of pursuing L_{dn} contour evaluations, we have evaluated the other aircraft operations cited in the comments. The problem is complicated by the AICUZ studies using the military's Noise Map computer model while DOT

Suspense

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	LP			
	HOC			
	HMGT			
	LREF			
	LEGAL			
	PERS			
	PLNG			

DIRECTOR
EDWARD Y. HIRATA

STATE OF HAWAII
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IN REPLY REFER TO:
AIR-EP
87.2153

August 6, 1987

RECEIVED
AUG 1 2 1987
DARBY & ASSOCIATES

MR. RUSSELL N. FUKUMOTO, EXECUTIVE DIRECTOR
HAWAII HOUSING AUTHORITY

ATTN: MR. LLOYD HARAGUCHI

FROM: AIRPORTS ADMINISTRATOR

SUBJECT: KAPOLEI VILLAGE, EWA, OAHU, HAWAII

The information provided in the subject report by Darby & Associates, does not support the following conclusions contained in Paragraph 7.0 Summary: "In this analysis, a simplified technique to estimate the worst case Ldn values in the project site is developed. The technique is essentially validated by using the same inputs as reported in the 1984 AICUZ by showing that, under those assumptions, an Ldn 65 contour 'arm' would exist over the project site. Then, an independent estimate of worst case Ldn values is made using aircraft noise source levels and averaging techniques that I believe to be reasonable based on my experience and upon data from the literature. The result of these calculations indicate that there should not be sufficient aircraft noise impact to place constraints on residential housing in the project according to local and federal guidelines." The additional conclusion at the bottom of Page 3 is not substantiated by the study: "The final resultant Ldn of 57.7 dB implies that no Ldn 60 or Ldn 65 'arm' would extend over the project and therefore the project site should be exposed to less than Ldn 60."

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The above conclusions of the Darby & Associates study are not supported by the results reported in the study for the following reasons:

1. All of the aircraft flight tracks and noise contributors modeled by the 1984 AICUZ were not considered in the Darby study. Specifically, these tracks which were included in the 1984 AICUZ, but not in the Darby study, are Tracks 25, 34, 39(HIA), and all jet departure noise contributions from NAS, BP RWY 04R. The Darby study did not include "the same inputs as reported in the 1984 AICUZ," or supporting calculations to substantiate the insignificance of the track omissions on the computed Ldn values at Location A. Unless this degree of thoroughness is undertaken to include all significant noise contributors into the cumulative Ldn computations on the project site, the Darby study cannot be interpreted as providing "the worst case Ldn values in the project site."

2. Because only a single Location A was evaluated in the Darby study, and because the combined aircraft noise exposure from NAS, BP, and HIA aircraft may be greatest along the southern boundary of the project, the conclusion "that no Ldn 60 or Ldn 65 'arm' would extend over the project and therefore the project site should be exposed to less than Ldn 60" has not been demonstrated in the Darby study. The necessity for inclusion of HIA ILS Track 39 and NAS, BP departure tracks from RWY 04R, as was done in the 1984 AICUZ, is more obvious along the southern boundary of the project than at Location A.

3. In studies of this type, where significant policy or land use decisions could be formulated from the conclusions of the study, a greater reliance should be placed on measured sound exposure data rather than published, generic, or assumed data (or aircraft power settings). This is particularly true if conclusions are to be made within 2.3 Ldn tolerance of the 60 Ldn planning threshold. The use of measured sound exposure data should have been used to support the study purpose "to objectively review and comment on" the 1984 AICUZ and the Parnell Associates, Inc. report.

4. The source of Darby's information regarding the civil aircraft source noise, or "SEL value reportedly used in the AICUZ," should be disclosed because of the apparent significance of the assumptions on his results. Was the source a personal, first-hand examination of the 1984 AICUZ computer model input listing, information provided by the Navy or its representatives, or Campbell Estate or its representatives?

5. Similar disclosure by Darby should be made of the method in which the 100% F-4 aircraft and P-3 power settings were confirmed to have been used in the 1984 AICUZ ("Similar power settings and SEL's were apparently used in the 1984 AICUZ," para 4. page 4). If the source of the information was Campbell Estate as indicated in TABLE I (Reference 4) of the Darby report, then the conclusions may not be Darby's but a restatement of Campbell Estates' conclusions by Darby.

Should there be any questions, please contact Mr. Dean Nakagawa of my staff at 836-6526.

OWEN MIYAMOTO

Table I - Comparisons of SEL Values for INM Kapolei Study and SEL Values in Preliminary DOT Study for HIA (ref. 2) (Applicable to HIA ILS for Noise Contours in Figures 1 and 2.)

LOCATION A

Preliminary DOT INM for HIA (TR 16, 17 & 19)				Kapolei INM Study (TR 16)					Measured Prelim. DOT For HIA	
A/C	OPS D/N	SEL	L_{dn} Contrib.	A/C	OPS D/N	SEL	ΔSEL_1	L_{dn} Contrib.	SEL	ΔSEL_2
F4 HIA	8.1	92.7	52.4	F4 HIA	10.3	92.9	+0.2	53.7	92.7	+0.2
C5A	1.6	98.6	50.1	C5A	1.8	99.2	+0.6	52.6	94.3	+4.9
C141	6.6	89.1	46.7	C141	5.3 /.1	89.7	+0.6	48.0	84.8	+4.9
KC 135	3.8	94.2	49.7	KC 135	3.9	96.3	+2.1	52.8	--	--
747 10A 747 20A	16.8	85.9	47.8	747 100	16.8	86.2	+0.3	49.0	85.2	+1.0
DC 101A DC 103A	9.7	82.9	45.4	DC 1010	19.3	80.2	-2.7	43.6	81.3	-1.1

$\Delta SEL_1 = SEL_{(INM\ Kapolei)} - SEL_{(INM\ DOT)}$

$\Delta SEL_2 = SEL_{(INM\ Kapolei)} - SEL_{(Meas.\ DOT)}$

$L_{dn(INM\ DOT)}$ = 58.1 dB

$L_{dn(INM\ Kapolei)}$ = 58.9 dB

Table II - Comparisons of SEL Values for INM Kapolei Study and SEL Values in Preliminary DOT Study for HIA (ref. 2) (Applicable to HIA ILS for Noise Contours in Figures 1 and 2.)

LOCATION B

Preliminary DOT INM for HIA (TR 16, 17, 18 & 19)				Kapolei INM Study (TR 16)					Measured Prelim. DOT For HIA	
A/C	OPS D/N	SEL	L_{dn} Contrib.	A/C	OPS D/N	SEL	ΔSEL_1	L_{dn} Contrib.	SEL	ΔSEL_2
F4 HIA	8.4	91.3	51.1	F4 HIA	10.3	92.3	+1.0	53.1	87.9	+4.4
C5A	1.6	97.5	50.1	C5A	1.8	97.1	-0.4	50.5	--	--
C141	6.6	87.9	46.7	C141	5.3/.1	87.5	-0.4	45.8	88.3	-0.8
KC 135	3.8	93.2	49.6	KC 135	3.9	93.7	+0.5	49.9	91.9	+1.8
747 10A 747 20A	16.8	84.9	47.8	747 100	16.8	84.4	-0.5	47.2	83.6	-2.4
DC 101A DC 103A	19.3	81.9	45.4	DC 1010	19.3	78.8	-3.1	42.3	81.6	-2.8

$\Delta SEL_1 = SEL_{(INM\ Kapolei)} - SEL_{(INM\ DOT)}$

$\Delta SEL_2 = SEL_{(INM\ Kapolei)} - SEL_{(Meas.\ DOT)}$

$L_{dn(INM\ DOT)}$ = 57.6 dB

$L_{dn(INM\ Kapolei)}$ = 57.2 dB

Table III - Comparisons of SEL Values from TR7 from Kapolei Studies, Manual vs. INM. (Applicable to BPNAS Aircraft in Noise Contours in Figure 2.)

LOCATION C

Kapolei Manual Study Using Noise Map Data				Kapolei INM Study				
A/C	OPS	SEL	L_{dn} Contrib.	A/C	OPS	SEL	SEL	L_{dn} Contrib.
P3	14.6	92.7	54.9	"C130"	14.6	88.5	-4.2	50.7
C-130	4.5	90.7	47.8	C130	4.5	88.5	-2.2	45.6
A-4	0.3	88.7	33.3	"A7D"	0.3	92.7	+4.0	37.3
F-4	0.1	102.7	42.8	"F4C"	0.1	102.4	-0.3	42.6
T-33	0.2	87.1	29.7	"A7D"	0.2	92.7	+5.6	35.1
Civil	4.2	75.0	49.9	"Comsep"	4.2	76.5	+1.5	33.4
H-52/53	2.6	95.2	46.5	"CH53"	2.6	88.3	-6.9	43.1
CH-46/47	0.6	98.0	38.2	"CH47"	0.6	96.1	-1.9	44.6
H-1/58	1.2	87.0	31.9	"UH1"	1.2	87.6	+0.6	38.9
U-11, O-2, C-12, C-7, Misc.	Neglected			BEC58p	0.6	81.7		30.5

L_{dn} (Manual Study) = 57.3 dB

L_{dn} (INM Study) = 55.1 dB

INTEGRATED NOISE MODEL - DETAILED GRID ANALYSIS REPORT

X = 4510. Y = 5090.

METRIC LDN TOTAL = 60.0

ENCLOSURE 1

LOCATION "A"

Applicable to Noise Contours in Figure 2

AIRCRAFT	PROFILE	MOD	APPROACH PARAM	NOISE CURVE	STAGE	T AND G APPROACH	FLIGHT TYPE	TRACK	RUNWAY	SEL	OPERATIONS DAY	EVENING	NIGHT	CONTRIBUTION
F4RIA	MMIL30	0	AS4R	J79MIR	.0		A	TR16	22R	92.9	10.3	.0	.0	.53657E+02
KC135A	MIL30	0	AS3R	J57A	0		A	TR16	22R	96.3	3.9	.0	.0	.52039E+02
C5A	MMIL30	0	AC5A	TF391	0		A	TR16	22R	99.2	1.8	.0	.0	.52616E+02
C130K	1PC130	0	AP13	T56A15	1		I	TR7	04L	88.7	19.0	.0	.0	.52070E+02
747100	MST030	0	AP1	JT9000	0		A	TR16	22R	86.2	16.0	.0	.0	.49004E+02
F4CK	IPF4C	0	APS4	J79	1	MIL30	G	TR3	04R	99.4	.0	.0	.0	.48750E+02
C141	MMIL30	0	AC141	MC141	0		A	TR16	22R	89.7	5.3	.0	.1	.47981E+02
707320	TOP30	0	AP7	JT3D	1	ST030	G	TR1	04R	93.0	1.9	.0	.0	.46451E+02
CH47	MFLT47	0	MCLT47	MCCH47	2		T	TR7	04L	96.0	.6	.0	.0	.45222E+02
F4CK	IPF4C	0	APS4	J79	1		T	TR7	04L	104.1	.1	.0	.0	.44199E+02
CH53	MFLT53	0	MCLT53	MCCH53	1		T	TR7	04L	89.0	2.6	.0	.0	.43700E+02
DC1010	MST030	0	AP15	CF660	0		A	TR16	22R	80.2	19.3	.0	.0	.43615E+02
A7DK	TPA7D	0	APS5	TF41	1	MIL30	G	TR3	04R	85.1	3.6	.0	.0	.41212E+02
COMSEP	TPCOM	0	APS2	COMSEP	1		T	TR7	04L	84.1	4.2	.0	.0	.40951E+02
A7DK	TPA7D	0	APS5	TF41	1		T	TR7	04L	93.0	.4	.0	.0	.40396E+02
UH1	MFLT1	0	MCLT1	MCUH1	3		T	TR7	04L	88.3	1.1	.0	.0	.39511E+02
C130K	K30LMD	0	AP13	T56A15	0		D	TR11	04L	85.2	1.2	.0	.0	.36189E+02
F4CK	K30LMD	0	APS4	J79	0		D	TR11	04L	101.9	.0	.0	.0	.32493E+02
CH47	COPTR	0	MCLT47	MCCH47	0		D	TR11	04L	89.2	.1	.0	.0	.30965E+02
BECCAP	TPBEC	0	APS1	TSIO52	1		T	TR7	04L	88.1	.6	.0	.0	.29133E+02

Note: TR16-RNWY 22R is HIA ILS

PEAK LEVEL = 101.1

		DECIBELS BELOW 10S 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
NUMBER OF FLIGHTS	-	1	0	0	1	0	2	0	0	2	0
NUMBER OF OPERATIONS	DAY -	0	0	0	0	0	3	0	0	5	0
	EVENING-	0	0	0	0	0	0	0	0	0	0
	NIGHT -	0	0	0	0	0	0	0	0	0	0

INTEGRATED NOISE MODEL - DETAILED GRID ANALYSIS REPORT


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I X =  8720.    Y =  2960. I
I                          I
I METRIC LDN    TOTAL = 59.1 I
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ENCLOSURE 2

LOCATION "B"

Applicable to Noise Contours in Figure 2

AIRCRAFT	PROFILE	MOD	APPROACH PARAM	NOISE CURVE	STAGE	T AND G APPROACH	FLIGHT TYPE	TRACK	RUNWAY	SEL	OPERATIONS DAY	OPERATIONS EVENING	OPERATIONS NIGHT	CONTRIBUTION
707320	10P30	0	AP7	JT3D	1	S1830	T	T01	04R	99.9	4.9	.0	.0	.53412E+02
F4N1A	MMIL30	0	AS4A	J79M1R	0		A	1R16	22R	92.3	10.3	.0	.0	.53019E+02
C5A	MMIL30	0	ACSA	TF391	0		A	1R16	22R	97.1	1.0	.0	.0	.50467E+02
KC135A	MIL30	0	AS3A	J57A	0		A	1R16	22R	93.7	3.9	.0	.0	.50233E+02
F4C	TPF4C	0	APS4	J79	1	MIL30	T	1R3	04R	90.3	.0	.0	.0	.47672E+02
747100	MS1030	0	AP1	JT9D00	0		A	1R16	22R	84.4	16.0	.0	.0	.47209E+02
C141	MMIL30	0	AC141	NC141	0		A	1R16	22R	87.5	5.3	.0	.1	.45705E+02
DC1010	MS1030	0	AP15	CF668	0		A	1R16	22R	70.0	19.3	.0	.0	.43290E+02
B70K	TPA70	0	APS5	TF41	1	MIL30	T	1R3	04R	81.7	3.6	.0	.0	.37961E+02
C130X	TPC130	0	AP13	T56A15	1		D	1R7	04L	69.0	19.0	.0	.0	.33210E+02
F4C	TPF4C	0	APS4	J79	1		D	1R7	04L	92.7	.1	.0	.0	.32011E+02
B70K	TPA70	0	APS5	TF41	1		D	1R7	04L	80.2	.0	.0	.0	.26791E+02
CH47	HFL147	0	HCL147	HCCH47	2		D	1R7	04L	71.6	.6	.0	.0	.20039E+02
COMKAP	TPCOM	0	APS2	CGASCP	1		D	1R7	04L	62.6	4.2	.0	.0	.19496E+02
C130X	E30LN0	0	AP13	T56A15	0		A	1R11	04L	67.9	4.2	.0	.0	.19299E+02
CH53	HFL153	0	HCL153	HCCH53	1		D	1R7	04L	62.0	2.6	.0	.0	.16706E+02
CH47	COP1R	0	HCL147	HCCH47	0		A	1R11	04L	74.0	.1	.0	.0	.15760E+02
F4C	E30LN0	0	APS4	J79	0		A	1R11	04L	83.9	.0	.0	.0	.14520E+02
UH1	HFL11	0	HCL11	HCUH1	3		D	1R7	04L	62.7	1.1	.0	.0	.13064E+02
CH53	COP1R	0	HCL153	HCCH53	0		A	1R11	04L	64.7	.6	.0	.0	.12023E+02

Note: TR16-RNWY 22R is HIA ILS

PEAK LEVEL = 99.9

		DECIBELS BELOW 100 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
NUMBER OF FLIGHTS	-	1	1	1	0	0	0	1	2	0	0
NUMBER OF OPERATIONS	DAY -	2	1	2	0	0	0	4	10	0	0
	EVENING -	0	0	0	0	0	0	0	0	0	0
	NIGHT -	0	0	0	0	0	0	0	0	0	0

INTEGRATED NOISE MODEL - DETAILED GRID ANALYSIS REPORT


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I X = -3100.    Y = 10000. I
I                          I
I METRIC LDN    TOTAL = 55.1 I
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ENCLOSURE 3

LOCATION "C"

Applicable to Noise Contours in Figure 2

AIRCRAFT	PROFILE	MOD	APPROACH PARAM	NOISE CURVE	STAGE	T AND G APPROACH	FLIGHT TYPE	TRACK	RUNWAY	SEL	OPERATIONS DAY	OPERATIONS EVENING	OPERATIONS NIGHT	CONTRIBUTION
C130X	TPC130	0	AP13	T56A15	1		D	1R7	04L	80.5	19.0	.0	.0	.51911E+02
CH47	HFL147	0	HCL147	HCCH47	2		D	1R7	04L	96.1	.6	.0	.0	.44593E+02
CH53	HFL153	0	HCL153	HCCH53	1		D	1R7	04L	88.3	2.6	.0	.0	.43093E+02
F4C	TPF4C	0	APS4	J79	1		D	1R7	04L	102.4	.1	.0	.0	.42576E+02
F4N1A	MMIL30	0	AS4A	J79M1R	0		A	1R16	22R	81.7	10.3	.0	.0	.42443E+02
C130X	E30LN0	0	AP13	T56A15	0		A	1R11	04L	89.0	1.2	.0	.0	.41129E+02
B70K	TPA70	0	APS5	TF41	1		D	1R7	04L	92.7	.4	.0	.0	.39271E+02
F4C	E30LN0	0	APS4	J79	0		A	1R11	04L	100.6	.0	.0	.0	.39197E+02
UH1	HFL11	0	HCL11	HCUH1	3		D	1R7	04L	87.6	1.1	.0	.0	.38950E+02
KC135A	MIL30	0	AS3A	J57A	0		A	1R16	22R	81.0	3.9	.0	.0	.38279E+02
F4C	TPF4C	0	APS4	J79	1	MIL30	T	1R3	04R	80.2	.0	.0	.0	.37572E+02
CH47	COP1R	0	HCL147	HCCH47	0		A	1R11	04L	95.0	.1	.0	.0	.37569E+02
CH47	COP1R	0	HCL147	HCCH47	0		A	1R25	22R	91.9	.3	.0	.0	.37252E+02
CH53	COP1R	0	HCL153	HCCH53	0		A	1R11	04L	88.0	.6	.0	.0	.36194E+02
B70K	E30LN0	0	APS5	TF41	0		A	1R11	04L	100.1	.0	.0	.0	.35432E+02
747100	MS1030	0	AP1	JT9D00	0		A	1R16	22R	71.1	16.0	.0	.0	.33993E+02
C5A	MMIL30	0	ACSA	TF391	0		A	1R16	22R	88.5	1.0	.0	.0	.33927E+02
COMKAP	TPCOM	0	APS2	CGASCP	1		D	1R7	04L	76.5	4.2	.0	.0	.33364E+02
C141	MMIL30	0	AC141	NC141	0		A	1R16	22R	74.2	5.3	.0	.1	.32961E+02
UH1	COP1R	0	HCL11	HCUH1	0		A	1R11	04L	87.3	.3	.0	.0	.32083E+02

Note: TR16-RNWY 22R is HIA ILS

PEAK LEVEL = 100.6

		DECIBELS BELOW 100 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
NUMBER OF FLIGHTS	-	1	0	0	0	0	0	1	0	1	0
NUMBER OF OPERATIONS	DAY -	0	0	0	0	0	0	0	0	0	0
	EVENING -	0	0	0	0	0	0	0	0	0	0
	NIGHT -	0	0	0	0	0	0	0	0	0	0

APPENDIX B

Traffic Study:
Parsons, Brinckerhoff, Quade and Douglas, Inc.

Hawaiian Housing Authority
Attn: Lloyd Haraguchi

studies utilize FAA Integrated Noise Model (INM) and difference will exist when fine line comparisons are made due to the two different models.

Figure 1 shows the resulting noise contours when the BPNAS touch-and-go operations are based on the FAA's INM procedure. In these contours, the engine thrust levels and SEL's are pre-established by the model. Because this technique doesn't honor the 1,000-foot level flight involved in the touch-and-gos; the INM was rerun by redefining the touch-and-go operations in more detail. Figure 2 shows these results. Both sets of noise contours do not indicate that 60 L_{dn} is exceeded on the project site. Thus, the contours substantiate the judgements made in the report. Enclosures 1 through 3 are computer model output for first-hand examination. Figure 3 shows the aircraft flight tracks considered.

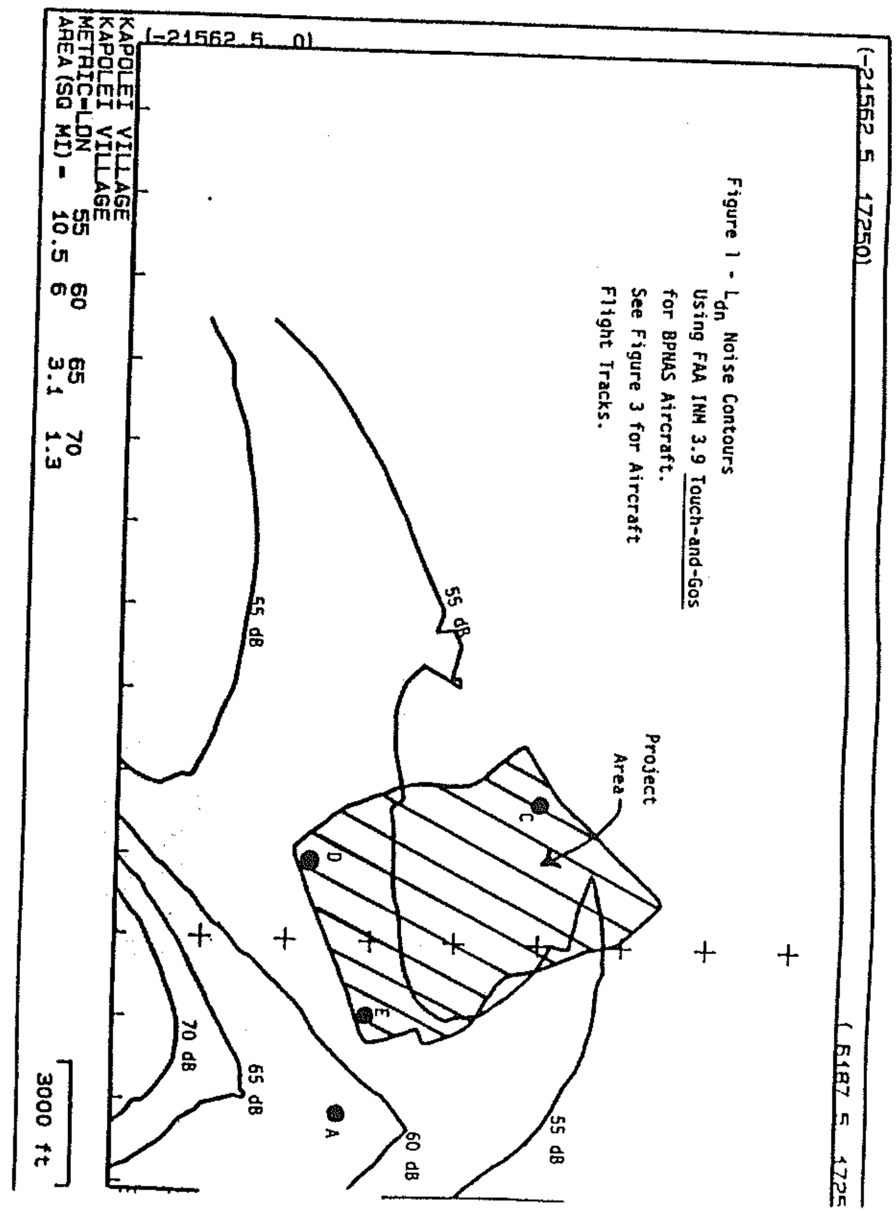
There are no known aircraft SEL measurements on the project site. However, HIA data obtained at locations "A" and "B" (shown in Figure 3) from reference 2 are tabulated in Tables I and II to validate the HIA ILS traffic noise. The table also compares values from the most recent preliminary HIA INM data from reference 2. Table III shows comparisons at Location "A" in the original study (redefined as location "C") between the simplified manual effort and the INM data.

Sincerely,

Ronald A. Darby, P.E.

RAD:djs
encls.

References: 1. Letter to L. Haraguchi from R. Darby dated December 12, 1986.
2. "Inventory of Existing Noise Mitigation Programs and Noise Map Information", Draft - "HIA Master Plan Update and Noise Compatibility Program", March 1987.



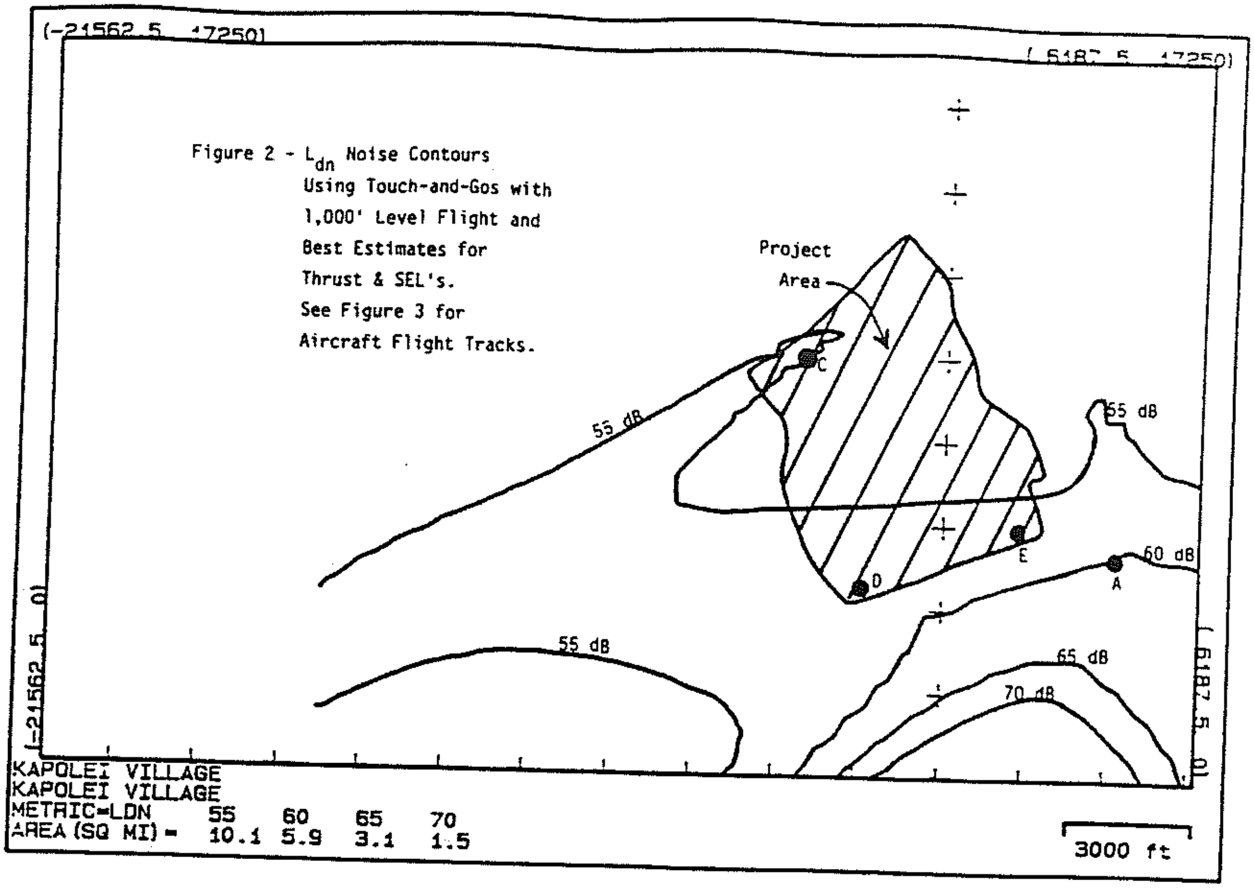


Figure 2 - L_{dn} Noise Contours Using Touch-and-Gos with 1,000' Level Flight and Best Estimates for Thrust & SEL's. See Figure 3 for Aircraft Flight Tracks.

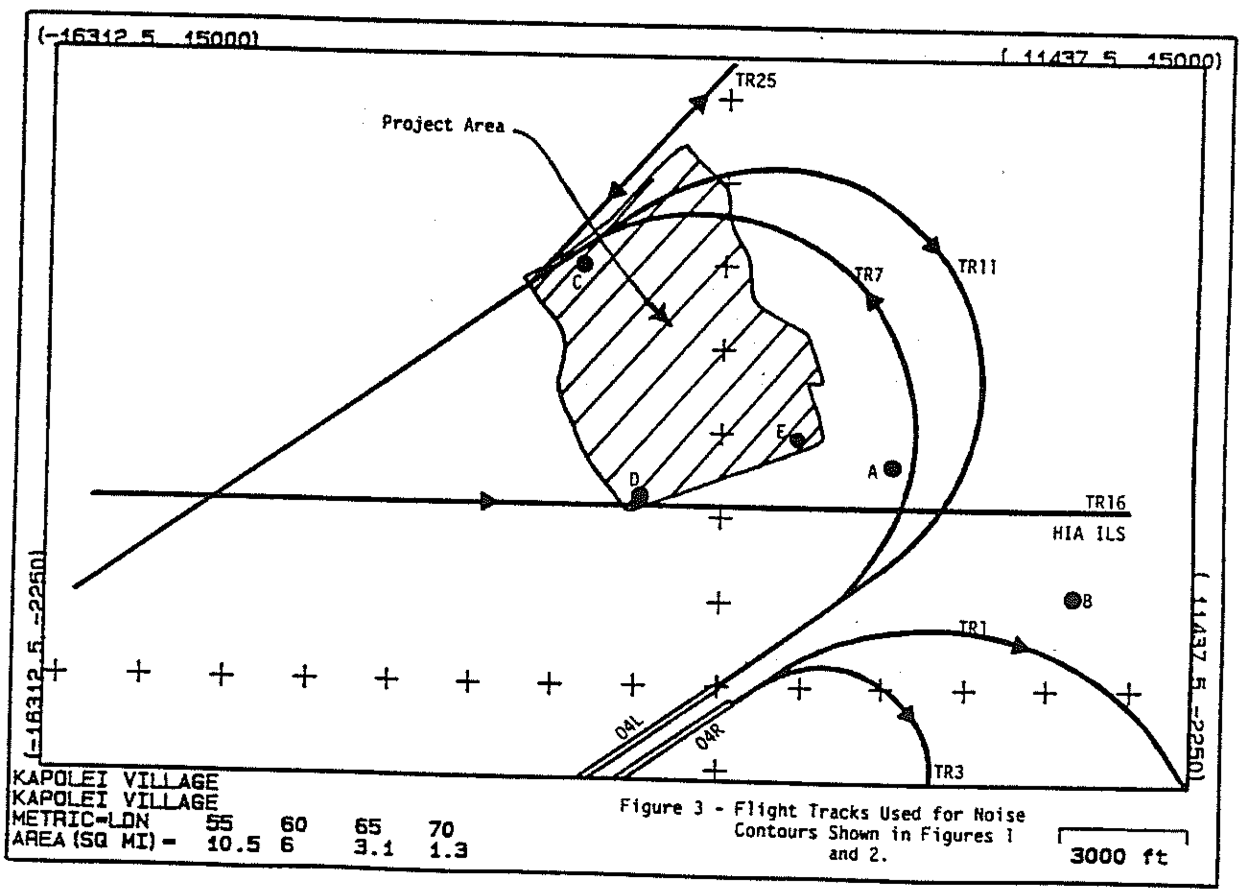


Figure 3 - Flight Tracks Used for Noise Contours Shown in Figures 1 and 2.

TRAFFIC IMPACT STUDY

KAPOLEI VILLAGE

Ewa, Oahu, Hawaii

October 1987

Prepared for:

Housing Finance and Development Corporation

Prepared by:

Parsons Brinckerhoff Quade and Douglas, Inc.

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KAPOLEI VILLAGE

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TRAFFIC IMPACT STUDY

INTRODUCTION

The State of Hawaii's Housing Finance and Development Corporation, in conjunction with the City and County of Honolulu's Department of Housing and Community Development, has proposed to develop a residential community on approximately 850 acres near the center of the Ewa Plain on leeward Oahu. The project includes approximately 4,940 residential dwelling units, commercial areas, a golf course, and sites for churches, schools and parks. This report summarizes the findings of an evaluation of the traffic impacts of the proposed project. Other developments proposed in the Ewa area which will contribute to traffic in the vicinity of the proposed project have also been considered. Recommendations for transportation system improvements are provided.

EXISTING CONDITIONS

The project site is on the Ewa Plain on leeward Oahu and is situated between Makakilo and the Naval Air Station at Barbers Point (Figure 1). Presently, Oahu Sugar Company uses the land to grow sugarcane and there is no public vehicular access into the project site.

Roadway System

Farrington Highway forms the northern boundary of the project site. It is presently a two-lane rural highway with a 20-foot wide pavement structure and connects to the east to Waipahu; to the west, the two-lane highway ties to a four-lane Farrington Highway at the Palailai Interchange with the H-1 Freeway.

Barbers Point Access Road (also referred to as Fort Barrette Road) forms the western boundary of the project site and serves the main gate to the Barbers Point Naval Air Station. This two-lane highway becomes wider as it nears Farrington Highway, which it crosses at-grade in a signalized intersection. The present intersection includes turn lanes and a demand-actuated traffic signal system. Mauka of the intersection, the road continues up to Makakilo as the six-lane Makakilo Drive, crossing over the H-1 Freeway at Makakilo Interchange. Ramps provide connections toward Honolulu to/from both the makai and mauka directions. However, connections to or from Waianae are made via Farrington Highway and Palailai Interchange, located approximately one mile to the west.

Waimanalo Road, a private agricultural road used by the Oahu Sugar Company to transport harvested sugarcane from the site and fields located to the west of the site, bisects the project site

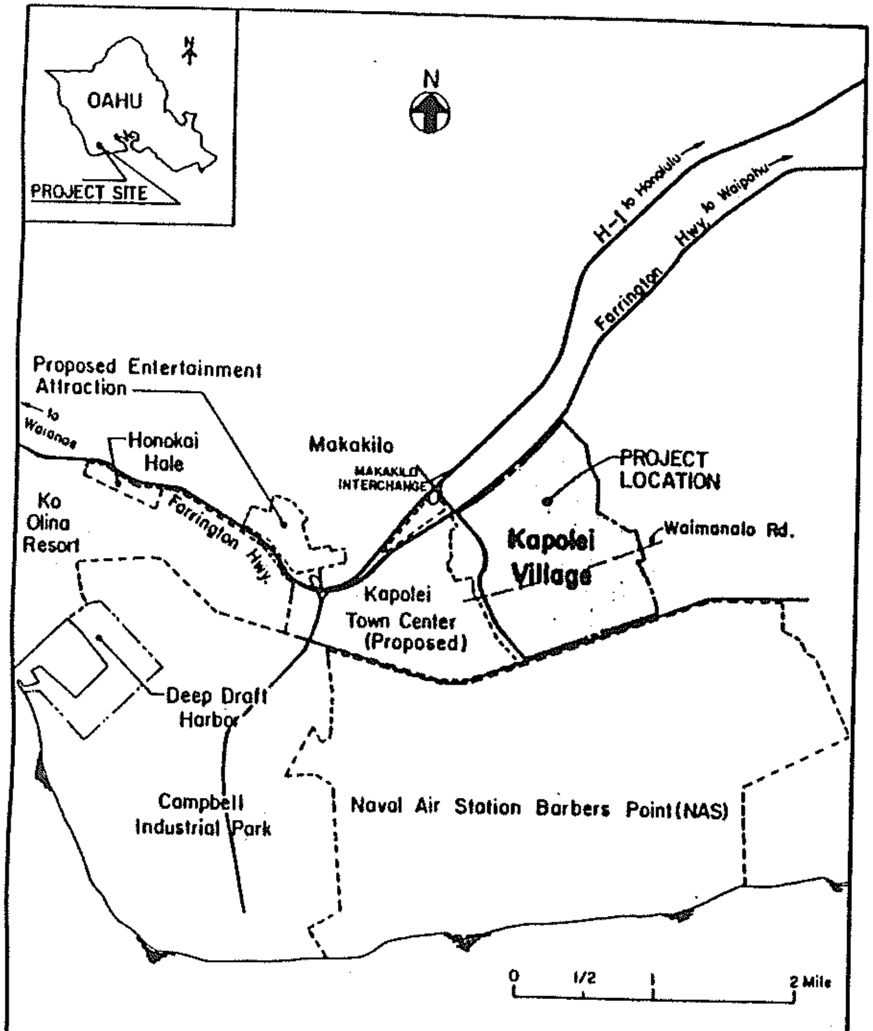

FIGURE 1
LOCATION MAP

in a east-west direction. Waimanalo Road is a two-lane paved roadway which crosses Barbers Point Access Road at a signalized intersection.

Traffic Conditions

In the vicinity of the project site, the existing roadways operate well during peak periods. Traffic on Farrington Highway, west of Barbers Point Point Access Road, exhibits directional splits during peak periods typical of suburban commuter routes. The existing two-way peak hour traffic volumes on this portion of Farrington Highway are between 500 and 600 vehicles per hour. East of Barbers Point Access Road, eastbound and westbound traffic are almost evenly distributed. The major employment areas at Campbell Industrial Park and NAS Barbers Point attract traffic during the morning which balances the eastbound commuter traffic produced in residential areas. Highest hourly traffic on Farrington Highway adjacent to the project site occurs in the afternoon, with a two-way volume of 580 vehicles per hour, or approximately one-third of the highway's capacity.

The section of Barbers Point Access Road adjacent to the project site carries a two-way volume of approximately 1,300 vehicles per hour during the morning peak hour and 1,200 vehicles per hour during the afternoon peak hour. Traffic on Makakilo Drive exhibits the typical pattern of a residential area by displaying high directional splits reflecting home-to-work and work-to-home commuting. The existing two-way peak hour traffic volumes on Makakilo Drive near the H-1 Freeway overpass are approximately 1,300 vehicles per hour during the morning (AM) and afternoon (PM) peak periods[1].

The signalized intersection of Farrington Highway and Barbers Point Access Road has an estimated capacity of 2,700 vehicles per hour total entering traffic. At this intersection, the existing counts show the volume to be 1,750 vehicles per hour during both morning and afternoon peak hours.

The H-1 Freeway in the vicinity of the proposed project is presently being upgraded from a four-lane freeway to a six-lane freeway. The on-ramps from Makakilo Drive merge before entering the freeway and presently handle a peak volume of 830 vehicles per hour in the morning during which time the freeway volume is approximately 1,300 vehicles per hour approaching the ramp. Westbound traffic from the freeway using the off-ramp to Makakilo and NAS Barbers Point is stopped at Makakilo Drive; some delays occur in the morning because of high volumes wishing to turn left towards the air station.

FUTURE DEVELOPMENTS

The Estate of James Campbell is the major landowner in the Ewa area with approximately 34,000 acres of land within the Ewa Plain. The Estate maintains a planning program to coordinate the long range development of their Ewa lands. Proposed land uses identified on the long range plan in the area of the project site are described below.

The Estate of James Campbell is pursuing the development of a 580-acre site immediately to the west of the project site called the "Kapolei Town Center". The Town Center has been proposed to fulfill the long range growth policy of the City and County of Honolulu's Oahu General Plan to establish a Secondary Urban Center in Ewa. The Estate has submitted a petition to the Land Use Commission to reclassify a portion of the Town Center site from the Agricultural district to the Urban district.

Makakilo, a 22-year old residential community consisting of single family and multi-family housing units, is located on the lower slopes of the Waianae Range to the north of the project site. About 2,400 housing units had been built by 1985, with an estimated 2,700 units remaining to be built. Population in 1985 was 9,000 with ultimate future population estimated at 16,700 residents.

James Campbell Industrial Park is located southwest of the project site. Ultimately planned for an approximate 2,400 acres, the industrial park presently covers 1,360 acres. Employment at the park is estimated at 2,500 people in 1985.

The Barbers Point Deep Draft Harbor is located west of the industrial park. Development of wharf and dock facilities will be started with the first phase of development to begin this year. Complete development of the harbor and all supporting facilities is expected to take 10 to 15 years.

Groundbreaking for the planned 970-acre Ko 'Olina residential/resort community (formerly, the "West Beach Resort") took place on December 2, 1986. Land and infrastructure development began in March 1987 with completion anticipated for mid-1989. First phase development plans call for 5,200 housing units. Of these, 3,700 units will be apartment/condominumium units, primarily in highrise buildings, with 1,500 units designated as low rise, lower density attached units located around the golf course. Another 4,000 visitor units, consisting of hotel rooms and resort condominiums, are also planned.

Campbell Estate is planning to pursue development of an approximate 106-acre site mauka of Farrington Highway (approximately 1.5 miles west of the site) into an entertainment attraction "which will take both residents and visitor on a journey around the pacific and Asian Basin." The attraction is expected to employ up to 1,200 persons and is planned to be operational by 1991.

Gentry Pacific Ltd., is proposing a residential subdivision, Ewa Villages, on 544-acres located east of the project site. The subdivision would consist of approximately 2,700 multi-family and 3,000 single family units to be built by year 2000. In addition, the Department of Housing and Community Development has proposed to develop the West Loch Estates, approximately 1,500 units on acres north of Ewa Village.

PROPOSED PROJECT

The proposed project includes 4,937 residential units, a golf course and clubhouse, two parks/recreation centers, four church/day care centers, four schools, two commercial developments and a park-and-ride facility.

Roadway System

Access to the proposed project will be provided by the existing Farrington Highway and Barbers Point Access Road and a new road, Ewa Parkway, running from east to west between the Ko 'Olina and Ewa Village areas. The project's internal roadway system includes local streets, minor collectors and arterial streets (Figure 2). Local streets and minor collectors will provide access to residential properties, while schools, parks, churches and commercial areas will be accessed from arterial streets.

The neighborhoods will be linked by an arterial street system which includes the Ewa Parkway, a loop road, a "Village Parkway" connecting the loop road to Farrington Highway, and a smaller arterial street ("Road A") between the loop road and Barbers Point Access Road. The parkways and the loop road north of the Ewa Parkway will include planted medians, with no on-street parking allowed. Access to the residential area located on the makai side of Farrington Highway just east of Village Parkway will be provided by three minor roads referred to as Access 1, Access 2 and Access 3.

The Ewa Parkway will carry traffic between the Kapolei area, Campbell Industrial Park, and Ko 'Olina to the west and the Ewa Village/Ewa Beach area to the east. The Ewa Parkway through the project site will be a 150-foot corridor, within which a divided,

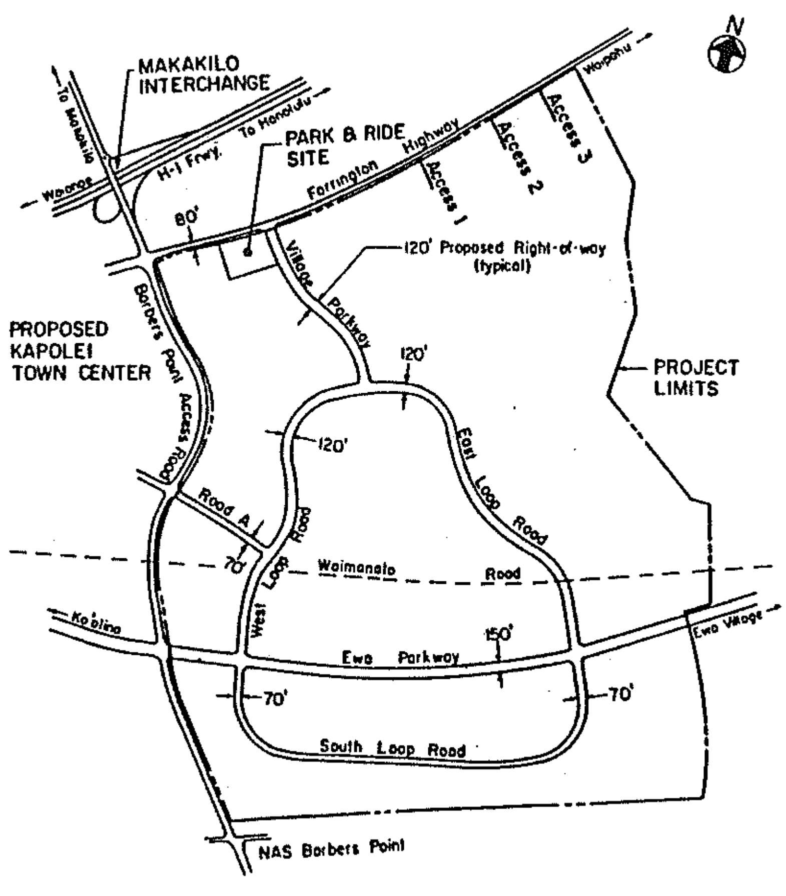

FIGURE 2

PROPOSED ROADWAY SYSTEM

six-lane boulevard with landscaped medians and roadside areas could ultimately be constructed. Full development of Ewa Parkway is planned between Barbers Point Access Road and West Loop Road. East of the West Loop Road, the Ewa Parkway will be built along the mauka side of the corridor with a 40-foot pavement structure comprised of one lane in each direction and an auxiliary left turn lane in the center of the roadway.

The Village Parkway and the East and West Loop Roads will be constructed within 120-foot rights-of-ways. These four-lane divided roadways will include landscaping in their medians and along the roadsides. The 32-foot pavement areas will include two automobile travel lanes and a bike lane in each travel direction. Additional pavement width at major intersections for turning lanes will be provided by reducing the widths of median or roadside areas. Because the parkways are intended primarily for the movement of traffic, median openings will be provided only at street intersections. A limited number of driveways will be allowed, but ingress/egress to these will be via right turn movements only.

The South Loop Road and Road A will be within 70-foot rights-of-ways. On these streets, median left turn lanes will be provided to facilitate access to driveways.

TRAFFIC GENERATION

Traffic generation is composed of trip generation which estimates the number of trips that the project produces or attracts, trip distribution which determines the origins and destinations of those trips, and traffic assignment which places the project traffic onto the proposed roadway network.

Trip Generation

Trip generation estimates the number of trips that the project produces or attracts. The trip rates were based on the Institute of Transportation Engineers informational report, Trip Generation, Third Edition[2]. The study classified the rental and assisted units as multi-family dwelling units. The trip rates for the parks included estimates of their use during peak hours. For the commercial developments, the study assumed a floor area ratio (FAR) of 0.35 for each site. The study also estimated that the schools will have densities of 850 students per six-acres. Full utilization of the park-and-ride facility was assumed, with 35% (approximately 200 vehicles) of the available spaces used by vehicles entering during the AM peak period. Table 1 shows the trip generation rates and Table 2 shows the trip generation.

TABLE 1

TRIP GENERATION RATES

Land Use (Parameter)	Daily (vpd) Enter & Exit	AM Peak Hour (vph) Enter	AM Peak Hour (vph) Exit	PM Peak Hour(vph) Enter	PM Peak Hour(vph) Exit
Single Family (Dwelling Unit)	10.00	0.21	0.55	0.63	0.37
Multi-Family* (Dwelling Unit)	6.60	0.12	0.48	0.47	0.23
Elderly Homes (Dwelling Unit)	3.30	0.11	0.29	0.25	0.15
Golf Course (Acre)	6.90	0.22	0.05	0.08	0.31
Park/Recreation Center (Acre)	6.00	0.00	0.00	0.46	0.92
Church/Day Care (Children)	2.50	0.55	0.50	0.35	0.40
Elementary/Intermediate School (Student)	1.02	0.11	0.05	0.00	0.00
High School (Student)	1.39	0.22	0.08	0.02	0.06
Neighborhood Commercial (TSF)	107.76	1.43	1.29	6.50	6.58
Commercial (TSF)	73.75	0.99	0.88	3.57	3.47
Park and Ride (Acre)	300.00	40.00	1.00	1.00	40.00

Notes: vpd = vehicles per day
vph = vehicles per hour

*Includes Assisted and Rental Units
TSF = Thousand Square Feet

Source: Institute of Transportation Engineers (ITE), Trip Generation

TABLE 2

TRIP GENERATION

Land Use (Parameter)	Daily (vpd) Enter & Exit	AM Peak Hour (vph) Enter	AM Peak Hour (vph) Exit	PM Peak Hour (vph) Enter	PM Peak Hour (vph) Exit
Single Family Units (3,802 DU)	38,020	798	2,091	2,395	1,407
Multi-Family Units* (701 DU)	4,627	84	336	829	161
Elderly Untis (434 DU)	1,432	48	126	109	65
Golf Course/Club House (147.2 acres)	1,016	32	7	12	46
Park/Rec. Center (24.3 acres)	146	0	0	11	22
Church/Day Care (218 children)	545	120	109	76	87
Elem./Inter. School (3,382 students)	3,450	372	169	0	0
High School (4001 students)	5,561	880	200	80	240
Neighborhood Commercial (46 TSF)	4,957	66	59	299	303
Commercial (115 TSF)	8,481	114	101	411	399
Park and Ride (5 acres)	1,500	200	5	5	200
TOTAL TRIP ENDS	69,735	2,714	3,204	3,727	2,930

Note: vpd = vehicles per day; vph = vehicles per hour; TSF = thousand square feet; DU = dwelling unit

*Includes Assisted and Rental Units

Trip Distribution

Trip distribution determines the origins and destinations of traffic generated by the project. The distribution was based on the completion of the other proposed developments in the Ewa area and the Ewa Parkway which would provide a direct connection from this project to Ewa Villages, Ewa Beach and Ko 'Olina. The trips were distributed in five directions: north to Makakilo, south to Barbers Point NAS, east to Honolulu and Waipahu, west to Waianae and southeast to Ewa Villages and Ewa Beach. The trip distribution factors are shown in Table 3.

TABLE 3

TRIP DISTRIBUTION FACTORS

Direction	AM Peak Hour Enter	AM Peak Hour Exit	PM Peak Hour Enter	PM Peak Hour Exit
North	0.19	0.07	0.08	0.13
South	0.03	0.06	0.07	0.03
East	0.28	0.23	0.17	0.41
West	0.42	0.61	0.65	0.40
Southeast	0.08	0.03	0.03	0.03
	1.00	1.00	1.00	1.00

Traffic Assignment

Traffic assignment designates the roadways that project traffic can be expected to utilize. Traffic entering and exiting from the north and south are assigned to Barbers Point Access Road or Farrington Highway. Traffic to/from the east and west are assigned to Farrington Highway and Ewa Parkway. The internal trips are assigned to the various collector roads within the project. Figures 3, 4, 5, 6 and 7 show the estimated "Future Traffic Assignment With Project."

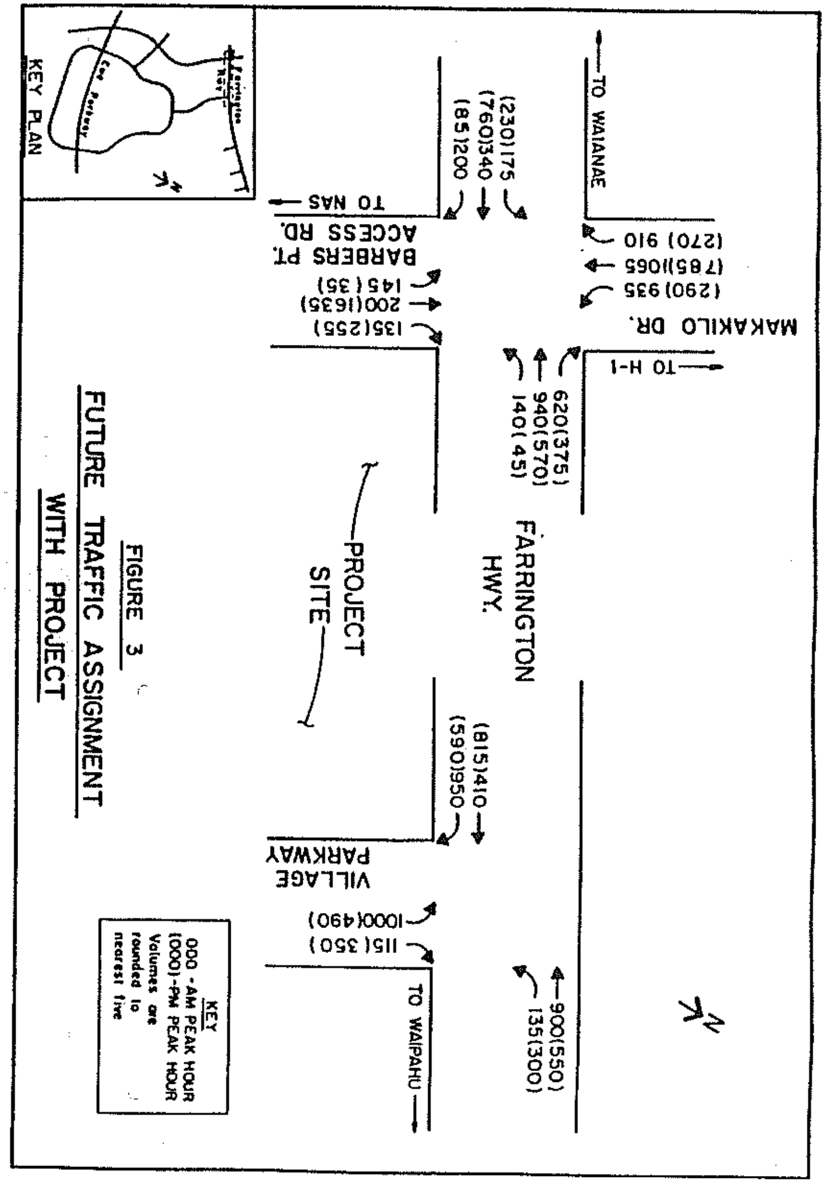

FIGURE 3

FUTURE TRAFFIC ASSIGNMENT WITH PROJECT

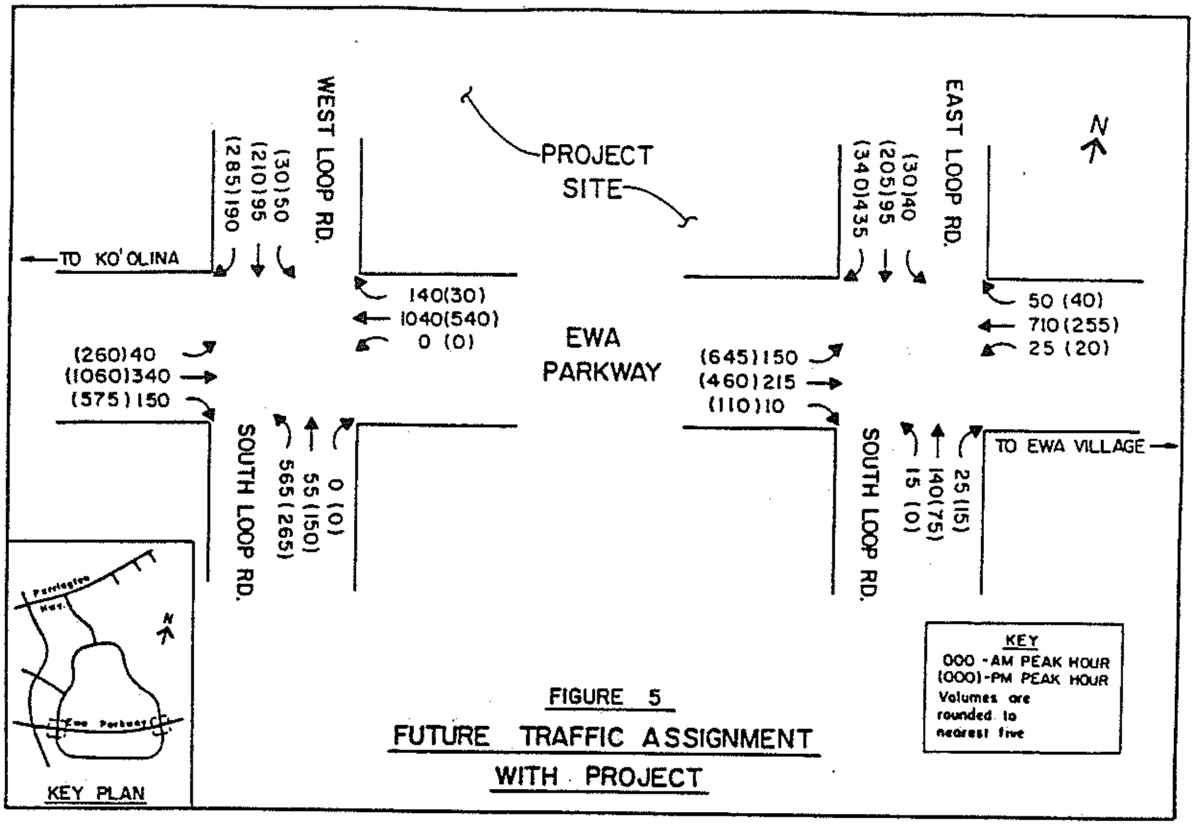

FIGURE 5

FUTURE TRAFFIC ASSIGNMENT WITH PROJECT

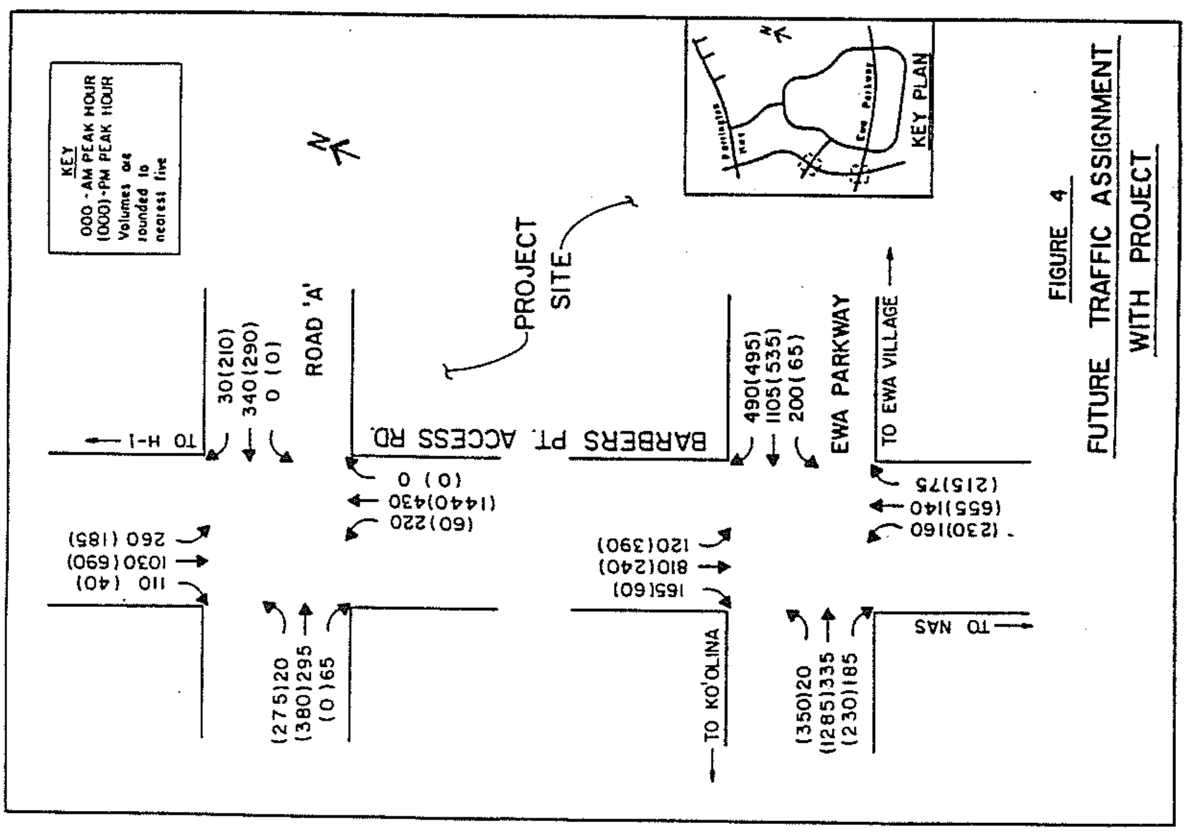

FIGURE 4

FUTURE TRAFFIC ASSIGNMENT WITH PROJECT

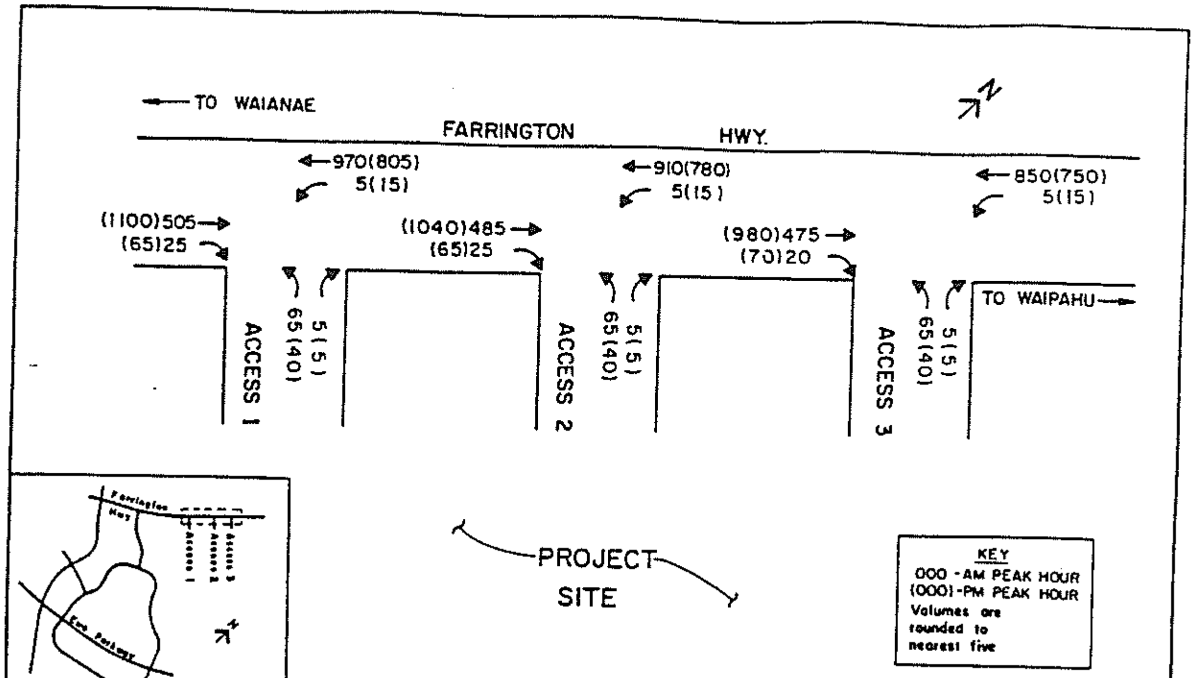

FIGURE 7

FUTURE TRAFFIC ASSIGNMENT WITH PROJECT

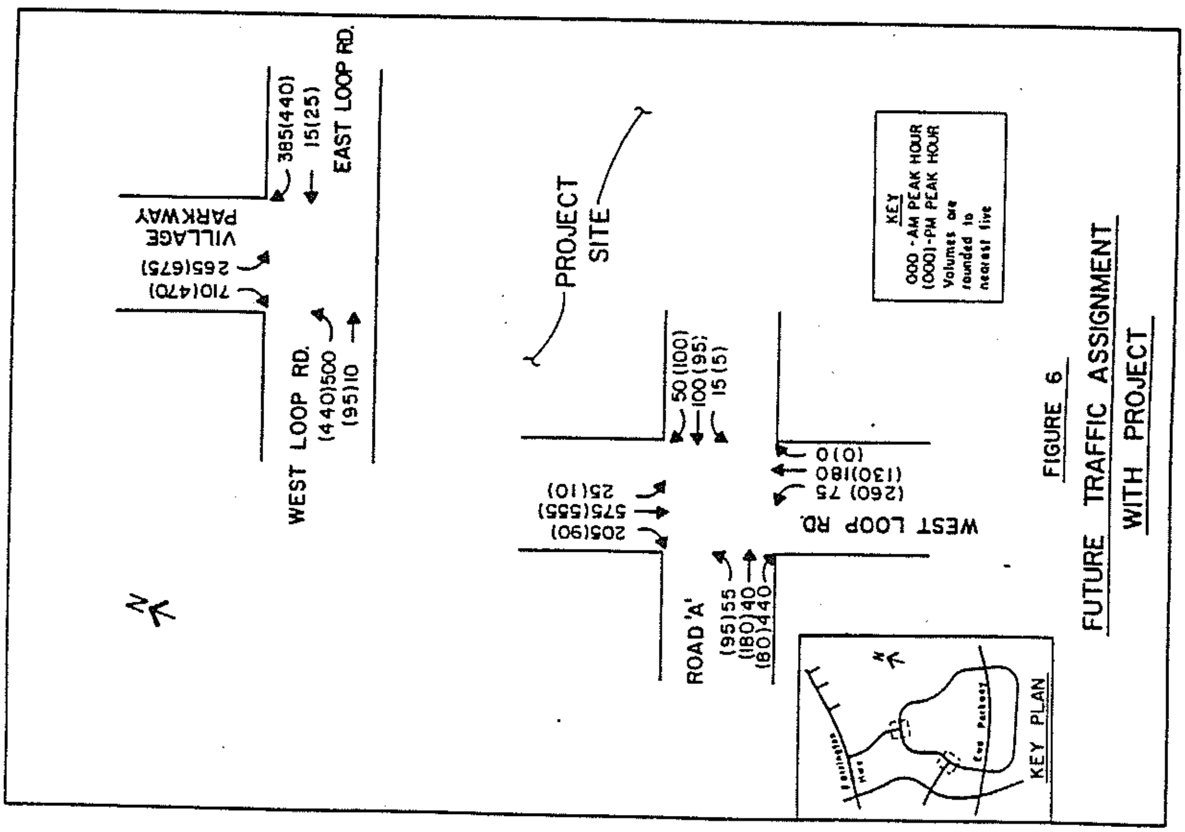

FIGURE 6

FUTURE TRAFFIC ASSIGNMENT WITH PROJECT

PROJECT IMPACTS

The following discussion on project traffic impacts identifies conditions and improvements at full development. Traffic generated by the project will impact the existing roadway system and the new internal roadways within the project site. The study used the NCAP[3] computer software which analyzed signalized and unsignalized intersections using computation methods from the 1985 Highway Capacity Manual[4]. Table 4 lists the results of the analysis for each intersection.

The Kapolei Village master plan proposes signalization at the following intersections: Barbers Point Access Road/Road 'A', Barbers Point Access Road/Ewa Parkway and Farrington Highway/Village Parkway. Signalization of the major intersections of Ewa Parkway/West Loop Road, Ewa Parkway/East Loop Road, East (West) Loop Road/Village Parkway and West Loop Road/Road 'A' would also be justified at full development using the Manual on Uniform Traffic Control Devices[5] Warrant 11 for peak hour volumes.

The development of a major employment center at Kapolei Town Center west of Barbers Point Access Road will generate large volumes of traffic to or from the H-1 Freeway in the Honolulu direction. A new eastbound on-ramp from the Town Center directly into H-1 was assumed to carry 1,150 vehicles during the PM peak hour. Significant left turn volumes onto the Barbers Point Access Road are still expected.

The signalized cross-intersection of Barbers Point Access Road/Makakilo Drive with Farrington Highway was assumed to have the following improvements. The northbound approach on Barbers Point Access Road would be widened to include a left turn lane, two through lanes, and a shared lane for through and right turn

TABLE 4

INTERSECTION ANALYSIS

Signalized Intersection	AM Peak Hour CV (vph)/Status	AM Peak Hour RT Arrow	PM Peak Hour CV (vph)/Status	PM Peak Hour RT Arrow
Barbers Point/Farrington	1386/near	1234/near	1266/near	1198/under
Barbers Point/Road 'A'	1150/under	--	1199/under	--
Barbers Point/Ewa Pky	1129/under	1129/under	1302/near	1199/under
Ewa Pky/West Loop	1100/under	1062/under	1234/near	1156/under
Ewa Pky/East Loop	1357/near	1208/near	1283/near	1148/under
Farrington/Village Pky	1585/over	1085/under	1238/near	1057/under
Village Pky/Loop Road	1595/over	1096/under	1349/near	1215/near
West Loop/Road 'A'	920/under	--	774/under	--

Notes: CV = critical volume
vph = vehicles per hour
RT = right turn

Maximum Sum of Critical Volumes	Status
0 to 1,200	under-capacity
1,201 to 1,400	near-capacity
> 1,400	over-capacity

movements. The southbound approach on Makakilo Drive would include double turn lanes for left and right turn movements and two lanes for through traffic. The eastbound approach on Farrington Highway would also be widened to include two lanes for left turns, two through lanes, and a separate lane for right turns. The westbound approach on Farrington Highway would be similar except it would contain a single lane for left turns. This intersection would operate at near-capacity conditions during the AM and PM peak periods.

The intersection of Barbers Point Access Road with the new Road 'A' forms a cross-intersection which will be signalized. The northbound approach on Barbers Point Access Road and the westbound approach on Road 'A' will be striped for a left turn lane, a through lane, and a shared lane for right turn and through movements. The southbound approach on Barbers Point Access Road would be similar except that it would contain two lanes for left turns. The eastbound approach on Road 'A' would be striped for two left turn lanes and a shared lane for through movements and right turns. Analysis of this intersection shows that it will be under-capacity during the AM and PM peak hours.

The Barbers Point Access Road/Ewa Parkway intersection is another signalized cross-intersection. The analysis assumed that the northbound approach on Barbers Point Access Road will have a single lane for left turns, a through lane, and a shared lane for through movements and right turns. The southbound approach on Barbers Point Access Road includes two left turn lanes, two through lanes, and a single lane for right turns. The eastbound approach on Ewa Parkway would be striped for two left turn lanes, two through lanes, and a shared lane for through movements and right turns. The westbound approach on Ewa Parkway contains single lanes for left and right turns and two lanes for

through traffic. The analysis shows that this intersection will operate at under-capacity conditions during the AM peak period and near-capacity conditions during the PM peak period.

The intersection of Ewa Parkway with West Loop Road will form a cross-intersection which will be signalized. The northbound approach on West Loop Road will contain a left turn lane, a shared lane for left turns and through movements, and another shared lane for through movements and right turns. The southbound approach on West Loop Road will be striped for single lanes for left turns, through movements and right turns. The eastbound and westbound approaches on Ewa Parkway will have a left turn lane, a through lane, and a shared lane for through movements and right turns. The Ewa Parkway/West Loop Road intersection would operate at under-capacity conditions during the AM and peak hour and near-capacity conditions during the PM peak hour.

Another signalized cross-intersection will be formed by Ewa Parkway and East Loop Road. The analysis assumed that the northbound approach on East Loop Road will be striped for a left turn lane, a through lane, and a shared lane for through and right turn movements while the southbound approach on East Loop Road will include a separate lanes for left turns, through traffic, and right turns. Both Ewa Parkway approaches would contain a single left turn lane and a shared lane for through and right turn movements. The Ewa Parkway/East Loop Road intersection would operate at near-capacity during the AM and PM peak periods.

The intersection of Farrington Highway with Village Parkway would be a signalized T-intersection with Village Parkway serving as the stem of the intersection. Both approaches on Farrington Highway are assumed to have two through lanes and separate lanes for turns into Village Parkway. The Village Parkway approach includes two left turn lanes and a single right turn lane. The analysis shows that this intersection will be over-capacity during the AM peak period and near-capicity during the PM peak period due to the high southbound right turn traffic on Farrington Highway.

The East (West) Loop Road/Village Parkway intersection is another signalized T-intersection with Village Parkway forming the stem of the intersection. The two Loop Road approaches will include a single through lane with a separate turn lane leading into Village Parkway. The Village Parkway approach will be striped for two left turn lanes and a right turn lane. The analysis shows that this intersection will be over-capacity during the AM peak hour and near-capacity during the PM peak hour.

The intersection of West Loop Road with Road 'A' forms a signalized cross-intersection. The northbound and southbound approaches on West Loop Road each contain a left turn lane, a through lane and a shared lane for through and right turn traffic. The eastbound approach on Road 'A' will be striped for single lanes for left turns, through movements, and right turns. The westbound approach on Road 'A' will contain a right turn lane and a shared lane for through movements and left turns. The analysis shows that this intersection would operate at under-capacity conditions during the AM and PM peak hours.

The <u>Highway Capacity Manual</u> analysis for unsignalized intersections evaluates gaps in the major street traffic flow and calculates capacities available for left turns across oncoming traffic and for left and right turns onto the highway from the minor street. Table 5 shows the criteria for levels of service for unsignalized intersections.

The intersections of Access 1, Access 2 and Access 3 with Farrington Highway form unsignalized T-intersections with the Access Roads serving as the stems of each T-intesection. Analysis of these intersections assuming a shared lane for left and right turns onto Farrington Highway shows that the shared lane operates at Level of Service (LOS) E during both peak hours. The left turn movement from Farrington Highway into each Access Road operates at LOS A during the AM peak hour and LOS B during the PM peak hour.

TABLE 5

LEVEL OF SERVICE CRITERIA
(UNSIGNALIZED INTERSECTIONS)

Reserve of Capacity	Level of Service	Expected Delay to Controlled Movement
≥ 400	A	Little or no delays
300 - 399	B	Short traffic delays
200 - 299	C	Average traffic delays
100 - 199	D	Long traffic delays
0 - 99	E	Very long traffic delays
≤ 0	F	Demand exceeds capacity; extreme delays

The <u>Highway Capacity Manual</u> analysis of two-lane highways evaluates percent time delay with highway speed and portion of capacity utilized serving as secondary measures. The section of Farrington Highway located east of the site is projected to carry a two-way volume of 1335 vehicles per hour (vph) and 1750 vph during the AM and PM peak periods, respectively. At these volumes, Farrington Highway will operate at LOS E.

The ramp volumes for the H-1 Freeway's Makakilo Interchange were estimated using the projection of Ewa development made by Campbell Estate. Kapolei Town Center was assumed to be a major employment area that would attract many work trips from Kapolei Village. In addition, a new on-ramp to eastbound H-1 directly from the town center was assumed. A high percentage of the new traffic from Makakilo was also assumed to travel to the town center. The estimate also included growth in Campbell Industrial Park and Ko 'Olina. Figure 8 shows the traffic assignment developed for Makakilo Interchange. An evalulation of the interchange ramps indicates that the interchange has the capacity to service the projected traffic demand.

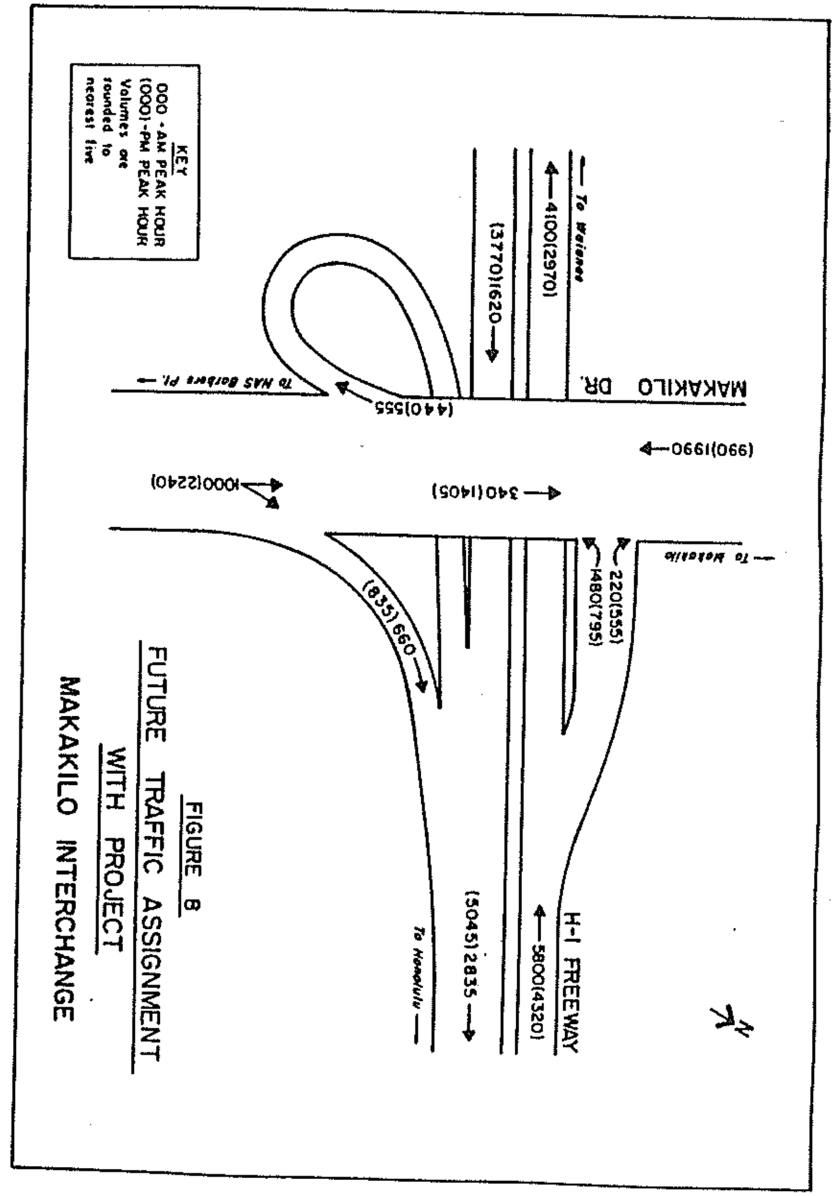

FIGURE 8
FUTURE TRAFFIC ASSIGNMENT WITH PROJECT
MAKAKILO INTERCHANGE

MITIGATION MEASURES

In order to lower the critical volumes at intersections with high right turn volumes, a right turn arrow could be included in the signal phasing to allow right turns during the phase for its complementary left turn. The procedure used in the NCAP program for signalized intersections was modified to account for phase overlaps when right turn movements are allowed to occur simultaneously with its complementary (non-conflicting) left turn movement at intersections with heavy right turn traffic volumes (see Table 4).

The following signalized intersections should include a right turn arrow for turns on red:

- Barbers Point Access Road/Farrington Highway:

  This intersection would be near-capacity during the AM peak period and under-capacity during the PM peak period if the northbound right turn traffic from Farrington Highway is allowed to turn during with the eastbound left turn traffic from Makakilo Drive.

- Barbers Point Access Road/Ewa Parkway:

  Allowing the northbound right turn traffic from Ewa Parkway to turn with the eastbound left turn traffic from Barbers Point Access Road will improve the condition of this intersection to under-capacity during the PM peak period.

- Ewa Parkway/West Loop Road:

  If a turn arrow for the westbound right turn traffic from West Loop Road is provided to allow turns with the northbound left turn traffic from Ewa Parkway, this intersection will operate at under-capacity during the PM peak hour.

- Ewa Parkway/East Loop Road:

  If the westbound right turn traffic from East Loop Road is provided a green arrow with the left turn traffic from Ewa Parkway, the intersection will be near-capacity during the AM peak period and under-capacity during the PM peak period.

- Farrington Highway/Village Parkway:

  Providing a turn arrow for the southbound right turn traffic on Farrington Highway to turn with the westbound left turn traffic from Village Parkway will improve the condtion this intersection to under-capacity during the AM and PM peak hours.

- East (West) Loop Road/Village Parkway:

  The condition of this intersection can be improved to under-capacity during the AM peak period and near-capacity during the PM peak period if the westbound right turn traffic from Village Parkway is allowed to turn with the northbound left turn traffic from the Loop Roads.

RECOMMENDATIONS AND CONCLUSIONS

The proposed project will increase traffic on the existing roadways in the area of the project. Other developments proposed in the Ewa area will also have an impact on the existing roadway system. General recommendations are as follows:

- The park-and-ride facility should be constructed during the first phase of the project in order to encourage its use and to get the residents of Kapolei Village comfortable with using public transportation.

- The other proposed developments in the Ewa area should also implement ridesharing programs.

The following recommendations apply to the roadway system for Kapolei Village.

- Provisions for traffic signals should be included during construction at the following intersections: Village Parkway/East (West) Road, West Loop Road/Ewa Parkway, East Loop Road/Ewa Parkway and West Loop Road/Road 'A'. Traffic volumes at these intersections need to be monitored and signalization should be provided when neccssary and warranted.

- Farrington Highway should be widened to include two lanes in each direction from Barbers Point Access Road to the Access 1 intersection.

- The Farrington Highway approaches for Access 1, Access 2 and Access 3 should include a deceleration lane for right turns and a left turn lane for turns onto the Access Roads. Separate lanes for left and right turns should be provided from each of the three Access Roads.

The following recommendations are for Makakilo Interchange and H-1 Freeway.

- The intersection of the westbound off-ramp from H-1 Freeway with Makakilo Drive should be signalized. The off-ramp approach should be widened to include two left turn lanes for southbound traffic and a right turn lane for northbound traffic. Makakilo Drive should be re-striped to include four through lanes on the southbound approach and two through lanes on the northbound approach of this intersection. Analysis of this signalized intersection shows that it will be near-capacity during the AM peak hour and under-capacity during the PM peak hour.

- The eastbound on-ramp for traffic from the south should be extended to enter the freeway separately from the eastbound loop on-ramp from the north.

- The High Occupancy Vehicle (HOV) designation of the center lanes on the H-1 Freeway should be reviewed; westbound traffic volumes in the AM peak period and eastbound volumes in the PM peak period would each require three lanes. Improved access to the HOV lane from the local streets should be considered in view of the high volumes on the freeway.

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APPENDIX C

Biological Study:
Char & Associates, Botanical/Environmental Consultants

BIOLOGICAL SURVEY

KAPOLEI VILLAGE MASTER PLAN

'EWA DISTRICT, ISLAND OF O'AHU

by

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Prepared for: R.M. Towill Corporation
September 1987

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1.0 INTRODUCTION

The State's Hawaii Housing Authority proposes to develop a housing complex on approximately 850-acres of land within the 'Ewa District, island of O'ahu. The majority of the ± 850-acre parcel is presently under active sugar cane cultivation by Oahu Sugar Company.

The proposed Kapolei Village residential community site is bound by Farrington Highway on the north; by Oahu Sugar Company lands on the east; the Naval Air Station, Barbers Point on the south; and Fort Barrette Road on the west. Elevation on the project site ranges from 50 ft. along the southern boundary to approximately 100 ft. along Farrington Highway, its northern boundary. Rainfall on this part of O'ahu is low, about 20 in./year. The soils on the project site generally belong to the Lualualei-Fill land-'Ewa association, which are deep, nearly level to moderately sloping, well-drained soils found on the coastal plains (Foote et al 1972).

The ± 850-acre parcel is presently zoned "Agriculture". The proposed housing development will require a land use change to redesignate the project site to the "Urban" designation. An Environmental Impact Study (EIS) is required as part of this process. A field study to gather the biological information which would be incorporated into the EIS was conducted in October 1986 for approximately 600 acres; a survey was later conducted in September 1987 for the additional 250 acres.

2.0 FLORA SURVEY

The primary objectives of the survey were to describe and inventory the vegetation; search for rare, threatened or endangered species of plants; and to identify areas of potential environmental problems or concerns.

Field work was conducted on 23 October 1986 for the ± 600-acre parcel and on 10 September 1987 for the ± 250-acre parcel.

A total of 60 plant species was found on the project site. Of these, 56 (93.3%) are introduced or exotic species, 3 (5%) are native, and 1 (1.7%) is of early Polynesian introduction.

2.1 Survey Methods

Prior to undertaking the field survey, a search was made of the pertinent literature to familiarize the principal investigator with other biological studies conducted in the general area.

Existing topographic maps, as well as an aerial photograph, were examined to determine access, terrain characteristics, and potential logistical and technical problems. Access onto parts of the project site was provided by the paved and unpaved roads (cane-haul roads) which transect the site.

A walk-through survey method was used. Species were identified in the field; plants which could not be positively identified were collected for later determination in the herbarium and laboratory. Notes were made of the species present in each of the major vegetation types. The species recorded are indicative of the season (rainy vs. dry) and environmental conditions under which this survey was taken. Surveys taken at different times of the year and under varying environmental conditions, would no doubt yield slight variations in the kinds of plants recorded. The abundance of weedy, annual species may vary significantly.

2.2 Description of Vegetation

In their survey of the 'Ewa Plains flora for the U.S. Fish and Wildlife Service, Char and Balakrishnan (1979) mapped most of the ± 850-acre project site as sugar cane fields; scattered patches of koa-haole were distributed around the margins of the project site. A more recent study by Char and Whistler (1986b) of an adjacent ± 1,400-acre parcel also describes similar vegetation types.

During the present survey, three major vegetation types are recognized on the project site. Actively cultivated sugar cane fields cover most of the area. Along the Naval Air Station fence is a thicket composed of koa-haole shrubs and scattered kiawe trees. A weedy mixture of small shrubs, grasses, and herbs is found along the paved roadsides.

Cane Fields. This vegetation type covers the most area on the ± 850-acre parcel. Associated with the cane fields is a network of unpaved cane-haul roads and irrigation and drainage systems. Makakilo and Makalapa Gulches drain this area. Both drainage systems have been highly modified.

Weedy species which are found associated with these cultivated fields include nutgrass (Cyperus rotundus), swollen fingergrass (Chloris inflata), red pualele (Emilia fosbergii), sowthistle (Sonchus oleraceus), and hairy spurge (Euphorbia hirta). Locally common along the margins of the fields are two vines, wild bitter melon (Momordica charantia var. pavel) and little bell (Ipomoea triloba).

Drainage areas support a dense growth of Californiagrass (Brachiaria mutica), two Panicum species, and Natal redtop (Rhynchelytrum repens). Scattered clumps of castor bean (Ricinus cummunis) and koa-haole (Leucaena leucocephala) shrubs are also frequently encountered.

The spiny-fruited puncture vine (Tribulus terrestris) is locally abundant on some of the cane-haul roads.

Roadside Vegetation. Along the paved roads, i.e. Farrington Highway and Fort Barrette Road, is a narrow band of vegetation which is periodically maintained. The roadside or ruderal vegetation is composed of a mixture of grass, small shrub, and herbaceous species. These species are weedy in nature and have adapted to the more or less frequent disturbances from vehicular and pedestrian traffic as well as periodic mowing, clearing, and herbicide treatment.

The most abundant element in this vegetation type is buffelgrass (Cenchrus ciliaris). Also abundant is pitted beardgrass (Andropogon pertusus). Other grasses occasionally found here include Bermuda grass (Panicum maximum), and sourgrass (Tricachne insularis). Among the small shrubs and weedy annual species, the following are frequently encountered: spiny amaranth (Amaranthus spinosus), several weedy Euphorbia species, golden crown-beard (Verbesina encelioides), coat buttons (Tridax procumbens), partridge pea (Cassia lechenaultiana), indigo (Indigofera suffruticosa), 'uhaloa (Waltheria indica var. americana), and 'ilima (Sida fallax).

Kiawe - Koa-haole Thicket. This vegetation type consists of very scattered kiawe trees (Prosopis pallida) with a rather dense cover of koa-haole shrubs (Leucaena leucocephala) filling in the matrix between the trees. Buffelgrass (Cenchrus ciliaris) forms a more or less dense ground cover. A number of sisal plants (Agave sisalana) are found in this vegetation type. Sisal was grown on the 'Ewa Plains from 1893 to the 1920's to provide material for sisal or marine rope and sisal twine.

The OR&L (Oahu Railway and Land Company) right-of-way, with rail bed and tracks, runs along the length of this vegetation type.

2.3 Rare, Threatened or Endangered Plants

The project site has been actively cultivated for a long time. Today, those areas which are not actively cultivated support a vegetation dominated by introduced species such as koa-haole, buffelgrass, and Guinea grass. Wild descendants of sisal plants, which were once cultivated, are found in the kiawe - koa-haole thicket.

Two officially listed (federal and state) endangered plants, the 'Ewa Plains 'akoko (Euphorbia skottsbergii var. kalaeloana) and Achyranthes rotundata, are found on the nearby Naval Air Station, however, no plants considered rare, threatened or endangered by federal and state governments (U.S. Fish and Wildlife Service 1980; Fosberg and Herbst 1975) occur on the project site itself. In an earlier survey of the 'Ewa Plains, Char and Balakrishnan (1979) did not report any such plants from the ± 850-acre parcel.

The three native species found during this survey -- 'uhaloa, 'ilima, popolo -- are found throughout the Hawaiian Islands and the Pacific. They are often considered "weedy natives" as they favor disturbed areas.

3.0 FAUNA SURVEY

The following survey was undertaken to provide information primarily on the bird and mammal populations on the ± 850-acre Kapolei Village parcel proposed for development.

Ten species of birds were recorded from the study site: nine are foreign (or introduced) species and one is an indigenous migratory species. Only one species of mammal, the Indian Mongoose, was recorded from the site.

3.1 Survey Methods.

The field work was carried out on 23 October 1986 between the hours of 0800 and 1400 and 10 September 1987 between 0630 and 0800. Birds were detected both by sight and by their vocalizations. To ensure a more complete study, the list of birds recorded during the field survey was compared with checklists made from other bird surveys for the Environmental Impact Statements of nearby areas such as Makakilo (U.S. Department of Housing and Urban Development 1978), Barbers Point Deep-draft Harbor (M. & E. Pacific 1978), and Campbell Industrial Park (Belt, Collins and Associates 1980). Two other recent checklists (Char and Whistler 1986a, 1986b) compiled from studies of adjacent parcels were also examined.

Although no mammals were observed on the study site, their presence was determined indirectly by tracks and scat.

3.2 Faunal Habitats

The study site is covered by three basic types of vegetation: (1) cane fields, including the vegetation occurring along the margins of fields and in drainage ditches; (2) roadside vegetation, occurring mostly along the paved and unpaved roads; and (3) kiawe - koa-haole thicket which occurs primarily along the Barbers Point Naval Air Station boundary. More complete descriptions of these vegetation types can be found in the flora survey.

Over the three types of vegetation, a total of ten bird species was recorded. Due to the highly disturbed nature of the vegetation, all but one of the bird species observed were introduced (or foreign) ones. The sole native species, the Pacific Golden Plover (_Pluvialis dominica_), is a wide-ranging migratory species. The nine introduced species were the Cattle Egret (_Bulbulcus ibis_), Spotted Dove (_Streptopelia chinensis_), Zebra Dove (_Geopelia striata_), Black-rumped Waxbill (_Estrilda troglodytes_), Chestnut Mannikin (_Lonchura malacca_), Northern Cardinal (_Cardinalis cardinalis_), Red Avadavat (_Amandava amandava_), Red-vented Bulbil (_Pycnonotus cafer_), and Common Myna (_Acridotheres tristis_).

No mammals were actually observed on the site, but tracks of the Indian Mongoose (_Herpestes auropunctatus_) were found along the edge of the cane fields.

A number of other bird and mammal species are also likely to use the study site, or at least pass through on occasion. The Mockingbird (_Mimus polyglottos_), reported from the Barbers Point Deep-draft Harbor site (M. & E. Pacific 1978) and Campbell Industrial Park (Belt, Collins and Associates 1980), can be expected to utilize the study area to some degree. Four other bird species which are common in the thickets in adjacent parcels are the Red-crested Cardinal (_Paroaria coronata_), House Finch (_Carpodacus mexicanus_), House Sparrow (_Passer domesticus_), and the Japanese White-eye (_Zosterops japonica_). Another bird, the Nutmeg

Mannikin (Lonchura punctulata), is commonly seen in adjacent areas feeding in overgrown grassy areas and can be expected to utilize the study site.

Other mammal species which are likely to be found on the study site but were not observed during this survey include the Roof Rat (Rattus rattus), the Norway Rat (Rattus norvegicus), the Polynesian Rat (Rattus exulans), the House Mouse (Mus musculus), and, possibly, also feral dogs (Canis familiaris) and feral cats (Felis catus).

No terrestrial reptiles or amphibians were noted during the study. The Hawaiian Islands do not have any native amphibians or terrestrial reptiles. It is likely, however, that introduced gecko and skink species, such as the Mourning Gecko (Lepidodactylus lugubris), occur on the project site in those areas with shrubs and trees.

3.3 Annotated Species List

Common and scientific names of the bird species are in accordance with those listed in Hawaii's Birds (Hawaii Audubon Society 1984).

Birds (Aves)

A. ARDEIDAE

Cattle Egret (Bulbulcs ibis); Foreign

The Cattle Egret is common in the Pearl Harbor area where it feeds in wetlands and occasionally in disturbed, dryland areas. Several egrets were seen flying over the study site, but this species is not likely to make much use of the area because of the lack of suitable habitat.

B. CHARADRIIDAE

Pacific Golden Plover (Pluvialis dominica); Migratory

The Pacific Golden Plover (also called American Golden Plover and Kolea in Hawai'i) is an indigenous, migratory species which winters in the islands and leaves for the Arctic by April. It is found in various open habitats from sea level to 10,000 ft. elevation. Several plover were seen feeding in recently plowed cane fields, both in the October 1986 and September 1987 surveys.

C. COLUMBIDAE

Spotted Dove (Streptopelia chinensis); Foreign

The Spotted Dove (also known as the Chinese Dove or Lace-necked Dove) is an introduced species which is common in cultivated and habitated areas throughout the islands. At the study site, many individuals were observed on the ground in open places.

Zebra Dove (Geopelia striata); Foreign

The Zebra Dove (also known as Barred Dove) is an introduced species which is very common in cultivated and habitated areas throughout the islands, often congregating in flocks. At the study site, numerous, mostly solitary birds were observed on the ground in open, weedy areas.

D. FRINGILLIDAE

Black-rumped Waxbill (Estrilda troglodytes); Foreign

The Black-rumped Waxbill (also known as Red-eared Waxbill) was reported in Hawaii's Birds as occurring around Diamond Head. At the study site it is common in flocks on the edges of the cane fields and in weedy areas with tall grass.

Chestnut Mannikin (Lonchura malacca); Foreign

The Chestnut Mannikin (also known as Black-headed Munia or Black-Headed Mannikin) is an introduced species reported to be particularly common around Pearl Harbor and Wahiawa. At the study site, it is common in flocks or singly along the edges of cane fields and in weedy areas.

Northern Cardinal (Cardinalis cardinalis); Foreign

The Northern Cardinal (also called Kentucky Cardinal) is an introduced species occasional to common in the lowlands of the larger main islands. It is occasional at the study site in the kiawe - koa-haole thicket.

Red Avadavat (Amandava amandava); Foreign

The Red Avadavat (also called Red Munia or Strawberry Finch) is an introduced species which is common around Pearl Harbor. At the study site it is rather common in grassy areas and on the edge of the cane fields, singly or in mixed flocks with other species of mannikin.

E. PYCNONOTIDAE

Red-vented Bulbil (Pycnonotus cafer); Foreign

The Red-vented Bulbil is an introduced bird which in recent years has become common in urban areas on the island of O'ahu. It was occasional at the study site, but since it lacks its preferred habitats of urban and wooded areas, it probably makes little use of the study site.

F. STURNIDAE

Common Myna (Acridotheres tristis); Foreign

The Common Myna is an introduced species which is widespread in habitated and agricultural areas, only occasionally found in forested areas. At the study site it was occasional in cultivated areas, however, most of the individuals seen were just flying through the area and are not likely to make much use of it.

Mammals (Mammalia)

A. VIVERRIDAE

Indian Mongoose (Herpestes auropunctatus); Foreign

Scat and tracks of mongoose were seen along the edge of the cane fields and it can be expected to occur in all three vegetation types.

3.4 Threatened or Endangered Fauna

No threatened or endangered vertebrate animal species were observed in the study area during the course of this survey.

Although there are ponds in an abandoned quarry on the adjacent parcel west of the study site, there are no wetlands of any kind on the study site. Hence, no native waterbirds are expected here. There are also no significant wooded areas on the site and the site does not provide suitable nesting and roosting areas.

The Hawaiian Owl or Pueo (Asio flammeus sandwichenis), which is scarce on O'ahu and prefers areas with less human activity, would not find suitable roosting areas at the site.

The endangered Hawaiian Hoary Bat or 'ope'ape'a (Lasiurus cinereus semotus) is the only native land mammal in the Hawaiian Islands. It may fly into the area to feed in the evenings but there is no record of this. Bats forage for insects in openings in woodlands, along the shore or over ponds and streams near the sea during dusk and at night. Very little is known about the habits of this species (Tomich 1969; Van Riper and Van Riper 1982).

4.0 DISCUSSION AND RECOMMENDATIONS

The vegetation on the project site consists almost exclusively of actively cultivated sugar cane fields. Uncultivated areas support a ruderal or roadside vegetation type composed of a weedy mixture of grasses, shrubs, and herbs. A thicket of scattered kiawe trees and koa-haole shrubs lines the Barbers Point Naval Air Station boundary.

The proposed project is not expected to have a significant impact on the flora as it consists primarily of cultivated lands. The few native plant species which are found here occur in similar environmental habitats throughout the islands; none of the plant species are rare, threatened or endangered. There is little of botanical interest on the site.

The terrestrial vertebrate fauna is composed primarily of foreign or introduced species. Of the 10 avian species observed at the project site, only one, the Pacific Golden Plover, is an indigenous migratory species. Tracks of the introduced Indian Mongoose were found. No endangered native fauna were observed at the project site.

The project site does not provide suitable habitat for native terrestrial fauna. Some of the introduced bird species, especially those commensal with man such as the Common Myna and House Sparrow, are expected to increase in numbers when the project is completed as it will provide more available habitat -- trees, grassy areas, etc.

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APPENDIX A. PLANT SPECIES LIST, PROPOSED KAPOLEI VILLAGE PROJECT, 'EWA DISTRICT, O AHU

In the plant species list, families are arranged alphabetically within each of two groups: Monocotyledons and Dicotyledons. Taxonomy and nomenclature of the flowering plants, Monocotyledons and Dicotyledons, follow St. John (1973) except where more recently accepted names are used. Hawaiian names are in accordance with Porter (1972) or St. John (1973). The following information is provided:

1. Botanical name with author citation.
2. Common English or Hawaiian name, when known.
3. Biogeographic status of the species. The following symbols are used:
   - I = indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s)
   - P = Polynesian = plants of Polynesian introduction; all those plants brought by the Polynesian immigrants prior to contact with the Western world
   - X = introduced or exotic = not native to the Hawaiian Islands; brought here intentionally or accidentally after Western contact
4. Vegetation types. Three vegetation types are recognized on the project site and are discussed in detail in the text. The symbol heading each of the columns refers to the following vegetation types:
   - c = cane fields
   - r = roadside vegetation
   - k = kiawe - koa-haole thicket
5. Relative abundance within each of the three vegetation types; absence is noted by a dash (-). These ratings reflect the abundance of the particular species within the project area and are not applicable to areas outside the project. The following symbols are employed:
   - A = abundant = the major or dominant species in a given vegetation type
   - C = common = distributed in large numbers throughout a given vegetation type

   - L = locally common = found in localized patches where it occurs in relatively large numbers but otherwise occasional to rare within a certain vegetation type
   - O = occasional = occurring widely throughout a given vegetation type in moderate numbers
   - U = uncommon = observed infrequently but not more than 10 times in a certain vegetation type
   - R = rare = observed 1 to 10 times in a certain vegetation type.

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPE c	r	k
MONOCOTYLEDONS					
AGAVACEAE (Agave Family)					
Agave sisalana Perrine ex Engelm.	sisal, malina	X	-	-	O
COMMELINACEAE (Spiderwort Family)					
Commelina diffusa Burm. f.	honohono	X	R	-	-
CYPERACEAE (Sedge Family)					
Cyperus rotundus L.	nutgrass	X	O	-	-
GRAMINEAE (Grass Family)					
Andropogon aristatus Poir.	Wilder grass	X	-	U	-
Andropogon pertusus (L.) Willd.	pitted beardgrass	X	U	C	O
Brachiaria mutica (Forsk.) Stapf	Californiagrass	X	L	-	-
Cenchrus ciliaris L.	buffelgrass	X	L	A	A
Chloris inflata Link	swollen fingergrass, mau'ulei	X	O	O	O
Cynodon dactylon (L.) Pers.	Bermuda grass, manienie	X	O	O	U
Dactyloctenium aegyptium (L.) Willd.	beach wiregrass	X	R	-	-
Eleusine indica (L.) Gaertn.	wiregrass	X	-	U	-
Panicum maximum Jacq. var. maximum	Guinea grass	X	L	O	O
Panicum maximum var. trichoglume Eyles ex Robyns	green panicgrass	X	U	-	-
Rhynchelytrum repens (Willd.) C.E. Hubb.	Natal redtop	X	L	O	U
Saccharum officinarum L.	sugar cane, ko	P	A	-	R
Setaria verticillata (L.) Beauv.	bristly foxtail	X	U	-	-
Sporobolus africanus (Poir.) Robyns & Tournay	African dropseed	X	-	U	-
Tricachne insularis (L.) Nees	sourgrass	X	-	O	-

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPES c	r	k
DICOTYLEDONS					
AMARANTHACEAE (Amaranth Family)					
Amaranthus spinosus L.	spiny amaranth	X	O	O	U
Amaranthus viridus L.	slender amaranth	X	-	O	-
COMPOSITAE (Daisy Family)					
Bidens cynapifolia HBK.	West Indian beggar's tick	X	U	-	-
Bidens pilosa L.	Spanish needle, ko'oko'olau	X	-	R	-
Calyptocarpus vialis Less.	hierba del cabello	X	-	O	-
Emilia fosbergii Nicolson	red pualele	X	O	O	-
Pluchea odorata (L.) Cass.	pluchea	X	-	U	-
Sonchus oleraceus L.	sowthistle, pua-lele	X	O	-	-
Tridax procumbens L.	coat buttons	X	U	O	U
Verbesina encelioides (Cav.) B. & H. ex Gray	golden crown-beard	X	U	O	U
Wedelia trilobata (L.) Hitchc.	wedelia	X	-	U	-
CONVOLVULACEAE (Morning-glory Family)					
Ipomoea obscura (L.) Ker-Gawl		X	R	-	-
Ipomoea triloba L.	little bell	X	L	U	-
CUCURBITACEAE (Squash Family)					
Cucurbita pepo L.	pumpkin, pala'ai	X	R	-	-
Momordica charantia var. pavel Crantz	wild bittermelon	X	L	O	O
EUPHORBIACEAE (Spurge Family)					
Euphorbia geniculata Ortega	wild spurge, kaliko	X	O	U	-
Euphorbia glomerifera (Millsp.) L.C. Wheeler		X	-	O	-
Euphorbia heterophylla var. cyathophora (Murr.) Griseb.	Mexican fire plant	X	U	-	-

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPES c	r	k
Euphorbia hirta L.	hairy spurge	X	O	O	U
Euphorbia prostrata Ait.	prostrate spurge	X	-	O	-
Ricinus communis L.	castor bean, koli	X	L	O	U
LABIATAE (Mint Family)					
Leonotis nepetaefolia (L.) Ait. f.	lion's-ear	X	U	-	-
LEGUMINOSAE (Pea Family)					
Cassia lechenaultiana DC.	partridge pea, lauki	X	-	O	-
Cassia surattensis Burm. f.	kolomona	X	-	R	-
Crotalaria incana L.	fuzzy rattlepod	X	U	R	-
Desmanthus virgatus (L.) Willd.	virgate mimosa	X	U	O	-
Desmodium canum (Gmel.) Schinz. & Thell	Spanish clover	X	-	O	-
Indigofera suffruticosa Mill.	indigo	X	-	O	-
Leucaena leucocephala (Lam.) de Wit	koa-haole, ekoa	X	L	O	A
Phaseolus lathyroides L.	cow pea, wild bush bean	X	-	L	-
Prosopis pallida (Humb. & Bonpl. ex Willd.) HBK.	kiawe, mesquite	X	-	R	O
Samanea saman (Jacq.) Merr.	monkeypod	X	-	R	-
MALVACEAE (Hibiscus Family)					
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	X	U	-	U
Malvastrum coromandelianum (L.) Garcke	false mallow	X	-	O	-
Sida fallax Walp.	'ilima	I	U	O	O
Sida rhombifolia L.	Cuba jute	X	-	O	-
Sida sp.		X	-	R	-
NYCTAGINACEAE (Four o'clock Family)					
Boerhavia coccinea Mill.		X	R	U	-

SCIENTIFIC NAME	COMMON NAME	STATUS	VEGETATION TYPES c	r	k
PORTULACACEAE (Purslane Family)					
Portulaca oleracea L.	common purslane, 'ihi	X	R	U	-
SOLANACEAE (Tomato Family)					
Solanum nigrum L.	popolo	I?	R	-	-
STERCULIACEAE (Cocoa Family)					
Waltheria indica var. americana (L.) R. Br. ex Hosaka	'uhaloa, hi'aloa	I	U	O	U
ZYGOPHYLLACEAE (Tribulus Family)					
Tribulus terrestris L.	puncture vine	X	L	U	-

Table 1.— OSCo ACREAGE REQUIREMENTS FOR ONE AND TWO MILLS, BY YIELD LEVEL[1]

Yield (tons of raw sugar per harvested acre)	One Mill[2] (67,500 tons of raw sugar per year)	Two Mills[3] (92,500 tons of raw sugar per year)
10	13,500 acres	18,500 acres
11	12,273	16,818
11.3 (1979 average yield)	11,947	16,372
12	11,250	15,412
13	10,385	14,231
14	9,643	13,214
15 (1987 average yield)	9,000	12,333
16 (1995 conservative projection)	8,438	11,563
17	7,942	10,882
18 (2008 conservative projection)	7,500	10,278
19	7,105	9,737
20	6,750	9,250
21	6,429	8,810
21.6 (record yield)	6,241	8,553
22	6,136	8,409

[1]It is assumed that one-half of the acreage is harvested annually.

[2]The estimated output from a one-mill operation would be from 60,000 to 75,000 tons of raw sugar per year.

[3]Current production from the two-mill operation is from 90,000 to 95,000 tons of raw sugar per year.

Table 1 indicates that OSCo could reduce acreage and maintain economies of scale by increasing its average yield and/or switching from a two- to a single-mill operation. Increasing the average yield to 16 tons per acre would reduce land requirements from the current 13,540 acres to about 11,560 acres, thereby freeing about 1,980 acres. If the average yield were to increase to 18 tons per acre, this would reduce land requirements to about 10,280 acres, which would free about 3,260 acres. Switching from a two- to one-mill operation while maintaining yields at 15 tons per acre would reduce land requirements to about 9,000 acres and free about 4,540 acres. Switching to a single mill and increasing yields to 16 tons per acre would reduce land requirements to about 8,440 acres, and free about 5,100 acres. Finally, switching to a single mill and increasing yields to 18 tons per acre would reduce land requirements to only about 7,500 acres, and free about 6,040 acres.

Although these acreage reductions would allow economies of scale to be maintained, economic viability will also depend on other factors, one of the most important of which will be a favorable U.S. price for sugar. The agricultural quality of the lands which remain, and the form of the plantation would also be important. In general, any reduction in the plantation lands should occur from the outside in because this would result in a compact plantation with high-quality lands: a more compact plantation reduces trucking and other costs, while higher quality lands contribute to higher yields.

Outlook for OSCo

Assuming that U.S. sugar prices will continue to be high enough to justify continued sugar operations in Hawaii, an important question is whether Kapolei Village—combined with other planned and proposed projects—would eventually cause the closing of OSCo, either by reducing sugarcane acreage sufficiently to reduce economies of scale, and/or by contributing to a scattered and therefore inefficient plantation rather than a more compact and efficient one. The concern is over three proposed projects: Kapolei Village, Kapolei Town Center, and Ewa Gentry.

Outlook to 1995

Assuming that all the planned and proposed developments previously listed are approved, a 20-year average development period for the housing, commercial, and resort projects, and at least a one-year delay before construction begins for most of the projects, then the loss of sugarcane acreage by the end of 1995 when the major lease with Campbell Estate expires would be about 1,780 acres. Remaining acreage under cultivation by OSCo would fall from 13,540 acres to about 11,760 acres, assuming no replanting of fallowed land.

In terms of land required to maintain economies of scale, 11,760 acres would provide sufficient land to maintain a two-mill operation, assuming the projected average yield of about 16 tons per year in 1995 (see Table 1).

In terms of the form of the plantation, the development sequence for Kapolei Village and Kapolei Town Center would proceed from mauka to makai (from north to south). This is not the preferred sequence (from the outside in, which is west to east), nor is it the worst sequence (from within the plantation towards the outside, which is from east to west). For Ewa Gentry, the development sequence would be from Ewa Villages starting on land already approved for development, then proceeding makai. Again, this is not the preferred sequence, but it does proceed from an existing urban area in an outward direction toward inferior lands rather than inward toward superior lands.

If the resulting form of the plantation proves to be inefficient for a two-mill operation (or if urbanization proceeds much more rapidly than projected), then an efficient sugar operation could be achieved by switching to a one-mill operation. For this case, land requirements would be about 8,440 acres, assuming a yield of 16 tons per acre (see Table 1). This would provide a buffer of 3,320 acres from which to assemble an efficient plantation; the figure of 3,320 acres is based on 11,760 acres remaining after projected urbanization assuming approval of all planned and proposed projects, minus the estimated 8,440 acres needed for a one-mill operation.

In summary, by the end of 1995 when the major lease with Campbell Estate expires, Kapolei Village, in combination with other planned and proposed projects, is not expected to threaten the economic viability of OSCo. However, in order to retain economic viability, a switch from a two- to a one-mill operation may be required if urbanization proceeds rapidly, or if the sequence of urbanization results in a scattered plantation that is inefficient for a two-mill operation.

Long-Term Outlook

Assuming approval and full development of all the planned and proposed projects, the amount of land under cultivation by OSCo would decline by 5,022 acres, from 13,540 acres to about 8,520 acres. If development proceeds gradually, and if yields increase sufficiently (possibly resulting from advances in genetic engineering), then it is conceivable that OSCo could maintain economies of scale and an economically viable operation with two mills. It is more likely, however, that a

switch to a one-mill operation would be required to maintain economic viability. Assuming an average yield of 18 tons per acre, a one-mill operation would require about 7,500 acres. This would provide a buffer of about 1,020 acres from which to assemble an efficient plantation; the figure of 1,020 acres is based on 8,520 acres remaining after urbanization assuming approval of all planned and proposed projects, minus the estimated 7,500 acres needed for a one-mill operation.

In summary, given a change from a two- to a single-mill operation, Kapolei Village, in combination with other approved and proposed projects, is not expected to threaten the economic viability of OSCo.

Economic Impact of Reducing OSCo Operations

Assuming that a two-mill operation remains economically viable, little or no loss in revenues to OSCo would occur as a result of urbanizing sugarcane lands because production would remain near its current level. Also, the reduction in employment associated with the projected reduction in acreage is not expected to require any layoffs of sugar workers since OSCo makes a practice of reducing employment through attrition.

For a one-mill operation, production would decline by about 25,000 tons of raw sugar per year, or 27 percent of current production. Based on 1986 prices ($334.59 per ton for sugar, and $45.80 per ton for molasses, with one-third of a ton of molasses produced for each ton of sugar), lost revenues would amount to about $8.7 million per year. But because less sugar would be grown and milled, production costs would also decline. Whether or not attrition would be sufficient to accommodate a reduction in employment associated with a switch to a one-mill operation is uncertain.

Economic Impact of Closing OSCo

If OSCo were to cease operations for whatever reason (most likely because of low sugar prices), the loss of jobs would be less than 450 direct jobs and 510 indirect jobs, with the actual number dependent upon the reduced employment made possible by continuing productivity increases. This would be the economic equivalent of losing of a hotel about half the size of the Hyatt Regency in Waikiki. Immediately following the mill closing, there would be a significant economic loss and social disruption. But over the long term, the economic loss would be absorbed easily by expanding economic opportunities in the Ewa/Central-Oahu area. For example, the new hotels at Ko Olina will be the equivalent of about nine OSCos in terms of direct plus indirect jobs and—when tip income and all indirect jobs are considered—will provide higher average wages (based on analysis with the State Economic Model). Other new jobs in the Ewa area will be provided by Barbers Point Harbor, expansion of Campbell Industrial Park, development of Kopolei Town Center, growth of diversified agriculture made possible by lands freed from sugar (growth which is likely to be at the expense of Neighbor Island farmers), and other economic activities which may be attracted to the area or which may occur spontaneously due to of the increased availability of land and water, and lower urban land costs than would otherwise be the case. Therefore, most if not all sugar employees can be expected to find other employment if this should be required. However, some unskilled sugar workers and those having non-transferable skills may receive reduced pay when and if they are forced to find non-sugar jobs.

Assuming a policy favoring rapid urbanization of lands freed by the closing of sugar operations—a policy which presumably would be designed to increase the supply of land for housing and various economic opportunities, and increase competition among landowners and developers, with the objective of decreasing housing costs and increasing economic opportunities—three to four decades, or even longer, would be required to absorb the land. During this period, a huge supply of land and water would remain available for diversified agriculture and other economic activities. Even at full urbanization, over 2,000 acres would remain available for agriculture in the blast zone surrounding the Navy's magazine storage area located at West Loch, Pearl Harbor.

IMPACT ON WAIALUA SUGAR COMPANY

If OSCo ceases operations for whatever reason, the profitability of WSCo would be decreased—an operation which employs about 450 workers. This is because OSCo's contribution to the Honolulu Harbor terminal charges would be lost. In 1986, these charges were $978,000, of which $418,800 were WSCo's share. If only WSCo's production were to be handled by the Harbor, then the terminal manager estimates that the charge would be only about $100,000 less than currently. Therefore, the terminal charge to WSCo would increase from $418,800 to about $878,000, or an increase of $460,000. Based on WSCo's 1986 production of 72,446 tons, the increase in WSCo's cost amounts to 0.3 cent per pound. This is less than a 2-percent increase in the cost of production.

Rather than absorb the increased terminal charges, a more profitable alternative would be to increased the refining capacity of C&H in Aiea from about 45,000 tons per year to about 72,500 tons per year so as to process all of the WSCo

production. A crude estimate for the cost of the plant expansion is about $2 million. Refined sugar in excess of the 36,000-ton-per-year Hawaii requirements would be shipped at favorable backhaul rates to Los Angeles and Seattle. Currently, Hawaiian sugar is delivered to these markets by rail from the C&H refinery in Crockett, California near San Francisco. The economic feasibility of this alternative is considered to be "very probable."

In view of the above, a closing of OSCo for whatever reason is unlikely to force the closing of WSCo. Like OSCo, the future economic health of WSCo will be determined primarily by the price of sugar in the U.S. market.

IMPACT ON DIVERSIFIED AGRICULTURE

The development of Kapolei Village is an irretrievable commitment of prime agricultural land to urban use. For the purposes of this discussion, prime agricultural land is loosely defined to mean any high-quality agricultural land capable of providing high yields for a variety of crops, and would include the lands currently cultivated in the petition area. This commitment to urban use raises the question of whether Kapolei Village would affect adversely the development of diversified agriculture (including aquaculture), either immediately or in the long term. Before addressing this question, the demand for and the supply of prime agricultural land for diversified agriculture is clarified.

Demand for Prime Agricultural Land

As part of its analysis to identify IAL (see page 2), the LESA Commission adopted projections of the amount of agricultural land required to increase food and animal-feed self-sufficiency given resident plus visitor population growth, and increased crop exports. The projections for the State and Oahu are shown in Tables 2 and 3, respectively. As indicated, an estimated 52,684 additional acres will be required Statewide to accommodate the the 1983-to-1995 increase in production. The corresponding figure for Oahu is 7,979 acres. As shown, the crops and acreage requirements are categorized according to those which generally do not require prime agricultural land (although some crops may be grown profitably on prime agricultural land), those crops which generally do require prime agricultural land, plus a contingency of 10 percent of all acreage other than for beef and cattle.

It should be noted that the LESA projections and the corresponding Illustrative Generalized IAL Maps contain, or appear to contain, a number of major flaws which have led to a gross overestimation of the amount of agricultural land required:

Table 2.— **LESA AGRICULTURAL ACREAGE REQUIREMENTS, STATE OF HAWAII: 1983 AND 1995**

Crop or Activity	1983	1995	Increase
Crops and Activities which Generally Do Not Require Prime Agricultural Lands			
Beef/cattle[1,2]	765,450	365,090	--
Livestock:			
Dairy	1,000	1,182	182
Eggs/Poultry	281	515	234
Swine	600	1,050	450
Subtotal for Livestock	1,881	2,747	866
Unique Crops:			
Aquaculture	500	4,500	4,000
Coffee	2,000	5,700	3,700
Flowers/Nursery	1,786	3,040	1,254
Papaya	2,120	11,850	9,730
Taro/Watercress	400	527	127
Subtotal for Unique Crops	6,806	25,617	18,811
Macadamia Nuts	15,800	27,000	11,200
Crops and Activities which Generally Do Require Prime Agricultural Lands			
Plantation:[2,3]			
Sugarcane	194,300	177,700	-16,600
Pineapple	36,000	36,049	49
Subtotal for Plantation	230,300	213,749	-16,551
Other:			
Guava	965	1,400	435
Seed Corn	730	1,060	330
Bananas	1,100	2,200	1,100
Feed/Forage[2,4]	8,705	12,495	3,790
Fruits	635	1,156	521
Vegetables/Melons[5]	4,340	7,022	2,682
Subtotal for Other Crops	16,475	25,333	8,858
Contingency[6]	--	29,500	29,500
TOTAL	1,036,712	689,036	--
TOTAL, Excluding Beef/Cattle	271,262	323,946	52,684

Table 2.— **LESA AGRICULTURAL ACREAGE REQUIREMENTS, STATE OF HAWAII: 1983 AND 1995**
(continued)

[1] Includes marginal grazing and pasture lands. The 1983 figure includes arid zones and other areas having low carrying capacity, while the 1995 figure does not.

[2] Often includes land in a holding operation awaiting discovery of profitable uses.

[3] The decline in acreage primarily reflects the loss of Puna Sugar Co.

[4] Includes some pasture and 8,000 of guinea grass from Molokai.

[5] Overstated in that the acreage figures are for harvested acres, not the amount of land required.

[6] Based on 10% of all acreage other than that for beef/cattle. Adding a contingency amounts to double counting in that the projections are optimistic to begin with. Also, the contingency figure includes 17,770 acres for expansion of sugarcane, even though the sugar industry is expected to decline, not expand.

Table 3.— **LESA AGRICULTURAL ACREAGE REQUIREMENTS, CITY AND COUNTY OF HONOLULU: 1983 AND 1995**

Crop or Activity	1983	1995	Increase
Crops and Activities which Generally Do Not Require Prime Agricultural Lands			
Beef/cattle[1,2]	18,200	10,090	--
Livestock:			
Dairy	340	402	62
Eggs/Poultry	250	390	140
Swine	144	200	56
Subtotal for Livestock	734	992	258
Unique Crops:			
Aquaculture	300	2,400	2,100
Flowers/Nursery	495	850	355
Papaya	70	170	100
Taro/Watercress	60	85	25
Subtotal for Unique Crops	925	3,505	2,580
Crops and Activities which Generally Do Require Prime Agricultural Lands			
Plantation:			
Sugarcane[2]	27,200	25,300	-1,900
Pineapple	11,829	11,800	-29
Subtotal for Plantation	39,029	37,100	-1,929
Other:			
Guava	--	242	242
Seed Corn	125	180	55
Bananas	540	836	296
Feed/Forage[2,3]	1,741	2,912	1,171
Fruits	90	200	110
Vegetables/Melons[4]	1,155	1,595	440
Subtotal for Other Crops	3,651	5,965	2,314
Contingency[5]	--	4,756	4,756
TOTAL	62,539	62,408	--
TOTAL, Excluding Beef/Cattle	44,339	52,318	7,979

Table 3.— **LESA AGRICULTURAL ACREAGE REQUIREMENTS, CITY AND COUNTY OF HONOLULU: 1983 AND 1995**
(continued)

[1] Includes marginal grazing and pasture lands. The 1983 figure includes arid zones and other areas having low carrying capacity, while the 1995 figure does not.

[2] Often includes land in a holding operation awaiting discovery of profitable uses.

[3] Includes some pasture.

[4] Overstated in that the acreage figures are for harvested acres, not the amount of land required.

[5] Based on 10% of all acreage other than that for beef/cattle. Adding a contingency amounts to double counting in that the projections are optimistic to begin with. Also, the contingency figure includes 2,530 acres for expansion of sugarcane, even though the sugar industry is expected to decline, not expand.

—Based on a thorough, in-depth, and widely reviewed analysis of the market potential for crops grown on Molokai (Plasch and Garrod), and analysis of previous projections distributed by the State of Hawaii Department of Agriculture, the LESA projection for diversified agriculture appears to be excessively optimitistic. Apparently, it is assumed that many unprofitable crops will become profitable, that Hawaii farmers will be able to undersell low-cost summer crops from California, and that each and every activity will experience rapid growth. Verification of the exent of these flaws is hampered by the fact that the assumptions and analysis which underlie the LESA projections have not been made available for public inspection.

—Some of the acreage estimates are for harvested acreage, which leads to an overestimate of the land requirements for those crops which are harvested more than once a year (e.g., a crop harvested twice a year should have its acreage requirement halved).

—The LESA contingency of 29,500 acres is excessive, especially since LESA projects a requirement for less than 9,000 additional acres of prime agricultural lands. The contingency is large primarily because the LESA methodology implicitly allows for expansion of sugar operations—a grossly unrealistic possibility. Furthermore, the contingency amounts to double counting since optimistic projections have a built-in contingency.

—The LESA methodolgy assumes that prime agricultural lands that were freed from sugar and pineapple production and placed in pasture or some other low-profit operation will stay in these uses. This is very unrealistic in that these are holding operations for land until profitable crops can be identified:

—The LESA methodolgy incorrectly assumes that sugar is a healthy industry, and that sugar lands would be unavailable for more profitable replacement crops.

—The Illustrative Generalized IAL Maps incorrectly allocates prime agricultural lands to certain activities which do not need such lands (e.g., aquaculture should be allocated the agriculturally low-quality coastal lands at Kahuku).

The relevant figures from Tables 2 and 3 are not the total figures, but the increase in the amount of prime agricultural land required to accommodate diversified agriculture: the increase is 8,858 acres for the State, and 2,314 acres for Oahu.

As discussed above, these figures are excessive; a more realistic estimate for the State is probably closer to 1,200 acres (Plasch and Garrod). Nevertheless, even using the excessive LESA estimate, the amount of additional prime agricultural land that would be required to accommodate diversified agriculture, and provide the hope (but not the realistic expectation) of profitable operations, is surprisingly small.

If diversified agriculture is to require a large amount of prime agricultural land, then additional crops will have to be grown for the export market rather than the small Hawaii market. However, the extreme difficulty of developing large export markets should be noted. Numerous and extensive crop searches and experiments for over a century by many people and organizations has led to surprisingly few major long-term successes in Hawaii, thereby indicating the <u>extreme</u> difficulty in identifying new export crops and developing them into new and profitable industries. Furthermore, the difficulty in developing export markets is increasing because of increasing competition from other sugarcane-growing areas. As noted previously, low sugar prices have led nearly all sugarcane operators throughout the world to search for profitable replacement crops, particularly crops which can maintain export earnings.

<u>Supply of Prime Agricultural Land</u>

Regarding the supply of land, an enormous and growing supply of prime agricultural land is available for other uses. Since 1970, about 83,000 acres of Hawaii's prime agricultural land has been freed from sugar and pineapple production: about 43,000 acres of land freed from sugar production (about 9,000 acres on Oahu and 33,600 on the Neighbor Islands), and over 40,000 acres freed from pineapple production (about 12,000 acres on Oahu and over 28,000 on the Neighbor Islands) [Plasch, <u>Hawaii's Sugar Industry</u>, HSPA, Hawaii Agricultural Reporting Service]. Some of the land freed from sugar and pineapple production has or will be converted to urban, diversified agriculture, and aquaculture uses. Also, some of the land freed from pineapple use on Oahu was converted to sugar production. Making allowances for the various conversions, uncommitted acreage which remains available to diversified agriculture and aquaculture amounts to many tens of thousands of acres, with a large share of this on Oahu. Much of this land is fallow, in pasture, or some other low-value land-holding operation.

This supply of prime agricultural land probably will increase given the very real possibility of future sugar-mill closings. As discussed above, the outlook for sugar prices is unfavorable, and some unprofitable mills are in operation today only because they have lease and/or energy contracts which make closing too expensive. However, these contracts eventually will end.

Furthermore, much of the sugarcane lands is in holding awaiting the discovery of profitable replacement activities, so is part of the supply of prime agricultural land available to profitable diversified agriculture crops. For example, one of the components of the OSCo Survival Plan is to experiment with a variety of crops in order to find profitable replacements to sugar.

Many of the lands freed, to be freed, or which can be freed from sugar and pineapple production have excellent agricultural qualities and climatic conditions, and are well-suited for a variety of crops. Also, water is available for most of these lands, especially lands freed from sugar production. However, some of the lands freed from sugar are at high elevations where pumping costs are relatively high.

Additional lands which have been made available for diversified agriculture are in government-sponsored agricultural parks throughout the State. Lands for agricultural activities which do not require prime agricultural land include pasture land, land for livestock operations, and unique lands. Unique lands are not prime agricultural lands, but are important lands for certain crops, the principal examples are the coffee lands in Kona, and certain lava lands in Puna that are well-suited for growing papaya. The supply of unique lands is quite large and distinct from the supply of prime agricultural lands.

Availability of Land to Small Farmers

Even though considerable agricultural land is available, it should be noted that in many areas of the State small agricultural parcels are not available to small-scale farmers under long-term leases. The reason for the unavailability is that land-use regulations and the political environment make it unprofitable and too risky to lease small farm parcels. It is unprofitable because agriculture is generally a low-value use of land which can afford only relatively low lease rents, while County subdivision regulations designed for rural estates require expensive electrical power, paved rather than gravel roads, and buried rather than surface water lines. The combination of low rents and expensive subdivision requirements makes it unprofitable to subdivide land for small farms. For example, rather than develop the State agricultural park in Kahuku, it would have been cheaper for the State to give each farmer $100,000. In addition, there is the risk that when the lease expires, the farmer will turn to the legislature to try and prevent an escalation of the lease rent, or to prevent eviction by the landowner in favor of a higher and more profitable use—this is often the case for long-term leases for land on which the farmer has built a home. Such an economic environment favors leases to large-scale operators (including

cooperatives consisting of many small farmers), short-term and illegal leases of unsubdivided land, subdivision of the land into rural estates for sale to buyers who can afford the costs of the subdivision requirements, or leaving the land fallow.

The unavailability of small parcels of land to farmers is a serious problem, but does not invalidate the fact that there is a vast supply of prime agricultural land available for profitable diversified agricultural activities. However, the activities must be large scale, or the subdivision requirements circumvented.

Outlook for Diversified Agriculture

Based on the above analysis, ample prime agricultural land will be available to easily accommodate prime agricultural land requirements of diversified agriculture. This conclusion derives from the fact that there is a vast amount of prime agricultural land and water that has been freed from sugar and pineapple production in recent years, the very real possibility that additional sugarcane acreage and water will be freed given the outlook for low sugar prices, the fact that some if not most or even all of the sugar operations would make their lands available for profitable replacement crops, and the surprisingly modest land requirements for diversified agriculture. In other words, the limiting factor will be the market, not the land supply. Kapolei Village, combined with other major housing developments in the Ewa/Central-Oahu area and elsewhere, involves far too little land to affect this conclusion. Therefore, **Kapolei Village would not affect adversely the growth of diversified agriculture.**

Consistency with Overseas Long-Term Trends

Hawaii's increased availability of prime agricultural land compared to that of prior decades is part of some very long-term and accelerating trends occurring throughout most developed and developing market economies. For example, an excess of about 45 million acres of agricultural land exists in the United States (Dvoskin). Productivity and yields have been increasing faster than population growth; and genetic engineering—which gives promise of developing crops having higher yields, increased resistance to diseases and pests, and increased tolerance to climatic variations—and other advances, combined with slower population growth, indicate an acceleration of these trends. Rapid productivity and yield increases lead to overproduction, market gluts, low agricultural prices, low farm income, bankruptcies, and a need to withdraw labor, land, and other resources from agriculture in order to restore balanced markets and increase farm income to those who remain.

The major agricultural problem facing the United States and many other economies is how to make this withdrawal an orderly one so as to minimize social problems. This is a problem associated with tremendous success in agriculture, and contrasts sharply with and invalidates the 200-year old prediction of Thomas Malthus that population will increase faster than the food supply.

CONSISTENCY WITH STATE AND COUNTY PLANS

Kapolei Village is consistent with the major thrust of the agricultural portions of the Hawaii State Plan, the State Agriculture Functional Plan, and the General Plan of the City and County of Honolulu. This thrust is to preserve the economic viability of plantation agriculture and to promote the growth of diversified agriculture (see Table 4). To accomplish this, an adequate supply of agriculturally suitable lands and water must be assured. The thrust of these plans is not to preserve prime agricultural lands simply for the sake of preservation—preservation is to occur only if there is a potential agricultural need for these lands.

Regarding housing, the Kapolei Village is clearly in support of the Hawaii State Plan, particularly those policies, objectives, and priority directions which encourage development of reasonably priced, safe, sanitary, livable homes in suitable environments. Nevertheless, certain priority guidelines (but not objectives or policies) dealing with population growth and distribution do call for directing urban growth primarily to existing urban areas and marginal agricultural lands, and away from important agricultural lands (e.g., Section 226-104 (b)(2)). While this is desirable, it is unrealistic in terms of the supply of lands suitable for building reasonably priced housing, and unrealistic as to the agricultural market which could use the vast supply of prime agricultural lands profitably.

Kapolei Village is also consistent with the City and County policy of directing population growth to Ewa which, by definition, must occur at the expense of sugarcane acreage.

Since the Kapolei Village would not adversely affect the economic viability of OSCo, would not limit the growth of diversified agriculture, but would contribute to a healthier housing market in an area designated for development, the **project is consistent with the major thrust of the State and County Plans.** Also, the project would provide a public benefit which would override the proposed IAL designation of the LESA Commission.

Residents of homes adjacent to and/or downwind from sugar operations often complain about the dust generated when fields are prepared for planting, noise from

Table 4.— **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 4.— **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. 82-188)

Population

Objective C. To establish a pattern of population distribution that will allow the people of Oahu to live and work in harmony.

Policy 1. Encourage the gradual development of a secondary urban center in the West Beach-Makakilo area to relieve developmental pressures in the urban-fringe and rural areas.

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.

trucks and harvesters, and smoke when fields are burned prior to harvesting. In order to minimize conflicts and complaints, sugar operations and housing would be buffered from one another by the Kapolei golf course. Therefore, with one exception, Kapolei Village would not adversely affect cultivation of adjacent sugarcane acreage, and complies with the Hawaii Right-to-Farm Act. The one exception concerns the burning of fields just prior to harvesting; in order to minimize complaints, OSCo is likely to schedule the burning of adjacent fields when the fewest residents are at home—such as during the work day rather than on weekends—or to harvest without burning. Similar operations are already conducted for other fields adjacent to urban areas.

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APPENDIX F

Agricultural Impacts: Decision Analysts Hawaii

PROPOSED KAPOLEI VILLAGE: IMPACT ON AGRICULTURE

January 1988

CONTENTS

TABLES

EXECUTIVE SUMMARY

The development of Kapolei Village would result in the urbanization of approximately 775 acres of sugarcane lands which are currently under cultivation by Oahu Sugar Company, Ltd. (OSCo), plus the eventual fallowing of an additional 241 acres to the west of the project because of the expense of farming this relatively small and isolated area. Assuming that U.S. sugar prices will continue to be high enough to justify continued sugar operations in Hawaii, an important question is whether Kapolei Village—combined with other planned and proposed projects—would eventually cause the closing of OSCo, either by reducing sugarcane acreage sufficiently to reduce economies of scale, and/or by contributing to a scattered and therefore inefficient plantation rather than a more compact and efficient one.

Assuming that all proposed projects will be approved, and that it would take about 20 years to realize the full development of all projects, OSCo would retain about 11,760 acres under cultivation in 1995 when its major lease expires. If yields increase from their current average of about 15 tons of raw sugar to 16 tons per acre by the end of 1995 (which is a conservative projection), then 11,760 acres would be sufficient land to maintain the current production of about 90,000 to 95,000 tons of raw sugar per year, without any loss in economies of scale. No layoffs of sugar workers would be expected, since OSCo has a practice of reducing its employment by attrition.

However, if the sequence of urbanization results in a scattered plantation that is too inefficient to operate at the current level of production, or if urbanization and loss of sugarcane acreage proceeds at too rapid a rate to be compensated by increasing yields, then a switch from a two- to one-mill operation would be required to maintain an efficient and economically viable operation. For this case, land requirements would be about 8,440 acres, assuming a yield of 16 tons per acre and production of about 67,500 tons per year. This would provide a buffer of 3,320 acres from which to assemble an efficient plantation; this figure is based on 11,760 acres remaining after projected urbanization (assuming approval of all planned and

proposed projects), minus the estimated 8,440 acres required for a one-mill operation. It is uncertain whether or not attrition would be sufficient to accommodate a reduction in employment associated with a switch to a one-mill operation.

At full development of all the planned and proposed projects (assuming approval of all projects), the amount of land under cultivation by OSCo would be about 8,520 acres. If development proceeds gradually, and if yields increase sufficiently (as a result of genetic engineering and other advances), then it is conceivable that OSCo could maintain production near its current level. In order for this to occur, the average yield would have to increase by about 45 percent, from 15 to 21.7 tons per acre.

It is more likely, however, that a switch to a one-mill operation would be required to maintain economic viability. Assuming an average yield of 18 tons per acre by the time the various projects reach full development (which is a conservative projection), a one-mill operation would require about 7,500 acres. This would provide a buffer of about 1,020 acres from which to assemble an efficient plantation; this figure is based on 8,520 acres remaining after urbanization (assuming approval and full development of all planned and proposed projects), minus the estimated 7,500 acres needed for a one-mill operation.

To summarize the above, Kapolei Village, in combination with other approved and proposed projects, is not expected to threaten the economic viability of OSCo; economies of scale and a compact efficient plantation would be possible by (1) switching to a single-mill operation, or (2) retaining a two-mill operation provided that urbanization proceeds gradually and yields can be increased rapidly to compensate for the loss of acreage.

If OSCo were to cease operations for whatever reason (most likely because of low sugar prices), the loss of jobs would be less than 450 direct jobs and 510 indirect jobs. This would be equivalent to the loss of a hotel about half the size of the Hyatt Regency in Waikiki. Immediately following the mill closing, significant economic loss and social disruption would occur. But over the long term, the economic loss would be absorbed easily by expanding economic opportunities in the Ewa/Central-Oahu area.

Assuming that OSCo does close, revenues to Waialua Sugar Company, Inc. (WSCo) would be decreased slightly because OSCo's contribution to shared terminal facilities and services would be lost. At worst, the economic effect would correspond to an increase in production cost of less than 2 percent. But rather than absorb increased terminal charges, a more profitable alternative would be to increase the refining capacity of C&H in Aiea to process all of the WSCo production. Refined

sugar in excess of the Hawaii requirements would be shipped at favorable backhaul rates to Los Angeles and Seattle. Currently, Hawaiian sugar is delivered to these markets by rail from the C&H refinery in Crockett, California near San Francisco. Consequently, the net economic effect of the closing of OSCo on WSCo would be small, and would be unlikely to force the closing of WSCo—like OSCo, the future economic health of WSCo will be determined primarily by the price of sugar in the U.S. market.

The development of Kapolei Village on sugarcane acreage would eliminate the possibility of using these lands for diversified agriculture (including aquaculture). However, it is extremely doubtful that this would adversely affect the growth of diversified agriculture in Hawaii. There are four reasons for this assessment: (1) an extensive amount of prime-agricultural land and water has been freed from sugar and pineapple production because of past mill closings and reductions in operations; (2) a very real possibility exists that additional land and water will be freed from sugar production given the outlook for low sugar prices; (3) some—if not most or even all—of the sugar operations will make their lands available for profitable replacement crops to the extent that such crops are available; and (4) compared to the available supply, a very small amount of land and water is required to grow proven and promising crops to achieve a realistic level of food and animal-feed self-sufficiency, and to increase exports. The increasing availability of prime agricultural land in Hawaii is part of very long-term and accelerating trends occurring throughout most developed and developing market economies. Productivity and yields have been increasing faster than population growth, and genetic engineering and other advances, combined with slower population growth, indicate an acceleration of these trends. Rapid productivity and yield increases require that labor, land, and other resources be withdrawn from agriculture in order to restore balanced markets and to increase farm income for those who remain.

Since the Kapolei Village is not expected to adversely affect the economic viability of OSCo, and would not limit the growth of diversified agriculture, the project is consistent with the major thrust of the agricultural portion of the Hawaii State Plan, the State Agriculture Functional Plan, and the General Plan of the City and County of Honolulu. This thrust is to preserve the economic viability of plantation agriculture and to promote the growth of diversified agriculture. Also, the project would provide a public benefit (i.e., affordable housing) which would override the proposed "important agricultural lands" designation of the Land and Evaluation Site Assessment (LESA) Commission.

The project is also consistent with the City & County policy of directing population growth to Ewa which, by definition, must occur at the expense of sugarcane acreage.

Sugar operations and housing would be buffered from one another by the Kapolei golf course, which would help minimize conflicts between the two. Therefore, with one exception, the project would not adversely affect cultivation of adjacent sugarcane acreage, and complies with the Hawaii Right-to-Farm Act. The single exception concerns complaints over the burning of fields just prior to harvest; in order to minimize these complaints, OSCo is likely to schedule the burning of adjacent fields when the fewest residents are at home—such as during the work day rather than on weekends—or to harvest without burning. Similar operations are already conducted for other fields adjacent to urban areas. Nevertheless, complaints should be expected over dust generated when fields are prepared for planting, noise from trucks and harvesters, and smoke from burning cane prior to harvesting.

PROPOSED KAPOLEI VILLAGE: IMPACT ON AGRICULTURE

The proposed Kapolei Village would involve the urbanization of about 775 acres of sugarcane lands cultivated by Oahu Sugar Company, Ltd. (OSCo). The impacts of this loss on OSCo operations, as well as on Waialua Sugar Compay, Inc. (WSCo) which shares terminal facilities at Honolulu Harbor, and on the potential growth of diversified agriculture (including aquaculture), are summarized in this report.

SOIL QUALITY OF AFFECTED SUGARCANE ACREAGE

The affected sugarcane acreage consists primarily of four soil types:

—WkA: Waialua silty clay, 0 to 3 percent slope, comprising about 40 percent of the area and located primarily in the upper half of the development;

—MnC: Mamala stony silty clay loam, 0 to 12 percent slopes, comprising about 25 percent of the area and located primarily in the lower half of the development;

—HxA: Honouliuli clay, 0 to 2 percent slopes, comprising about 20 percent of the area and located primarily in the northeast side of the development;

—EmA: Ewa silty clay loam, moderately shallow, 0 to 2 percent slopes, comprising about 5 percent of the development and located in the lower half of the development.

These soils can be used for sugarcane, truck crops, and pasture (USDA Soil Conservation Service).

The soils within the petition area have been rated in terms of four classification systems commonly used in Hawaii:

—Land Capability Classification by the United States Department of Agriculture Soil Conservation Service (SCS).

This classification rates soils according to eight levels, ranging from the highest classification level I to the lowest level VIII. If irrigated, WkA and HxA both have a capability classification I, which indicates that the soils have few limitations which restrict their use. Soil type EmA is in

Subclass IIs if irrigated, which indicates that the soil has a moderate limitation of stoniness, unfavorable texture, shallowness, or low water-holding capacity. Soil type MnC is in Subclass IIIs if irrigated, which indicates that the soil has a severe limitation of stoniness, unfavorable texture, shallowness, or low water-holding capacity.

—Agricultural Lands of Importance in the State of Hawaii (ALISH), by the SCS, University of Hawaii College of Tropical Agriculture and Human Resources, and the State of Hawaii Department of Agriculture.

This system classifies lands into three categories: (1) 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; (2) unique agricultural land which is non-prime agricultural land that is currently used for the production of specific high-value crops; and (3) other prime agricultural land which is non-prime and non-unique agricultural land that is of importance to the production of crops. Generally, the upper half of the development consists of soils which are rated as "prime" agricultural lands.

—Overall Productivity Rating, by the Land Study Bureau (LSB) of the University of Hawaii.

This classification rates soils according to five levels, with "A" representing the class of highest productivity and "E" the lowest. Most of the petition lands now planted in sugarcane are rated A. The remaining lands, which comprise about 25 percent of the development, are rated B. About half of these B lands are located on the west side of the project, and the remainder on the east side.

—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, this proposed system would designate a sufficient amount of the better agricultural lands so as to meet projected agricultural goals. The designated lands would be termed important agricultural lands (IAL) and, based on the proposed maps, would include all of the lands in the petition area now under cultivation. However, the identification would be subject to change based on a change in nearby activities and a change in County land-use plans. Also, the designation could be changed if there is an overriding public benefit.

IMPACT ON OSCo[1]

Background Information

Amfac's OSCo first milled sugar in 1899, and is now the fourth largest sugar operation in the State. It cultivates about 13,540 acres of sugarcane land, and produces about 90,000 to 95,000 tons of raw sugar, or nearly 10 percent of Hawaii's total sugar production. Its lands cover portions of Central Oahu on each side of Kunia Road above Pearl Harbor, and portions of the Ewa Plain to the west of Pearl Harbor. The Ewa lands were taken over from Ewa Plantation in 1970.

Another 4,860 acres of OSCo lands were in production in 1982, the bulk of which are now fallow, while a few hundred acres have been urbanized. These lands are mostly mauka lands with high pumping costs, and lands close to the seashore where soils tend to be inferior, yields low, and hauling costs high because of the distance to the mill.

Nearly all of the land which OSCo cultivates is leased, principally from Campbell Estate with a lease expiration date of 1995, and from Robinson Estate with a lease expiration date of 1996. The lease rents on these lands are among the highest in the State for sugarcane acreage, and are adjusted as a function of the revenues from sugar operations. Both leases allow partial withdrawal of lands for urbanization. The Campbell Estate lands above H-1 Freeway and west of Kunia Road have been dedicated to agricultural use in order to obtain special property tax assessments.

OSCo is one of the major water users on Oahu, pumping up to 92.5 million gallons per day (MGD) of groundwater, and diverting in normal-rainfall years 25 to 30 MGD from the Windward side via Waiahole Ditch. Per-acre usage by OSCo can exceed 9,000 gallons per day. For comparison, pumpage by the Board of Water Supply averages about 140 MGD, and per-acre useage for single-family homes at 5 units per acre averages about 2,130 gallons per day.

Field, mill, and management employment at OSCo is approximately 450 workers. Indirect employment dependent upon OSCo is estimated to be 510 jobs (multiplier of 1.13, based on the State Economic Model). For comparison, OSCo's economic contribution to Hawaii's economy is less than half that of the Hyatt Regency Hotel in Waikiki.

[1] Unless otherwise noted, the material in this section is from OSCo, Amfac, and/or Section B, Chapter VI of Hawaii's Sugar Industry: Problems, Outlook, and Urban Growth Issues.

Because of favorable growing conditions, good farming practices, and drip irrigation, sugar yields at OSCo are very high, about 14.5 to 15.5 tons per acre, versus a 1986 Statewide average of 12.5 tons per acre (HSPA, "Hawaii Sugar News," March 30, 1987). In fact, OSCo holds the world record sugar yield at 21.63 tons per acre set in April 1985 (HSPA, "Hawaii Sugar News," June 26, 1985). The current average yield is about 33 percent higher than the 1979 yield of 11.3 tons per acre.

But even with high yields and very efficient operations, OSCo is only marginally profitable—the principal problem being low sugar prices. The marginal profitability is measured before accounting for new capital investment needed to replace equipment.

Outlook for Sugar Prices

In the long term, the survival of OSCo will depend primarily on the price of sugar, for which the outlook is pessimistic. In the world market, the average price of sugar is expected to remain well below the production costs for all countries. This is because most sugar is traded in controlled and/or subsidized markets, with surplus sugar dumped onto the world market for sale at a loss. Dramatic price increases have occurred, however, following a 6- to 9-year cycle, with prices increasing whenever world production falls short of consumption. But, there have been a number of fundamental developments in sugar and related industries in the past 10 years which appear to have altered the pattern of sugar prices, reducing peak prices and extending the periods of low prices. These changes include: the decline or stagnation of sugar consumption in most developed countries; inroads made by the liquid sweetener high-fructose corn syrup (HFCS); the availability of substantial sugar reserves in the form of sugarcane now devoted to ethanol production; major gains in sugar beet productivity in several European countries which were traditionally cane sugar importers; and the appearance of the European Economic Community ECC as a major exporter of refined sugar (Brown).

In the United States, Federal legislation protects sugar from the low world prices by import quotas, tariffs, and import fees. However, U.S. sugar prices are managed so that they are fairly low in order to prevent accelerating the growth of competing sweeteners, and to maintain public support. Under the U.S. Farm Bill, which runs to 1991, the target price for sugar is 18 cents per pound, with no adjustments for inflation.

The competing sweetener of major concern has been HFCS. It is as sweet or sweeter than regular sugar, costs less to produce, sells for less, is more profitable, is very similar to liquid sugar, can be substituted readily in many applications, and is easier and cheaper to handle. It has experienced rapid growth in sales at the expense of regular sugar sales. However, HFCS has captured nearly all of the liquid-sweetener market so that continued growth will depend on the market acceptance of Crystar, the crystaline version of HFCS. In addition, the new low-calorie sweetener aspartame, sold under the brand name "Equal," is capturing market share and putting additional downward pressure on U.S. sugar prices.

Regarding the long-term outlook for sugar legislation, it should be noted that, because of HFCS, many corn states have joined the sugar and sweetener coalition, making it larger and stronger than in the past, even though a number of sugar companies have closed in recent years. Also, the Farm Act is generally supported by those countries which receive a sugar quota, since they benefit from a high price for a major portion of their sugar. The considered expectation among sugar experts and lobbyists is that sugar will continue to be included in the U.S. Farm Act, but that the price-support level may be relatively low and may increase at a rate that is somewhat slower than inflation. Even though this is expected, there is a risk that efforts by sugar users and consumer groups to exclude sugar from the Farm Act or to reduce the support price will be successful.

OSCo Plans

In 1982, Amfac developed a Master Agricultural Plan which included a Survival Plan for OSCo. This plan, which has been fully implemented, was developed in response to an operating loss of nearly $10 million in 1981 and an outlook for low sugar prices. In recognition of the fact that sugar plantations are in place with substantial improvements, but suitable replacement crops have yet to be identified, the plan amounts to a holding action to gain time to find as many replacement crops as possible before OSCo may be forced by outside economic factors to cease operations. Key components of the plan are:

—continue to improve the economic efficiency of OSCo by increasing sugar yields and reducing production costs (both of which have been improved substantially in the last few years);

—urbanize Waikele (the only OSCo land owned by Amfac) in order to derive revenues to help support and justify continued sugar operations; and

—experiment with a variety of crops (papaya, sweet corn, potatoes, forage and feed crops, coffee, etc.) in order to find profitable replacements to sugar.

An important component of OSCo's reduction in costs is a continued decline in the labor force; over the past 2 years, employment decreased by about 150 jobs, or about 25 percent. The employment decrease is accomplished by attrition—that is, employees who retire or leave OSCo for other voluntary reasons generally are not replaced.

Continued success of the OSCo Survival Plan will depend on (1) continued Federal price supports for sugar which are sufficiently high to justify continued operations, (2) union support to reduce costs, (3) an adequate allocation of water from the Pearl Harbor aquifer, and (4) retaining fields which are economical to farm and which provide sufficient yields to operate the mill at an economical level. After the major leases expire with Campbell Estate and Robinson Estate in 1995 and 1996, respectively, continued sugar operations also will depend on success in negotiating favorable lease terms.

An additional option which has been under consideration by OSCo is to contract operations by running a single mill rather than two mills in parallel as is currently the case. With a single mill, OSCo could reduce production from its current level of from 90,000 to 95,000 tons per year to from 60,000 to 75,000 tons without losing its economies of scale; a corresponding decrease would occur in the acreage requirements for OSCo. Of significance, Amfac's Kekaha Sugar Company, Inc., which has climatic conditions similar to those of OSCo lands and a similar yield potential, historically has been one of the most profitable sugar operations in the State. Yet this plantation has only about 8,000 acres under cultivation, and produces only about 55,000 tons of sugar per year.

Of interest, nearly all sugarcane operators throughout the world are pursuing a similar strategy to that expressed in the OSCo Survival Plan: improve efficiency by increasing yields and reducing production costs; and search for alternative crops (Brown).

Urbanization Pressures on OSCo

The gradual growth westward of urban Honolulu has consumed a large amount of former sugarcane land as evidenced by the fact that the eastern boundary of OSCo lands has moved westward by 9 miles from Moanalua Valley out past Waikele Stream. Since the 1960s, four ridges west of Halawa have been urbanized. But because of new plantings in the foothills of the Waianae mountains and on former pasture lands, sufficient acreage was cultivated to maintain economies of scale. The westward urbanization pressures of Honolulu continues, but plantings of new lands to compensate for lost fields is no longer feasible.

The economic forces which create urbanization pressures on OSCo include:

- —Financial returns from urban land uses far exceed those from agricultural uses.
- —Proximity to the new or growing employment centers of West Beach, Barbers Point Harbor, Campbell Industrial Park, and downtown Honolulu.
- —Reasonable travel times to these employment centers because of the H-1 Freeway.
- —Availability of water if it is freed from sugar production.
- —Proximity to the Honouliuli waste-treatment facility.
- —Low construction costs compared to areas that require extensive grading or removal of structures.

In contrast, redevelopment of downtown suffers from the high expense and displacement problems required to remove existing structures, the high expense and inconvenience of redeveloping inadequate infrastructure, less desirable high-rise housing compared to single-family homes, and strong community opposition on occasion. Hawaii Kai suffers from a lack of employment growth centers, relatively little land available for further single-family housing, severe transportation problems, and community opposition to further development. Similarly, the Windward side suffers from a lack of growing employment centers, transportation problems, and community opposition to further development.

In view of these factors, the City & County of Honolulu has designated the Ewa area as a "Secondary Urban Center" which will be developed to accommodate a major portion of Honolulu's future growth. Developments approved and proposed for the Ewa/Central-Oahu area which would affect OSCo acreage include:

	Sugarcane Acreage
Kapolei Village	775
Kapolei Town Center	693
Lusk Kapolei	55
Ko Olina Resort (approved)	281
Other (see text)	241
Ewa Gentry (300 acres approved by the State, and 75 by the County)	932
Ewa Marina (approved)	410
West Loch Estates	195
Village Park (547.5 acres approved by the State)	980
Kunia Golf Course	190
Golf Course (J. Myers)	270
Total	**5,022**

In this listing of major developments, the 241 acres for "Other" represents acreage to the west of Kapolei; OSCo expects to fallow this acreage due to the expense of farming this relatively small and isolated area. It is likely that this land would be laid fallow as soon as Kapolei Village is developed down to Waimanalo Road, which would occur in the latter stages of the project. Regarding the Kunia Golf Course, the land owner lacks withdrawal rights before the lease expires in 1996.

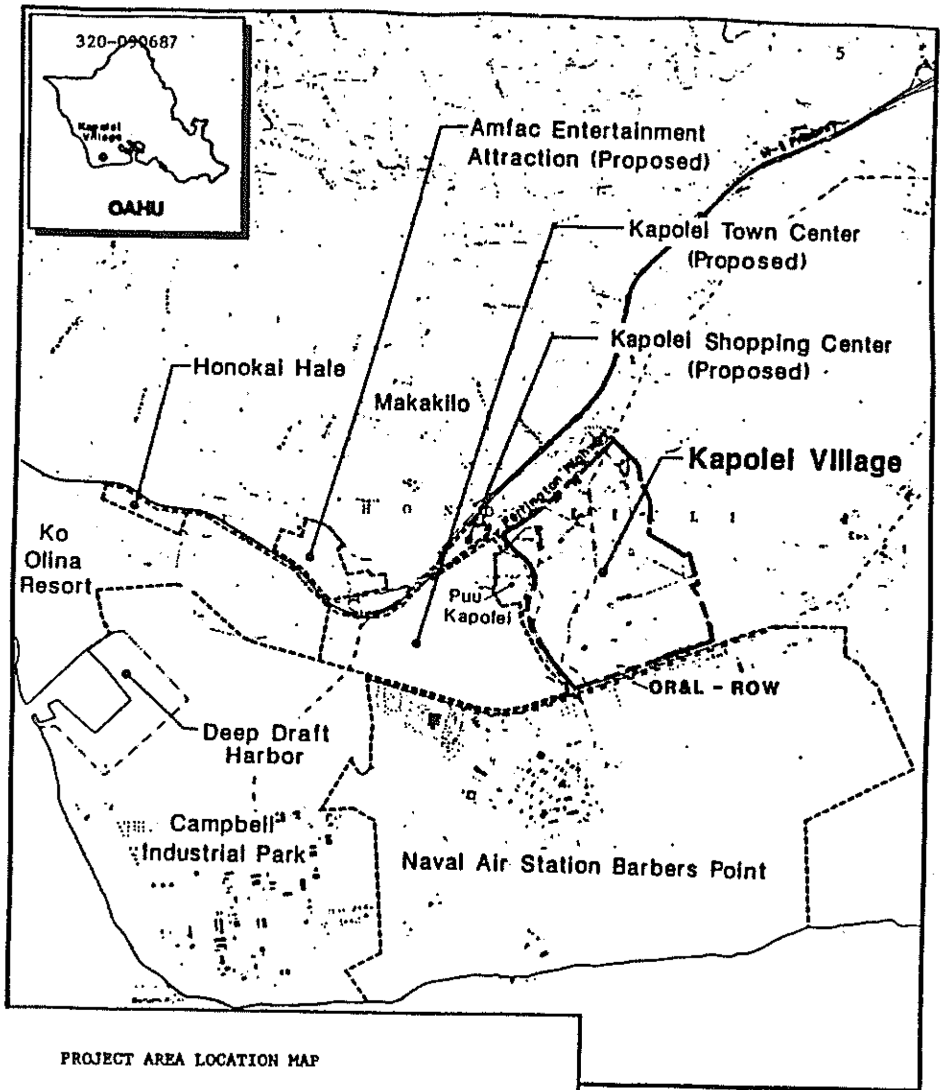
Acreage Required to Maintain Economies of Scale

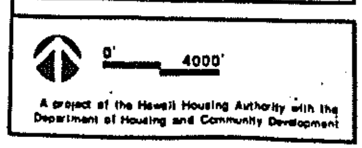
Before addressing the question of how the acreage withdrawals for the above projects would affect the economic viability of OSCo, acreage requirements of OSCo are discussed. These requirements are summarized in Table 1 for a one- and two-mill operation as a function of yield. As mentioned previously, OSCo currently produces from 90,000 to 95,000 tons of raw sugar per year using two mills. With a single mill, OSCo could reduce production to from 60,000 to 75,000 tons without losing its economies of scale. The mid-values for these ranges are used in Table 1: 67,500 and 92,500 tons of raw sugar per year for a one- and two-mill operation, respectively.

Also shown in Table 1 are yield assumptions, along with two past yields and OSCo's world-record yield: 11.3 tons of raw sugar per harvested acre in 1979, 15 tons in 1987, and 21.63 tons for the record yield. The two past yields indicated the substantial increase which can occur over time, while the record yield indicates future potential under favorable farming conditions.

Average sugar yields fluctuate from year to year but, over the long term, yields have increased gradually over time, and are expected to continue their gradual increase. For the future, increasing yields are expected to occur as a result of contracting operations to higher-quality fields, introducing improved varieties of cane, improving farming practices, adding chemical ripeners, introducing more efficient harvesters, etc. In the long-term, genetic engineering provides the promise of dramatically improved cane varieties that will have much higher yields and will be cheaper to farm because they will require less fertilizer, will resist diseases, and will produce less leafy trash.

Based on long-term industry trends, a conservative projection of OSCo's average yield in 1995, when the lease with Campbell Estate expires, is 16 tons of raw sugar per harvested acre; 20 years into the future, a conservative projection for the average yield is 18 tons per acre. The projected increase in the average yield is less than 1 percent per year.





PROJECT AREA LOCATION MAP

Archaeological Reconnaissance Survey
for Environmental Impact Statement
Kapolei Village Project Area
Honouliuli, Ewa District, Island of Oahu

PHRI Project 87-320 August 1987

<u>APPENDIX E</u>

An Affordable Housing Development Concept, State of Hawaii,
Hawaii Housing Authority, March 20, 1986

GEORGE R. ARIYOSHI
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF SOCIAL SERVICES AND HOUSING
HAWAII HOUSING AUTHORITY
P. O. BOX 17907
HONOLULU, HAWAII 96817

RUSSELL N. FUKUMOTO
EXECUTIVE DIRECTOR

IN REPLY REFER
TO:

March 20, 1986

MEMORANDUM

TO: Hawaii Housing Commissioners

From: Russell N. Fukumoto
Executive Director

SUBJECT: AN AFFORDABLE HOUSING DEVELOPMENT CONCEPT

The attached report introduces a development concept directed at producing a consistent level of affordable housing units. Under the concept, the Authority assumes a more aggressive role than in the past to meet Hawaii's housing needs.

A workshop will be held in April to discuss your questions and concerns relating to the concept.

RUSSELL N. FUKUMOTO
Executive Director

Attachment

3/19/86

AN AFFORDABLE HOUSING DEVELOPMENT CONCEPT

I. Introduction

This report presents a development concept that is directed at producing a consistent level of affordable housing units for elderly and handicapped persons and for lower-income and gap group families. (Attachment 1 outlines the income limits for these targeted groups.) The objective of this report is to stimulate thinking and feedback in regards to the concept. If workable, further refinements are required.

The concept was formulated in response to the increasing difficulties in meeting the need for more affordable housing. It is not only guided by the complementary objectives of the Hawaii Housing Authority and the State Housing Functional Plan, but is sensitive to county general plans. The concept utilizes Chapter 359G, HRS.

Parts II and III of the report set the stage for the concept by establishing the need for more affordable housing and the preferred course of action for meeting that need. Parts IV and V introduce and discuss the various aspects and concerns of the development concept.

II. Overview of the Housing Market

A. Housing Demand

According to a 1981 study by Daly and Associates, required residential housing production in Hawaii for the 10 year period from 1980 to 1990 is estimated at 77,357 units, or roughly

7,700 units a year. (Staff's estimate of required housing production for the next decade, from 1990-2000, is attached as Attachment 2.) This is an ideal estimate based on the anticipated number of new households, the expected number of housing unit losses due to demolition and the economically preferred vacancy rate of 5%. (A vacancy rate of 5% is generally acknowledged to be the minimum level adequate to assure choice and mobility for housing consumers. It is also an acceptable vacancy level that landlords can absorb.) Table 1 details the components of required housing production.

Table 1

Estimated Housing Production Requirements: 1980-1990

	Honolulu	Maui	Hawaii	Kauai	State
New Households	40,187	7,787	4,395	2,860	55,229
Demolition Replacement	6,040	900	880	100	7,920
Additional Vacancies	10,964	1,277	1,355	612	14,208
Total New Units	57,191	9,964	6,630	3,572	77,357

Assumptions:

1) Existing residential vacancy rate of 1.6%
2) 1990 average household size of 3.0.
3) 5% residential vacancy rate achieved by 1990.
4) 1990 population figures based on DPED II-F projections.
5) 4% of projected population assumed residing in group quarters.
6) Annual demolition equal to the 1975-1980 annual average.

Source: Daly & Associates, Inc., Affordable Housing Issue Paper, December 1981.

B. Housing Production

Statewide, there were 39,793[1] building permits authorized for new residential construction from 1980 through 1985, averaging 6,600 units per year. By comparison, from 1965-1980, the number of units during 11 of the 15 years averaged more than 10,000 units.

It is not known how many of the units authorized were "affordable"; however, based on average sales prices on Oahu in 1984 of $140,700 and $81,372[2] for new for new single-family and multi-family dwellings, respectively, it is assumed that the majority of the units produced were not "affordable."

C. Housing Shortfall

Based upon the average authorization rate of 6,600 units per year, the housing inventory in 1990 would fall short of the projected "ideal" by about 11,300 units. Although these figures are approximations, it appears that low residential construction rates in the face of rising household formations will tend to keep upward pressure on prices and further limit housing affordability.

1 Source: Bank of Hawaii, Construction in Hawaii 1985 and files; County of Maui, Department of Public Works.
2 Bank of Hawaii, Construction in Hawaii 1985.

III. State Housing Functional Plan

The State Housing Functional Plan is one of 12 State functional plans formulated to manage and coordinate functional area activities and to guide resource allocation decision making. It presents a balanced set of programs and projects directed toward meeting Hawaii's future housing needs.

The actions proposed in the State Housing Functional Plan are not intended to limit government, industry or individuals to a single course of action when another course can achieve the same or better result. However, the implementing actions of the functional plan present a preferred course of action given current conditions and available information.

One of the objectives of the State Housing Functional Plan is to "assist the orderly development of residential areas sensitive to community needs and other land uses." A preferred course of action to achieve this objective is to "assess and delineate lands suitable for future housing development." (State Housing Functional Plan Implementing Action B(1)(a).) The intent of this action is to insure the availability of lands for future residential use and to undertake the planning for those areas in an organized manner. Staff has formulated a development concept along these lines.

IV. Development Concept

The development concept basically incorporates a planned development with emphasis on providing a large percentage of

residential units affordable to lower-income and gap group families.

This concept is predicated on government acquiring, master planning and developing large parcels of land in the various counties. By assuming this role, government would be subject to various development risks, which include, but are not limited to, loss of funds advanced for feasibility and preliminary engineering studies and for master planning should requested land use and zoning changes be denied, as well as unforeseen construction problems such as strikes and acts of God. However, with the provisions of Chapter 359G, HRS, it appears that the advantages of government taking the lead far outweighs the risks.

Section 359G-10.5 allows the Authority to develop projects that include <u>market</u> units. Under this concept, the net income derived from the sale of these <u>market</u> units could be used to reduce the cost of some or all of the affordable units within the development.

The following sub-sections will further describe the concept.

A. Site Selection Criteria

Criteria for site selection would include the following:

1. Reasonably priced land. (The usual case would be land not classified for urban and/or residential use.)

2. Adjacent to existing or planned infrastructure, i.e., water, sewer, draingage, roads and power, thereby minimizing infrastructure cost.
3. Relatively flat land so as to decrease massive grading.
4. Close to employment centers, existing communities and/or areas of growth.

B. Land Use

Given a 500 acre parcel in which all the land is useable, and assuming 70%, or 350 acres (500 A. x 70%), is used for housing at a density of approximately 8.6 units per acre, roughly 3,000 units (350 A. x 8.6 units) could be built. The remaining 30%, or 150 acres, would support infrastructure, public facilities, commercial development, day care centers and other uses, as needed.

C. Housing Mix

To provide for economically integrated housing, Section 359G-10.5, HRS, entertains a 60/40 housing mix whereby not less than sixty percent of the units would be sold in price ranges established by the Authority and the balance of the units would be sold at other prices. Under the development concept, 60% of the units would be sold and/or rented at affordable levels. The remaining 40% would be designed to be marketed at higher prices. Using this ratio, the number of affordable units and market units would be 1,800 and 1,200, respectively.

1. Market Units

The 1,200 market units would be offered for sale at appraised value and would not be subject to the buyback restrictions under Chapter 359G. However, as with FHA-insured mortgages, buyers must be owner-occupants.

The excess revenues derived from the sale of the market units could be used to reduce the cost of the affordable units. For example, assuming a per unit sales price of $140,000 and cost of development of $125,000, the estimated excess revenue from the sale of each market unit would be $15,000. The excess revenues from the sale of all 1,200 market units would then be $18 million. This $18 million could be used to lower the cost of some or all of the 1,800 affordable units.

2. Affordable Units

The affordable units would provide housing for elderly and handicapped persons and lower-income and gap group families. A suggested distribution of the affordable units is shown in the following table.

Table 2

Suggested Distribution of Affordable Units

Low rent (10% x 1,800)	180 units
Elderly (10% x 1,800)	180 units
Market rent (10% x 1,800)	180 units
For-sale (70% x 1,800)	1,260 units
Total affordable	1,800 units

Assuming 1) a typical 3-bedroom, 1-1/2 bath, 1,000 square foot gap group unit could be developed for $100,000 and 2) the $18 million excess revenues generated from the sale of the market units is used solely to lower the initial cost of the 1,260 gap group units (by $14,280 each), then the average sales price of a home would be $85,720. This lowered price will enable more first-time homebuyers to qualify for mortgage financing. (Attachment 3 compares the annual income needed to qualify for a home priced at $100,000 and $85,720 at prevailing interest rates.)

The $14,280 per unit reduction would be recouped so that additional funds would be available for future housing development. (Note that all Dwelling Unit Revolving Fund (DURF) moneys are recaptured when the units are initially sold.) To recoup the per unit reduction of $14,280, the Authority could either 1) defer payment until such time that the property is sold or transferred to someone other than a spouse or 2) offer the lot in leasehold with the option to purchase the fee.

Under the leasehold method, the leased fee value of the land could be set at $14,280 for the first 10 years of the lease. Thereafter, the leased fee interest could be based upon the appraised value or incrementally increased by predetermined amounts for the remainder of the lease. The intent is to induce homeowners to purchase the leased fee interest within the first 10 years of the lease.

The lease could be for a total of 55 years, of which lease

rents could be fixed for the entire lease term. As shown in Table 3, lease rents during the fixed period could be gradually increased, producing a steady income stream to support the various activities of the Authority.

Table 3

Leasehold Illustration

Years	Annual Lease Rent/Lot	Annual Lease Rent From 1,260 Lots	Total Lease Rent From 1,260 Lots
1 - 5	$ 300	$ 378,000	$ 1,890,000
6 - 10	420	529,200	2,646,000
11 - 20	1,050	1,323,000	13,230,000
21 - 30	1,200	1,512,000	15,120,000
31 - 55	1,500	1,890,000	28,350,000
			$ 61,236,000

Also, under the leasehold method, homeowners should have an easier time obtaining financing for home improvements as compared to the deferred sales price method. This is because a deferred sales price is an encumbrance on the property.

D. Commercial Property

As required, a commercial parcel would be developed. This parcel would be owned in fee simple by the Authority and leased to potential developers. The premiums and fair market rents derived from lease of the property would support the various functions of the Authority.

V. Discussion

A. HHA would be the developer and thereby assumes the up-front risks.

HHA would take the lead and the associated risks involved in acquiring and master planning the land, and in obtaining appropriate land use district boundary amendments and proper zoning.

In order to successfully implement the concept, the Authority must be able to control the many variables which contribute to the high cost of housing. Of the 16 variables listed in Table 4, HHA is able to exert some amount of control over 10 of them.

Table 4

Variables Which Contribute to the Cost of Housing

*1.	Land
*2.	Interim financing
*3.	Taxes (Property and General excise tax)
*4.	Zoning (City Council)
*5.	Master plan
*6.	Profit/overhead
*7.	Sales expense and commission
*8.	Architect/engineering
**9.	Park and water (fees and assessment)
**10.	Offsite improvements
+11.	Land use (State Land Use Commission redesignation process)
12.	Construction of house (labor, materials)
13.	Permanent financing
14.	On site improvements
15.	Community opposition
16.	Environmental impact statement requirements

*Can be controlled by HHA
**May be controlled by HHA through site selection
+A bill pending before the 1986 Legislature would exempt HHA from land use district boundary proceedings.

The following discussion details how these variables may be controlled by the Authority primarily through the use of the tools available under Chapter 359G.

1. Land. Purchase land that is not classified as urban and utilize the state's power of condemnation.

2. Interim financing at a below market interest rate is available through DURF.

3. Real property tax/General excise tax (GET). HHA is exempt from paying property tax and may provide GET exemptions.

4. Zoning. Chapter 359G, HRS, provides a means for expediting county approvals on variances from subdivision standards, building codes and zoning and general and development plans.

5. Master plan. The Authority would oversee the master planning effort.

6. Profit/overhead. With HHA as the developer, there is no profit and HHA overhead (administrative cost) is usually lower than that of a private developer.

7. Sales expense/commission and
8. Architect and engineering fees are negotiated by HHA and therefore, are usually lower than that of a private developer.

9. Land use. If the Legislature clarifies that HHA is exempt from land use district boundary proceedings in the development of housing projects, decisions on land use change petitions would be made within 45 days.

B. Private Sector Involvement.

Private sector participation is an integral part of the development concept. Once the land is acquired and master planned, and proper land use and zoning designations are obtained, the Authority may then develop the parcel in phases or grant development rights to private developers. The bulk of the development activities, such as the architectural, engineering, construction and appraisal work, will be performed by the private sector.

This concept could also be applied to private sector developments where government provides the previously stated cost-saving tools under Chapter 359G.

C. The development would involve a desired income mix of families.

The planned development will encompass a mix of housing projects -- low rent, elderly, market rent, and below-market and market for-sale -- to satisfy a spectrum of housing needs.

D. Increase in housing stock.

The estimated 3,000 housing units produced by implementing the concept will increase the supply of housing units and should have a stabilizing effect on sales prices and rent levels.

E. Competing interests for agricultural land.

The protection and maintenance of agricultural lands has consistently received support among Hawaii's residents. However, when asked to express their preference with respect to conflicting alternatives, sentiment for protection of agricultural lands has lost support over the years. Table 5 presents public attitudes on the trade-off

between preserving agricultural lands versus lowering housing costs.

Table 5
Public Attitudes on the Trade-off Between Preserving Agricultural Lands or Lowering Housing Costs*
Statewide Average (%)

	1977	1978	1981	1984
Preserve ag lands	82%	75%	36%	37%
Lower housing costs	17%	24%	60%	51%
Don't Know	2%	1%	4%	12%

* The trade-offs posed were as follows: In 1976--"Land for agriculture should be protected, even if this means less land for housing." In 1978, the words "...and higher prices for housing" were added to the above query. In 1981--"Which one is more important to you--lower housing costs or preserving agricultural land?" In 1984--"We should have more affordable housing for residents even if we lose prime agricultural land."

Source: Hawaii State Dept. of Planning and Economic Development, The Hawaii State Plan Survey; January 1977, December 1978, July 1981, and November 1984.

Staff recognizes the importance of preserving productive agricultural lands and will therefore be sensitive to the concerns of those affected by the acquisition.

F. The concept will create more job opportunities.

VI. Conclusion

The development concept presented in this report is a bold and aggressive vehicle for producing a consistent level of affordable housing units. It provides a "win-win" situation for the consumer of housing services, the private development sector, and the state as a whole.

Under this concept, government would take the lead and assume the up-front risks associated with acquiring, master planning, and obtaining proper land use and zoning designations for the development of large parcels of land. Government could also opt to develop and/or market the housing units. With the tools available under Chapter 359G, many variables which contribute to the high cost of housing can be controlled, thereby reducing the cost of units and consequently, making the units more marketable.

Additionally, government will continue to work with the private sector in the master planning and development of the large land parcels. Hence, increased job opportunities for Hawaii's labor force will be provided.

The largest social benefit of the concept is the ability to achieve a balanced mix of households in well-planned communities. This mix will include elderly and handicapped persons, lower-income and gap group families and "market" families that do not require governmental assistance. As required, daycare centers, public and commercial facilities are envisioned for these planned communities. This is one way that government can really "make a dent" in the housing marketplace and take care of the ever-growing list of families in need or want of better shelter.

Income Limits for Targeted Groups

1. Lower income limits are determined by the Dept. of Housing and Urban Development at 80% of a county's median. Income limits are as follows:

Lower-Income Family Size	Hawaii	Honolulu	Kauai	Maui
1	$13,900	$17,550	$15,100	$16,350
2	$15,900	$20,050	$17,300	$18,700
3	$17,850	$22,550	$19,450	$21,000
4	$19,850	$25,050	$21,600	$23,350
5	$21,100	$26,600	$22,950	$24,800
6	$22,350	$28,200	$24,300	$26,250
7	$23,550	$29,750	$25,650	$27,750
8+	$24,800	$31,300	$27,000	$29,200

2. Elderly income limits follow those established for lower-income families. An elderly family is one whose head or spouse (or sole member) is a person who is 62 years old or older, disabled or handicapped.

3. Gap group households have income that are too high to qualify for rental subsidy programs, yet too low to be able to purchase a home with conventional financing. The upper income limits for this group are defined by HHA's Hula Mae eligibility requirements (150% of median) and may be raised by 4% for every 1/2 percentage point over a Hula Mae interest rate of 10%. The current limits are as follows:

Family Size (Persons)	Income Limits*	Income Limits**
1	$36,154	$39,546
2	$39,904	$43,296
3	$41,154	$44,546
4	$42,404	$45,796
5	$43,654	$47,046
6	$44,904	$48,296
7	$46,154	$49,546
8+	$47,404	$50,796

*The income limits based on a simple interest rate of 9.70%
**The income limits based on a simple interest rate of 11.00%

Attachment 2

Estimated Housing Production Requirements: 1990-1995-2000

1990-1995

	Honolulu	Maui	Hawaii	Kauai	State
New Households	12,032	4,768	3,776	2,816	23,392
Demolition Replacement	2,445	85	300	220	3,050
Additional Vacancies	602	238	189	141	1,170
TOTAL NEW UNITS	15,079	5,091	4,265	3,177	27,612

1995-2000

	Honolulu	Maui	Hawaii	Kauai	State
New Households	9,216	4,352	2,816	1,664	18,016
Demolition Replacement	2,445	85	300	220	3,050
Additional Vacancies	461	218	141	83	901
TOTAL NEW UNITS	12,122	4,655	3,257	1,967	21,967

	Honolulu	Maui	Hawaii	Kauai	State
GRAND TOTAL NEW UNITS 1990-2000	27,201	7,522	5,144	9,746	49,599

Assumptions:
1) 1995 and 2000 household size of 3.0
2) 5% vacancy level maintained
3) 1990, 1995 and 2000 resident population figures based on DPED Baseline Series M-F projections
4) 4% of projected population assumed residing in group quarters
5) Annual demolition equal to the 1980-1984 annual average

Estimated housing production requirements were calculated by using the methodology developed by Daly & Associates Inc. for their December 1981, Affordable Housing Issue Paper .

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Qualifying Annual Income for Fee Simple vs. Leasehold Purchase

The following examples calculate the amount of annual income needed to qualify for mortgage financing under three scenarios. The calculations assume that 1) the interest rate is fixed for 30 years; 2) monthly payment amounts include principal, interest, private mortgage insurance, homeowner's insurance, real property taxes, and, if applicable, lease rent; and 3) an income-to-payment ratio of 3.2:1.

	Fee Simple/ No deferral	Leasehold	Deferred fee simple sales price
Example 1			
Sales price	$100,000	$ 85,720	$ 85,720
10% down payment	10,000	8,572	8,572
Loan Amount	$ 90,000	$ 77,148	$ 77,148
Monthly payment	$ 885	$ 791	$ 774
Annual Income	$ 33,980	$ 30,375	$ 29,720
Example 2 Interest rate = 10.50%			
Sales price	$100,000	$ 85,720	$ 85,720
10% down payment	10,000	8,572	8,572
Loan Amount	$ 90,000	$ 77,148	$ 77,148
Monthly payment	$ 952	$ 848	$ 831
Annual Income	$ 36,530	$ 32,560	$ 31,900

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Sales price	$100,000	$ 85,720	$ 85,720
10% down payment	10,000	8,572	8,572
Loan Amount	$ 90,000	$ 77,148	$ 77,148
Monthly payment	$ 952	$ 848	$ 831
Annual Income	$ 36,530	$ 32,560	$ 31,900

Attachment 2

Estimated Housing Production Requirements: 1990-1995-2000

1990-1995

	Honolulu	Maui	Hawaii	Kauai	State
New Households	12,032	4,768	3,776	2,816	23,392
Demolition Replacement	2,445	85	300	220	3,050
Additional Vacancies	602	238	189	141	1,170
TOTAL NEW UNITS	15,079	5,091	4,265	3,177	27,612

1995-2000

	Honolulu	Maui	Hawaii	Kauai	State
New Households	9,216	4,352	2,816	1,664	18,016
Demolition Replacement	2,445	85	300	220	3,050
Additional Vacancies	461	218	141	83	901
TOTAL NEW UNITS	12,122	4,655	3,257	1,967	21,967

	Honolulu	Maui	Hawaii	Kauai	State
GRAND TOTAL NEW UNITS 1990-2000	27,201	7,522	5,144	9,746	49,599

Assumptions:
1) 1995 and 2000 household size of 3.0
2) 5% vacancy level maintained
3) 1990, 1995 and 2000 resident population figures based on DPED Basaline Series M-F projections
4) 4% of projected population assumed residing in group quarters
5) Annual demolition equal to the 1980-1984 annual average

Estimated housing production requirements were calculated by using the methodology developed by Daly & Associates Inc. for their December 1981, Affordable Housing Issue Paper .

Attachment 3

Qualifying Annual Income for Fee Simple vs. Leasehold Purchase

The following examples calculate the amount of annual income needed to qualify for mortgage financing under three scenarios. The calculations assume that 1) the interest rate is fixed for 30 years; 2) monthly payment amounts include principal, interest, private mortgage insurance, homeowner's insurance, real property taxes, and, if applicable, lease rent; and 3) an income-to-payment ratio of 3.2:1.

Example 1

	Fee Simple/ No deferral	Leasehold	Deferred fee simple sales price
Sales price	$100,000	$ 85,720	$ 85,720
10% down payment	10,000	8,572	8,572
Loan Amount	$ 90,000	$ 77,148	$ 77,148
Monthly payment	$ 885	$ 791	$ 774
Annual Income	$ 33,980	$ 30,375	$ 29,720

Example 2 Interest rate = 10.50%

	Fee Simple/ No deferral	Leasehold	Deferred fee simple sales price
Sales price	$100,000	$ 85,720	$ 85,720
10% down payment	10,000	8,572	8,572
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<u>APPENDIX D</u>

Archaeology Study:
Paul H. Rosendahl, Ph.D., Inc., Consulting Archaeologist

PAUL H. ROSENDAHL, Ph.D., Inc.
Consulting Archaeologist

Report 320-090687 September 6, 1987

Hawaii Housing Authority
c/o R.M. Towill Corporation
677 Ala Moana Blvd., Suite 1016
Honolulu, Hawaii 96813

Subject: Archaeological Reconnaissance Survey
for Environmental Impact Statement
Kapolei Village Master Plan Project
Honouliuli, Ewa District, Island of Oahu

Gentlemen:

At the request of Mr. Chester Koga of R.M. Towill Corp., acting for their client, the Hawaii Housing Authority, Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological reconnaissance survey of the approximately 850 ac Kapolei Village project area in Honouliuli, Ewa, Island of Oahu. The primary objective of this survey was to provide information--concerning the presence or absence of any sites or features of potential archaeological significance within the project area limits—both appropriate to and sufficient for an Environmental Impact Statement (EIS) being prepared as part of the Kapolei Village Master Plan project and in anticipation of a Land Use Boundary District Amendment petition to be submitted to the State Land Use Commission.

The goal of the reconnaissance survey was to identify—to discover and locate on available maps--sites and features of potential archaeological significance. A reconnaissance survey comprises the initial level of archaeological investigation. It is extensive rather than intensive in scope, and is conducted basically to determine the presence or absence of archaeological resources within a specified project area. Reconnaissance survey indicates both the general nature and variety of archaeological remains present, and the general distribution and density of such remains. A reconnaissance survey permits a general significance assessment of the archaeological resources, and facilitates formulation of realistic recommendations and estimates for such further work as might be necessary or appropriate. Such work could include intensive survey—data collection involving detailed recording of sites and features, and selected test excavations; and possibly subsequent mitigation—data recovery research excavations, construction monitoring, interpretive planning and development, and/or preservation of sites and features with significant scientific research, interpretive, and/or cultural values.

The specific objectives of the reconnaissance survey of the Kapolei Village project area were four-fold: (a) to identify (find and locate) any sites or features present within the project area; (b) to evaluate the potential general significance of any identified archaeological remains; (c) to determine the possible impacts of proposed development upon any identified remains; and (d) to define the general scope of any subsequent data collection or mitigation work that might be necessary or appropriate.

The potential general significance of any archaeological remains identified during the reconnaissance survey was to be evaluated in terms of the National Register criteria contained in 36 CFR Part 60, Section 6. The State Department of Land and Natural Resources-Historic Sites Section (DLNR-HSS) uses these criteria to evaluate eligibility for both the Hawaii State and National Register of Historic Places. It was anticipated that the potential significance of any identified remains would most likely relate to National Register criterion "(d)," which refers to remains "...that have yielded, or may be likely to yield, information important in prehistory or history". Once potential significance had been tentatively evaluated, DLNR-HSS was to be consulted (a) to determine and fix formally the significance of the remains, and (b) to determine appropriate mitigation actions to be undertaken.

In order to facilitate future cultural resource management decisions regarding site treatments, any significant sites identified within the project area were also to be evaluated in terms of three value modes--scientific research, interpretive, and cultural values--which may be derived from the previously mentioned State and National Register eligibility criteria. Research value refers to the potential of archaeological resources for producing information useful in the understanding of culture history, past lifeways, and cultural processes at the local, regional, and interregional levels of organization. Interpretive value refers to the potential of archaeological resources for public education and recreation. Cultural value, within the framework for significance evaluation used here, refers to the potential of archaeological resources for the preservation and promotion of cultural and ethnic identity and values.

Reconnaissance survey field work was carried out on July 20 and August 24, 1987, by PHRI Principal Archaeologist Dr. Paul H. Rosendahl. Approximately six man-hours of labor were expended in carrying out the field work. Oral reports on field work findings were given respectively to Ms. Colette Sakoda and Mr. Chester Koga of R.M. Towill Corp. on August 24 and 26, 1987. Field work findings were also subsequently discussed with Dr. Joyce Bath, DLNR-HSS staff archaeologist for Oahu. The present letter report constitutes the final report on the reconnaissance survey.

Based on a preliminary review of available background literature and records, and discussions with Mr. Koga and Dr. Bath, the following specific objectives were determined to constitute an adequate scope of work for the reconnaissance survey of the Kapolei Village project area:

1. To review and evaluate available archaeological and historical literature relevant to the immediate project area;

2. To conduct a sample field inspection of the approximately 850 acre project area and determine the presence or absence of any potentially significant archaeological sites;

3. To determine the nature of the physical conditions of the project area that would influence the conduct of any subsequent archaeological field work, should such be necessary; and

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APPENDIX G

Air Quality Impact Report
J. W. Morrow, Environmental Management Consultant
December 7, 1987

AIR QUALITY IMPACT REPORT

KAPOLEI VILLAGE

December 7, 1987

J. W. MORROW
ENVIRONMENTAL MANAGEMENT CONSULTANT
KAILUA, HAWAII

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KAPOLEI VILLAGE

1. INTRODUCTION

A major residential community is being proposed by the Housing Finance and Development Corporation (HFDC) in cooperation with the Department of Housing and Community Development (DHCD) of the City and County of Honolulu. The project situated approximately 35 kilometers west of downtown Honolulu in the Ewa District of Oahu encompasses 830 acres and is master planned for some 5,000 residential dwelling units. In addition, there will be commercial/retail establishments, community facilities, and recreation facilities including an 18-hole golf course.

The purpose of this report is to assess the impact of the proposed development on air quality both on a local and regional basis. The overall project is clearly an "indirect source" of air pollution as defined in the federal Clean Air Act [1] since its primary association with air pollution is due to its inherent generation of mobile source, i.e., motor vehicle activity. Much of the focus of this analysis therefore is on the project's ability to generate traffic and the resultant impact on air quality. Air quality impact was evaluated for existing and future (2005) conditions.

A residential project such as this also has off-site impacts due to increased demand for electrical energy which must be met through the combustion of some type of fuel. Disposal of the refuse generated by the residents will also result in offsite impact as it will most probably be burned in the City's proposed resource recovery facility (HPOWER). Both of these combustion processes result in pollutant emissions to the air which have been addressed.

Finally, during construction of the various buildings and facilities air pollutant emissions will be generated due to vehicular movement, grading and general dust-generating construction activities. These impacts have also been addressed.

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 240 micrograms/cubic meter (ug/m3) [8]. The carbon monoxide (CO), particulate matter, sulfur dioxide (SO2), and nitrogen dioxide (NO2) standards are currently under review, but final action has not been taken yet [9].

Finally, the State of Hawaii also has fugitive dust regulations for particulate matter (PM) emanating from construction activities [10]. There simply can be no visible emissions from fugitive dust sources.

3. EXISTING AIR QUALITY

The nearest State Department of Health air monitoring station to the project area is located at the Campbell Industrial Park about 4.5 kilometers to the southwest. The State Department of Health has monitored air quality at the park since 1971, and a summary of the data is presented in Table 2. Total suspended particulates (TSP), sulfur dioxide (SO2), and nitrogen dioxide (NO2) were all monitored on a 24-hour basis. Initially, the site was at the Barbers Point Lighthouse, but the proximity to the ocean resulted in very high TSP levels due to salt spray. The station was therefore moved to the Chevron Refinery site about

1.7 kilometers north of the lighthouse on March 17, 1972. In 1976, NO_2 monitoring was ceased. On August 7, 1979, the monitoring station was moved to a rooftop location at the same Chevron site.

It should also be noted that total suspended particulate monitoring with a high-volume sampler was ceased at the site in October, 1985. In November, 1985, a new PM-10 sampler was installed. This instrument measures respirable particulate matter under 10 microns in aerodynamic diameter. PM-10 and SO_2 monitoring data for 1986 are summarized in Table 3.

It is evident from the data in Tables 2 and 3 that both the National Ambient Air Quality Standards (NAAQS) and Hawaii Ambient Air Quality Standards (HAAQS) are being met at those monitoring sites. Because the Campbell Industrial Park monitoring station is situated relatively close to the elevated sources, i.e., the stacks, located at the industrial park, the data collected may not be representative of the highest ambient pollutant levels resulting from the various industrial sources at the park. Computer modeling done in conjunction with the City's resource recovery facility permitting indicated maximum SO_2 concentrations occurring some 1.0 to 1.5 kilometers north of the park in the flat terrain as well as on the hillsides also north of the park [11].

Unfortunately, there are no routine monitoring data for the primary automotive pollutant, i.e., carbon monoxide. The nearest CO monitoring site is at the Department of Health building in downtown Honolulu some 21 kilometers east-southeast of the project area. Because the area is presently at an early stage of development, it can be surmised that present CO levels are also relatively low.

4. CLIMATE & METEOROLOGY

Weather conditions in the project area are typical of sites located on the leeward coast of Oahu. Long-term climatic data collected at Barbers Point Naval Air Station indicate mean daily maximum and minimum temperatures of 81 and 69 degrees Fahrenheit, respectively; mean annual rainfall of 20.3 inches; and prevailing winds from the northeast at 9 knots [12]. Annual rainfall is of interest because of its role in particulate matter removal from the atmosphere, while wind speed and direction are determinants of pollutant concentration and potential receptors, respectively. Atmospheric stability is another important factor in determining the potential for air pollution problems. It is largely a function of insolation and wind speed, and an objective methodology for determining it has been developed by Turner [13].

Historical meteorological data from Barbers Point NAS which had been processed using the Turner method were also reviewed [14,15,16]. They confirmed the annual predominance of north-easterly trade winds, but also indicated a significant occurrence of onshore winds primarily associated with a midday seabreeze regime. A screening of the 1967 - 71 Barbers Point surface observations indicated SE to SW winds occurred 643 - 1,032 hours per year. This is equivalent to 6.5 - 11.8% of the time.

Secondly, they indicate that almost 25% of the time slightly to moderately unstable conditions exist. Such conditions are conducive to bringing smoke plumes from elevated sources, e.g., smoke stacks, down to the ground within a relatively short distance downwind. Somewhat surprisingly, the data also show a very significant percentage (45%) of stable air conditions which tend to carry plumes largely intact for great distances. Such conditions can result in high pollutant concentrations if the plume reaches hills which are at approximately the same height as the stack. Such stable conditions can also contribute to high pollutant concentrations if they coincide with peak traffic hours because automotive pollutants are emitted close to the ground.

Finally, since the impact analysis focuses on the a.m. peak hour of traffic, a recent year of meteorological data (1984) was processed to produce a 7:00 a.m. (0700 Hawaiian Standard Time) wind rose as shown in Table 4. The predominance of low wind speed northeasterly winds is clearly evident in the table. Winds between east and north northeast comprise about 95% of the data while winds of 6 knots or less comprise about 74%. Figures 1 and 2 depict the same data but show the frequency of occurrence in terms of numbers of hours per year.

5. MOBILE SOURCE IMPACT

5.1 Mobile Source Activity. A traffic impact study was prepared for the proposed development [17] and served as the basis for this mobile source impact analysis. Existing (1985) [18] and projected p.m. peak-hour volumes at the following intersections were obtained for use in the air quality impact analysis:

- Makakilo Drive at H-1 Freeway
- Barbers Point Access Road at Farrington Highway
- Barbers Point Access Road at Ewa Parkway
- Farrington Highway at Village Parkway
- East Loop Road at Ewa Parkway

- West Loop Road at Ewa Parkway
- East-West Loop Roads at Village Parkway

5.2 Mobile Source Emission Factors. Carbon monoxide (CO) emission factors for vehicles were generated for the year 2005 using the MOBILE-3 emissions model [19]. The emission factors were localized by use of the age distribution of registered vehicles in the City & County of Honolulu [20]. Fraction of vehicle miles travelled (VMT) was assumed to be directly proportional to the registration distribution. Emission factors were based on traffic speeds ranging from 10 - 40 mph depending on the volumes on each leg of the intersections. Intersections were assumed to be signalized with green/cycle ratios proportional to approach demands. Queue lengths and emission strengths at intersection approachs were determined by an EPA method [21].

5.3 Modeling Methodology. While emissions burden analysis is one means of evaluating a project's impact, it is generally more important to estimate the ambient impact since air quality standards are expressed as ambient concentrations, and it is the ambient concentrations to which living things are exposed. Computer modeling is normally employed to generate these ambient concentration estimates, most commonly with 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) [22], and it comprises the largest fraction of automotive emissions.

The EPA guideline model CALINE-4 [23,24] was employed to estimate maximum 1-hour CO concentrations at receptor locations 10 - 40 meters from intersections during the worst-case AM peak hour traffic. Worst-case meteorological conditions were selected accordingly.

Because of the time of day of the analysis (AM peak hour), the currently low level of urbanization in the area which would otherwise contribute to a "heat island" effect and increased turbulence, a stable atmosphere (Pasquill-Gifford Class "F") [13] and 1 meter per second (m/sec) wind speed were assumed as worst case meteorological conditions. A background CO level of 0.1 parts per million (ppm) was also assumed to account for the existing low level of traffic activity, but was raised to 1.0 ppm for the year 2005 analysis.

Wind directions were based on preliminary modeling with 10 - 45 degree wind-road angles and were selected based on their ability to produce the maximum pollutant concentrations at each intersection. Specifically, due to the traffic volumes, predicted queuing, and probability of occurrence, northwest thru northeast winds direction were used for the "worst-case" analysis.

5.4 Results: 1-Hour Concentrations. The results of the modeling for existing conditions are presented in Figures 3 - 6 for the intersections and road segments under study. It is evident that with the exception of one intersection, both state and federal 1-hour CO standards appear to be met even under "worst-case" conditions of traffic, meteorology, and receptor location. At the Barbers Point Access Road - Farrington Highway intersection there appears to be some potential for queuing on the east-bound approach resulting in some predicted high CO levels close (within 10 meters) to the highway.

Figures 7 through 13 depict the predicted CO concentrations at the intersections identified in the traffic study as approaching or exceeding their respective capacities. The results again indicate that both state and federal standards would be met at all locations except in close proximity to the Barbers Point Access Road - Farrington Highway intersection.

5.5 Results: 8-Hour Concentrations. Estimates of 8-hour concentrations can be derived by applying a "persistence" factor of 0.6 to the 1-hour concentrations. This "persistence" factor is recommended in an EPA publication on indirect source analysis [25] and has been further corroborated by analysis of carbon monoxide monitoring data in Honolulu which yielded the same 8-hour-to-1-hour ratio [26]. When using this approach any 1-hour CO concentration greater than 8.4 mg/m3 (7.3 ppm) would indicate exceedance of the State's 8-hour standard. Similarly, any 1-hour concentration over 16.7 mg/m3 (14.5 ppm) would indicate exceedance of the federal 8-hour standard.

Applying this factor to the 1-hour concentration estimates reveals results quite similar to those just described above. Exceedance of the state, but not the federal 8-hour standard, appears possible at the Barber Point Access Road intersection with Farrington Highway. In addition, exceedances appear possible at the Makakilo Interchange with the H-1 Freeway.

5.6 Correlation with Meteorological Data. In light of the possible exceedances predicted for two of the intersections under study, a more detailed analysis of the Barbers Point meteorological data was undertaken in order to estimate the frequency of occurrence of those high concentrations.

First, the NNE (19 degree) wind direction and 1 m/sec (2 kts) wind speed used in the modeling at the intersections in question were reviewed in light of the data in Table 4 and Figures 1 and 2. This review suggested that the frequency of occurrence of such conditions was on the order of 5 times per year at 0700 HST without regard to the stability category. A screening of the 1984 data revealed only one day on which the 0700 HST weather matched the stability, wind speed and direction conditions used in this analysis.

5.7 In-Vehicle CO Levels. It should also be noted that operators and passengers can be exposed to levels of carbon monoxide inside vehicles significantly higher than that indicated by the microscale ambient air quality impact analysis. This exposure is, of course, exacerbated as congestion increases. When volume capacity ratios reach the 0.90 - 1.0 range and service levels drop to E and F, this occurs. With vehicles at idle or very low speed, CO emissions increase sharply and the occupants of vehicles are delayed in traffic; thus, for both reasons their CO exposure increases sharply. Unfortunately, there is currently no standardized modeling technique to estimate this exposure. In this particular instance, these conditions might occur during portions of a commute trip to Honolulu.

One recently reported commuter trip from the Ewa area to downtown Honolulu resulted in an average carbon monoxide exposure of 12.8 mg/m3 (11.1 ppm) over a 33-minute trip [27]. Unfortunately, the commute cited began at 7:30 a.m. and thus was near the end of the normal peak traffic period. The CO exposure was comparable to levels found during a previous study of a.m. peak hour commutes along the Pali Highway [28].

6. STATIONARY SOURCE IMPACT

6.1 Electrical Generation. The estimated 36 million kilowatt hours of annual electrical demand by the ultimate development will necessitate the generation of electricity by power plants. Currently, most of Oahu's electrical energy is generated at Hawaiian Electric Company's (HECO) Kahe Power Station located near Nanakuli on the leeward coast. This is currently a six-unit, approximately 650-megawatt facility firing low-sulfur fuel oil. A seventh 150-megawatt unit was proposed by HECO [29], but more recently two outside companies have proposed building new oil- and coal-fired power plants at Campbell Industrial Park and selling power to the utility [30]. For the purposes of this analysis, oil-firing was assumed. Estimates of annual emissions were computed based on EPA emission factors and the fuel required to meet a 36 million KWhr demand. The results are presented in Table 5.

6.2 Solid Waste Disposal. The refuse generated by the residents of the 5,000 new homes in Kapolei Village will require disposal. Presently, about 80% of Oahu's refuse is being landfilled with the remaining 20% being burned at the Waipahu Incinerator [31]. In the future, most refuse will be burned at the City's proposed resource recovery facility. Estimates of annual emissions attributable to the combustion of Kapolei Village refuse at that facility are included in Table 5.

7. OTHER LONG-TERM IMPACTS

7.1 Agricultural Burning. Burning of sugar cane fields prior to harvest is a long-standing practice in Hawaii's sugar industry. Unfortunately for the plantations and new residents, however, as urbanization closes in around agricultural operations, human exposure increases and the inevitable concerns about air pollution 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 [32]. Concentrations of particulates can reach high levels within about one mile of the fires [33]. 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.

7.2 Campbell Industrial Park. The industrial sources at Campbell Industrial Park obviously affect air quality in the Ewa area. The maximum concentrations of total suspended particulates (TSP) 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 impending construction of the City's resource recovery facility and the future construction of new power plants and 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 complied with.

8. SHORT-TERM IMPACT

The principal source of short-term air quality impact will be construction activity. Construction vehicle activity will increase automotive pollutant concentrations along roads serving the area as well as in the vicinity of the project site itself. Because of the moderate existing off-peak traffic volumes, 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.

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 a precipitation/evaporation (P/E) index of 50 [34,35].

The principal soil types in the project area are Mamala stony silty clay loam and Waialua silty clay with silt contents of about 55%. The precipitation/evaporation (P/E) Index for the area is 39. Compared to the EPA estimates and conditions, it would appear that there is a greater potential for fugitive dust due to the drier local climate, i.e., P/E Index of 39 versus 50 and higher silt content of the local soils.

Other offsite activities which will have temporary impacts on air quality include concrete batching operations to produce the concrete necessary for building foundations within the project and asphalt batching operations to build the new roads. At this point in time, the magnitude of these operations have not been quantified and thus a quantitative impact analysis is not possible.

9. DISCUSSION AND CONCLUSIONS

9.1 Mobile Source Impacts.

At complete buildout the presence of project-generated traffic will clearly increase ambient carbon monoxide levels in the area but, with the possible exception of the H-1 Makakilo Interchange area, will not create new exceedances of state air quality standards. The traffic will continue to contribute to potential state standard exceedances in the vicinity of the Barbers Point Access Road intersection with Farrington Highway. Federal standards do not appear to be threatened by emissions from the

additional traffic that will be generated. Currently, the principal means of controlling automotive emissions within the state is dependence on the federal motor vehicle control program [36].

9.2 Stationary Source Impacts. The emissions estimates may be compared to the 1980 county emissions inventory in Table 6 in order to provide some perspective on their significance. The project's contribution to county emissions appears to be less than 1%.

9.3 Other Long-Term Impacts. As noted in Section 7, 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 Campbell Industrial Park, an increasing number of industrial air pollution sources will over time have an increased impact on the project area. However, because of the relatively low frequency of the southwesterly winds necessary to carry emissions from the industrial park to Kapolei Village and government requirements for "best available control technology" (BACT) on new plants which will minimize emissions, it is not likely that air pollution levels in the project area will approach or existing standards for many years.

9.4 Short-Term Impacts. Since as noted in Section 8, 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.

9.5 Conclusions. Based on the foregoing analysis, the following conclusions may be drawn:

- The proposed project will result in increased air pollutant emissions due to its inherent traffic generation ability, and its requirements for electrical power and solid waste disposal;

- The addition of project-related traffic will increase the existing probability of exceedances of state 1-hour and 8-hour carbon monoxide standards within 20 meters of Barbers Point Access Road at Farrington Highway;
- Annual emissions of criteria pollutants due to electrical generation and solid waste disposal attributable to Kapolei Village will increase county emissions by less than 0.5%; and
- Due to the relatively dry climate and fine soils in the area, dust control measures during construction will be important to prevent violations of state fugitive dust standards.

9.6 Mitigation Measures. The principal means available to reduce the predicted CO concentrations are:

- improve intersections to increase capacity
- increase bus service to area
- encourage car-pooling
- modify business/school starting hours
- develop mass transit system
- increase employment opportunities in Ewa
- restrict residential development

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T A B L E S

TABLE 1

SUMMARY OF STATE OF HAWAII AND FEDERAL
AMBIENT AIR QUALITY STANDARDS

POLLUTANT	SAMPLING PERIOD	FEDERAL STANDARDS PRIMARY	FEDERAL STANDARDS SECONDARY	STATE STANDARDS
1. Total Suspended Particulate Matter (TSP)	Annual Geometric Mean	75	60	60
(micrograms per cubic meter)	Maximum Average in Any 24 Hours	260	150	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. Photochemical Oxidants (as O3) (micrograms per cubic meter)	Maximum Average in Any 1 Hour	240		100
7. Lead (Pb) (micrograms per cubic meter)	Maximum Average in Any Calendar Quarter	1.5		1.5

TABLE 2

AIR MONITORING DATA
CAMPBELL INDUSTRIAL PARK
1971-85

	TSP			SO_2			NO_2		
YEAR	RANGE	MEAN	>AQS	RANGE	MEAN	>AQS	RANGE	MEAN	>AQS
1971	18-471	125	54	<5-16	<5	0	<20-49	29	0
1972	24-155	55	4	<5- 7	<5	0	<20-49	21	0
1973	14-129	50	1	<5-5	<5	0	<20-33	<20	0
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	------	--	-

NOTES:
1. TSP = total suspended particulates
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

TSP & SO2 MONITORING DATA
BARBERS POINT, OAHU
1986

	Particulate Matter-10u (PM-10) 24-Hour Concentrations (ug/m3)				Sulfur Dioxide (SO2) 24-Hour Concentrations (ug/m3)			
MONTH	SAMPLES	MIN.	MAX.	MEAN	SAMPLES	MIN.	MAX.	MEAN
Jan 86	5	13	31	19	4	<5	<5	<5
Feb 86	4	21	40	27	4	<5	10	5
Mar 86	4	16	28	20	2	<5	<5	<5
Apr 86	4	27	31	28	5	<5	7	<5
May 86	5	19	20	24	5	<5	6	<5
Jun 86	3	18	42	31	5	<5	<5	<5
Jul 86	5	12	26	19	6	<5	<5	<5
Aug 86	3	24	35	29	5	<5	<5	<5
Sep 86	5	21	31	27	5	<5	<5	<5
Oct 86	5	17	43	28	5	<5	<5	<5
Nov 86	5	19	66	33	5	<5	<5	<5
Dec 86	4	7	40	24	5	<5	<5	<5
ANNUAL	52	7	66	26	56	<5	10	<5

SOURCE: Department of Health

TABLE 4

0700 HST Wind Rose
Barbers Point Naval Air Station
1984

Direction	1-3	4-6	7-10	11-16	17-21	>21	Total
N	0.00275	0.00000	0.00275	0.00000	0.00000	0.00000	0.00550
NNE	0.01374	0.02473	0.02198	0.00275	0.00000	0.00000	0.06320
NE	0.06868	0.19231	0.04945	0.00549	0.00000	0.00000	0.31593
ENE	0.17033	0.22527	0.10440	0.02198	0.00000	0.00000	0.52198
E	0.00824	0.02473	0.01923	0.00000	0.00000	0.00000	0.05220
ESE	0.00275	0.00275	0.00000	0.00549	0.00000	0.00000	0.01099
SE	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
SSE	0.00000	0.00000	0.00000	0.00275	0.00000	0.00000	0.00275
S	0.00000	0.00000	0.00275	0.00000	0.00000	0.00000	0.00275
SSW	0.00000	0.00000	0.00000	0.00000	0.00000	0,00000	0.00000
SW	0.00000	0.00000	0.00549	0.00000	0.00000	0.00000	0.00549
WSW	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
W	0.00000	0.00000	0.00275	0.00000	0.00000	0.00000	0.00275
WNW	0.00000	0.00000	0.00000	0.00275	0.00275	0.00000	0.00550
NW	0.00000	0.00000	0.00000	0.00275	0.00000	0.00000	0.00275
NNW	0.00000	0.00000	0.00000	0.00275	0.00000	0.00000	0.00275
Total:	0.26649	0.46979	0.20880	0.04671	0.00275	0.00000	0.99454
Calms:	0.00549					Total:	1.00003

TABLE 5

Estimates of Annual Emissions Due to
Electrical Generation and Solid Waste Disposal
Kapolei Village

Pollutant	Emissions (T/Yr) Electrical Generation	Solid Waste Disposal
Sulfur dioxide	99.5	6.2
Nitrogen oxides	131.4	30.3
Particulate Matter	10.0	2.5
Carbon monoxide	6.3	26.7
Hydrocarbons	1.3	1.6

TABLE 6

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

F I G U R E S

FIG. 1: BARBERS POINT NAVAL AIR STATION

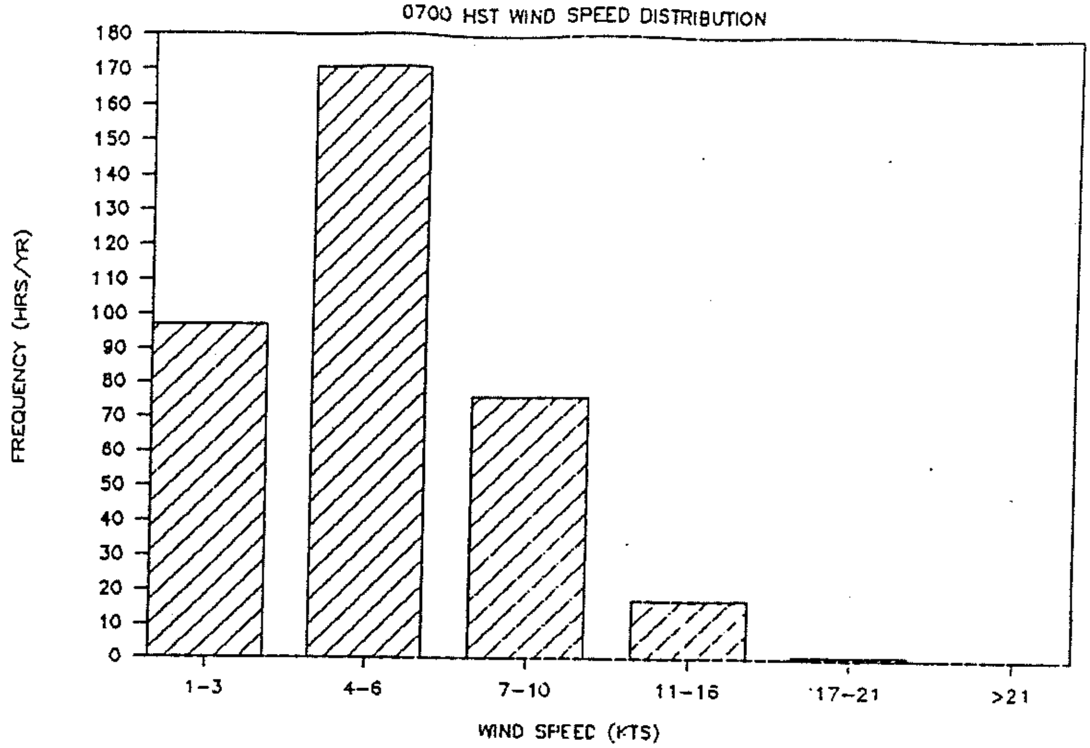


FIG. 2: BARBERS POINT NAVAL AIR STATION

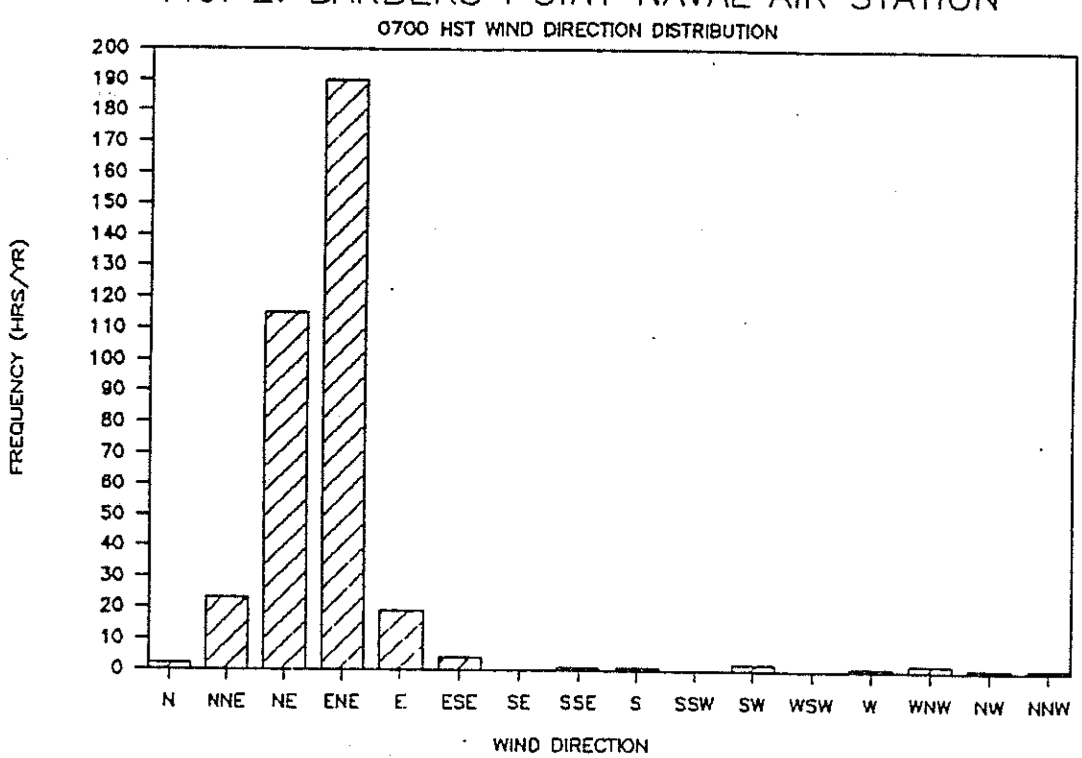
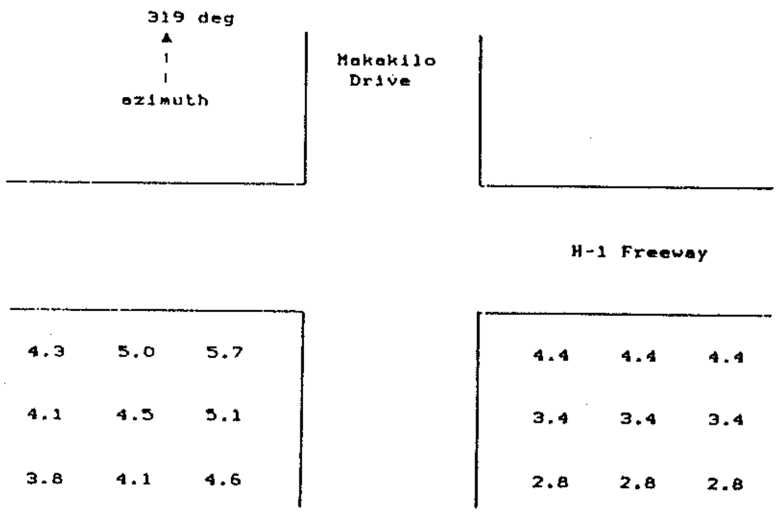


FIGURE 3
ESTIMATES OF MAXIMUM 1-HOUR CARBON MONOXIDE CONCENTRATIONS

MAKAKILO DRIVE AT H-1 FREEWAY
A.M. PEAK HOUR (1985)

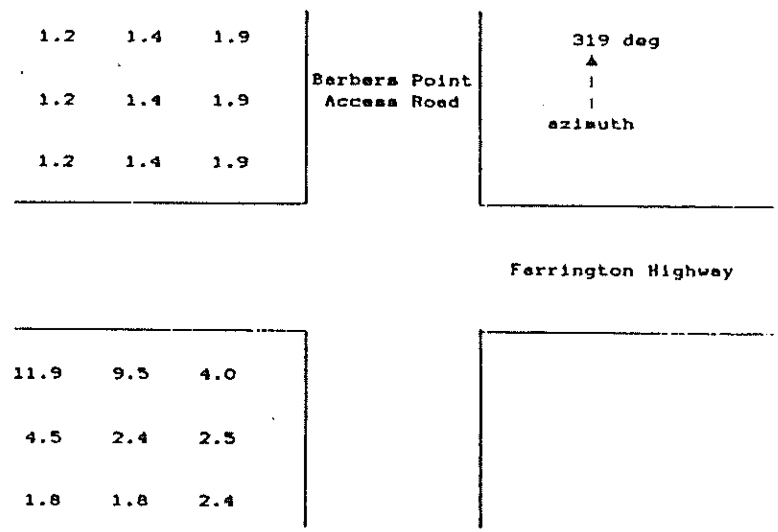


NOTES

CO concentrations = parts per million (ppm)
Receptor spacing = 10 meters
Wind direction = 19 deg
Wind speed = 1 meter per second (m/s)
Atmospheric stability = "F" (P-G Class 6)
Background CO concentration = 0.1 ppm
Diffusion model: CALINE-4
Emissions model: MOBILE-3

FIGURE 4
ESTIMATES OF MAXIMUM 1-HOUR CARBON MONOXIDE CONCENTRATIONS

BARBERS POINT ACCESS ROAD AT FARRINGTON HIGHWAY
A.M. PEAK HOUR (1985)

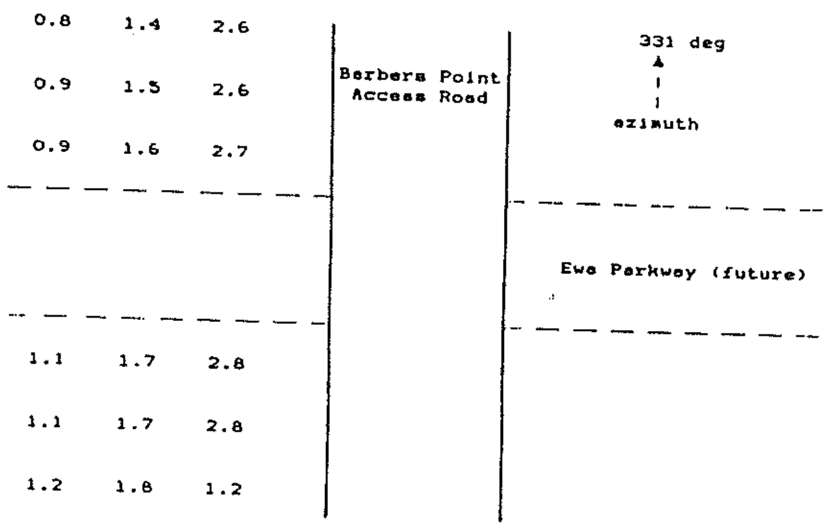


NOTES

CO concentrations = parts per million (ppm)
Receptor spacing = 10 meters
Wind direction = 19 deg
Wind speed = 1 meter per second (m/s)
Atmospheric stability = "F" (P-G Class 6)
Background CO concentration = 0.1 ppm
Diffusion model: CALINE-4
Emissions model: MOBILE-3

FIGURE 5
ESTIMATES OF MAXIMUM 1-HOUR
CARBON MONOXIDE CONCENTRATIONS

BARBERS POINT ACCESS ROAD
SOUTH OF FARRINGTON HIGHWAY
A.M. PEAK HOUR (1985)

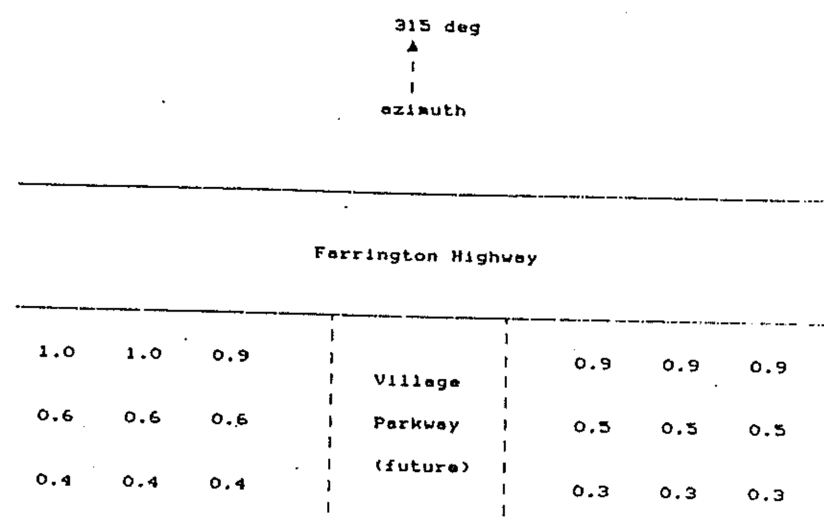


NOTES

CO concentrations = parts per million (ppm)
Receptor spacing = 10 meters
Wind direction = 341 deg
Wind speed = 1 meter per second (m/s)
Atmospheric stability = "F" (P-G Class 6)
Background CO concentration = 0.1 ppm
Diffusion model: CALINE-4
Emissions model: MOBILE-3

FIGURE 6
ESTIMATES OF MAXIMUM 1-HOUR
CARBON MONOXIDE CONCENTRATIONS

FARRINGTON HIGHWAY
EAST OF BARBERS POINT ACCESS ROAD
A.M. PEAK HOUR (1985)

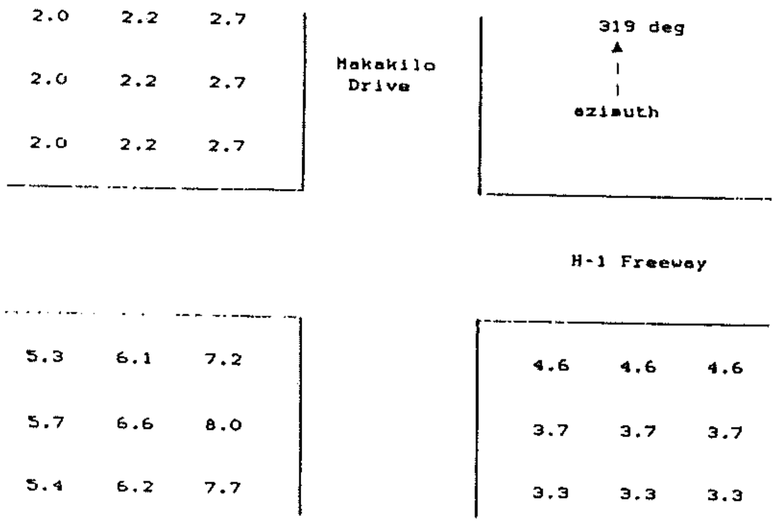


NOTES

CO concentrations = parts per million (ppm)
Receptor spacing = 10 meters
Wind direction = 35 deg
Wind speed = 1 meter per second (m/s)
Atmospheric stability = "F" (P-G Class 6)
Background CO concentration = 0.1 ppm
Diffusion model: CALINE-4
Emissions model: MOBILE-3

FIGURE 7
ESTIMATES OF MAXIMUM 1-HOUR
CARBON MONOXIDE CONCENTRATIONS

MAKAKILO DRIVE AT H-1 FREEWAY
A.M. PEAK HOUR (2005)

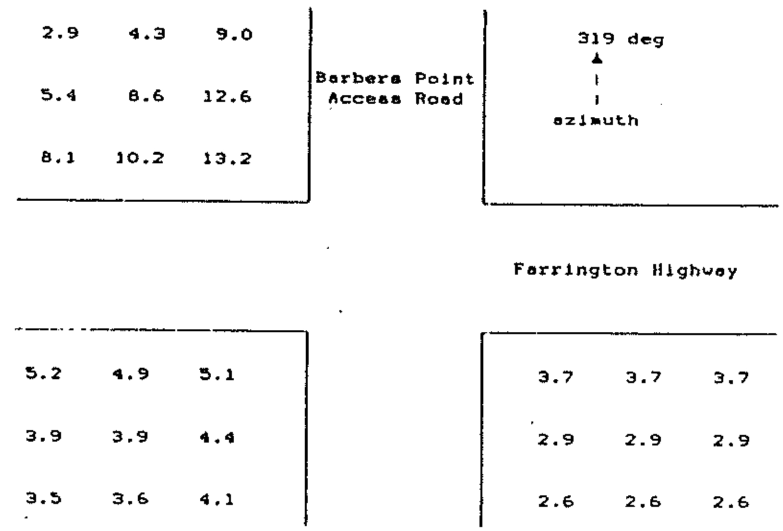


NOTES

CO concentrations = parts per million (ppm)
Receptor spacing = 10 meters
Wind direction = 19 deg
Wind speed = 1 meter per second (m/s)
Atmospheric stability = "F" (P-G Class 6)
Background CO concentration = 1.0 ppm
Diffusion model: CALINE-4
Emissions model: MOBILE-3

FIGURE 8
ESTIMATES OF MAXIMUM 1-HOUR
CARBON MONOXIDE CONCENTRATIONS

BARBERS POINT ACCESS ROAD AT FARRINGTON HIGHWAY
A.M. PEAK HOUR (2005)

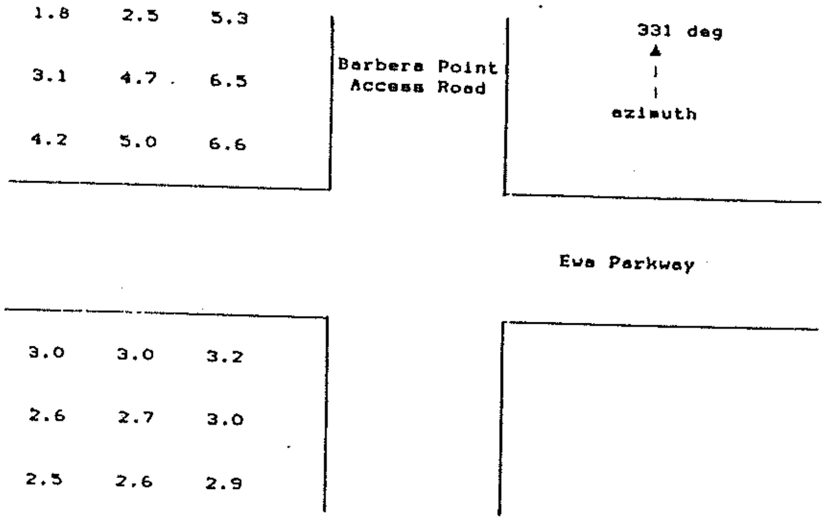


NOTES

CO concentrations = parts per million (ppm)
Receptor spacing = 10 meters
Wind direction = 19 deg
Wind speed = 1 meter per second (m/s)
Atmospheric stability = "F" (P-G Class 6)
Background CO concentration = 1.0 ppm
Diffusion model: CALINE-4
Emissions model: MOBILE-3

FIGURE 9
ESTIMATES OF MAXIMUM 1-HOUR
CARBON MONOXIDE CONCENTRATIONS

BARBERS POINT ACCESS ROAD AT EWA PARKWAY
A.M. PEAK HOUR (2005)

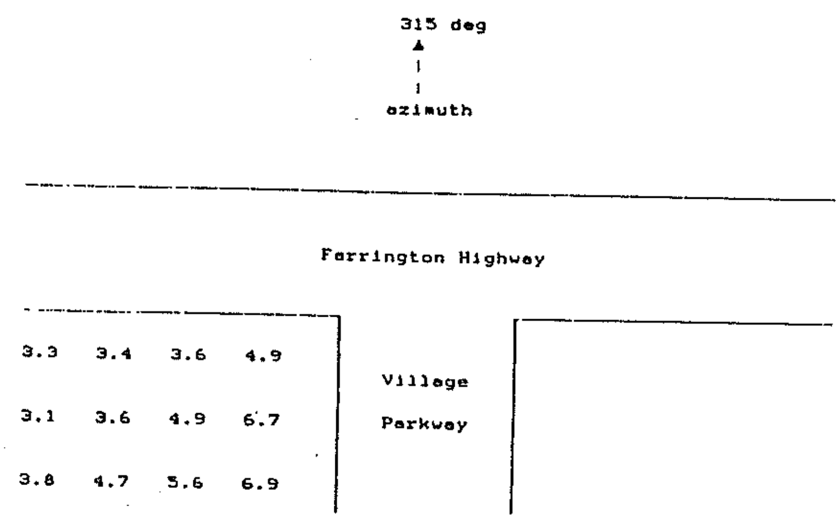


NOTES

CO concentrations = parts per million (ppm)
Receptor spacing = 10 meters
Wind direction = 31 deg
Wind speed = 1 meter per second (m/s)
Atmospheric stability = "F" (P-G Class 6)
Background CO concentration = 1.0 ppm
Diffusion model: CALINE-4
Emissions model: MOBILE-3

FIGURE 10
ESTIMATES OF MAXIMUM 1-HOUR
CARBON MONOXIDE CONCENTRATIONS

FARRINGTON HIGHWAY AT VILLAGE PARKWAY
A.M. PEAK HOUR (2005)

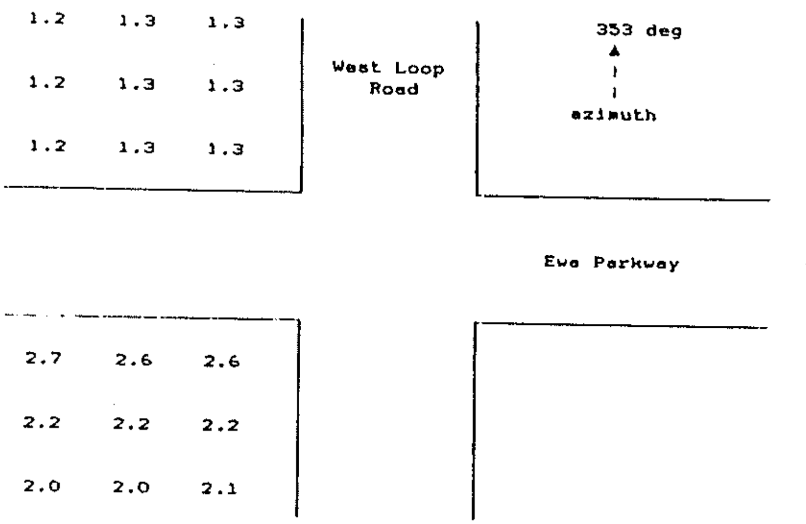


NOTES

CO concentrations = parts per million (ppm)
Receptor spacing = 10 meters
Wind direction = 15 deg
Wind speed = 1 meter per second (m/s)
Atmospheric stability = "F" (P-G Class 6)
Background CO concentration = 1.0 ppm
Diffusion model: CALINE-4
Emissions model: MOBILE-3

FIGURE 11
ESTIMATES OF MAXIMUM 1-HOUR
CARBON MONOXIDE CONCENTRATIONS

WEST LOOP ROAD AT EWA PARKWAY
A.M. PEAK HOUR (2005)

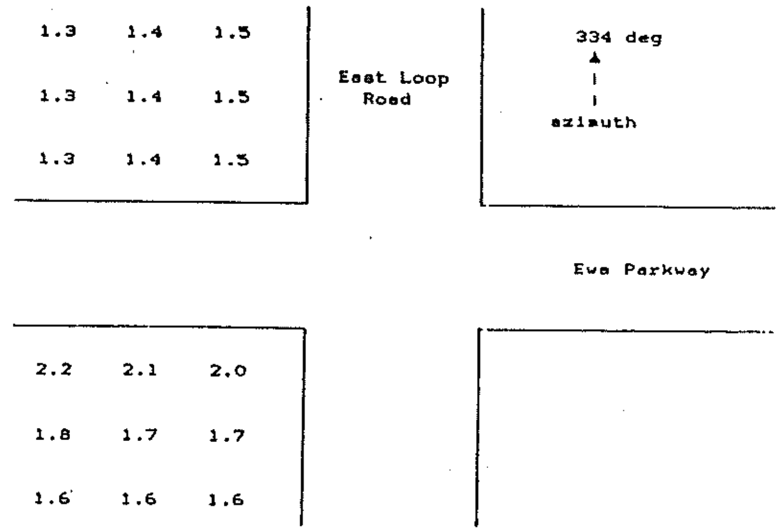


NOTES

CO concentrations = parts per million (ppm)
Receptor spacing = 10 meters
Wind direction = 53 deg
Wind speed = 1 meter per second (m/s)
Atmospheric stability = "F" (P-G Class 6)
Background CO concentration = 1.0 ppm
Diffusion model: CALINE-4
Emissions model: MOBILE-3

FIGURE 12
ESTIMATES OF MAXIMUM 1-HOUR
CARBON MONOXIDE CONCENTRATIONS

EAST LOOP ROAD AT EWA PARKWAY
A.M. PEAK HOUR (2005)



NOTES

CO concentrations = parts per million (ppm)
Receptor spacing = 10 meters
Wind direction = 34 deg
Wind speed = 1 meter per second (m/s)
Atmospheric stability = "F" (P-G Class 6)
Background CO concentration = 1.0 ppm
Diffusion model: CALINE-4
Emissions model: MOBILE-3

FIGURE 13
ESTIMATES OF MAXIMUM 1-HOUR
CARBON MONOXIDE CONCENTRATIONS

VILLAGE PARKWAY AT EAST-WEST LOOP ROADS
A.M. PEAK HOUR (2005)

2.1	2.3	2.6		338 deg ↑ azimuth
2.2	2.9	4.5	Village Parkway	
3.0	3.7	4.6		

West Loop Road

East Loop Road

5.0	3.6	2.4
2.4	1.8	1.5
1.6	1.4	1.4

NOTES

CO concentrations = parts per million (ppm)
Receptor spacing = 10 meters
Wind direction = 38 deg
Wind speed = 1 meter per second (m/s)
Atmospheric stability = "F" (P-G Class 6)
Background CO concentration = 1.0 ppm
Diffusion model: CALINE-4
Emissions model: MOBILE-3